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THE IMPACT OF VAPING ON PATIENTS UNDERGOING GENERAL ANESTHESIA: A LITERATURE REVIEW

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ABSTRACT

Background: *Particularly among adolescents and young adults vaping or electronic cigarettes has become more popular in recent years. In Indonesia, e-cigarette use increased significantly from 0.3% in 2011 to 3% in 2021.General anesthesia requires maintaining hemodynamic stability to avoid complications. Vaping has been linked to pulmonary and cardiovascular issues, which may complicate anesthesia management and increase risks during anesthesia. This study aims to assess patients' vaping history during preoperative evaluations.*
Method: *This research used a literature review method with the PICO framework to analyze secondary data from databases like Google Scholar, PubMed, and ScienceDirect. The search strategy involved adjusting keywords to match Medical Subject Headings (MeSH) and using Boolean operators (AND, OR) and quotation marks for precision. Keywords selected for the study were "Vaping," "Undergoing," and "General Anesthesia." Articles published between 2020 and 2025 in English or Indonesian, from reputable journals, and classified as original research, were included. Relevant studies were identified, critically appraised using the JBI tools, and synthesized into PICO tables for presentation.*
Result: *From a total of 1,965,989 articles identified through database searches, three studies met the inclusion criteria and were included in the review. The findings from these studies demonstrated that vaping is associated with several respiratory complications during general anesthesia, such as increased airway reactivity, bronchospasm, and impaired gas exchange. One case series highlighted the occurrence of hypoxia and increased oxygen requirements in patients with vaping-associated lung injury (EVALI). Another large-scale retrospective cohort study reported a slightly higher incidence of pulmonary complications among vapers compared to non-vapers; however, the difference was not statistically significant.*
Conclusion: *Vaping may increase the risk of perioperative and intraoperative respiratory complications, particularly in patients undergoing general anesthesia. The presence of harmful chemicals in e-cigarette aerosols, such as nicotine and volatile organic compounds, can exacerbate pre-existing respiratory conditions or contribute to new ones. These risks highlight the importance of including vaping history in preoperative assessments. Anesthesia providers should be vigilant in monitoring and managing airway function in patients with a history of vaping to ensure safe and effective anesthetic care.*

Keywords: *Vaping; Undergoing; General Anesthesia*

INTRODUCTION

Vaping or using of electronic cigarettes (e-cigarettes) has been linked to various chronic health outcomes (Steinert et al., 2022). However, using of electronic cigarettes has more recently gained popularity, especially among adolescents and young adults. According to the Indonesian Global Adult Tobacco Survey (GATS) Indonesia Report 2021 highlights that using of electronic cigarettes in Indonesia increased tenfold over a decade—from 0.3% in 2011 to 3% in 2021. It also notes that 34.5% of Indonesian adults use tobacco products (WHO, 2024).

General anesthesia is a cornerstone of modern surgical practice, ensuring patient safety and comfort during procedures. Maintaining hemodynamic stability throughout anesthesia is essential for optimizing patient outcomes, minimizing complications, and facilitating smooth recovery. Disruptions in cardiovascular and respiratory stability during anesthesia can lead to adverse events such as hypotension, arrhythmias, and respiratory depression, which may increase perioperative morbidity and mortality rates (Scott et al., 2024).

The rising popularity of vaping introduces new challenges in perioperative care. Vaping use has been associated with various pulmonary effects, including airway hyperreactivity, impaired gas exchange, increased susceptibility to respiratory infections, and cardiovascular diseases These effects may complicate anesthesia management, as patients who vape could be at higher risk (Novelli et al., 2022; Steinert et al., 2022).

Given the potential perioperative risks associated with e-cigarette use, it is imperative for nurse anesthetist or anesthesia provider to assess patients' vaping history during preoperative evaluations. Based on this background, the study aims to identify potential anesthesia risks in patients with a history of vaping who undergo general anesthesia.

METHODS

This research employed a literature review method using the PICO framework. Secondary data are obtained from data bases such as Google Scholar, PubMed, ScienceDirect. Search strategies includes adjusting keywords to align with Medical Subject Headings (MeSH) and combining them with Boolean operators (AND, OR), along with the use of quotation marks to enhance search precision.

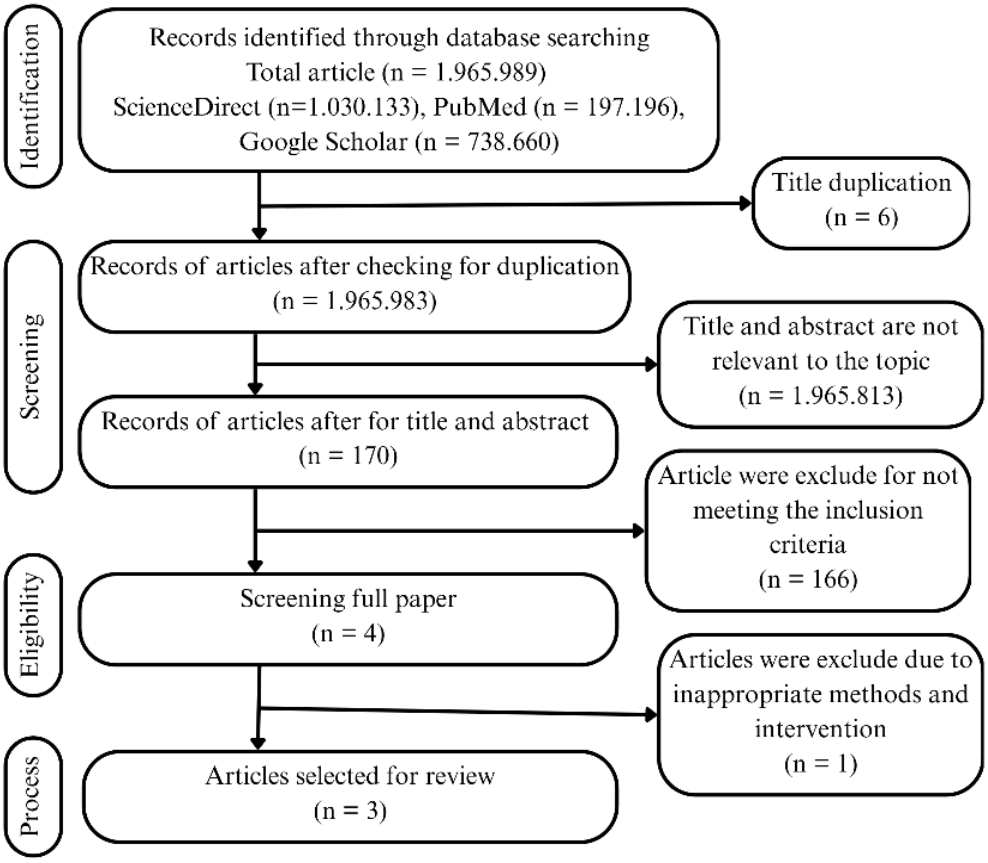


Figure 1. PRISMA Diagram Article Search

The selected keywords for this evidence-based research are “Vaping”, “Undergoing”, and “General Anesthesia”. Inclusion criteria consist of articles published between 2020 and 2025, written in either English or Indonesian, sourced from reputable national or international journals, and categorized as original research articles. The relevant studies were searched and selected, and a review was conducted along with a critical appraisal using the JBI tools instrument. Then synthesized and presented using PICO tables.

Table 1. PICO Table

PICO	Inclusion	Exclusion
Population	Patients undergoing general anesthesia (with a history of vaping/e-cigarette use)	Patients undergoing regional anesthesia
Intervention	Exposure to vaping (prior to surgery/anesthesia)	None
Comparation	None	None
Outcome	Risk of anesthesia	None

Literature searches were conducted using the PRISMA flowchart. The search process identified a total of 1,965,989 articles sourced from various databases, including 1,030,133 from Science Direct, 197,196 from PubMed, and 738,660 from Google Scholar. After removing 6 duplicate titles, 1,965,983 articles remained for screening. During the screening of titles and abstracts, 1,965,813 articles were excluded for being irrelevant to the topic, leaving 170 articles for further evaluation. There were 166 articles were excluded for not meeting the inclusion criteria, and 4 articles underwent full-text review. From this stage, 1 article was excluded due to inappropriate methods and intervention. Ultimately, 3 articles were selected and included for review and analysis.

RESULTS AND DISCUSSION

According to the reviewed studies, vaping has been found to have adverse impacts during general anesthesia. The detailed results of the review are presented in the synthesis table below:

Table 2. Article Search Result

Title	Purpose	Design	Sample	Result
Perioperative Implications of Vaping (Krishna et al., 2020)	To explore the respiratory complications associated with vaping and their implications for anesthetic care in a clinical setting.	Case report	n= 1	The study presented a case of a 16-year-old female patient who experienced respiratory complications linked to vaping, which necessitated bronchoscopy and bronchoalveolar lavage. The findings indicated that vaping can lead to significant respiratory issues, including airway reactivity and increased risk of postoperative complications, similar to those seen with traditional tobacco use. This underscores the importance of recognizing vaping as a potential risk factor in patients undergoing anesthesia.
E-cigarette, or Vaping, Product Use-Associated Lung Injury—Lessons Learned: A Case Series (Saab et al., 2024)	The study aimed to highlight the challenges and outcomes of providing anesthesia to patients with vaping-associated lung injury (EVALI) undergoing diagnostic procedures like bronchoscopy.	Case report	n = 4	The study found that patients with EVALI experienced increased airway reactivity and hypoxia during anesthesia, leading to higher oxygen requirements and complications. It emphasized the need for careful anesthesia management in these patients and the importance of vaping cessation to prevent further health issues.
The association of	The study purposes to investigate the	Retrospective cohort study of	n = 110.940	Study on noncardiothoracic surgery patients found no

Title	Purpose	Design	Sample	Result
vaping and electronic cigarette use with postoperative hypoxemia and respiratory complication: a retrospective cohort analysis (Helm et al., 2020)	association of vaping/e-cigarette use with postoperative hypoxemia and respiratory complications in adults undergoing noncardiothoracic surgeries.	110.940 patients; 1.941 were vapers.		significant link between vaping and immediate postoperative hypoxemia or pulmonary complications. However, the incidence of pulmonary complications was slightly higher in the vaping group compared to the non-vaping group, but the difference was not statistically significant, as indicated by an odds ratio of 1.04 (P = 0.84). Despite the lack of strong short-term effects, anesthesiologists should remain vigilant and further research is needed to clarify vaping's long-term impact.

Patients who use electronic cigarettes (e-cigarettes) are at risk for various perioperative and postoperative complications when undergoing general anesthesia. Among the most concerning are respiratory complications, including increased airway reactivity, bronchospasm, and impaired gas exchange, which are primarily due to inflammation and irritation of the airway mucosa. These physiological alterations pose significant challenges in maintaining adequate ventilation and oxygenation during and after surgical procedures (Cutts & O'Donnell, 2021; Krishna et al., 2020).

The inhalation of nicotine and various chemical substances contained in e-cigarettes can trigger inflammatory responses in the airways, leading to bronchoconstriction and increased airway resistance. These effects are mediated by stimulation of afferent pathways in the bronchial mucosa, which activate parasympathetic cholinergic pathways and result in bronchospasm. Furthermore, volatile organic compounds and other irritants present in e-cigarette aerosols can exacerbate airway inflammation, promote excessive mucus production, and increase the risk of airway obstruction. These pathophysiological changes may be amplified during sedation or general anesthesia, potentially leading to impaired gas exchange, reduced oxygen saturation, and a heightened risk of intraoperative bronchospasm (Cutts & O'Donnell, 2021; Kim & et.al, 2022).

Moreover, vaping-induced airway sensitivity poses a critical concern during anesthetic procedures, particularly those involving airway manipulation, such as bronchoscopy or endotracheal intubation. Inflammation and injury of the airway epithelium from e-cigarette exposure heighten the risk of acute bronchospasm and hypoxemic events, as compromised airway function impedes airflow and efficient gas exchange. As a result, patients may require higher concentrations of supplemental oxygen to maintain adequate oxygen saturation levels (Helm et al., 2020).

Emerging clinical evidence supports the link between vaping and perioperative respiratory complications. A recent study noted a slightly higher incidence of pulmonary complications in patients with a history of vaping (1.4%) compared to non-vaping individuals (1.3%), suggesting a potential association with increased anesthetic risk (Saab et al., 2024). Additionally, the presence of harmful substances in vaping products—such as vitamin E acetate and other toxic compounds—may aggravate pre-existing respiratory disorders or lead to new

complications, particularly in the high-risk environment of surgery where patients are already physiologically stressed (Krishna et al., 2020).

Given these risks, it is imperative that nurse anesthetists and anesthesiologists recognize the perioperative implications of e-cigarette use. A thorough preoperative evaluation should include assessment of vaping habits, enabling clinicians to adjust anesthetic plans accordingly and ensure vigilant intraoperative respiratory monitoring. Failure to account for vaping-related respiratory effects may lead to insufficient preparation, increased perioperative complications, and adverse patient outcomes. Therefore, understanding the impact of vaping is essential for optimizing respiratory stability and ensuring safe, effective anesthesia management (Krishna et al., 2020; Scoot, 2024).

CONCLUSION

This study concluded that the use of electronic cigarettes presents significant perioperative and intraoperative respiratory risks, especially in patients undergoing general anesthesia. The chemical components in e-cigarette aerosols can induce airway inflammation, bronchospasm, and impaired gas exchange, all of which compromise respiratory stability during surgical procedures. These effects are particularly concerning due to the heightened vulnerability of anesthetized patients and the physiological stress of surgery. Therefore, recognizing vaping as a critical factor in preoperative assessment is essential for anesthetists to tailor anesthetic management, anticipate complications, and implement appropriate respiratory monitoring strategies to ensure optimal patient safety and outcomes.

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CONFLICT OF INTEREST

Authors declared that there was no conflict of interest.

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THE PROPORTION OF ANIMAL PROTEIN CONSUMPTION WITH A PREVALENCE OF STUNTING, WASTING, AND UNDERWEIGHT IN TODDLERS IN INDONESIA

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ABSTRACT

Background: *Stunting, wasting, and underweight are the main indicators of malnutrition that have a significant impact on children's growth and health. In Indonesia, the prevalence of these conditions is still high, especially in children under the age of two. One of the factors causing this nutritional problem is low consumption of animal protein. This study aims to analyze the relationship between the proportion of animal protein consumption and the prevalence of stunting, wasting, and underweight in children under the age of two in Indonesia using data from the 2023 Indonesian Health Survey (IHS).*
Method: *This study used a cross-sectional design with aggregate data from 38 provinces in Indonesia. Bivariate analysis used the Spearman correlation test.*
Result: *The results showed that the proportion of animal protein consumption was significantly associated with the prevalence of stunting (p-value 0.000), underweight (p-value 0.001), and wasting (p-value 0.003). The data showed that areas with higher animal protein consumption, such as Java and Bali, had a lower prevalence of nutritional problems compared to areas such as Nusa Tenggara and Papua.*
Conclusion: *This study concluded that there was a significant relationship between the proportion of animal protein consumption and the prevalence of stunting, wasting, and underweight in children under the age of two in Indonesia. Increasing access to animal protein consumption is an important step in reducing the prevalence of malnutrition among children. This study is expected to provide recommendations for more effective interventions in addressing nutritional problems in Indonesia.*
Keywords: *Animal Protein; Stunting; Wasting; Underweight*

INTRODUCTION

Stunting, wasting, and underweight are three main indicators of malnutrition that have a significant impact on children's growth and overall health. These three conditions often occur together and reflect the double burden of malnutrition, especially in developing countries. Stunting is characterized by a height that is lower than the standard for age due to chronic long-term malnutrition. Wasting refers to a body weight that is disproportionate to height, usually caused by short-term nutritional deficiencies or due to illness. Meanwhile, underweight describes a body weight that is not appropriate for a child's age, which can be an indication of chronic or acute malnutrition (Bahar et al., 2024).

According to UNICEF data in 2017, there were 92 million (13.5%) toddlers in the world who were underweight, 151 million (22%) toddlers experienced stunting, and 51 million (7.5%) toddlers experienced wasting. Most toddlers in the world who experienced underweight, stunting, and wasting came from the continents of Africa and Asia. In Indonesia, based on the 2023 Indonesian Health Survey (IHS), the prevalence of underweight was

10.4%, stunting 12.9%, and wasting 6.6% (BKPK, 2023). Underweight is seen based on weight per age (WAZ) which indicates acute and chronic malnutrition. Stunting is seen based on height per age (HAZ) which describes chronic malnutrition over a long period of time and occurs before the child is two years old. While wasting is seen based on weight per height (WHZ) which represents acute malnutrition (Badriyah, 2019).

This incident can be caused by a deficiency or low quality of protein containing essential amino acids. Bone growth begins with cartilage synthesis, which then goes through the ossification process. The process of cartilage synthesis requires a large amount of sulfur because one of its main components is sulfur. The body obtains most of its sulfur through amino acid catabolism, so adequate protein intake is very important to support child growth (Sudirman et al., 2023). Therefore, most of the protein that should be consumed by toddlers should come from high-quality sources, such as animal protein. This is because animal protein has better digestibility and more complete essential amino acid content compared to vegetable protein (Haryani et al., 2023).

Several studies have shown that animal protein intake has a fairly close relationship with the incidence of stunting in toddlers. Stunted toddlers tend to have lower animal protein intake when compared to toddlers who are not stunted (Iswara & Ahmad Syafiq, 2024). According to research Zulfiana et al., (2023) There is a significant relationship between protein intake and the prevalence of wasting in children. For this reason, sufficient energy is needed with complete nutritional data based on age to recognize. According to research Listyawardhani & Yunianto, (2024) There is a relationship between the level of protein and fat adequacy and the incidence of underweight.

Various previous studies have discussed the prevalence of stunting in Indonesia, but most of them only focus on certain or specific areas. However, this study examines the prevalence of stunting, wasting, and underweight in toddlers based on provinces in Indonesia using IHS 2023 data. This study will provide a comprehensive analysis of the prevalence of stunting, wasting, and underweight based on provinces in Indonesia. Therefore, researchers are interested in conducting research to analyze the relationship between animal protein intake and the incidence of stunting, wasting, and underweight in Indonesia.

There has been no study on national prevalence using aggregate data comparing the results of IHS data, so researchers want to describe and see how nutritional events in Indonesia by comparing data on the proportion of animal protein consumption with the incidence of nutritional problems in toddlers in Indonesia from IHS 2023 data, and research on the relationship between the proportion of animal protein consumption with the prevalence of stunting, wasting, and underweight in toddlers in Indonesia is still limited. The novelty of this study lies in the use of IHS 2023 national aggregate data to compare the proportion of animal protein consumption with the prevalence of stunting, wasting, and underweight throughout Indonesia, as well as the differences between 7 regions of Indonesia. This study is expected to provide a more comprehensive picture of nutritional problems in Indonesia and provide recommendations for more effective policies. The purpose of the study was to explain the description of the proportion of animal protein consumption, a description of the prevalence of stunting, wasting, and underweight in toddlers in 7 regions of Indonesia, and the relationship between the proportion of animal protein consumption with the prevalence of stunting, wasting, and underweight in toddlers in Indonesia. The results of this study are expected to provide deeper insight into the relationship between animal protein consumption and nutritional status in toddlers in Indonesia, as well as provide a basis for more appropriate

interventions in addressing nutritional problems in Indonesia.

METHODS

This study uses secondary data obtained from data aggregate in the 2023 Indonesian Health Survey (IHS) report with a Cross-sectional Study research design. IHS 2023 was conducted in the period from August to October 2023, covering all provinces in Indonesia. The population in this study were all toddlers (under two years old) who experienced stunting, wasting, and underweight in 34 provinces in Indonesia, which were grouped into seven regions, namely Sumatra, Java-Bali, NTB-NTT, Kalimantan, Sulawesi, Maluku, and Papua. The sample of this study consisted of the total population in all provinces covered by IHS 2023.

The variables analyzed in this study consisted of independent and dependent variables. The independent variable used was the proportion of animal protein consumption (meat/fish/eggs), which was calculated based on the number of children who consumed animal protein (meat/fish/eggs) in the previous 24 hours divided by the total number of toddlers. The dependent variables analyzed included the prevalence of stunting, wasting, and underweight in toddlers. The prevalence of stunting, wasting and underweight is calculated based on the number of children experiencing each condition divided by the total number of toddlers, then multiplied by 100%. Stunting is determined based on the anthropometric index of height for age (HAZ) <-2 SD, wasting based on weight for height (WHZ) <-2 SD, and underweight based on weight for age (WAZ) <-2 SD.

Weight data is obtained using a baby scale (accuracy level of 0.1 kg), while height data is measured using a length board (accuracy level of 1 mm). Data collection is carried out by enumerators with technical supervision by the technical person in charge of the Regency/City and administrative supervision by the person in charge of the Regency/City operations. In data collection, 1 team is responsible for 10 to 12 census blocks. 1 census block consists of 10 ordinary households with an additional ± 7 toddler households to obtain toddler nutritional status figures. After the data was collected, the data was processed and analyzed statistically using the SPSS version 22 program. Univariate analysis was conducted to describe the characteristics of each variable, using the middle and variance measures (mean, standard deviation, minimum value, and maximum value). To analyze the relationship between animal protein consumption variables and the prevalence of stunting, underweight, and wasting, bivariate analysis was conducted using the Spearman correlation test because the normality assumption was not met. The implementation of the Indonesian Health Survey has received approval and an ethical clearance letter from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023.

RESULTS AND DISCUSSION

Table 1 shows that the highest proportion of animal protein consumption is in the Java and Bali regional areas, namely in the province of D.I Yogyakarta (88.3%) and the lowest proportion of animal protein consumption is in the Papua regional area, namely the province of Papua Pegunungan (40.0%). Nationally, the proportion of animal protein consumption in Indonesia averages 76%.

The results of this study indicate that there are significant differences in the proportion of animal protein consumption and the prevalence of nutritional problems (stunting, wasting, and underweight) between regions in Indonesia. In general, the proportion of animal protein consumption in Indonesia is still low, with a national average of 76%. This

figure illustrates the low animal protein consumption, which has an impact on children's nutritional status. The highest proportion of animal protein consumption is found in Java and Bali, while the lowest is found in Papua. This shows that there is inequality in access and consumption of animal protein between regions. The indirect causes are income factors and economic disparities, food systems, health systems, urbanization, and others (Purnamasari & Febry, 2023).

Table 1. Distribution of the Proportion of Animal Protein Consumption by Region of Indonesia in 2023

Region	Minimum	Maximum	$\underline{X}$ ± SD
Sumatera	74.1	85.4	81.4 ± 3.2
Jawa dan Bali	76.9	88.3	81.1 ± 4.3
Nusa Tenggara	70.0	80.3	75.1 ± 7.3
Kalimantan	73.1	80.7	77.4 ± 2,8
Sulawesi	64.1	77.6	71.7 ± 4.4
Maluku	72.5	72.9	72.7 ± 0.3
Papua	40.0	77.9	65.3 ± 15.7
Indonesia	**40.0**	**88.3**	**76.0 ± 8.8**

From Table 1, it is found that the proportion of animal protein consumption by province in Indonesia is lowest in the Papua Pegunungan province at 40% and the highest is in the D.I Yogyakarta province at 88.3%. Animal protein is an important component for the growth and cognitive development of children. Consumption of high-quality animal protein in children reduces the risk of nutritional problems such as underweight, stunting, and wasting. Animal protein has advantages such as having more complete essential amino acids than vegetable protein (Rawani et al., 2024).

Protein plays an important role in children's growth. Protein is a nutrient for children's physical growth because it is needed for bone and muscle growth. According to WHO recommendations, children under 1 year old should get 1.5 grams of protein/kg/day. Based on the Regulation of the Minister of Health (PMK) no. 28 of 2019, children's daily protein intake requirements are adjusted to the age of the child, namely 6-11 months as much as 15 grams/day, 1-3 years as much as 20 grams/day, 4-6 years as much as 25 grams/day and 7-9 years as much as 40 grams/day (Nursani et al., 2023). The amount of protein is adequate if it contains all types of essential amino acids in sufficient quantities and is easily digested and absorbed by the body. Amino acids needed by toddlers are lysine, leucine, isoleucine, valine, threonine, phenylalanine, tyrosine, methionine, cysteine, tryptophan, histidine, and arginine, the majority of which are essential amino acids. Therefore, most of the protein consumed by toddlers must be of high quality such as animal protein because it has better digestibility and a more complete essential amino acid content than vegetable protein (Haryani et al., 2023).

Table 2. Distribution of Nutritional Status by Region of Indonesia in 2023

Region	Stunting			Underweight			Wasting		
	Min	Max	$\underline{X}$ ± SD	Min	Max	$\underline{X}$ ± SD	Min	Max	$\underline{X}$ ± SD
Sumatera	8.8	17.2	11.9 ± 2.7	6.1	13.7	9.4 ± 2.7	5.0	9.9	6.8 ± 1.5
Jawa dan Bali	5.0	13.6	11.6 ± 3.0	3.7	12.0	9.1 ± 2.7	3.2	8.3	5.8 ± 1.6
Nusa Tenggara	15.1	21.0	18.0 ± 4.2	12.7	18.5	15.6 ± 4.1	6.0	9.9	7.9 ± 2.8
Kalimantan	10.8	16.2	13.7 ± 1.9	10.1	13.8	12.5 ± 1.5	6.7	9.3	7.9 ± 1.2
Sulawesi	14.6	17.2	15.8 ± 0.8	11.1	14.9	13.6 ± 1.5	7.5	9.5	8.4 ± 0.7
Maluku	13.7	14.2	13.9 ± 0.4	14.6	15.8	15.2 ± 0.8	10.8	12.3	11.5 ± 1.1
Papua	13.3	18.2	15.8 ± 1.7	5.4	15.5	13.1 ± 3.8	6.8	14.2	9.8 ± 2.7
Indonesia	**5.0**	**21.0**	**13.7 ± 2.9**	**3.7**	**18.5**	**11.6 ± 3.3**	**3.2**	**14.2**	**7.8 ± 2.2**

Table 2 shows that the highest prevalence of stunting occurred in the Nusa Tenggara region (21.0%) and the lowest prevalence of stunting occurred in the Java and Bali regions (5.0%). The highest prevalence of underweight occurred in the Nusa Tenggara region (18.5%) and the lowest prevalence of underweight occurred in the Java and Bali regions (3.7%). Meanwhile, the highest prevalence of wasting occurred in the Papua region (14.2%) and the lowest prevalence of wasting occurred in the Java and Bali regions (3.2%). National figures show a stunting prevalence of 13.7%, an underweight prevalence of 11.6%, and a wasting prevalence of 7.8%.

Table 3. Relationship between the Proportion of Animal Protein Consumption and the Prevalence of Nutritional Problems in Toddlers in Indonesia in 2023

Animal Protein Consumption Proportion	Prevalence of Stunting	Prevalence of Underweight	Prevalence of Wasting
Betta	-0.428	-0.168	-0.265
Constant	93.754	81.230	84.252
Correlation	-0.551	-0.947	-0.464
Coefficient (r)	0.000	0.001	0.003
p-value			

Table 3 shows the results of the analysis that the proportion of animal protein consumption is related to the prevalence of stunting (p-value 0.000), the prevalence of underweight (p-value 0.001), and the prevalence of wasting (p-value 0.003). Based on the beta coefficient value, it shows that the higher the proportion of animal protein, the lower the incidence of stunting, underweight, and wasting. The high proportion of animal protein consumption is very strongly related to the prevalence of underweight (r = 0.947), and moderately related to the prevalence of stunting and wasting (r = 0.551 and r = 0.464).

3.1 Proportion of Animal Protein Consumption with Stunting Prevalence

Stunting is a condition of failure to grow in the body and brain due to long-term malnutrition so that children are shorter than normal children of the same age and have delays in thinking (Anjani et al., 2024). According to WHO, 2022, the stunting rate in the world is 148.1 million toddlers, or 22.3%. Indonesia ranks 27th out of 154 countries with stunting data, making Indonesia ranked 5th in Asia and the second highest in Southeast Asia.

Based on IHS, 2023, the highest stunting prevalence occurs in Nusa Tenggara (21%%), which shows that geographical factors and access to nutritious food play a major role in the high stunting rate in the area. Meanwhile, the prevalence of stunting in Java and Bali is relatively lower (5.0%), which may be related to easy access to more diverse food resources and better health facilities in this region. According to research Nirmalasari (2020), stunting can be caused by many factors such as socioeconomic conditions, maternal nutrition during pregnancy, illness in infants, and lack of nutritional intake in infants. Generally, these causes last for a long time (chronic).

The results of the study (Sholikhah & Dewi, 2022), that food ingredients sourced from animal protein can accelerate growth rates and prevent stunting. Research (Afiah et al., 2020) also states that consumption of animal protein is protective against stunting, toddlers who do not finish their food at every meal are 3 times more at risk of stunting and households that provide vegetables less than 3 days a week are 10 times more at risk of stunting. Research (Sudirman et al., 2023) is also in line with previous research, it was found that protein intake is one of the triggers for stunting in toddlers.

The problem of stunting in toddlers is caused by direct and indirect causes. Food intake and infectious diseases are direct causes. Parenting habits and food security are indirect causes. Food intake caused by calorie-rich foods and a lack of animal products, fruits, and vegetables results in stunting. Food intake is used in the form of energy and protein which functions to support all body activities. Stunting children who lack protein are more likely to

lose muscle mass, experience fractures, and get infectious diseases in addition to the risk of growth and development failure. Protein is very important for the development of the structure, function, and regulation of living cells. Some foods that contain protein, such as meat, fish, eggs, almonds, and milk. Growth is greatly influenced by protein consumption. Stunting can occur due to a lack of protein consumption because in general protein is needed for the development, synthesis of structural components, and antibody production (Juliyusman et al., 2023). This is because toddlers need more protein for muscle and antibody formation. However, the 2014 Individual Food Consumption Survey Data reported that toddlers' animal protein intake tended to be lacking, namely <5% in children aged 6 months and over (H. P. Sari et al., 2022).

Factors that can cause stunting in toddlers include internal and external factors. Internal factors include the baby's health condition, such as heredity, metabolism, and infection. Examples of internal factors that can cause stunting in babies include disorders of the digestive system, hormonal disorders, and disorders of the nervous system. External factors include the baby's environment and socio-economic conditions, such as the availability of clean water, poor sanitation, parenting and nutrition patterns, and the level of parental knowledge. Examples of external factors that influence the occurrence of stunting in babies include exclusive breastfeeding, providing additional intake other than breast milk, the availability of food with poor nutrition, poor access to sanitation, access to clean water, and the mother's minimal knowledge in caring for and providing nutrition to babies. In addition to the factors that can cause stunting above, researchers are examining other factors to find innovations in research, namely economic factors where family income can also influence the incidence of stunting in toddlers (Febriani et al., 2024).

3.2 Proportion of Animal Protein Consumption with Underweight Prevalence

Underweight or lack of body weight is caused by a lack of energy intake compared to energy expenditure. Lack of energy intake or inadequate consumption of essential nutrients needed by the body will usually cause a decrease in activities carried out (E. Kartika Sari et al., 2019). The United Nations International Children's Emergency Fund (UNICEF) in 2020 stated that 167 million toddlers worldwide are underweight. Most toddlers in South Asia are underweight at 52%, followed by West Asia with 15%, and Southeast Asia with 17%.

Regarding the prevalence of underweight, SKI 2023 data shows that the Nusa Tenggara region has the highest figure (18.5%) and the lowest prevalence of underweight incidents occurs in the Java and Bali regions (3.7%). Children with low body weight can cause growth and development disorders. This nutritional problem affects the development of the child's brain which will later hinder academic and non-academic development in the next period of life. The period of children requires optimal nutrients to support very rapid growth and development (Putri et al., 2024). The decrease in the prevalence of underweight was also found to be very strong along with the increase in animal protein consumption ($r = 0.94$), which shows the importance of animal protein in improving children's nutritional status. This study is in line with research conducted that animal protein consumption is significantly related to the incidence of underweight (Ilmi et al., 2021).

Factors causing underweight are the mother's education and knowledge, parenting patterns, and history of breastfeeding. The education received and the things that mothers of toddlers know about nutrition affect the provision of exclusive breastfeeding for their babies. There is a relationship between exclusive breastfeeding and the nutritional

status of toddlers because, in the process of consuming foods containing nutrients, exclusive breastfeeding is important. After all, breast milk has the most complete source of nutrients according to the child's age which must be given to help the process of growth and development (Esti, 2024). Other supporters of underweight toddlers are deteriorating family conditions, namely low socio-economic status (poverty), poor household hygiene and sanitation, and low dietary diversity, as well as a lack of agricultural products resulting in a lack of food availability in the household. Minimal household access to health facilities will worsen the nutritional status of toddlers (Selvianita & Sudiarti, 2021). The weight parameter based on age (BB/A) is a parameter commonly used to assess the nutritional status of toddlers. This index can be used to assess children with underweight (underweight - 3 SD to <- 2 SD) or very underweight (severely underweight <-3 SD) (Putri et al., 2024).

3.3 Proportion of Animal Protein Consumption with Wasting Prevalence

Wasting is one of the nutritional problems in Indonesia, a combination of wasted and very wasted based on the Body Weight Index according to Body Length or Height (WHZ) with a threshold (Z-score) <-2 SD (Octari & Dwiyana, 2021). According to data from the World Health Organization (WHO), there were 32.5 million people in the world who experienced wasting in 2019, and the Asia and Pacific region had the highest number of wasting cases with 8.7% of cases coming from Southeast Asia. After Timor Leste, Indonesia is the country with the second highest wasting cases in Southeast Asia and is ranked sixth out of 30 countries. Based on SKI, 2023, the highest prevalence of wasting incidents occurred in the Papua region (14.2%) and the lowest prevalence of wasting incidents occurred in the Java and Bali regions (3.2%).

Table 3 shows the results of the prevalence of wasting in toddlers with the proportion of animal protein consumption obtained a p-value of 0.003, there is a significant relationship between the proportion of animal protein consumption and the prevalence of wasting in toddlers in Indonesia. This is greatly related to the intake of nutrients, especially essential animal protein to prevent wasting (Abdullah et al., 2023). This study is in line with the study (Zulfiana et al., 2023), that there is a significant relationship between protein intake and the prevalence of wasting in children. The study (Veronica et al., 2023) is also in line with previous studies, that there is an influence between giving high-protein nuggets on the weight of wasting toddlers in the work area of the Palembang City Reading Park Health Center.

This growth disorder occurs due to several factors including socio-economic factors, consumption factors, and maternal nutritional status factors. One of the parameters to determine the nutritional status of pregnant women is the Upper Arm Circumference (UAC) anthropometric indicator in mothers, where insufficient energy and protein intake in pregnant women can cause Chronic Energy Deficiency (CED). Pregnant women with CED during pregnancy are at risk of wasting in toddlers. Pregnant women with low nutritional intake and experiencing infectious diseases will give birth to babies with Low Birth Weight (LBW). A child's life from in the womb to the age of two years (1,000 The First Day of Life) is a critical period in supporting optimal child growth and development (Saleh et al., 2022). The impact of Wasting is that it makes a person less social, less cheerful, and apathetic and reduces concern for the environment. The long-term impacts of wasting are behavioral problems, decreased achievement in learning, cognitive disorders, and even a high possibility of death (Sadik et al., 2025).

Based on the results of this study, increasing the proportion of animal protein consumption is an important step in reducing the prevalence of stunting, wasting, and

underweight. The Indonesian government needs to focus on programs to increase access to high-protein foods throughout the region, especially in areas that still have difficulty in meeting basic nutritional needs. Nutrition education programs for mothers and families. More integrated policies between the health and education sectors are essential in addressing the problem of malnutrition in children in Indonesia.

CONCLUSION

The conclusion of this study shows that there is a significant relationship between the proportion of animal protein consumption and the prevalence of stunting, wasting, and underweight in toddlers in Indonesia. The results of the analysis show that the higher the proportion of animal protein consumption, the lower the prevalence of stunting (p-value 0.000), underweight (p-value 0.001), and wasting (p-value 0.003). The data indicate that areas with better access to animal protein sources, such as Java and Bali, show a lower prevalence of nutritional problems compared to areas with less access, such as Nusa Tenggara and Papua. This study also found that consumption of high-quality animal protein is very important to support children's growth and development, as well as prevent long-term nutritional problems. Therefore, increasing access to and consumption of animal protein should be a primary focus of nutrition policy in Indonesia.

Recommendations for further research include longitudinal studies to evaluate the impact of animal protein consumption in more depth and analysis of other factors that influence children's nutritional status, such as maternal education and socio-economic conditions. This study is expected to provide more comprehensive insights for policymakers in designing effective interventions to address nutritional problems in children in Indonesia.

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CONFLICT OF INTEREST

The authors have no conflicts of interest related to the material presented in this research.

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IRON FOLIC ACID (IFA) SUPPLEMENTATION IN SCHOOLS FOR ADOLESCENTS: BARRIERS AND SUPPORT FACTORS

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ABSTRACT

Background: *Weekly iron and folic acid supplementation in schools is considered an effective measure to increase hemoglobin levels and has been adopted as one of the national health policies. In addition, the school-based weekly iron and folic acid supplementation program aims to improve compliance and reduce the possibility of side effects without reducing effectiveness. Increasing the WIFAS (weekly iron folic acid supplementation) program to reach larger populations are a challenge in some developing countries. This study aims to analyse Weekly IFA Supplementation program (WIFAS) in schools for adolescents has been proven to reduce the prevalence of anemia.*
Method: *Preferred Reporting Items for Review Systematic Review and Meta-Analysis (PRISMA) was used to review articles not earlier than 2019 for scientific reports in English. The navigation terms used are supplementation Iron Folic Acid; adolescents, ten criteria of the paper meet the criteria for assessment.*
Result: *By identifying the barriers in the weekly IFA (iron folic acid) tablet supplementation program, supporting factors will be found to reduce the barriers of the WIFAS program appropriately. Low knowledge and compliance of adolescents, lack of teacher participation in health education and supervision of IFA consumption are the barriers found.*
Conclusion*: Providing health education by combining several media and methods accompanied by supervision by peers or teachers during IFA consumption has succeeded in increasing the knowledge, attitudes, intentions, motivations, and behavior of adolescents in taking IFA tablets, ultimately reducing anemia. It is hoped that the results of this review can be used as a way to increase the coverage of weekly supplementation programs in schools.*

Keywords: *Iron Folic Acid; Supplementation; Adolescents*

INTRODUCTION

Anemia is a decrease in red blood cells or hemoglobin (Hb) concentration. (WHO, 2015, 2011) About 50% of anemia cases are caused by iron deficiency which occurs due to a lack of iron available to produce red blood cells normally. (WHO, 2015; WHO, 2005; Tesfaye, et.al, 2015) The World Health Organization (WHO) defines adolescence as the period between the ages of 10 and 19 years. About a quarter of adolescents in developing countries suffer from anemia,HoweverThe estimated prevalence of anemia in adolescents in the Southeast Asia region ranges from 27% to 55% (WHO, 2006). Adolescents' vulnerability to anemia is generally due to the biological need for micronutrients (such as iron and folate) associated with rapid physical growth, as well as the loss of these micronutrients due to parasitic infestations such as malaria and hookworm (de Benoist, et.al, 2008). In late adolescence, males rapidly regain adequate nutrient stores, while females remain susceptible to anemia due to menstrual blood loss. Therefore, females may continue to be anemic or become more anemic due to increased micronutrient needs from menstruation, pregnancy, and lactation. (Prentice, 2015) Anemia not only negatively

impacts the physical growth of adolescents, but also prevents them from reaching their full potential by reducing educational achievement and work productivity (WHO, 2006).

Anemia is also one of the main problems in adolescents in Indonesia. Research data from various regions in Indonesia shows that the prevalence of anemia in adolescent girls ranges from 32.4–61% (Ministry of Health of the Republic of Indonesia, 2015). Weekly iron and folic acid supplementation in schools is considered an effective step to increase hemoglobin levels and has been adopted as one of the national health policies (Ministry of Health of the Republic of Indonesia, 2014). In addition, the school-based weekly iron and folic acid supplementation program aims to increase compliance and reduce the possibility of side effects without reducing effectiveness (Briawan, 2008; Joshi, 2013). However, compliance with supplementation is still low. The 2018 basic health research found that the high coverage of iron supplements in schools (80.9%) was not followed by high consumption of iron supplements according to needs, reported only 1.4% of adolescent girls in schools consumed 52 tablets (Ministry of Health of the Republic of Indonesia, 2018).Scaling up weekly iron folic acid (WIFAS) programs to reach larger populations is a challenge in some developing countries. There are many barriers to successful implementation, such as supply chain management, inadequate procurement plans, and lack of understanding about anemia, the function of IFA supplements and how to deal with side effects of IFA consumption (Joshi, 2013). These barriers lead to low compliance with IFA supplement consumption.

METHODS

By using Literature Study, scientific article search using Science Direct, Scopus, and Proquest databases for the period 2019–2023. Data collection using database-based data was carried out by entering the keywords “Iron Tablets, Supplementation Anemia, Adolescents”. Three electronic databases were searched until October 2023. Keywords were identified to improve results related to the Fe supplementation program to reduce anemia in adolescents. There were 860 articles screened. From Science Direct there were 137 articles, Scopus 72 articles, Proquest 651 articles. After adding filters related to subject, language, respondent gender, journal coverage, research articles, and open access, 366 articles were obtained. Articles published before 2019 were assumed to be incompatible with this year's conditions. Of the 366 articles, they were re-screened for full text, duplicate publications, and eligibility, 29 articles were finally obtained. Then the last process was reading and selecting articles based on inclusion and exclusion criteria, 10 relevant articles were obtained (Table 1). Article evaluation based on; Inclusion criteria: articles discussing iron supplementation, published in 2019-2023, national and international publications, national journals have ISSN, using Indonesian and English, original research, open access. Exclusion criteria: non-adolescent population, anemia interventions other than IFA supplementation, texts in the form of short communications, meta-analyses, and literature reviews.

Table 1. Description of Research Article

Author, year, research area	Design, objectives, research sample	Research Findings	Obstacle	Support Factor to Enhance Programs
Gosdin, L et al (2021), Ghana	Design: longitudinal study, Objective: to evaluate the context-specific effectiveness of a school-based integrated anemia control program with IFA supplementation. Sample: 1,551 adolescents	The calculation of the minimum effective number of IFA tablets shows that increasing compliance will improve program outcomes. The program target should be higher than the current target of 10 tablets in 1 school year.	Student non-compliance in taking IFA tablets. Lack of teacher role.	Targeting supplementation program issues in schools and increasing teacher engagement.
Gosdin, L et al (2020), Ghana	Design: longitudinal and cross sectional. Objective: to evaluate barriers and facilitators to fidelity of a school-based anemia reduction program with weekly IFA supplementation. Sample: 1,387 adolescents	Schools are ultimately responsible for coverage and compliance with IFA supplementation.	Student non-compliance with the program. Lack of student knowledge about anemia and supplementation programs. Missed IFA distribution.	Ensure annual training for school staff, including leaders, that includes guidance on addressing missed IFA distributions.
Bali, S & Alok, Y (2022), India.	Design: cross sectional Objective: to assess knowledge about the WIFAS program in adolescents. Sample: 3,213 adolescents.	Knowledge of the WIFAS program was significantly associated with the incidence of anemia and the severity of anemia.	Lack of student knowledge about anemia and the WIFAS program.	Ensuring availability of IFA tablets, monitoring side effects, training for school authorities and health workers. Educational interventions based on problem-based learning and behavior change theory. Utilizing mass media and peer advocacy.
Shinde, S, et.al (2021). India.	Design: longitudinal study. Objective: to examine the relationship between IFA supplementation, deworming, and dietary diversity.	It is important to identify contextual and structural barriers to adherence. Students receiving IFA had higher hemoglobin.	Lack of knowledge, attitudes, beliefs, and compliance of students towards the IFA supplementation program.	Evidence-based science strategies and implementation must be used. Ensuring compliance is not just about IFA distribution.
Madanijah, et.al. (2020). Indonesia	Design: cross sectional. Objective: to determine students' determinants in consuming IFA.	Schools are responsible for the coverage and compliance of students consuming IFA.	Respondents were not compliant because they considered IFA unnecessary. Lack of health media	Building teacher capacity in educating students to consume IFA. The WIFAS program must involve the education and health

Author, year, research area	Design, objectives, research sample	Research Findings	Obstacle	Support Factor to Enhance Programs
	Sample: 274 high school female adolescents.		Lack of knowledge about anemia and IFA.	sectors and coordinate with other sectors.
Alifah, E, et.al. (2020). Indonesia.	Design: cross sectional. Objective: to assess coverage and compliance with the WIFAS program among school-going adolescent girls. Sample: 1,856 adolescent girls.	Coverage and compliance in consuming IFA is very low in adolescent girls.	Compliance with the WIFAS program. Implementation of different WIFAS program rules. The IFA awarding system varies from school to school.	WIFAS program campaign by making 1 day an IFA drinking day under the supervision of teachers and peers.
Jafari, et.al. (2023). Iran.	Design: cross sectional. Objective: to examine the barriers and facilitations of the WIFAS program. Sample: 399 adolescent girls.	Students are more obedient in consuming IFA when there is education about IFA from teachers.	Lack of knowledge about IFA and anemia. Lack of means to drink IFA in class.	The most important facilitators of IFA supplement use are distribution by students, health education, and teachers' positive attitudes toward the WIFAS.
Madestria, et.al. (2021). Indonesia.	Design: quasi-experimental. Objective: The effect of anemia video education and IFA packaging modification on IFA drinking behavior. Sample: 62 adolescent girls.	Education with videos about anemia and modification of IFA packaging increases student compliance in consuming IFA.	Low knowledge, attitudes, intentions, and compliance of adolescents towards the WIFAS program.	The use of two or more media simultaneously in health education will have a stronger influence on changes in IFA consumption behavior.
Rusdin, et.al. (2021). Indonesia.	Design: quasi experiment. Objective: The influence of the active, creative, effective, and enjoyable learning education model on WIFAS compliance. Sample: 249 adolescent girls.	The active, creative, effective and enjoyable learning education model increases the knowledge, attitudes and motivation of adolescents about anemia and IFA consumption.	Low knowledge, attitudes, and motivation affect the WIFAS program.	Combining complementary health education media and methods increases the effectiveness of WIFAS program interventions.
Singh, et.al. (2020). India.	Design: quasi experiment. Objective: effectiveness of one month of education on knowledge and compliance with WIFAS. Sample: 210 adolescent girls	The WIFAS program accompanied by health education increases the chances of overcoming anemia in adolescent girls.	Knowledge and compliance in consuming IFA in adolescents.	At least health education about anemia and WIFAS is provided once a month.

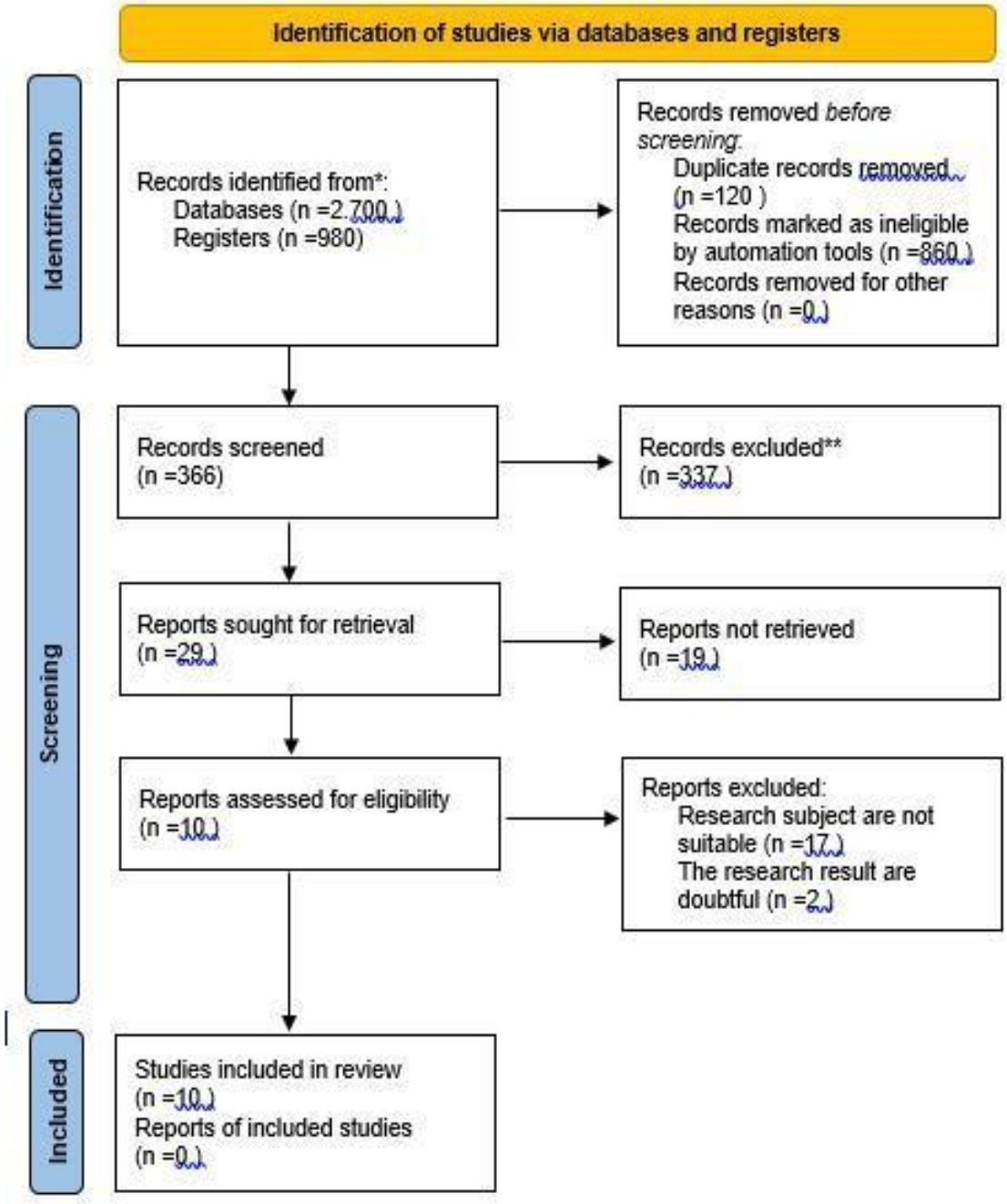


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram of study selection

RESULTS AND DISCUSSION

The results of the literature review show that pheredity the prevalence of anemia in the population by 5.4 points, meaning a reduction of around 22,000 cases of anemia among adolescent girls in schools in the surveyed area in just 8 months.

Compliance with weekly iron folate supplementation (WIFAS) program was lower than with similar iron folate (IFA) programs (Vir SC, et.al, 2008; Risonar, et.al, 2008), this

implies a program bottleneck. Barriers such as supply chain, training, stakeholder engagement, side effects, and perceptions have been identified by similar programs in other countries and may be causes of low compliance (Aguayo, et.al, 2013; Roche, et.al, 2018; Priya, et.al, 2016). In this evaluation, only 3% of schools missed the distribution of IFA tablets due to lack of supplies, and other school factors, including school-level teacher training, distribution, and perceptions. teacher, is associated with obedience (Gosdin, et.al, 2020). In this study 26.7 tablets weekly during the school year may be the minimum effective number of IFA tablets for 1 school year in the population (Gosdin, et.al, 2021). Gosdin's (2020) study found that the ability to make IFA distributions without missing was the only statistically significant student-level predictor. In addition, teacher training on the WIFAS program, and teacher experience and perceptions of the program were significant predictors at the school level. In schools that reported problems with refusing to take IFA tablets, female students consumed an average of 4.02 ($P < 0.05$) fewer tablets. In schools where teacher respondents at the school considered the program difficult to implement and too time-consuming, female students consumed an average of 6.92 ($P < 0.01$) and 4.41 ($P < 0.05$) fewer tablets over 1 school year. Teacher training on the program remained the main predictor of the number of IFA tablets consumed, even in the adjusted model. Educators' experiences and perceptions of the program can influence their motivation and ultimately the performance of the WIFAS program in their schools. This is supported by research showing that knowledge of risks and benefits improves adherence to micronutrient interventions (Tumilowicz, et.al, 2019; Ford, et.al, 2019). Female students with low knowledge of IFA often thought the tablets were related to reproductive health, such as menstrual regulation, contraception, or fertility drugs (Malhotra, et.al, 2015). Annual training and additional training for school staff including other key stakeholders such as principals increased teacher loyalty and perceptions and motivation towards the program. Proper management of IFA tablets increased the availability of IFA tablets, improving schools' ability to maintain knowledge of the location, quantity, and condition of their stock. Challenges such as improper storage of IFA tablets can be addressed through adequate training at all levels (Malhotra, et.al, 2015; Jefferds, et.al, 2015; Reerink, et.al, 2017), frequent interaction between health staff and teachers, and thorough monitoring (Risonar, et.al, 2008). Similar findings were also conveyed from a similar study which stated that the main barriers to effective iron supplementation programs worldwide are lack of knowledge about the program, low compliance with iron tablet consumption due to potential adverse effects of the tablets, and irregular supply of good quality iron tablets (Malhotra, et.al, 2015). Knowledge of WIFAS has been shown to play a significant role in optimal coverage and utilization of IFA. (Bali and Alok, 2022) The findings of this study also suggest that the valuable insights gained from the success of the WIFAS trial have not been fully translated and assimilated into the rollout of the national program, which includes inclusion of all stakeholders, peer advocacy, and settlement problem Which fast. Problem implementation, continuous availability of supplements, and technical support and supervision (Sudfeld, et.al, 2020). Compliance is also influenced by knowledge, according to the results of Apriningsih's study (2019) The majority of respondents were not compliant in consuming IFA (62.8%) with the most common reason being that they considered it unnecessary (36.1%) and the factors that most influenced the decision to consume IFA were their knowledge about anemia and the benefits of IFA (37.2%), (51.1%) had checked their Hb but did not know or forgot the results (44.5%). Only 36.5% of schools implemented IFA

routinely once a week, while 50.4% of respondents stated that their teachers had conveyed about anemia and the benefits of IFA, and only 6.2% of respondents stated that their schools had health education media about anemia and the benefits of IFA. Only 39.8% of respondents mentioned that there was health education from health center officers (community health centers (Madanijah, et.al, 2020). The Ministry of Health should supervise the procurement and distribution of IFA supplies and coordinate with other sectors. The education office must implement this program with support from the school community, especially school teachers (Malhotra, et.al, 2015). A study in two provinces in Indonesia showed that the level of compliance in consuming IFA supplements was very low, namely 1% in East Java, and 0% in East Nusa Tenggara. On average, adolescent girls only consumed 0.4–0.7 tablets in the last 6 months. This coverage rate is very low so that the level of compliance also shows a very low figure, among adolescent girls who had received IFA in July to December 2017, only 22% in East Java and less than 1% in East Nusa Tenggara received IFA according to the recommended scheme (24 tablets in 6 months) (Alfiah, et.al, 2020). In some countries, knowledge about the benefits and potential side effects of IFA tablets from health workers health and society are the keys to the success of iron supplementation programs for both adolescent girls and pregnant women (Vir SC, et.al, 2008; Compaore, et.al, 2018; Niquini, et.al, 2016). Compliance also causes IFA tablets that have been received but not consumed,there may be many obstacles in supervision of weekly IFA supplementation administration through schools and health workers, in addition the IFA supplementation program has not operationalized the additional components of the 'test and treat' strategy, namely anemia screening and referral of cases to appropriate health facilities. The implementation of the program in the community is influenced by various factors, including support, resistance, or indifference from caregivers and other community members, as well as cultural and media norms, and educational activities. (Kapil, et.al, 2019) To close this policy-to-practice gap, evidence-based science and implementation strategies must be used. For example, teachers and frontline health workers must act to improve adolescents' knowledge, attitudes, and beliefs about IFA supplementation and ensure compliance beyond just distribution. (Shinde, et.al, 2021) Compliance is also influenced by peers as distributors, when the supplements are distributed by fellow students, the level of IFA consumption increases. One of the most effective groups in choosing health behaviors by students is the peer group, and adolescents are usually most influenced by their friends (Matos, et.al, 2012). Therefore, one of the groups in schools that is effective in encouraging students to behave healthily is the peer group. Educational programs increase the use of iron supplements by students, students use iron supplements or IFA more when educational programs are provided by teachers. It seems to provideTeacherhealth in every school may be one of the best ways to improve the quality of program implementation (Jafari, et.al, 2023).WIFAS accompanied by health education can overcome anemia, compliance is almost 100%, because the consumption of IFA tablets is directly supervised. In developing countries like India with a large adolescent population, WIFAS with health education can be seen as an important nutritional intervention. WIFAS increases compliance, reduces side effects, and is cost-effective compared to daily medication (Singh, et.al, 2020). If the media and health education methods are combined, they will complement each other. Using a health education program with an active learning approach that is conditioned creatively, effectively, and pleasantly. to improve knowledge, attitudes, motivation, and practices of taking Fe tablets in adolescent girls. can be an option. There is an influence of the

active learning education model that is conditioned creatively, effectively, and pleasantly and leaflet media and audiovisual media to increase respondents' knowledge about anemia and Fe tablets, active learning methods that are conditioned creatively, effectively, and fun increase respondents' motivation and actions in consuming IFA tablets. Respondent compliance in taking IFA tablets every week for 8 weeks is higher by 91.4% (Rusdin, et.al, 2021). In addition to active learning that is conditioned creatively, effectively, and fun, education in the form of videos and packaging modifications can also increase the knowledge of adolescent girls. In a study of the impact of a combination of audio-visual media in the form of educational videos about the importance of iron tablets and modifications to iron tablet packaging which are printed media, simultaneously had a more significant influence on changes in knowledge, attitudes, and intentions (Madestria, et.al, 2021). If education is carried out periodically and continuously with two educational media at once, the behavioral changes formed in adolescent girls towards consuming iron supplementation will become permanent and sustainable behavior (Andriastuti, 2019).

CONCLUSION

The weekly IFA supplementation program or WIFAS in schools for adolescents has been proven to reduce the prevalence of anemia. However, in its implementation, there are still many obstacles, so that the goal of reducing anemia in adolescents has not been achieved. These obstacles are more due to the low knowledge of students about IFA and anemia, which will ultimately lead to non-compliance in taking IFA. In addition to the non-compliance factor, other causes are the lack of teacher role in providing health education about IFA and anemia and the lack of teacher supervision when adolescents take IFA tablets. And the most common obstacle is related to the availability and distribution of IFA in schools. So from these obstacles, various supporting solutions need to be found to overcome the obstacles. Supporting factors as solutions that can be provided are teacher training on the WIFAS program which is expected to provide motivation and supervision that increases student knowledge and compliance (adolescents). In addition, by increasing the involvement of the principal as an influential leader. In providing health education, it should also pay attention to the media and methods used, for example by combining several media and methods at once in providing health education with the aim of making students active, creative, effective and enjoyable for students. Thus, it will increase students' knowledge, attitudes, intentions, motivation and behavior to consume IFA weekly.

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CONFLICT OF INTEREST

The author hereby declares that there is no conflict of interest with any party.

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RELATIONSHIP BETWEEN PROPORTION OF VEGETABLE AND FRUIT UNDER CONSUMPTION AND PROPORTION OF DIABETES MELLITUS TYPES IN INDONESIA

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ABSTRACT

Background: *Diabetes Mellitus (DM) is a global health problem with an increasing proportion in Indonesia. This study will analyze the relationship between average fruit and vegetable consumption and the proportion of Type 1, Type 2, and Gestational Diabetes Mellitus (GDM) in Indonesia based on data from the 2023 Indonesian Health Survey (IHS). This study aims to determine the relationship between the proportion of less consumed vegetables and fruits and the Proportion of types of Diabetes Mellitus (Type 1, Type 2, and GDM).*
Method: *This study uses a correlation design with secondary data aggregate from IHS2023 which covers all provinces in Indonesia. The independent variable is the proportion of people who consume fruits and vegetables, while the dependent variable is the proportion of each type of DM.*
Result: *The results showed that the proportion of undereating vegetables and fruits in Indonesia is very high (96.1%), highest in the Sumatra Region (97.1%) and lowest in the Papua Region (93.4%). Type 2 diabetes in Indonesia is dominated by type 2 (46.7%) followed by type I (21,6%), GDM (2,8%), and the rest are unknown DM types. The results of the analysis showed that there was a relationship between the proportion of eating less vegetables and fruits and the proportion of Type II Diabetes Mellitus (p-value 0.003, r=0.475), but it is not significantly related to Type I DM and GDM.*
Conclusion: *There is a significant relationship between the proportion of eating less vegetables and fruits and the proportion of Type II Diabetes Mellitus. The higher the proportion of eating less vegetables and fruits, the higher the proportion of type II DM.*

Keywords: *Consumption of vegetables and fruits; Type 1 diabetes mellitus; Type 2 diabetes mellitus; Gestational diabetes mellitus; 2023 Indonesian Health Survey (IHS)*

INTRODUCTION

Diabetes Mellitus belongs to a group of metabolic disorders with hyperglycemia characteristics that occur due to insulin abnormalities caused by work disorders and/or insulin secretion. Diabetes mellitus is a health problem that is considered important because it is a non-communicable disease that is the target of management by world leaders. The number of DM cases is increasing in the next few years (Milita et al., 2021).

A person is said to have diabetes if on the blood test of the fine blood vessels (capillaries) blood glucose is more than 120 mg/dL in a fasting state / or more than 200 mg/dL for 2 hours after eating. If blood is taken from the veins, the fasting glucose level is more than 140 mg/dL and/or 200mg/dL for 2 hours after eating. Blood glucose that is less than 120 or 140 mg/dL in the fasting state but between 140–

200 mg/dL 2 hours after eating is referred to as Impaired Glucose Tolerance (TGT) which does not require treatment but still requires periodic monitoring (Yosmar et al., 2018).

WHO predicts an increase in the number of people with Diabetes Mellitus, which is one of the global health threats. In addition, there were 415 million people with Diabetes Mellitus in the world in 2015, and in 2040 it is estimated to increase to 642 million people. WHO data estimates that the number of people with type 2 Diabetes Mellitus in Indonesia will increase significantly to 21.3 million people in 2030 (Sari et al., 2019). The predicted countries with the highest number of DM sufferers in the world by 2030 are India (79.4 million), China (42.3 million), the United States (30.3 million), Indonesia (21.3 million), Pakistan (13.9 million), Brazil (11.3 million), Bangladesh (11.1 million), Japan (8.9 million), the Philippines (7.8 million), and Egypt (6.7 million) (Hardianto, 2021).

The report shows that the Indonesian population experiences diabetes mellitus in the 2023 Indonesian Health Survey (IHS) as much as 1.7%. The proportion of diabetes mellitus increased by 0.2% within 5 years. Also based on the Indonesian Health Survey (IHS) 2023, type 1 diabetes mellitus is 16.1%, type 2 diabetes mellitus is 50.2%, and gestational diabetes mellitus is 2.6%. This study aims to determine the relationship between the proportion of undereating vegetables and fruits and the Proportion of types of Diabetes Mellitus (Type 1, Type 2, and GDM). The results of this study are expected to provide a deeper insight into the relationship between the proportion of undereating vegetables and fruits and the Proportion of types of Diabetes Mellitus (Type 1, Type 2, and GDM) in Indonesia, as well as provide a basis for more appropriate interventions in dealing with nutritional problems in Indonesia.

METHODS

The research uses secondary data obtained from the 2023 Indonesian Health Survey (IHS) report with a correlation research design. IHS2023 will be held in the period from January to December 2023, covering all provinces in Indonesia. The population in this study is the entire population >5 years old who have type 1 diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes mellitus in 34 provinces of Indonesia, which are grouped into seven regions, namely Sumatra, Java-Bali, NTB-NTT, Kalimantan, Sulawesi, Maluku, and Papua. The sample of this study consists of the total population in all provinces covered by the IHS2023.

The independent variable used is the proportion of eating less vegetables and fruits measured based on the questions in IHS2023. Proportion of Less consumption of eating vegetables and fruits if less than 5 servings per day in a week (Kemenkes, 2023). The dependent variables analyzed include the proportion of type 1 diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes mellitus in Indonesia as measured using blood sugar during (GDS), fasting blood sugar (GDP), prandial 2-hour blood sugar check (GD2PP), hBa1c test, oral glucose tolerance test (TTGO) in the form of a screening test. According to Widodo (2014), from the anamnesis, it is often obtained that typical diabetic complaints in the form of polyuria, polydipsia, polyphagia, and weight loss are not clear to the cause. Other complaints that are often conveyed are weakness, tingling, itching, blurred eyes, erectile dysfunction, and vulvae pruritus (Lestari et al., 2021). The diagnosis is established by checking blood sugar levels as follows: Fasting blood sugar > 126 mg/dl, Blood sugar 2 hours > 200 mg/dl, and Random blood sugar > 200 mg/dl.

This research received ethical approval from the Health Research Ethics Commission in 2023, by the procedures applicable to IHS2023. The Indonesian Health Survey (IHS)

has obtained an ethics clearance letter from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023. By using secondary data, this study maintains the confidentiality and security of data obtained from respondents.

RESULTS AND DISCUSSION

Table 1. Proportion of Eating Less Vegetables and Fruits Region Indonesia

Region	Minimum	Maximum	$\underline{X} \pm$ SD
Sumatera	93.7	98.9	97.1 ± 1.5
Jawa and Bali	95.3	98.8	96.7 ± 1.5
Nusa Tenggara	94.2	97.6	96.3 ± 1.8
Kalimantan	92.9	98.6	96.5 ± 2.3
Sulawesi	94.6	98.2	96.3 ± 1.3
Maluku	94.7	94.9	94.8 ± 0.1
Papua	88.2	98.0	93.4 ± 3.5
Indonesia	**88.2**	**98.9**	**96.1± 2.2**

Table 1 shows that the proportion of undereating vegetables and fruits in Indonesia is very high (96.1%), highest in the Sumatra Region (97.1%) and lowest in the Papua Region (93.4%).

Less consumption of fruit and vegetables are eating behaviors That can be detrimental to health. If somebody experiences less consumption of fruits and vegetables, then, the person will experience nutritional deficiencies such as vitamins, minerals, fiber, and other nutrients. Fruits and fresh vegetables also contain active enzymes that can accelerate chemical reactions in the body. Factors that affect the lack of consumption of vegetables and fruits include age, gender, and economic level of parents, knowledge, self-efficacy, and availability of vegetables and fruits (Amelia & Fayasari, 2020). As in Nusa Tenggara, the factor that makes people consume a lot of fruits and vegetables is environmental factors, people can take advantage of traditional knowledge of farming and utilize the surrounding natural resources, producing superior products that are affordable in traditional markets.

Table 2. The proportion of Type Diabetes Mellitus by Indonesia Region in 2023

Region	Type 1 DM			Type 2 DM			Gestasional DM		
	Min	Max	$\underline{X} \pm$ SD	Min	Max	$\underline{X} \pm$SD	Min	Max	$\underline{X} \pm$SD
Sumatera	12.0	27.2	21.4 ±5.2	44.3	63.4	53.3 ±6.3	0.0	11.3	2.3±3.4
Jawa and Bali	11.2	18.1	14.8 ±2.2	47.4	51.9	49.9 ±1.8	2.0	5.6	3.4 ±1.5
Nusa Tenggara	11.8	27.7	19.5 ±7.9	45.9	57.2	51.7 ±5.6	0.0	3.7	2.0 ±1.8
Kalimantan	15.2	24.5	21.06 ±4.2	49.4	65.1	54.7 ±6.3	0.3	4.5	1.6 ±1.7
Sulawesi	21.4	35.3	27.9±5.2	23.9	46.1	39.6±8.01	0.5	7.5	3.2±2.7
Maluku	20.9	27.0	23.9±4.3	26.1	44.7	35.4±13.1	2.0	16.7	9.3±10.3
Papua	18.4	35.3	23.3±6.3	25.3	45.3	34.3±8.1	0.0	3.4	1.9±1.5
Indonesia	**11.2**	**35.3**	**21.6 ± 6.1**	**23.9**	**65.1**	**46.7 ±10.1**	**0.0**	**16.7**	**2.8 ±3.2**

Table 2 shows that the proportion of type 1 diabetes mellitus occurs in the Papua region (35.3%) and the proportion of type 1 diabetes mellitus is lowest in the Java and Bali regions (11.2%). The highest proportion of type 2 diabetes mellitus occurs in region areas Kalimantan (65.1%) and the lowest proportion of type 2 diabetes mellitus occurred in the Sulawesi region (23.9%). Meanwhile, the highest proportion of gestational diabetes mellitus occurs in the Maluku region (16.7%) and the lowest proportion of gestational diabetes mellitus occurs in the Sumatra, Nusa Tenggara, and Papua regions (0%). National

figures show that the proportion of type 1 diabetes mellitus is 21.5%, the proportion of type 2 diabetes mellitus is 46.8%, and the proportion of gestational diabetes mellitus is 2.8%. Type 2 diabetes in Indonesia is dominated by type 2 (46.7%) followed by type I (21,6%), GDM (2,8%), and the rest are unknown DM types.

Table 3. The Relationship between the Proportion of Vegetable and Fruit Consumption with the Proportion of Diabetes Mellitus in Indonesia in 2023

The Proportion of Less Consumed Vegetables and Fruits in Indonesia	Proportion of type 1 DM	Proportion of type 2 DM	Proportion of Gestational DM
Beta	-0.111	2.123	-0.084
Correlation coefficient (r)	-0.041	0.475	-0.058
p-value	0.806	0.003	0.731

Table 3 shows that the proportion of vegetable and fruit consumption was not related to the proportion of type 1 diabetes mellitus (p-value 0.806) and gestational diabetes mellitus (p-value 0,731), however, less consumption of vegetables and fruits is significantly related to the proportion of type 2 Diabetes Mellitus (p-value 0.003). Based on the value of the correlation coefficient, it shows a tendency that the higher the proportion of less consumption of vegetables and fruits, the higher the proportion of Type 2 Diabetes Mellitus.

1. The Proportion of Less Consumed Vegetables and Fruits with Type 1 Diabetes Mellitus Prevalence

Type 1 diabetes is a systemic disorder due to impaired glucose metabolism characterized by chronic hyperglycemia. This condition is caused by damage to cells β pancreas by both autoimmune and idiopathic processes so that insulin production is reduced and even stopped (Ispriantari, & Priasmoro, 2017). Type 1 Diabetes Mellitus (DM) formerly known as Insulin Dependent Diabetes Mellitus (IDDM), occurs due to damage to pancreatic beta cells (autoimmune reactions). Pancreatic beta cells are the only cells in the body that produce insulin that functions to regulate glucose levels in the body. When pancreatic beta cell damage has reached 80-90%, DM symptoms begin to appear (Marzel, 2021).

The highest proportion of type 1 diabetes mellitus occurs in the Papua region (35.3%), which shows that as a large and geographically isolated area, it often faces challenges in the distribution of medicines and medical services needed for diabetes management, including insulin which is essential for the treatment of type 1 diabetes mellitus. The consumption of vegetables and fruits is not related to the proportion of type 1 diabetes mellitus. The value of the correlation coefficient (r) = 0.148 was obtained, which means that it has a very low relationship and a positive value. The more vegetables and fruits you consume, the less likely it is to cause type 1 diabetes mellitus.

This study shows that diets such as vegetable and fruit consumption patterns are not factors that cause type 1 diabetes mellitus. Factors that affect type 1 diabetes mellitus are heredity and insulin resistance. In type 1 diabetes, the beta cells of the pancreas are destroyed by autoimmune processes, so that insulin cannot be produced. Fasting hyperglycemia occurs because the production of glucose cannot be measured by the liver. Although glucose in food remains in the blood and causes postprandial hyperglycemia (after eating), glucose cannot be stored in the liver. If the concentration of glucose in the blood is high enough, the kidneys will not be able to reabsorb all the glucose that has been filtered. Therefore, the kidneys cannot absorb all the filtered glucose. As a result, it appears in the urine (diabetes). When excess glucose is excreted in the urine, this waste will be accompanied by excess excreta and electrolytes. This condition is called diuresisosmotic. Excessive fluid loss can lead to increased urination (polyuria) and thirst (polydipsia) (Hardianto, 2021).

2. The Proportion of Less Consumed Vegetables and Fruits with the Proportion of Type 2 Diabetes Mellitus

Type 2 diabetes mellitus is a hyperglycemia caused by impaired insulin sensitivity which results in insulin resistance in the body's cells unable to respond to insulin or due to impaired insulin secretion (Sihombing, 2022). Type 2 diabetes mellitus is a chronic disease caused by a condition in which the body cannot actively use the insulin produced by the pancreas. Generally, diabetes mellitus is characterized by hyperglycemia or an uncontrolled increase in blood sugar. Over time, diabetes mellitus can cause serious damage to the body's systems, such as damage to the peripheral nervous system that occurs due to disturbances in the micro blood vessels that flow blood to the nerve tissue. Type 2 diabetes mellitus is the most common type in the community, which is around 80% of 90% of all cases of diabetes mellitus (Syaharani et al., 2024). Decreased insulin secretion by pancreatic beta cells and or disruption of insulin function occurs in 3 ways, namely damage to pancreatic cells due to external influences (viruses, chemicals, etc.), decreased glucose receptors in the pancreatic gland, or damage to insulin receptors in peripheral tissues (Anisa & Indarjo, 2021).

The most common type of DM in Indonesia is type 2 (46.8%). The proportion of diabetes mellitus 2 is highest in the Kalimantan region (65.1%), this is due to several factors. One of the causes is an unhealthy lifestyle, such as a lack of physical activity and unbalanced food consumption. Genetic factors also play an important role in increasing the risk of type 2 diabetes mellitus. The consumption of vegetables and fruits is related to the proportion of type 2 diabetes mellitus. The value of the correlation coefficient (r) = 0.475 is obtained, which means that it has relationships that are low and of positive value.

This study shows that the relationship between the proportion less consuming fruits and vegetables can increase the proportion of type 2 diabetes mellitus. Meanwhile, in other studies, consuming a lot of vegetables and fruits will lower blood sugar levels, as shown by Sulistyorini et al., (2023), namely, the high intake of green or dark yellow leafy vegetables is related to a decrease in blood glucose levels, but the more mature the fruit that contains carbohydrates, the higher the glucose content and fructose, it is necessary to limit the amount of consumption of overripe fruit.

The risk factors for the occurrence of type 2 diabetes mellitus according to the American Diabetes Association (ADA) are divided into two, namely irreversible risk factors and modifiable risk factors. Factors that cannot be changed include age >45 years, ethnicity, family history of DM, birth history with a baby's birth weight >4000 grams, a birth history of <2500 grams (low), and a history of gestational DM. The risk factors that can be changed are hypertension, dyslipidemia, lack of physical activity, obesity (BMI > 25 kg/m2, abdominal circumference >80 cm for women and > 90 cm for men), and unhealthy eating patterns (Lasmawati et al., 2023)

The less fiber intake such as fruits and vegetables, the more likely it is to consume other foods such as foods high in sugar, high in carbohydrates, high in fat, and salt. The wrong diet is one of the causes of type 2 diabetes mellitus, this is in line with research presented by (Nur et al., 2016) (Silalahi, 2019) (Kuwanti et al., 2023).

3. The Proportion of Less Consumed Vegetables and Fruits with Proportion of Gestational Diabetes Mellitus

Gestational Diabetes Mellitus (GDM) is a collection of symptoms that arise in a pregnant woman caused by an increase in blood glucose levels due to a progressive decrease in insulin secretion. This DM is enforced based on blood glucose level checks where the recommended blood glucose is an enzymatic glucose examination with venous plasma blood material (Fitriani, 2017) .

The highest proportion of gestational diabetes mellitus occurs in the Maluku region region (16.7%), Maluku has limited access to health services, so its population has difficulty getting services adequate health, including the prevention and management of gestational diabetes mellitus. Risk factors for GDM consist of a family history of DM, certain ethnicities such as African, American, Pacific Islander, previously diagnosed with GDM, a history of macrosomia (≥ 4000gram baby), the age of the pregnant woman > 35 years, the presence of obesity, a history of 29 IUFDs, a history of giving birth to babies with congenital abnormalities, the presence of glucosuria at the first prenatal visit and diabetes-related medical conditions (Hutapea et al., 2024). Socio-economic factors also play an important role in increasing the risk of gestational diabetes mellitus in Maluku. Maluku has a high level of poverty, which can increase the risk of gestational diabetes mellitus due to a lack of access to healthy food and health services. The proportion less consumption of vegetables and fruits is not related to the proportion of gestational diabetes mellitus.

This study shows that the consumption of vegetables and fruits is not related to gestational diabetes mellitus. Various risk factors have been identified as predictors of GDM, such as advanced maternal age, obesity, low physical activity, and a family history of diabetes. In addition, maternal factors with macrosomia and multiparity are significant factors in the occurrence of gestational diabetes mellitus.

GDM is a public health problem because this disease has a direct impact on the health of the mother and fetus. Health problems in gestational diabetes mellitus can occur during the pregnancy and childbirth period (short-term impact) and after the baby is born (long-term impact). The short-term impact of GDM is an increased risk of pregnancy and childbirth complications. Pregnancy complications are mainly an increased risk of preeclampsia and eclampsia, while childbirth complications are related to large babies who are beyond gestational age (large for gestational age). Large babies tend to develop hyperinsulinemia so they are at risk of perinatal hypoglycemia. The long-term impact of GDM is obesity, increased risk of cardiovascular disease, and the onset of type 2 DM in both mothers and children (Wati et al., 2024).

CONCLUSION

The results showed that the proportion of undereating vegetables and fruits in Indonesia is very high. Type 2 diabetes in Indonesia is dominated by type 2. The results of the analysis showed There is a significant relationship between the proportion of eating less vegetables and fruits and the proportion of Type 2 Diabetes Mellitus. The higher the proportion of eating less vegetables and fruits, the higher the proportion of type 2 DM. Nationally, the proportion of type 1 diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes mellitus is still high, which indicates the importance of consumption patterns, including the consumption of vegetables and fruits.

Recommendations for future researcher is exploring factors that affect the high proportion of diabetes mellitus in Indonesia as factors of ancestry, age, consumption patterns, and lifestyle.

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CONFLICT OF INTEREST

All authors have no conflict of interest.

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CORRELATION OF HS-CRP LEVELS AND TOTAL CHOLESTEROL IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AT DR. BRATANATA HOSPITAL JAMBI CITY

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ABSTRACT

Background: *Type 2 Diabetes Mellitus (T2DM) is associated with disturbances in glucose and lipid metabolism that can trigger systemic inflammation. High-sensitivity C-reactive protein (hs-CRP) is a biomarker commonly used to predict cardiovascular risk, especially when assessed alongside total cholesterol levels. This study aims to investigate the relationship between high-sensitivity C-reactive protein (hs-CRP) levels and total cholesterol in individuals with type 2 diabetes mellitus.*
Method: ***T****his descriptive-analytic study used a cross-sectional design and was conducted at Dr. Bratanata Hospital, Jambi City. The sample consisted of T2DM patients selected through purposive sampling based on inclusion and exclusion criteria. hs-CRP levels were measured using a Wondfo Meter, and total cholesterol was analyzed using an Autolyser BT 3500. Statistical tests were conducted to determine the relationship between the variables.*
Result: *The average hs-CRP level was 4.25 mg/L, and the average total cholesterol was 218 mg/dL. There was no significant correlation between hs-CRP and total cholesterol levels ($p > 0.05$). The regression plot suggested a possible negative trend, the correlation was weak and not statistically significant.*
Conclusion: *There is no significant correlation between hs-CRP and total cholesterol levels in T2DM patients at Dr. Bratanata Hospital, Jambi City.*

Keywords: *Diabetes Mellitus; Total Cholesterol; hs-CRP, Inflammation*

INTRODUCTION

Diabetes Mellitus (DM) is a chronic condition that happens when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it does produce. Insulin plays a vital role in regulating blood glucose levels (WHO, 2023). Based on its underlying causes, DM is classified into two main types. Type 1 diabetes is caused by damage to the pancreatic beta cells, resulting in no insulin production. Meanwhile, type 2 diabetes — the more common form — is caused by a decline in insulin secretion from the pancreas (Kemenkes RI, 2020).

In individuals with diabetes, glucose metabolism—mainly from dietary carbohydrates like sugars and starches—is impaired. This is due to insulin dysfunction, which prevents glucose from being properly absorbed by cells, leading to elevated blood sugar levels, or hyperglycemia (Luhovyy & Kathirvel, 2022). This persistent state can affect nearly every tissue in the body, especially those sensitive to insulin. Hyperglycemia is known to trigger oxidative stress and inflammation, prompting the liver to produce C-reactive Protein (CRP), a marker of inflammation (Yerizel et al., 2015).

CRP is a key player in the acute-phase inflammatory response and is commonly used

as a biomarker for inflammation. One advanced method for measuring CRP is high-sensitivity C-reactive protein (hs-CRP), which can detect even very low levels of CRP, making it especially useful in predicting systemic inflammation and cardiovascular risk (Ridker, 2016). As a marker of systemic inflammation, CRP is also recognized as an independent risk factor for several cardiovascular diseases. Its predictive power becomes even more significant when assessed alongside cholesterol levels (Ansar, 2016).

There is a strong link between cholesterol and glucose metabolism in people with diabetes. Disruptions in cholesterol absorption and synthesis often reflect the severity of insulin resistance (Anggraini, 2018). Cholesterol is essential for the body in limited amounts, as it supports cellular function. It is normally kept in balance through synthesis and breakdown (Mailangkay et al., 2015). However, elevated cholesterol levels can lead to atherosclerosis, which may block blood vessels. Inflammation plays a central role in this process, often accompanied by increases in both CRP and cholesterol levels (Djamin, 2020).

Research on the relationship between hs-CRP levels and total cholesterol has yielded mixed results. Djamin (2020) reported a weak correlation between the two, suggesting that hs-CRP may not have a significant role in raisinSg cholesterol levels. On the other hand, studies by Muniyal et al. (2022) and Meriga et al. (2020) found a strong association, indicating a potential link to higher atherosclerosis risk and cardiovascular complications.

Based on prior research and the mixed results of DM cases, the author is interested in further exploring the correlation Between hs-CRP Levels and Total Cholesterol in Patients with Type 2 Diabetes Mellitus at Dr. Bratanata Hospital Jambi City.

METHOD

This study is a descriptive-analytic research utilizing a cross-sectional design. It aims to investigate the relationship between high-sensitivity C-reactive protein (hs-CRP) levels and total cholesterol in individuals with type 2 diabetes mellitus. The study population and sample consisted of patients diagnosed with type 2 diabetes mellitus, with data collection from 40 respondents and analysis conducted at Dr. Bratanata Hospital between November 30 and December 7, 2024. The instruments used in this study included Wondfo meter for analyzing hs-CRP levels and Autolyser BT 3500 for measuring cholesterol levels.

Primary data were collected through purposive sampling, which applied specific inclusion and exclusion criteria.

Inclusion criteria included:

1. Patients who were willing to participate as respondents and had signed an informed consent form.
2. Patients who had been clinically diagnosed with type 2 diabetes mellitus, as confirmed by their medical records.

Exclusion criteria included:

1. Pregnant women
2. Patients with diabetes mellitus who had known complications such as tuberculosis, HIV, anemia, and others

The research of this study has obtained an ethical approval from the Ethics Committee at the Jambi Ministry of Health Poltekkes.

RESULTS AND DISCUSSION

3.1 Respondent Characteristics

In this study, the author's research findings about respondent characteristics including demographic attributes. The demographic distribution is presented graphically below.

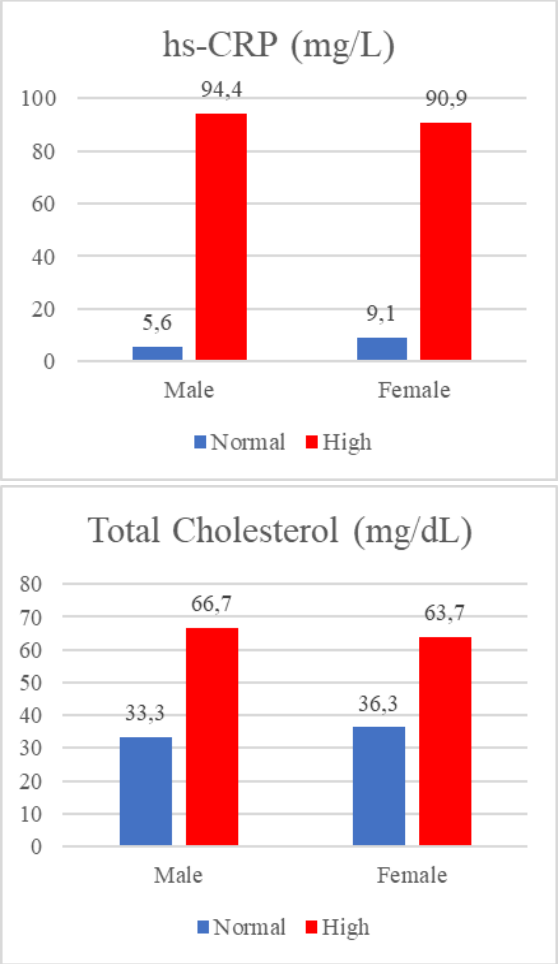


Figure 1. Distribution Based on Gender

Tabel 1. Results of Examination Based on Gender

HsCRP	N	Mean	Min	Max	SD	P-value
Male	18	4.31	0.8	5.1	1.20	0.386
Female	22	4.20	0.5	5.1	1.29	
Total Cholesterol						
Male	18	222.6	137	275	39.05	0.266
Female	22	214.7	120	301	39.12	

The distribution of hs-CRP and total cholesterol levels based on gender. The boxplot for hs-CRP shows a relatively similar distribution between males and females, with an average of 4.31 mg/L in males and 4.22 mg/L in females (p = 0.386), indicating no statistically significant difference. In the total cholesterol boxplot, females had a slightly higher median compared to males. The mean total cholesterol level was 222.6 mg/dL in males and 214.7 mg/dL in females (p = 0.266), also indicating no significant difference.

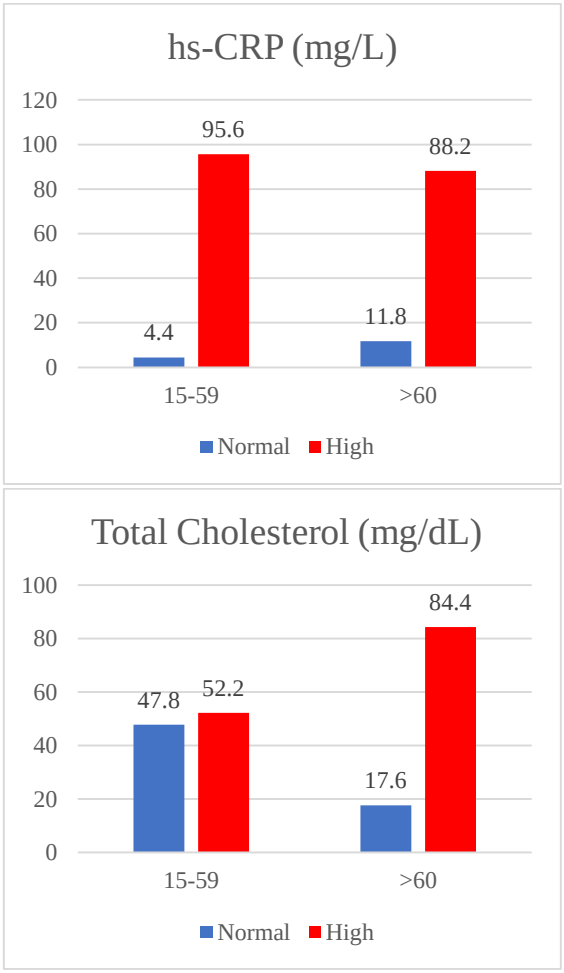


Figure 2. Distribution Based on Age

Table 2. Results of Examination Based on Age

HsCRP	N	Mean	Min	Max	SD	P-value
19 - 59	23	4.3	0.9	5.1	1.08	0.319
>60	17	4.1	0.5	5.1	1.44	
Total	40	4.2	0.5	5.1	1.26	
Total Cholesterol						
19 - 59	23	206	120	260	32.58	0.012
>60	17	234	137	301	41.85	
Total	40	220	120	301	14.8	

The distribution of hs-CRP and total cholesterol levels based on age group. The hs-CRP boxplot reveals similar distributions between the two groups, with a mean of 4.3 mg/L for individuals aged 19–59 years and 4.1 mg/L for those aged over 60 years (p = 0.319), suggesting no significant difference. In contrast, the total cholesterol boxplot shows a higher median in the >60 years group. The

mean cholesterol level was 206 mg/dL in the 19–59 years group and 236 mg/dL in the >60 years group (p = 0.012), indicating a statistically significant difference.

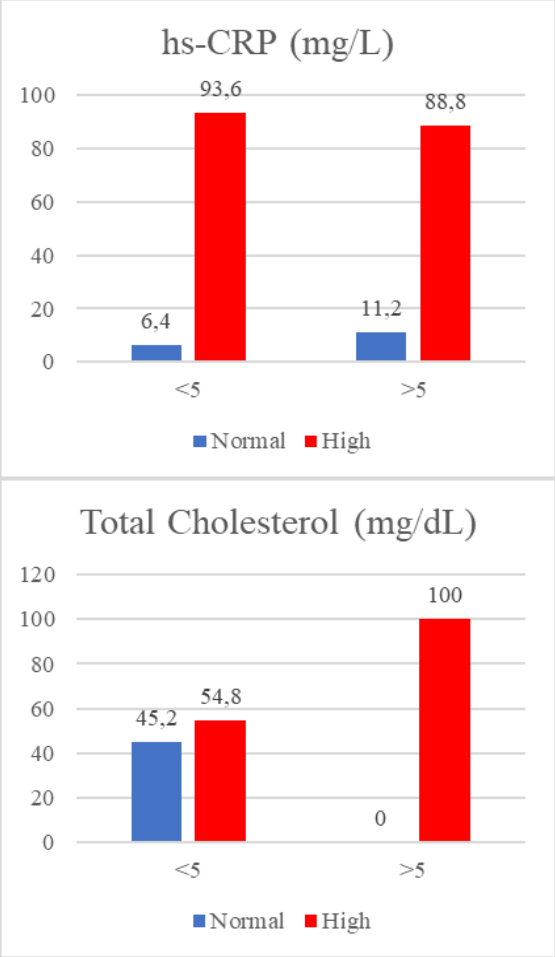


Figure 3. Distribution Based on Duration of Illness

Table 3. Results of Examination Based on Duration of Illness

HsCRP	N	Mean	Min	Max	SD	P-value
<5	31	4.35	0.8	5.1	1.14	0.164
>5	9	3.88	0.5	5.0	1.53	
Total	40	4.11	0.5	5.1	1.33	
Total Cholesterol						
<5	31	213	120	275	37.62	0.093
>5	9	233	190	301	41.16	
Total	40	223	120	301	39.39	

The distribution of hs-CRP and total cholesterol levels based on the duration of type 2 diabetes. The mean hs-CRP level was higher in patients with a disease duration of less than 5 years (4.35 mg/L) compared to those with more than 5 years (3.88 mg/L), although the difference was not statistically significant (p = 0.164). For total cholesterol, patients with a disease duration of more than 5 years had a higher mean level (233 mg/dL) compared to those with less than 5 years (213 mg/dL), but the difference was also not statistically significant (p = 0.093).

3.2 Correlation of hs-CRP Levels and Total Cholesterol in Patients with Type 2 Diabetes Mellitus at Dr. Bratanata Hospital Jambi City

The correlation analysis is presented in the figure below. Prior the test, data normality was assessed using the Shapiro-Wilk test, hs-CRP showed a p-value ≤ 0.05, while total cholesterol had a p-value > 0.05, indicating non-normal distribution. Therefore, the non-parametric Spearman correlation test was applied.

Table 4. Results of Correlation Spearman

Parameter	n	Mean	Median	Minimal-maximal	sd	Koefisien Korelasi	P
hs-CRP	40	4.25	4.9	0.5 – 5.1	1.2	-0.249	0.121
Kolesterol total	40	218.3	211.5	120.0 – 301.0	38.7		

Table 4 presents the Spearman correlation results between hs-CRP and total cholesterol levels among 40 patients with type 2 diabetes mellitus. The mean hs-CRP level was 4.25 mg/L, while the mean total cholesterol level was 218.3 mg/dL. Spearman correlation analysis revealed a weak negative correlation (r = -0.249) between hs-CRP and total cholesterol, which was not statistically significant (p = 0.121).

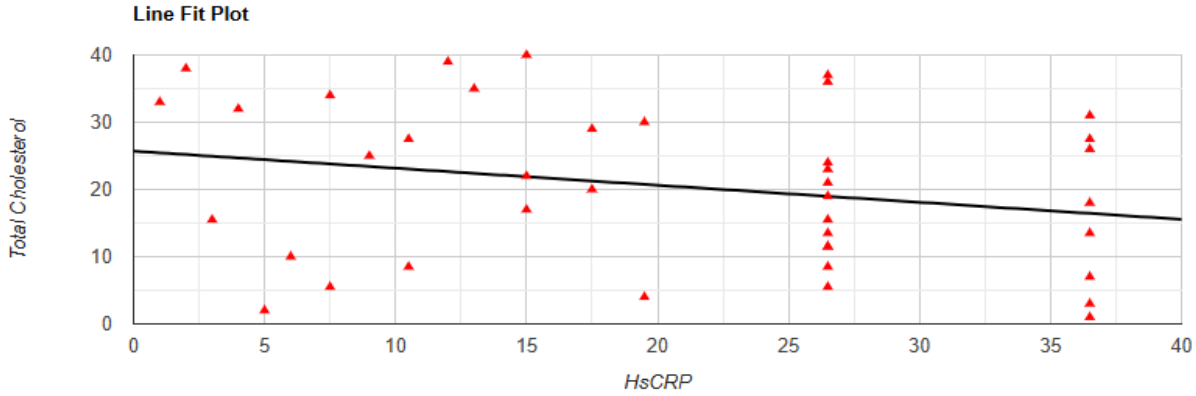


Figure 4. Results of Correlation Spearman

The correlations of hs-CRP levels (X) and total cholesterol levels (Y), with a linear regression line shown in black. Overall, the regression line has a negative slope, suggesting a potential inverse relationship between the two variables. In other words, as hs-CRP levels increase, total cholesterol levels tend to decrease. However, the wide spread of data points and the lack of a clear pattern indicate that this relationship may be weak or highly variable. Therefore, there is insufficient evidence to confirm a linear association between these two variables based on the findings of this study.

The studies conducted by Muniyal et al. (2022) and Meriga et al. (2020) reported contrasting findings, showing a significant positive association between hs-CRP levels and lipid parameters, specifically total cholesterol in patients with type 2 diabetes. In those studies, patients with hs-CRP levels above 3 mg/L tended to have higher total cholesterol levels, suggesting that increased systemic inflammation may be accompanied by elevated blood lipid levels.

These differing results may be due to variations in subject characteristics, such as medication use, glycemic control, statistical analysis methods, laboratory measurement techniques, sample size, and the inclusion and exclusion criteria applied. Additionally, the current study involved patients at the primary care level, many of whom may have already been receiving treatment or therapy, potentially resulting in lower observed cholesterol levels despite elevated hs-CRP values.

CONCLUSION

Based on research, we concluded that the average hs-CRP level in patients with type 2 diabetes mellitus at Dr. Bratanata Hospital, Jambi City, is 4.25 mg/L, The average total cholesterol level in patients with type 2 diabetes mellitus at Dr. Bratanata Hospital, Jambi City, is 218 mg/dL, and there is No significant relationship was found between hs-CRP levels and total cholesterol in patients with type 2 diabetes mellitus at Dr. Bratanata Hospital, Jambi City.

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CONFLICT OF INTEREST

The author declares there is no conflict of interest during this study.

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THE EFFECT OF E-BOODIE (ELECTRONIC BOOKLET ON DIABETES) EDUCATION ON KNOWLEDGE OF DIABETES MELLITUS PREVENTION EFFORTS AT SMA NEGERI 5 JAMBI CITY

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ABSTRACT

***Background**: Diabetes Mellitus is a non-communicable disease with a globally increasing prevalence, including among adolescents. According to the World Health Organization (WHO) in 2024, there are 422 million diabetes cases worldwide, with 877,531 cases recorded in Indonesia. In Jambi City, Diabetes Mellitus has become a major public health issue, with 21,172 cases reported in 2022 (Jambi City Health Office). One of the contributing factors to the rising number of cases is unhealthy lifestyle habits, such as the consumption of foods high in sugar and fat.*
***Method**: This study aims to determine the effect of education using E-BOODIE (Electronic Booklet on Diabetes) on students' knowledge regarding the prevention of Diabetes Mellitus at SMA Negeri 5 Jambi City. The study employed a quantitative method with a pre-experimental design (One Group Pretest-Posttest Design), involving 40 students as the sample.*
***Results:** The research instrument was a questionnaire, and data were analyzed using a paired t-test. The results showed a significant increase in the average scores of students' knowledge and attitudes after being given education using the E-BOODIE media ($p < 0.05$), rising from 5.65 to 8.48.*
***Conlusion**: These findings indicate that E-BOODIE is effective in enhancing students' understanding and awareness of Diabetes Mellitus prevention. Thus, E-BOODIE can serve as an innovative and interactive health education medium, particularly in improving adolescents' knowledge and attitudes toward early prevention of Diabetes Mellitus.*

***Keywords:** Diabetes Mellitus, E-BOODIE, Health Education, Knowledge*

INTRODUCTION

Diabetes Mellitus (DM) is a non-communicable disease with a globally increasing prevalence. According to WHO (2024), over 422 million people suffer from diabetes worldwide, causing 1.5 million deaths annually. The International Diabetes Federation (2022) projects this number to rise to 784 million by 2045, with nearly half of the cases undiagnosed.

In Indonesia, the 2023 Health Survey recorded 877,531 diagnosed cases of DM, with a significant rise among adolescents. Urban lifestyles and unhealthy dietary habits contribute to this increase, confirming Bowen & Rothman's (2010) findings that diabetes is becoming a major cause of morbidity among youth.

In Jambi Province, DM ranks among the top five public health issues, with Jambi City reporting the highest number—21,127 cases in 2022. This highlights the urgent need for effective prevention strategies targeting youth.

SMA Negeri 5 Jambi, located in the city center, provides students with easy access to high-sugar and high-fat foods. Most students come from middle to upper economic backgrounds and frequently consume fast food, increasing their risk of developing DM.

To address this, the researcher conducted an educational intervention using E-BOODIE (Electronic Booklet on Diabetes) to improve students' knowledge and attitudes toward DM prevention. The study is titled "The Effect of E-BOODIE Health Education on Knowledge of Diabetes Mellitus Prevention Among Students of SMA Negeri 5 Jambi City".

METHODS

This study is a quantitative research using a pre-experimental method with a one-group pretest - posttest design. It aims to determine the effect of health education using E-BOODIE (Electronic Booklet on Diabetes) on students' knowledge regarding the prevention of Diabetes Mellitus at SMA Negeri 5 Jambi City. The study was conducted from January to March 2025. This design does not include a control group but involves a pretest conducted prior to the intervention to assess changes following the treatment.

The study consists of two variables: an independent variable and a dependent variable. The independent variable is the health education using E-BOODIE, while the dependent variable is the students' level of knowledge about diabetes prevention.

The research instrument serves as a tool to collect, process, and interpret data obtained from 40 respondents using a consistent measurement approach. In this study, the instruments and materials used include the E-BOODIE as the educational media and a knowledge questionnaire on Diabetes Mellitus as the measurement tool.

RESULTS AND DISCUSSION

3.1. Respondent characteristics

Tabel 1 Distribusi Karakteristik Responden

Ages	Frequency	Percentage
16	24	60 %
17	16	40%
Total	**440**	**1100%**

Based on the table, the respondents in this study were adolescents aged between 16 and 17 years. The majority were 16 years old, totalling 24 individuals or 60% of the total respondents. Meanwhile, 16 respondents, or 40%, were 17 years old. These findings indicate that most of the respondents involved in the study were 16 years old.

Tabel 2. Frequency Distribution of Respondents' Gender

Gender	Frequency	Percentage
Male	9	22,5 %
Female	31	77.5%
Total	**40**	**100%**

Based on the data, the majority of respondents in this study were female, totalling 31 individuals or 77.5% of the total respondents. Meanwhile, the number of male respondents was 9 individuals or 22.5%. These results indicate that participation in this study was predominantly female.

3.2 Overview of the Average Knowledge Before and After Education on Diabetes Mellitus Prevention Among High School Students

Table 1. The Influence of E-BOODIE (Electronic Diabetes Booklet) on Knowledge of Diabetes Mellitus Prevention Efforts

Variable	N		Mean	SD	Min-Max
Knowledge of Diabetes Prevention Efforts	40	Pre-Test	5,65	1.051	4-8
		Post-Test	8,48	847	7-10

Based on the table above, regarding the knowledge variable on Diabetes Mellitus prevention efforts, there is a significant difference between the knowledge scores before and after the E-BOODIE intervention. The average knowledge score before the intervention was 5.65 with a standard deviation of 1.051, while after the intervention, the average score increased to 8.48 with a standard deviation of 0.847. The mean difference between the pre-test and post-test scores was 2.83, with a p-value of 0.000, indicating that the difference is highly significant ($p < 0.05$). Therefore, it can be concluded that the use of E-BOODIE has a significant positive effect on improving knowledge about Diabetes Mellitus prevention efforts.

Based on the research conducted on 40 respondents aged 16–17 years at SMA Negeri 5 Kota Jambi, it was found that there was an increase in knowledge after being provided with educational media in the form of E-Boodie regarding the prevention of Diabetes Mellitus. Before the intervention, most respondents had low to moderate knowledge levels about

Diabetes Mellitus prevention. After the intervention, a significant improvement in the respondents' knowledge was observed.

This study aligns with the research conducted by Sheladjiq & Yulianti (2023), which stated that E-Booklet media had an impact on knowledge about anemia prevention in adolescent girls at an MA in Kabupaten Bandung. Widuri et al. (2021) also mentioned that the use of e-booklets in health education can increase knowledge levels both before and after the intervention. Similar findings were obtained in a study by Kusumawati Y. (2021), which reported that the group receiving education through booklets had higher knowledge scores compared to the group that did not receive such education. Another study showed a significant increase in knowledge before and after the use of booklet media, with 100% of respondents falling into the "good" knowledge category (Yulianingsih E).

This demonstrates that educational interventions that are engaging and developmentally appropriate for adolescents can be an effective strategy for the prevention of non-communicable diseases in the future. This is evident in question P6, which discusses the common symptoms of Diabetes Mellitus. A significant increase in respondents' knowledge was observed after the E-Boodie intervention. Before the intervention, most respondents still lacked understanding of the early signs and symptoms of Diabetes Mellitus, such as frequent urination, excessive thirst, and unexplained weight loss. After the E-Boodie intervention, respondents' understanding of these general symptoms significantly improved.

During adolescence, lifestyle is greatly influenced by the surrounding environment, such as peers, family, and mass media. According to Soetjiningsih (2018), adolescence is a transitional phase from childhood to adulthood, marked by a growth spurt and psychological and cognitive changes. Optimal developmental achievement in adolescents largely depends on their biological potential, which is the result of the interaction between genetic and bio-psycho-social environmental factors. Several risk factors that can lead to chronic diseases in adolescents include stress, obesity, and excessive nutrient intake (Agustina R.).

Overall, data analysis shows a significant difference in the average knowledge level before and after the E-Boodie intervention. This proves that providing education through E-Boodie media is effective in raising adolescents' awareness of the symptoms of Diabetes Mellitus and the importance of early prevention. The E-Boodie media, which contains visual information and simple text, is considered effective in strengthening memory and clarifying the respondents' understanding.

In this study, the improvement in knowledge and attitudes of respondents after receiving E-Boodie education can be explained through Albert Bandura's Social Cognitive Theory. According to Bandura (1986), individuals learn not only through direct experience but also through observation and interaction with their environment. This theory emphasizes the role of personal factors (such as self-belief), behavior, and the environment in shaping an individual's behavior and attitudes.

CONCLUSION

Health education provided through the E-BOODIE media serves as an environmental stimulus that influences respondents' knowledge and attitudes, in line with the concept of observational learning within Social Cognitive Theory. After receiving information through this medium, respondents were able to form new perceptions regarding the importance of Diabetes Mellitus prevention, as reflected in a positive shift in their attitudes.

Thus, E-BOODIE can be considered a practical, effective, and appropriate alternative health education medium for 16–17-year-old adolescents, helping to raise awareness and understanding of the importance of Diabetes Mellitus prevention.

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CONFLICT OF INTEREST

All authors state that there are no conflict of interest.

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THE EFFECTIVENESS OF USING INTERACTIVE QUIZ CENTING (CEGAH STUNTING) ON THE KNOWLEDGE AND BEHAVIOR OF MOTHERS OF TODDLERS ABOUT STUNTING PREVENTION IN BUKIT PERENTAK VILLAGE, MERANGIN DISTRICT

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ABSTRACT

Backgorund: *Stunting is one of the most troubling global health problems, occurring in many countries in both developing and developed countries. The prevalence of stunting tends to be high in countries with poverty and limited access to adequate health, education and sanitation services. One of the efforts to reduce the prevalence of stunting is health promotion using interactive quiz CENTING (Prevent Stunting). This study aims to determine the effectiveness of using the CENTING interactive quiz (prevent stunting) in increasing the knowledge and behavior of mothers of toddlers about stunting prevention in Bukit Perentak Village, Merangin Regency.*
Methods: *This type of research is quantitative research with a pre-experimental research design, with a one group pretest-posttest research design. Sampling in this study used total sampling technique with a total sample size of 34 people.*
Results: *Data analysis using the Wilcoxon test. The average score of stunting prevention knowledge is pre-test (6.85), post-test (9.53). The average results of stunting prevention behavior are pre-test (24.63), post-test (29.43). There is a difference in increasing the score of knowledge and behavior of preventing stunting in mothers of toddlers in Bukit Perentak village, Merangin Regency who are given health promotion through interactive quiz CENTING (Prevent Stunting) with a p value of 0.000 (p <0.05).*
Conclusion: *Health promotion with CENTING interactive quiz (Prevent Stunting) is effective in increasing knowledge and behavior of preventing stunting in mothers of toddlers in Bukit Perentak village, Merangin Regency.*

Keywords: *Knowledge, behavior, stunting prevention, CENTING*

INTRODUCTION

Stunting is one of the most troubling global health problems, occurring in various countries in both the developing and developed world. Stunting is defined as “a state of failure to thrive in children characterized by height inappropriate for their age”. This condition is generally caused by chronic and/or prolonged malnutrition during a child's early growth period. The prevalence of stunting tends to be high in countries with high levels of poverty and limited access to adequate health, education and sanitation services[1].

According to WHO (2020), as many as 150.8 million or (22.2%) WHO determines five regions as the prevalence of stunting, including Indonesia, which is in the diagonal of Southeast Asia with a prevalence rate of (35.4%) (Panigoro, 2020). Based on the results of the Indonesian nutritional status survey (SSGI), the stunting rate in Indonesia is 24% in 2021 to 21.6% in 2024.

The study of Yadika et al. (2019) shows that stunting can have a negative impact on children's productivity and learning ability later in life, which in turn can affect a country's economic growth and social development,

stunting occurs when children have a height that is lower than the average height of children their age, and can have serious short- and long-term impacts on children's health and development. The prevalence of stunting tends to be high in countries with high levels of poverty and limited access to adequate health, education and sanitation services[3].

This study aims to the effectiveness of the use of Quiz Interactive CENTING (prevent stunting) in increasing knowledge and behavior about the prevention of stunting in the working area of the Sungai Jering Health Center, Pangkalan Jambu District. With this research, it is hoped that it can contribute to efforts to prevent and manage stunting in the community, especially in pregnant women and toddlers. Thus, this study will use a deductive approach to explain that the use of interactive Quiz "CENTING" can be effective in increasing knowledge and behavior about stunting prevention. Through this research, it is hoped that it can make a significant contribution to efforts to prevent and manage stunting in the community, especially in pregnant women.

METHODS

This type of research is quantitative research with a pre-experimental research design, with a one group pretest-posttest research design. Sampling in this study used purposive sampling technique with a total sample of 34 people who met the inclusion criteria. Data analysis using the Wilcoxon test.

RESULTS AND DISCUSSION

RESULTS

Puskesmas Sungai Jering is the first health service located at Jl. Raya Bangko-Kerinci, Sungai Jering, Kec. Pangkalan Jambu, Merangin Regency, Jambi. With zip code 37361. The sample in this study were 50 mothers of toddlers who were in the working area of the Sungai Jering health center, especially in Bukit Perentak village. However, at the time of the research only 34 respondents were obtained.

Table 1. Age Frequency distribution of respondents in Bukit Perentak Village, Merangin district

Age	Frequency	Persentage
20 years old	3	8.8%
22 years old	3	8.8%
23 years old	2	5.9%
24 years old	3	8.8%
26 years old	2	5.9%
27 years old	1	2.9%
28 years old	5	14.7%
32 years old	5	14.7%
33 years old	1	2.9%
34 years old	1	2.9%
35 years old	1	2.9%
36 years old	2	5.9%
38 years old	1	2.9%
40 years old	3	8.8%
41 years old	1	2.9%
Total	34	100%

Based on table 1, it is known that respondents are between 20 to 41 years old.

Table 2. Frequency distribution of gender of respondents in Sungai Baung village, Sarolangun district

Gender	Frequency	Persentage
Female	34	100
Total	**34**	**100**

Based on table 2, it can be seen that all respondents in this study were female, 34 people or (100%).

Based on table 3, it can be seen that knowledge before being given health promotion using interactive quiz media CENTING (Prevent Stunting) about stunting prevention (Pre-Test) mean value 6.85 and after being given health promotion using interactive quiz media CENTING (Prevent Stunting) about stunting prevention (Post-Test) mean value increased to 9.53 It can be seen that after being given health promotion using interactive quiz media CENTING (Prevent Stunting) about stunting prevention, respondents' knowledge has increased by 2.68. This shows that health

promotion using the CENTING interactive quiz (Prevent Stunting) is effective in increasing knowledge of stunting prevention.

Table 3. Results of Analysis of Respondents' Knowledge and Behavior About Stunting Prevention Before (Pre-Test) and After (Post-Test) Given Health Promotion Using CENTING Media (n = 34)

Variable	Treatment	Mean	Median	Std. Deviation
Stunting Preverention Knowledge	Pretest	6.85	7	.744
	Posttest	9.53	10	.706
Stunting Preverention Behavior	Pretest	24.63	25	2.008
	Posttest	29.43	30	.626

Based on table 3, it can be seen that the behavior before being given health promotion using CENTING interactive quiz media (Prevent Stunting) about stunting prevention (Pre-Test) mean value is 24.63 and after being given health promotion using CENTING interactive quiz media (Prevent Stunting) about stunting prevention (Post-Test) the mean value increases to 29.43. It can be seen that after being given health promotion using the CENTING interactive quiz media (Prevent Stunting) about preventing stunting, respondents' behavior has increased by 4.8. This shows that health promotion using the CENTING interactive quiz (Prevent Stunting) is effective in increasing stunting prevention behavior.

Table 4. Effectiveness of Using Quiz Interactive CENTING (Prevent Stunting) in Improving the Knowledge of Mothers of Toddlers about Stunting Prevention in Bukit Perentak Village, Merangin Regency

Ranks

		N	Mean Rank	Sum of Ranks
posttest – pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	34[b]	17.50	595.00
	Ties	0[c]		
	Total	34		

a. posttest < pretest

b. posttest > pretest

c. posttest = pretest

a. Negative Ranks or the difference (negative) between the results of the effectiveness of the use of interactive quiz CENTING (Prevent Stunting) in increasing the knowledge of mothers of toddlers about stunting prevention in Bukit Perentak Village, Merangin Regency for Pre-Test and Post-Test is 0, both in the N value, Mean Rank, and Sum Rank. This 0 value indicates no decrease (reduction) in knowledge from the Pre-Test value to the Post-Test value.

b. Positive Ranks or the difference (positive) between the results of the effectiveness of the use of interactive quiz CENTING (Prevent Stunting) in increasing the knowledge of mothers of toddlers about stunting prevention in Bukit Perentak Village, Merangin Regency for Pre-Test and Post-Test. Here there are 34 positive data (N), which means that 34 mothers of toddlers experienced an increase in the results of using the CENTING interactive quiz (Prevent Stunting) in increasing the knowledge of mothers of toddlers about stunting prevention in Bukit Perentak Village, Merangin Regency from the Pre-Test value to the Post-Test value. The Mean Rank or average increase is 17.50 for knowledge, while the number of positive ranks or Sum of Ranks is 595.00 for knowledge.

c. Ties is the similarity of Pre-Test and Post-Test values, here the Ties value is 0, so it can be said that there are no equal values between Pre-Test and Post-Test.

Table 5. Effectiveness of Using Quiz Interactive CENTING (Prevent Stunting) in Improving the Behavior of Mothers of Toddlers about Stunting Prevention in Bukit Perentak Village, Merangin Regency

Ranks

		N	Mean Rank	Sum of Ranks
posttest – pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	32[b]	16.50	528.00
	Ties	0[c]		
	Total	32		

a. posttest < pretest

b. posttest > pretest

c. posttest = pretest

a. Negative Ranks or the difference (negative) between the results of the effectiveness of the use of interactive quiz CENTING (Prevent Stunting) in improving the behavior of mothers of toddlers about stunting prevention in Bukit Perentak Village, Merangin Regency for Pre-Test and Post-Test is 0, both in the N value, Mean Rank, and Sum Rank. This 0 value indicates no decrease (reduction) in behavior from the Pre-Test value to the Post-Test value.

b. Positive Ranks or the difference (positive) between the results of the Effectiveness of Using interactive quiz CENTING (Prevent Stunting) in improving the Behavior of Mothers of Toddlers About Stunting Prevention in Bukit Perentak Village, Merangin Regency for Pre-Test and Post-Test. Here there are 34 positive data (N), which means that 34 mothers of toddlers experienced an increase in the results of using the CENTING interactive quiz (Prevent Stunting) in improving the Behavior of Mothers of Toddlers About Stunting Prevention in Bukit Perentak Village, Merangin Regency from the Pre-Test value to the Post-Test value. The Mean Rank or average increase is 17.50 for behavior, while the number of positive ranks or Sum of Ranks is 595.00 for behavior.

c. Ties is the similarity of Pre-Test and Post-Test values, here the Ties value is 0, so it can be said that there are no equal values between Pre-Test and Post-Test.

3.2. Discussion

3.2.1. Effectiveness of Using Quiz Interactive CENTING (Prevent Stunting) in Improving the Knowledge of Mothers of Toddlers about Stunting Prevention in Bukit Perentak Village, Merangin Regency

Based on the results of statistical tests using the Wilcoxon test, a significant value of p value = 0.000 <0.05 was obtained and it was known that the amount of increase between the pre-test and post-test on the respondents was 2.68. Based on these results it can be seen that with interactive quiz media CENTING (Prevent Stunting) there is a significant increase in knowledge. In line with Okva's research (2022) The results of statistical tests using the Wilcoxon test obtained ρ value = 0.000 <0,.05 using a confidence level of 95% which means that there is an effectiveness of using quiz to increase the knowledge and attitudes of PGRI 4 Padang high school students regarding SADARI.

Factors that influence the increase in knowledge are: level of education and information. This theory clearly shows how knowledge can change due to the influence of a factor27.

Information provided with a simple approach through interactive quiz media also has an effect on respondents' knowledge in stunting prevention. The source of information delivered is packaged in an interesting way so that it becomes more enthusiastic. So that respondents can have broader knowledge based on the information presented.

3.2.2. Effectiveness of Using Quiz Interactive CENTING (Prevent Stunting) in Improving the Behavior of Mothers of Toddlers about Stunting Prevention in Bukit Perentak Village, Merangin Regency

Based on the results of statistical tests using the Wilcoxon test, a significant value of p value = 0.000 <0.05 was obtained and it was known that the amount of increase between the pre-test and post-test on the respondents was 4.8. Based on these results, it can be seen that with the interactive quiz media CENTING (Prevent Stunting) there is a significant increase in behavior. In line with Rahmawati's research (2021), the results of statistical tests using the Wilcoxon test obtained ρ value = 0.000 <0.05 using a 95% confidence level, which means that there is an effectiveness of education using the quiz application to improve people's behavior about the covid-19 vaccine.

According to Notoatmodjo (2014), behavior is an activity or activity of the organism (living being) concerned. Behavior is the result of all kinds of human experiences and interactions with the environment. The form can be in the form of knowledge, attitudes, and actions. Human behavior tends to be comprehensive (holistic), and basically consists of psychological, physiological, and social perspectives.

After being given health promotion with CENTING interactive quiz media, all mothers experienced an increase in the average behavior score from before to after. This is because the use of CENTING interactive quiz media as educational media has an attractive design, quizzes are designed with attractive colors and images and by using simple language and does not take a long time so that mothers will not be bored.

CONCLUSION

There is a difference in increasing the score of knowledge and behavior of preventing stunting in mothers of toddlers in Bukit Perentak village, Merangin Regency who are given health promotion through interactive quiz CENTING (Prevent Stunting) with a p value of 0.000 (p <0.05). Health promotion with CENTING interactive quiz (Prevent Stunting) is effective in increasing knowledge and behavior of preventing stunting in mothers of toddlers in Bukit Perentak village, Merangin Regency. Suggestions from researchers that stunting prevention can continue to be carried out to reduce the incidence of stunting by using new media innovations.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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MATERNAL AND ENVIRONMENTAL HEALTH FACTORS AS PREDICTORS OF STUNTING IN FAMILIES AT RISK OF STUNTING IN INDONESIA

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ABSTRACT

Background: *Stunting is a chronic nutritional problem that affects children's physical and cognitive development, especially in children aged 6-23 months who come from families at risk of stunting. In Indonesia, the prevalence of stunting in 2023 reached 21.5%, which is still far from the 14% target set by the government. Stunting can affect children's long-term health and increase susceptibility to non-communicable diseases in adulthood.*
Objectives: *This study aims to analyze factors that act as predictors of stunting incidence in families at risk of stunting in Indonesia, using data from the 2023 Indonesian Health Survey (IHS).*
Methods: *The research design was an analytic study with a cross-sectional approach. This study used total sampling involving 4,766 mothers with children aged 6-23 months. The variables analyzed included maternal factors (birth spacing, number of births, maternal age, family planning participation) and environmental factors (latrine ownership).*
Results: *The analysis showed that too close birth spacing (OR 1.422), too many births (OR 1.323), and improper latrine ownership (OR 1.327) significantly affected the incidence of stunting in families at risk of stunting.*
Conclusion: *This study shows that birth spacing, number of births, and latrine ownership are predictors of stunting in families at risk of stunting. Maternal and environmental factors play an important role in the incidence of stunting in families at risk of stunting in Indonesia. These findings suggest that the need for a holistic approach that includes good family planning and improved sanitation and maternal nutrition should be the main focus of stunting prevention efforts in Indonesia.*

Keywords*: stunting, families at risk of stunting, maternal factors, sanitation*

INTRODUCTION

Stunting is a chronic malnutrition problem caused by a lack of nutritional intake due to feeding that does not meet basic nutritional needs. Stunting is a condition in which children under the age of 5 years fail to grow due to chronic nutritional deficiencies, causing to be smaller than their peers[1]. Malnutrition can begin in the womb and in the first days after birth, but does not appear until 2 years of age, even though the nutritional status of both mother and child is an important factor in child development[2]. Stunting affects intelligence levels, susceptibility to disease, reduced productivity and slowed economic growth, and also increases poverty and inequality. The government has established policies to address the problem of stunting through cross-ministerial/institutional cooperation[3].

The World Health Organization (WHO) says that 22.3% of all children under five will be stunted by 2022. This shows that the 20% target set by WHO has not yet been achieved[4]. Meanwhile, the stunting rate in Southeast Asia reached 30.1% in 2022[5]. Indonesia has the second highest prevalence of stunting in Southeast Asia after Timor Leste. According to data from the Indonesian Health Survey in 2023 the prevalence of stunting in Indonesia was 21.5 percent[6]. This figure is still less than the

target set by the government which is 14% by 2024[5]. Meanwhile, the prevalence of stunting increased significantly by age group, especially between the ages of 6 to 23 months. In the 6-11 month age group, the prevalence of stunting was 13.7% and increased sharply by 1.6 times to 22.4% in the 12 to 23 month age group in 2022[7].

The government established the National Strategy for Accelerating Stunting Reduction through a family approach at risk of stunting in Presidential Regulation No. 72 of 2021 to achieve the target of sustainable development goals by 2030 and also prepared a national action plan on Accelerating Stunting Reduction in order to accelerate stunting reduction [8].

According to BKKBN, Families at risk of stunting target families who have risk factors for giving birth to stunted children, with target families including: PUS, pregnant women, families with children 0 to 23 months, and families with children 24 to 59 months, as well as screening for risk factors that are easy to see and meet the requirements for significance in influencing the occurrence of stunting, namely sanitation, access to drinking water, as well as 4T conditions (too young, too old, too close, too many) and modern family planning participation"[9]. Based on the results of updating the Family Data Collection in 2023, the number of families at risk of stunting in Indonesia is 11.3 million families at risk of stunting. [10]

In an effort to reduce stunting, infants with families at risk of stunting need specific attention from all parties to reduce the risk of stunting because the age of infants is mainly 6 to 23 months. The age from 6 to 23 months is an important period in the development of a child's brain and body. Malnutrition during this period can inhibit brain development, which can lead to cognitive impairment and long-lasting delays in motor development[11]. Children who are stunted at an early age are more susceptible to non-communicable diseases such as hypertension, type 2 diabetes, and obesity in adulthood[12]. Therefore, early treatment of stunting is very important in preventing more serious health problems in the future. According to research, children who are stunted at this age are at higher risk of developing irreversible developmental disorders[13].

Interventions in the form of assistance provided to families at risk of stunting have also been carried out but have not succeeded in significantly reducing the incidence of stunting [14]. Several factors that can influence the incidence of stunting and families at risk of stunting are maternal factors consisting of birth spacing that is too close, the age of the mother at risk, which is too old and too young, as well as the number of births of too many children and family planning participation.

Based on previous research conducted, there is a correlation between maternal factors too young, too old, too close and too many with families at risk of stunting ($p = 0.000$). Family planning participation is also an indirect causal factor for stunting cases. The reason is due to the lack of proper pregnancy planning, so that the birth spacing becomes too close.[15] In addition, environmental factors such as latrine ownership can also affect the incidence of stunting and families at risk of stunting. Wahyudi's research (2024) found that not having a proper toilet was at risk of stunting with an OR = 6.289. [16

Therefore, it is necessary to explore the determinant factors that cause the incidence of stunted infants in family groups at risk of stunting [17]. The goal is that intervention and mentoring programs carried out by BKKBN and the Health Office for families at risk of stunting can be implemented to significantly reduce stunting rates. The assistance program carried out so far has not been able to significantly reduce the stunting rate, so it is necessary to explore the determinants that determine the incidence of stunting in families at risk of stunting [17].

This study aims to analyze the factors that act as predictors of stunting incidence in families at risk of stunting in Indonesia using

the 2023 Indonesian Health Survey (IHS) data. This research will focus on maternal and environmental health factors which are indicator variables for families at risk of stunting. This research is important because it looks at the influence of stunting risk factors on the incidence of stunting in families at risk of stunting, which has never been done before. There are previous studies examining risk factors in families at risk of stunting and risk factors for stunting incidence separately, but not seeing the effect of risk factors on the incidence of stunting in families at risk of stunting, especially in the 6-23-year-old group. Researchers hope that this research can contribute ideas about appropriate policies to reduce the prevalence of stunting and make it easier to provide assistance to families at risk of stunting.

METHODS

Design, Time, and Place

This research design is an analytic study with a *cross-sectional* approach, using data obtained from the Indonesian Health Survey (SKI) which is sourced from the Basic Health Research (Riskesdas) data in 2023. Data collection, processing and analysis were carried out from October 2024 to February 2025. This study has received ethical approval from the Diponegoro University Research Ethics Commission with number 416/EA/KEPK-FKM/2024.

Sampling

Population of this study was all families at risk of stunting who had under-fives aged 6-23 months representing 38 provinces in Indonesia totaling 4,766 under-fives who had complete dependent and independent variable data. The sampling technique used *total sampling* technique. Total sampling is a sampling technique in research where the entire existing population is sampled for analysis. In this method, every element or individual in the population will be included in the study, so that no sample is left out.[18]

Data Collection Methods

The main respondents in this study were mothers aged 15-49 years (childbearing age category) who had children aged 6-23 months who came from families at risk of stunting. Mothers were selected because they had information related to the characteristics of the infants, the number of births, birth spacing, family planning participation and maternal age. The criteria for families at risk of stunting were married couples whose wives were aged 15-49 years, had at least 1 risk factor of latrine screening or inadequate drinking water sources or had at least 1 risk factor from the PUS 4 Too (too young, too old, too close, too many) met and were not modern family planning participants (traditional family planning participants or not family planning participants). The inclusion criteria in this study were mothers of toddlers who were willing to participate, could communicate well, had toddlers aged 6-23 months at the time of data collection, had height/length measurements taken on their toddlers and came from families at risk of stunting. Exclusion criteria were mothers aged <15 years and≥ 50 years, mothers who had under-fives aged (6-23) but not biological children, and moved domicile. Body length/height data were obtained through anthropometric measurements conducted by the SKI team. *Stunting* in this study was defined as having a height-for-age (TB/U) *z-score* of less than -2 SD. Data on age, gender and place of residence were collected through interviews using a standardized questionnaire. Gender was divided into male and female. Place of residence was categorized into urban and rural. Body length was measured using a body length measuring instrument with a precision of 0.1 cm.

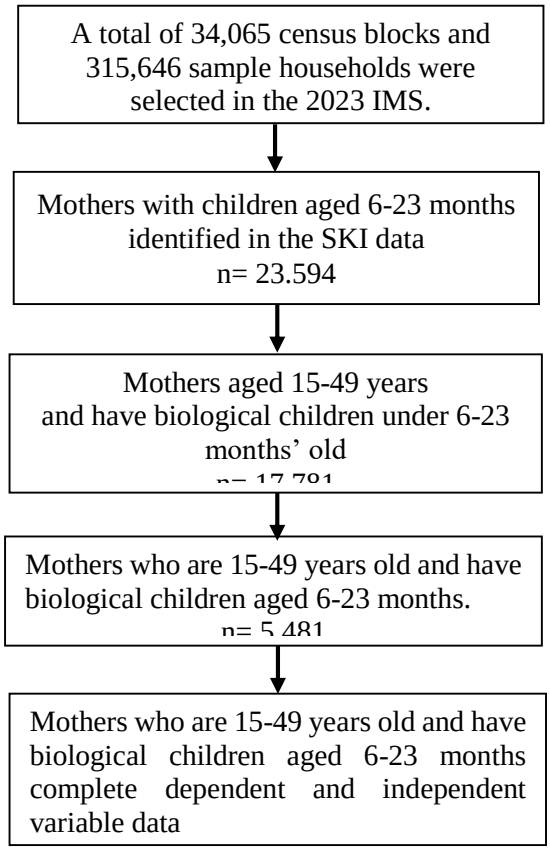


Figure 1. Flow of SKI 2023 Data Selection

Data Analysis

Univariate analysis was used to describe the collected variables such as maternal characteristics, characteristics of infants, birth spacing, number of births, family planning participation and maternal age, and latrine ownership. For categorical variables, analysis was conducted to determine the frequency distribution and proportion of the variables of incidence of stunting in families at risk of stunting, maternal characteristics, characteristics of infants, birth spacing, number of births, birth spacing, family planning participation and maternal age, and latrine ownership. Bivariate analysis was used to explore the relationship between independent variables and dependent variables. In addition, this analysis was used to select the independent variables that were included in the multivariate modelling. The statistical analysis test used was the *Chi-Square* test with a 95% confidence level and a significant level of alpha (a) = 0.05. Multivariate analysis was used to determine which variables had the most influence on the incidence of stunting in families at risk of stunting and to obtain the best model in determining the risk factors for stunting in families at risk of stunting in Indonesia. The analysis method used was multiple logistic regression. Independent variables that were significant in the bivariate analysis ($p < 0.25$) were included in the multivariate regression model.

RESULTS AND DISCUSSION

In this study, researchers will examine the characteristics of mothers and the characteristics of infants. Mother characteristics include mother's age, mother's education and mother's occupation, while the characteristics of the baduta include the sex of the baduta, the age of the baduta and the place where the baduta live. The age of the newborns and mothers in this study were not normally distributed. The median age of the children in this study was 15 months. Children who were stunted tended to be older than those with normal height. The median age of the stunted group was 17.00 ± 4.82 months, higher than the normal nutrition group (14.00 ± 5.22 months). This difference indicates that stunting cases increase with the age of the infants. This is because older children have experienced malnutrition and infectious diseases for longer, so this long exposure condition causes older children to experience more stunting[19].

The distribution by sex of the under-five children showed a higher proportion of stunting in boys (20.40%) compared to girls (15.70%). In other words, boys have a 1.3 times higher risk of being stunted than girls. This pattern of vulnerability by gender is consistent with global findings that show boys tend to be more vulnerable to stunting than girls. This is due to greater energy requirements for growth in males than females[20]. These higher energy needs are sometimes not always met, especially in families with economic limitations[21]. The distribution by mother's education showed a higher proportion of stunting in mothers with

low education levels (19.70%) compared to mothers with high education (16.70%). The level of education makes it easier for mothers to understand and receive information about nutrition and health from outside. Mothers with higher levels of education will more easily receive information from outside, compared to mothers who have lower levels of education[22]. Low levels of maternal education will make it difficult for mothers to receive direction and mothers tend not to believe in the importance of fulfilling nutritional needs or the importance of other health services that support the growth and development of children[23,24].

Table 1. Description of Subject Characteristics

Variables	Height (N=4766)				*p*
	Stunting (n=865) median±SD	n(%)	Normal (n=3901) median±SD	n(%)	
Toddler age (months)[a]	17,00 (4,82)		14,00 (5,22)		0,00[b]
Mother's age (years)[a]	33,00 (6,22)		33,00 (5,28)		0,24[b]
Gender					
Male		503 (20,40)		1957 (79,60)	0,00[c]
Female		362 (15,70)		1944 (84,30)	
Mother's Education					
Low (≤SMP)		445 (19,70)		1813 (80,30)	0,00[c]
High (≥SMA)		420 (16,70)		2088 (83,30)	
Mother's Occupation					
Work		389 (18,10)		1757 (81,90)	0,85[c]
Not Working		457 (17,90)		2100 (82,10)	
Place of Residence					
Rural		501 (19,80)		2032 (80,20)	0,00[c]
Urban		364 (16,30)		1869 (83,70)	

Presentation of data based on the normality of the data.
a. Non-Normal Distribution (median ± standard deviation).
b. Mann Whitney Test
c. Chi Square Test

The distribution according to where the children live shows that children living in rural areas (19.80%) are much more stunted than those living in urban areas (16.30%). In rural areas, the high incidence of stunting is due to several factors such as infectious diseases, poverty level and education. The prevalence of infectious diseases (such as diarrhea) in rural areas tends to be higher than in urban areas. This is due to inadequate sanitation and limited access to health services, leading to high cases of stunting in rural areas[25,26]. In addition, the high level of poverty in rural areas also results in limited access to nutritious food, health services, and education, which significantly contributes to the problem of stunting in children[25,27,28]. In addition, in rural areas, many mothers have low education levels. Low levels of maternal education will make it difficult for mothers to receive direction and mothers tend not to believe in the importance of fulfilling nutritional needs or the importance of other health services that support the growth and development of children. Maternal education is fundamental to achieving good under-five nutrition[23,24].

Table 2 shows the association between maternal and environmental health factors and the incidence of stunting in families at risk of stunting. The table shows that birth spacing, number of births, modern family planning, and latrine ownership are associated with the incidence of stunting in families at risk of stunting ($p < 0.05$). Maternal age was not associated with stunting in this study.

In this study, mothers whose birth spacing was at risk, their children tended to be stunted (22.7%) higher than mothers whose birth spacing was not at risk (17.7%). Likewise, with the number of births, mothers with too many births tended to have stunted children (19.8%), much higher than mothers with the ideal number of births (16.5%). In the modern family planning variable, a higher proportion of mothers who used modern family planning (19.4%) had stunted children, compared to mothers who did not use modern family planning (17.1%). Another finding in this study was that far more under-five children living in

households with improper latrines (19.8%) were stunted compared to under-five children living in households with proper latrines (16.7%).

Table 2. Relationship between Maternal and Environmental Health Factors and the Incidence of Stunting in Families at Risk of Stunting

Variables	Height (N=4766)				R	5%CI	p
	Stunting (n=865)		Normal (n=3901)				
	n	%	n	%			
Birth Distance							
At Risk	94	22,7	320	77,3			0,014
Not at Risk	771	17,7	3581	82,3	,282	,061-1,548	
Number of Births							
Too Much	482	19,8	1956	80,2			0,003
Ideal	383	16,5	1945	83,5	,202	,064-1,357	
Modern Family Planning							
Not using modern family planning	450	17,1	2181	82,9	,880	0,780-0,993	0,041
Using Modern Family Planning	415	19,4	1720	80,6			
Mother's age							
At Risk	348	18,6	1523	81,4			0,542
Not at Risk	517	17,9	2378	82,1	,042	0,921-1,178	
Latrine Ownership							
Not Feasible	438	19,8	1774	80,2	,184	1,050-1,336	0,007
worth	427	16,7	2127	83,3			

The results of the multivariate analysis listed in table 3 show that the predictors of stunting in families at risk of stunting are birth spacing (OR: 1.422; 95% CI: 1.1114-1.817), number of births (OR: 1.323; 95% CI: 1.137-1.540) and latrine ownership (OR: 1.327; 95% CI: 1.140-1.544). In this study, logistic regression analysis was conducted with variable selection using the *backward LR* method because it can minimize *overfitting* and help ensure that only variables that really have an influence on the dependent variable are included in the model. The first step, before conducting multiple logistic regression analysis, is to test for *multicollinearity* between the *independent* variables, namely the variable of birth spacing with modern family planning participation and the number of births with modern family planning participation, which in theory allows correlation. The results showed that there was a high correlation between birth spacing, number of births and modern family planning participation with *p value = 0*.000 so that the modern family planning participation variable which had the largest *p value was* not included in the model.

The second stage was to include all variables that had a *p-value* <0.25, namely the variables of birth spacing, number of births and latrine ownership with the exception of modern family planning participation, which had a very high correlation. Birth spacing had a B coefficient of 0.352, with a *p-value of* 0.005, which also showed a significant association. The OR value of 1.422 indicates that the shorter the birth spacing between children, the higher the chance of stunting with an increase of 42.2%. The number of births has a B coefficient of 0.280, which means that an increase in the number of births is associated with an increase in the likelihood of stunting in families at risk of stunting. The p value <0.001 indicates a significant relationship between the number of births and the incidence of stunting in families at risk of stunting. The OR value of 1.323 indicates that each additional birth increases the likelihood of stunting by 32.3%. Latrine ownership shows a B coefficient value of 0.283, with a *p-value* <0.001, which means that latrine ownership is significantly associated with the incidence of stunting in families at risk of stunting. The OR value of 1.327 indicates that inadequate latrine ownership is associated with an increased likelihood of stunting by 32.7%. Overall, the variables of number of births, birth spacing and latrine ownership significantly influence the incidence of stunting in families at risk of stunting in Indonesia.

Table 3. Analysis of Determinants of Stunting Incidence in Families at Risk of Stunting

Variables	**B**	**p**	**OR**	CI95%	
				Lower limit	Upper limit
Birth Distance	0,352	0,005	1,422	1,114	1,817
Number of Births	0,280	0,000	1,323	1,137	1,540
Latrine Ownership	0,283	0,000	1,327	1,140	1,544

Birth spacing that is too close has an effect on increasing the risk of stunting in children. Research conducted in Ghana showed that birth spacing between 24 to 35 months had a lower likelihood of stunting compared to birth spacing less than 24 months[29]. This may be explained by the fact that mothers who have short birth spacing do not have sufficient time to restore their body's nutrient reserves after giving birth to the previous child, which may affect the nutritional quality of subsequent pregnancies. In Indonesia, birth spacing of less than two years has long been considered a risk factor that can lead to health problems in mothers and children. A study in Purbalingga revealed that mothers with less than 2 years apart in pregnancy were 4 times more likely to give birth to stunted children[30]. Close birth spacing also increases the likelihood of low birth weight (LBW) and preterm birth, both of which are significant risk factors for stunting[31]. In Indonesia, research conducted by Hastuti et al. (2019) showed that shorter birth spacing is directly related to the incidence of child stunting, where children born to mothers with birth spacing of less than two years are more prone to stunted growth[32]. Too close a birth spacing reduces the mother's recovery time, which impacts the quality of nutrition that can be provided to the child, both during pregnancy and after birth. Therefore, setting a healthy birth spacing of more than two years can reduce the risk of stunting [33]. Research by Ratnawati et al. (2022) supports this finding, showing that birth spacing that is too close causes mothers to be unable to provide adequate care to each child, both in terms of exclusive breastfeeding and meeting appropriate nutritional needs [34].

Further research shows that short birth spacing is also associated with an increased prevalence of maternal and child infections, which in turn can affect the nutritional status of the child. This is in line with the results of a study that revealed that pregnancies that are too frequent and close together cause disruptions in the mother's recovery phase and limitations in breastfeeding[34]. The study by Santosa et al. (2022) confirmed that mothers with birth spacing of less than two years tend to have children who are more prone to stunting due to limited nutritional fulfillment during critical periods of child development[(35)].

The number of births is an important factor that can influence the incidence of stunting in children. Several studies have shown that a high number of births is associated with an increased risk of child stunting. This is due to various factors, including limited family resources, fatigue of mothers who give birth to a large number of children, and decreased attention to each child. The results of this study are supported by a study conducted in Palembang which concluded that mothers who have more than one child have a 12 times greater chance of having stunted children [30,36]. This condition is closely related to maternal nutritional limitations which can affect child development [37]. In addition, lower family socioeconomic factors also play a role in increasing the prevalence of stunting in children from families with many children[37]. Research by Fink et al. (2014) confirms that families with more children often face constraints in providing adequate nutritious food, which can affect children's growth[38]. Therefore, pregnancy management and limiting the number of births may serve as important strategies to reduce the prevalence of stunting[36].

Latrine ownership affects the incidence of stunting in families at risk of stunting. Proper latrine ownership and good environmental sanitation play an important role in preventing infectious diseases such as diarrhea, which can directly affect children's nutritional status and contribute to stunting. Several studies have shown that access to good sanitation is strongly associated with reduced stunting prevalence, as poor sanitation facilities can lead to recurrent infections and impaired child growth[39] [40]. Research conducted by Zalukhu et al. (2021) in Nagari Balingka, Agam Regency, found that poor environmental sanitation, including the

use of improper latrines, was significantly associated with the incidence of stunting. In this study, children from families without proper latrine facilities had a higher risk of stunting compared to children living in homes with proper latrine facilities[41]. This suggests that access to good latrine facilities can reduce the transmission of diseases that can affect children's nutritional status, thereby reducing the incidence of stunting. In addition, research by Olo et al. (2021) is also in line with this study, which shows that the use of inadequate toilet facilities, open defecation behavior, and lack of access to adequate sanitation contribute to the increasing prevalence of stunting in children in Indonesia. In this study, open defecation behavior and lack of healthy latrine facilities were found to have a strong association with the incidence of stunting, especially in areas with poor sanitation[42]. This emphasizes the importance of improving access to proper sanitation facilities as part of stunting prevention efforts. In addition to affecting the incidence of infections, poor sanitation is also associated with children's digestive system disorders, such as Environmental Enteric Dysfunction (EED), which is a chronic inflammation of the gastrointestinal tract that can inhibit nutrient absorption and lead to long-term malnutrition. EED has been shown to be one of the main causes of stunting in many developing countries, including Indonesia. Therefore, improved sanitation and increased access to proper latrines can serve as an effective preventive measure to reduce stunting rates[40].

Maternal age was not associated with stunting in families at risk of stunting. This could be because health education programs and better antenatal care may have reduced the negative impact of young maternal age <20 years on the incidence of stunting. Research by Santosa et al. (2021) in Indonesia showed that with better health services, such as regular antenatal check-ups and nutritional supplementation, maternal age was not always directly associated with stunting[43]. Research conducted by Arifin et al. (2022) in Indonesia revealed that although maternal age plays a role as a risk factor for stunting, factors such as maternal education and access to health services have more influence on child health[44]. ≥On the other hand, older maternal age, i.e. mothers who become pregnant at the age of over 35 years, is also often associated with a higher risk of pregnancy and birth complications, such as premature birth, low birth weight birth, or other health problems. However, in this study, no significant association was found between too old maternal age and the incidence of stunting. This may be due to increased access to medical technology and adequate health interventions for older mothers, which can help reduce the negative impact of pregnancy at an advanced age. Research by Gupta and Santhya (2020) in India also found that although maternal age is associated with some birth risks, optimal medical support can reduce adverse effects on the child, including stunting[45] . In addition, at older ages, mothers may have more experience in caring for children, and have more economic and social resources that support child health and nutrition. Research by Rana and Goli (2016) in Indonesia also showed that although older mothers have a higher likelihood of giving birth to low birth weight children, they are more likely to access better health care and have more knowledge about adequate nutrition to prevent stunting[46] .

Modern family planning participation is associated with the incidence of stunting in families at risk of stunting. However, a Prevalence Ratio (PR) value smaller than 1 indicates that the effect is relatively small. This may be because the direct effect of contraceptive use on stunting is more complex and influenced by other factors. In addition, a study by Rana and Goli (2016) showed that reducing the birth rate through contraceptive use not only reduces stunting, but also reduces maternal malnutrition which can have an

impact on child health[46]. Contraceptive use or participation in family planning programs has been shown to have an effect on reducing the risk of stunting through managing the number of births and healthier birth spacing. This is consistent with the pathway model proposed by Fentiana et al. (2022), which showed that contraceptive use reduced the prevalence of stunting by 2.25%[47]. Participation in modern family planning gives mothers the opportunity to recover and provide more attention to each child, reducing the risk of stunting. This is supported by research from Flood et al. (2019), which identified that modern contraceptive use in Guatemala had a positive effect on linear child growth and reduced the prevalence of stunting [48]**.** Multicollinearity between family planning participation, number of births and birth spacing caused the modern family planning participation variable not to be included in the multiple logistic regression analysis. This multicollinearity occurs because family planning participation and number of births and birth spacing are often interrelated. Families who have more children are less likely to participate in family planning programs, which in turn affects the welfare and growth of children. This study is in line with the analysis by Tamirat et al. (2021), which states that high-risk fertility behaviors, including very close births, are closely associated with increased prevalence of stunting and anemia in children. In this context, family planning participation serves as an intervention that can influence birth rates and birth spacing, which indirectly affect the incidence of stunting[49].

CONCLUSION

This study provides an overview of the variables that are associated with and have an influence on the incidence of stunting in families at risk of stunting in children aged 6-23 months in terms of maternal factors including birth spacing, number of births, maternal age, modern family planning participation and environmental health factors including latrine ownership. Birth spacing, number of births, and latrine ownership are predictors of stunting in families at risk of stunting. Several maternal and environmental factors play an important role in the incidence of stunting in families at risk of stunting in Indonesia. A high number of births is associated with an increased risk of stunting. Mothers who have too many births (≥ 3 years) have a greater risk of stunting due to limited family resources and divided attention for each child. Spacing births too close together (<2 years) was also found to be a factor that increases the risk of stunting, as it reduces the mother's recovery time and affects the quality of nutrition in subsequent pregnancies. In addition, proper latrine ownership and good environmental sanitation were shown to have a significant effect on reducing the incidence of stunting, as it can reduce infections that have an impact on children's nutritional status.

Maternal age, on the other hand, showed no significant association with stunting, which may be due to improvements in access to health services and better antenatal care. Modern family planning participation was associated with reduced risk of stunting, although the effect was relatively small due to *multicollinearity* with number of births and birth spacing. These findings suggest that factors such as good family planning and improved sanitation and maternal nutrition should be a major focus of stunting prevention efforts in Indonesia.

Suggestions for related agencies, especially the National Population and Family Planning Agency (BKKBN) and the Provincial or Regency / City Health Office that policies to extend birth spacing and limit the number of births need to be considered as part of efforts to reduce the prevalence of stunting. The approach to families at risk of stunting that emphasizes aspects of nutrition-sensitive interventions needs to pay attention to risk factors that affect the incidence of stunting in families at risk of

stunting so that the assistance provided is more targeted and effective and efficient. Through programs that support family planning and improve maternal nutrition, it is hoped that it can reduce the stunting rate, which is still a major problem in Indonesia. Therefore, a holistic approach involving improved maternal nutrition, good family planning, and appropriate health education is needed. In addition, proper latrine ownership and good environmental sanitation play an important role in preventing child stunting. Therefore, efforts to improve access to proper sanitation, including education on the importance of good hygiene behavior, as well as the development of better sanitation infrastructure, should be a priority in Indonesia's stunting reduction program. A good sanitation-based approach can help reduce the spread of infectious diseases and support the fulfillment of adequate nutritional needs. Future researchers are expected to examine the incidence of stunting in stunting risk families with the target of pregnant women. Because the nutritional status of mothers and maternal care during pregnancy can also affect the incidence of stunting, especially causing Low Birth Weight (LBW) which will have an impact on the nutritional status of children in the future.

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AUTHOR'S CONTRIBUTION

The lead author (RR) was responsible for determining the research objectives, conducting a review of relevant literature, developing the theoretical framework of this study, data processing, data analysis, preparing the initial draft of the article and revising the article until publication. The second author (MZ) provided methodological guidance regarding the use of secondary data, provided advice on appropriate statistical analysis, assisted in determining relevant variables for research, and guided in the preparation of the draft article. The third author (SR) contributed to the presentation of the research results and contributed to the direction of policy recommendations based on the research results. The fourth author (SU) provided important feedback during the writing process to improve the quality and feasibility of the article, provided additional perspectives regarding the interpretation of the results and analysis of the research results, and provided input on the discussion and conclusion sections to make the research results more applicable.

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CORRELATION OF HS-CRP LEVELS AND TOTAL PROTEIN IN PATIENTS WITH TYPE 2 DIABETES MELLITUS AT DR. BRATANATA HOSPITAL JAMBI CITY

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ABSTRACT

Background: *Type 2 Diabetes Mellitus (DM) is a chronic disease characterized by hyperglycemia and mild systemic inflammation. High-sensitivity C-Reactive Protein (hs-CRP) is an inflammatory marker elevated in type 2 DM, while total protein levels reflect the nutritional and inflammatory status of the body. The correlation between hs-CRP and total protein may provide insight into the inflammatory and metabolic status of type 2 DM patients.*
Methods: *This descriptive-analytic study used a cross-sectional design and was conducted at Dr. Bratanata Hospital, Jambi City. The sample consisted of T2DM patients selected through purposive sampling based on inclusion and exclusion criteria. hs-CRP levels were measured using a Wondfo Meter, and total protein was analyzed using an Autolyser BT 3500. Statistical tests were conducted to determine the relationship between the variables.*
Results: *The average hs-CRP level was 4.25 mg/L and the total protein level was 7.40 g/dL. A weak negative correlation was found between hs-CRP and total protein levels, which was statistically significant (p = 0.023).*
Conclusion: *There is a significant correlation between hs-CRP and total protein levels in type 2 DM patients. Increased hs-CRP tends to be followed by a decrease in total protein levels, although the correlation is weak. Measurement of hs-CRP and total protein can serve as early indicators of inflammatory and metabolic status in type 2 DM patients.*

Keywords: *Diabetes Mellitus; Total Protein; hs-CRP; Inflammation*

INTRODUCTION

Diabetes Mellitus (DM) is a non-communicable disease and a leading cause of death globally. It results from metabolic disorders in the pancreas, leading to hyperglycemia due to reduced insulin production, and can cause both macrovascular and microvascular complications (Saputri, 2016).

Indonesia ranks fourth in the world for the highest number of DM cases, after the U.S., China, and India (Muliani, 2015). The WHO estimates an increase from 8.4 million cases in 2000 to 21.3 million by 2030. About 90–95% of cases are type 2 DM (Saeedi et al., 2019). The IDF reported that in 2017, Indonesia ranked sixth with 10.2 million people aged 20–79 living with DM (Andamari et al., n.d.). In 2019, DM caused 1.5 million deaths, 48% of which occurred before age 70 (Global Burden of Disease Study, 2019).

In Jambi Province, the number of DM cases reached 45,781 in 2022, with 21,127 recorded at 20 public health centers and 1,010 outpatients diagnosed at Dr. Bratanata Hospital

in Jambi City in 2024 (Jambi Provincial Health Office, 2022). Hyperglycemia triggers chronic inflammation, which can be measured through leukocyte count. Pro-inflammatory cytokines such as IL-6 and IL-8 increase in DM patients and stimulate leukocyte, especially neutrophil, production (Farhangi et al., 2013; Yanti et al., 2017).

C-Reactive Protein (CRP) is an acute-phase protein that rises in response to inflammation and may increase several-fold in type 2 DM. Normal levels are <6 mg/L and can rise within 4–6 hours after tissue injury (Wibowo et al., 2018). CRP screening can help detect early complications such as diabetic kidney damage (Amelia et al., 2020). Insulin resistance affects carbohydrate, lipid, and protein metabolism. Proteins, including albumin (60%) and globulin (40%), are essential for bodily functions (Almatsier, 2014; The Journal of Clinical Investigation, 51). In DM, hyperglycemia increases protein and fat catabolism and alters plasma protein levels. Inflammation also induces acute-phase protein production.

CRP reflects systemic inflammation in DM and is associated with poor glycemic control and risks of complications like cardiovascular disease and nephropathy (Ridker et al., 2016). Changes in total protein, albumin, and globulin levels reflect patients' clinical and inflammatory status (Powers et al., 2022).

Studies on the relationship between CRP and total protein show varied results. Rachma et al. (2023) found no significant difference in total protein between controlled and uncontrolled DM, while Febrianto et al. (2021) reported a positive correlation between CRP levels and albuminuria in type 2 DM patients.

METHODS

This study is a descriptive-analytic research utilizing a cross-sectional design. It aims to investigate the relationship between high-sensitivity C-reactive protein (hs-CRP) levels and total protein in individuals with type 2 diabetes mellitus. The study population and sample consisted of patients diagnosed with type 2 diabetes mellitus, with data collection from 40 respondents and analysis conducted at Dr. Bratanata Hospital between November 30 and December 7, 2024. The instruments used in this study included Wondfo meter for analyzing hs-CRP levels and Autolyser BT 3500 for measuring protein levels.

Primary data were collected through purposive sampling, which applied specific inclusion and exclusion criteria.

Inclusion criteria included:

1. Patients who were willing to participate as respondents and had signed an informed consent form.
2. Patients who had been clinically diagnosed with type 2 diabetes mellitus, as confirmed by their medical records.

Exclusion criteria included:

1. Pregnant women.
2. Patients with diabetes mellitus who had known complications such as tuberculosis, HIV, anemia, and others.

The research of this study has obtained an ethical approval from the Ethics Committee at the Jambi Ministry of Health Poltekkes.

RESULTS AND DISCUSSION

3.1 Respondent Characteristics

Based on the processed data, the distribution of hs-CRP and total protein according to respondent characteristics is illustrated in the graphs and tables below:

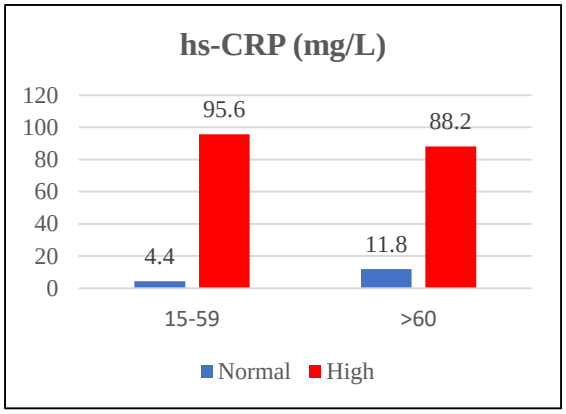


Figure 1. Distribution Based on Age

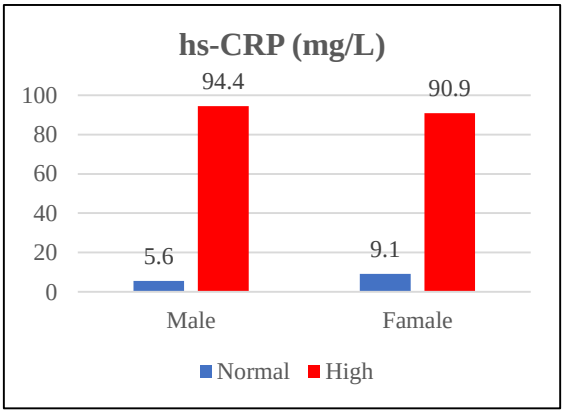


Figure 3. Distribution Based on Gender

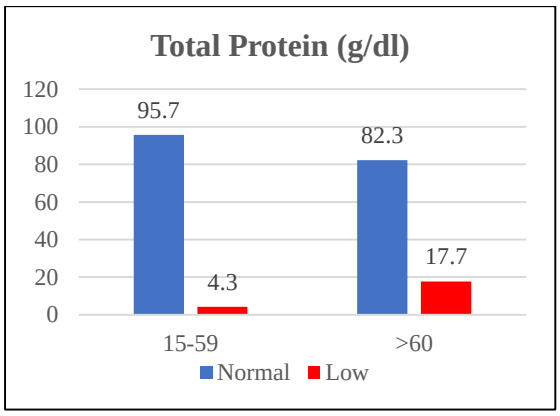


Figure 2. Distribution Based on Age

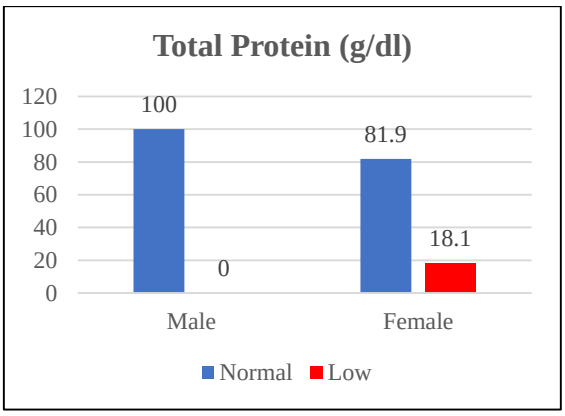


Figure 4. Distribution Based on Gender

Tabel 1. Results of Examination Based on Age

HsCRP	N	Mean	Min	Max	SD	P-value
19 - 59	23	4.3	0.9	5.1	1.08	0.319
>60	17	4.1	0.5	5.1	1.44	
Total	40	4.2	0.5	5.1	1.26	
Total Protein						
19 - 59	23	7,3	6,2	8,5	0,5	0,270
>60	17	7,4	6,2	8,3	0,7	
Total	40	7,35	6,2	8,5	0,6	

The distribution of hs-CRP and total protein by age. The hs-CRP boxplot shows a similar distribution among groups, with an average of 4.3 mg/L for the 19–59 age group and 4.1 mg/L for those over 60 years old (p = 0.319), indicating no significant difference between age groups. Conversely, the total protein boxplot shows a higher median in the over-60 group. The average total protein was 7.3 g/dL in the 19–59 age group and 7.4 g/dL in those over 60 years, with a p-value of 0.27, also showing no significant difference.

Tabel 2. Results of Examination Based on Gender

HsCRP	N	Mean	Min	Max	SD	P-value
Male	18	4.31	0.8	5.1	1.20	0.386
Female	22	4.2	0.5	5.1	1.29	
Total	40	4.25	0.5	5.1	1.24	
Total Protein						
Male	18	222.6	137	275	39.05	0.266
Female	22	214.7	120	301	39.12	
Total	40	218.3	120	301	38.8	

The istribution of hs-CRP and total protein based on gender. The hs-CRP boxplot displays nearly identical distributions between males and females, with an average of 4.31 mg/L for males and 4.22 mg/L for females (p = 0.386), indicating no significant difference. In the total protein boxplot, females had a slightly higher median than males. The average total protein was 7.11 g/dL for males and 7.62 g/dL for females, with a p-value of 0.0004, indicating a significant difference.

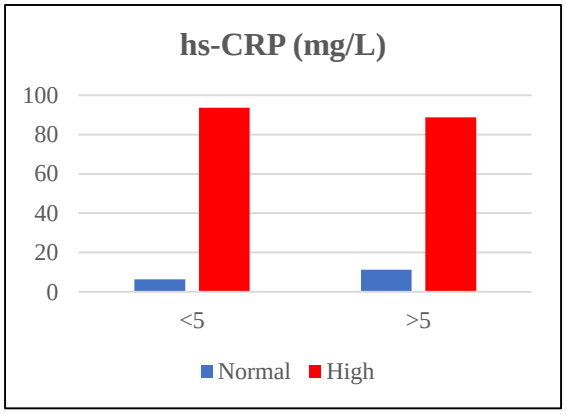


Figure 5. Distribution Based on Duration of Illness

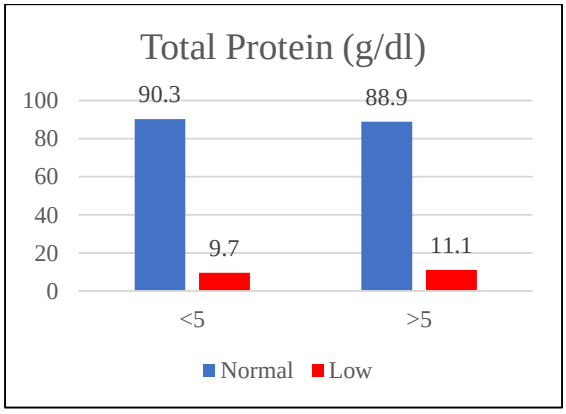


Figure 6. Distribution Based on Duration of Illness

Tabel 3. Results of Examination Based on Duration of Illness

HsCRP	N	Mean	Min	Max	SD	P-value
<5	31	4.35	0.8	5.1	1.14	0.164
>5	9	3.88	0.5	5.0	1.53	
Total	40	4.11	0.5	5.1	1.33	
Total Protein						
<5	31	7,36	6,2	8,5	0,63	0,250
>5	9	7,52	6,4	8,3	0,61	
Total	40	7,44	6,2	8,5	0,62	

The distribution of hs-CRP and total protein based on the duration of having type 2 diabetes mellitus. The average hs-CRP for patients with less than 5 years of disease duration was 4.35 mg/L, higher than the 3.88 mg/L for patients with more than 5 years of disease, though the difference was not significant (p = 0.164). Meanwhile, in terms of total protein, patients with more than 5 years of diabetes had a higher average of 7.52 g/dL compared to 7.36 g/dL in those with less than 5 years of disease duration. However, this difference was also not significant (p = 0.25).

3.2. Correlation of hs-CRP Levels and Total Protein in Patients with Type 2 Diabetes Mellitus at Dr. Bratanata Hospital Jambi City

The correlation test results are shown in the graph below. Before conducting the correlation test, the data were tested for normality using the Shapiro-Wilk test. The p-values for hs-CRP and total protein were ≤ 0.05 and < 0.05, respectively, indicating normally distributed data, thus the non-parametric Spearman Correlation test was used.

Table 4 presents the Spearman correlation results between hs-CRP and total protein levels among 40 patients with type 2 diabetes mellitus. The mean hs-CRP level was 4.25 mg/L, while the mean total protein level was 7.40 g/dl. Spearman correlation analysis revealed a weak negative correlation (r = -0.358) between hs-CRP and total protein, which was statistically significant (p = 0.023).

Table 4. Results of Correlation Spearman

Parameter	n	Mean	Median	Minimal-maximal	sd	Coefficient Correlation	P
hs-CRP	40	4.25	4.9	0.5 – 5.1	1.2	-0,358	0,023
Protein total	40	7,40		6,2 – 8,5	0,6		

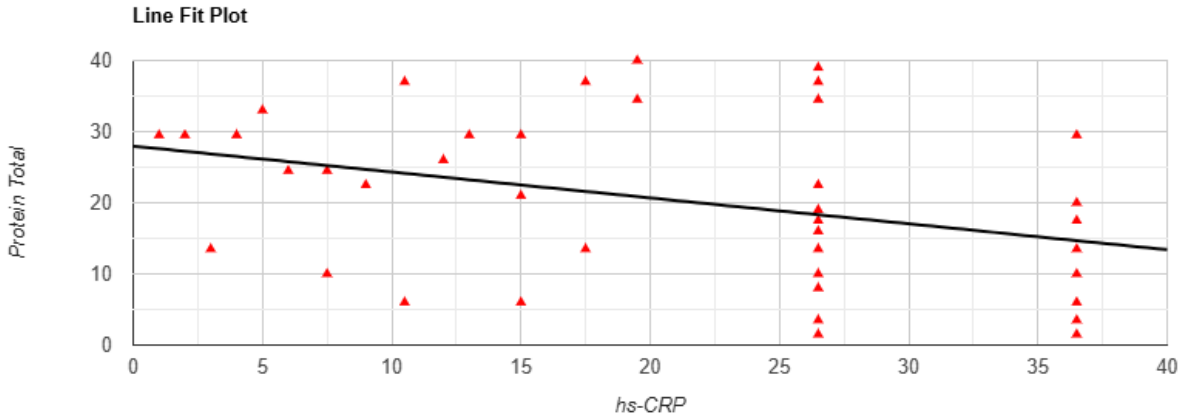


Figure 4. Results of Correlation Spearman

The analysis showed a weak negative correlation pattern between hs-CRP levels and serum total protein levels. This was illustrated by a scatter plot with a downward linear regression line (Figure 4). Although the observed correlation was negative, the wide data distribution showed that the correlation was not statistically significant nor clinically strong.

This pattern suggests that increased hs-CRP, an indicator of systemic inflammation, tends to be followed by a slight decrease in total protein levels. This aligns with physiological mechanisms where acute inflammatory responses alter liver protein synthesis. Inflammatory conditions increase the production of acute-phase proteins such as CRP while reducing the synthesis of other proteins, including albumin—a key component of total protein.

Additionally, factors such as hydration status, malnutrition, or liver and kidney dysfunction can independently affect total protein levels apart from hs-CRP levels. Thus, although a negative trend was indicated, the relationship between hs-CRP and total protein appears multifactorial and non-linear.

The analysis concluded that hs-CRP levels cannot be directly used as a predictor of total protein levels in serum. Comprehensive protein status evaluation must still consider other factors beyond systemic inflammation.

The analysis showed a weak negative correlation pattern between hs-CRP levels and serum total protein levels. This was illustrated by a scatter plot with a downward linear regression line (Figure 4.5). Although the observed correlation was negative, the wide data distribution showed that the correlation was not statistically significant nor clinically strong.

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CONCLUSION

The average hs-CRP level in type 2 DM patients at Dr. Bratanata Hospital Jambi City was 4.25 mg/L.

The average total protein level in type 2 DM patients at Dr. Bratanata Hospital Jambi City was 7.40 g/dL.

A significant correlation was found between hs-CRP and total protein levels in type 2 DM patients at Dr. Bratanata Hospital Jambi City, with a p-value of 0.023.

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CONFLICT OF INTEREST

The author declares there is no any conflict of interest during this study.

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THE EFFECTIVENESS OF HEALTH PROMOTION IN STUNTING PREVENTION TO IMPROVE KNOWLEDGE AND ATTITUDES OF MOTHERS OF TODDLERS USING BERDAZI (SMART AND NUTRITIOUS BALLS) MEDIA IN SUNGAI BAUNG VILLAGE, SAROLANGUN REGENCY

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ABSTRACT

Background: Stunting, a condition of growth failure in children due to chronic malnutrition, is a serious issue in Indonesia today with a prevalence rate of 21.6%. This figure indicates that around two in ten children in the country experience growth and developmental delays that can negatively impact their overall health status. One effort to reduce the prevalence of stunting is through health promotion using BERDAZI (Smart and Nutritious Balls). This study aims to determine the effectiveness of health promotion in stunting prevention to improve the knowledge and attitudes of mothers of toddlers using BERDAZI media (smart and nutritious balls) in Sungai Baung village, Sarolangun Regency.
Method: This type of research is quantitative research with a pre-experimental research design, with a one group pretest-posttest research design. Sampling in this study using purposive sampling technique with a total sample of 32 people. Data analysis using the Wilcoxon test.
Results: The average score of stunting prevention knowledge is pre-test (6.28), post-test (9.59). The average results of stunting prevention attitudes are pre-test (24.50), post-test (29.66).
Conclusion: There is a difference in increasing the score of knowledge and attitudes to prevent stunting in mothers of toddlers in Sungai Baung village, Sarolangun Regency who are given health promotion through BERDAZI (Smart and Nutritious Balls) with a p value of 0.000 (p <0.05). Health Promotion with BERDAZI (Smart and Nutritious Balls) is effective in increasing knowledge and attitudes to prevent stunting in mothers of toddlers in Sungai Baung village, Sarolangun Regency.

Keywords: Knowledge, attitude, stunting prevention, BERDAZI

INTRODUCTION

Stunting, a condition of growth failure in children due to chronic malnutrition, is a serious issue in Indonesia today with a prevalence rate of 21.6%. This figure indicates that around two in ten children in the country experience growth and developmental delays that can have a negative impact on their overall health status. This stunting phenomenon has triggered deep concern from various circles, as it is not only an individual child health issue, but also has a long-term impact on the productivity and socio-economic development of the country (Jambi, 2022).

Based on data from the National Nutrition Status Survey (SSGI) in 2022, the prevalence of stunting in Indonesia was 21.6%. While the average prevalence in 2005-2017 Indonesia is ranked 3rd in the Southeast Asia Region. Basic Health Research in 2018, states that the prevalence of stunting in toddlers in Indonesia is around 30.8%, this prevalence shows a decrease in the prevalence of stunting in the last 5 years, which was 37.2%. Although there has been a change, it has not yet reached the 2018 Riskesdas target of around 30.5% in toddlers and the RPJMN target in under-fives which is around 28% (Kemenkes RI, 2018).

Maternal knowledge about nutritional intake in children is an important factor in preventing stunting. Likewise, nutritional problems in pregnant women are very important because they affect the babies who

will be born later4. Based on the results of Angraini's research (2020), it is stated that there is a relationship between materal knowledge of nutrition and stunting.

TNP2K (2017) states that interventions that can be carried out to reduce the prevalence of stunting need to be carried out since the first 1000 days of life (HPK) of children. Specific nutrition intervention efforts for children under five are focused on pregnant women, pregnant women and children 0-23 months, because countermeasures for short children are most effective since 1000 HPK.

Based on the results of research conducted by Raodah (2023) that there was an increase in knowledge and attitudes of mothers of toddlers after being given the media Booklet of maternal parenting in the prevention of stunting. Veni's research (2022) states that stunting health education using stunting smart card media has increased significantly. This study aims to see the effectiveness of health promotion in stunting prevention to improve the knowledge and attitudes of mothers of toddlers using BERDAZI media (smart and nutritious balls) in Sungai Baung village, Sarolangun Regency.

METHODS

This type of research is quantitative research with a pre-experimental research design, with a one group pretest-posttest research design. Sampling in this study used purposive sampling technique with a total sample of 32 people who met the inclusion criteria. Data analysis using the Wilcoxon test.

RESULTS AND DISCUSSION

RESULTS

Sei. Baung is the first health service located at Jl. Lintas Sumatra, Panti, Kec. Sarolangun, Sarolangun, Jambi. With zip code 37481. The sample in this study were 45 mothers of toddlers who were in the working area of the Sei. Baung, especially in Sungai Baung village. However, at the time of the research only 32 respondents were obtained.

Table 1. Age Frequency Distribution of Respondents in Sungai Baung Village, Sarolangun District

Age	Frequency	Percentage
24 years old	2	6.2
30 years old	1	3.1
32 years old	2	6.2
33 years old	1	3.1
34 years old	1	3.1
35 years old	4	12.5
36 years old	2	6.2
37 years old	1	3.1
38 years old	1	3.1
39 years old	3	9.4
40 years old	4	12.5
43 years old	3	9.4
44 years old	2	6.2
45 years old	3	9.4
46 years old	1	3.1
48 years old	1	3.1
Total	32	100%

Based on table 1, it is known that respondents are between 24 to 48 years old.

Table 2. Frequency Distribution of Gender of Respondents in Sungai Baung village, Sarolangun District

Gender	Frequency	Persentage
Female	32	100
Total	**32**	**100**

Table 3. Results of Analysis of Respondents' Knowledge and Attitudes About Stunting Prevention Before (Pre-Test) and After (Post-Test) Given Health Promotion Using BERDAZI Media (n = 32)

Varible	Treatment	Mean	Median	Std. Deviation
Stunting Preverention Knowledge	Pretest	6.28	6	1.085
	Posttest	9.59	10	.615
Stunting Preverention Attitude	Pretest	24.50	25	1.704
	Posttest	29.66	30	.602

Based on table 3, it can be seen that before being given health promotion using BERDAZI media about stunting prevention (Pre-Test) the mean value is 6.28 and after

being given health promotion using BERDAZI media about stunting prevention (Post-Test) the mean value increases to 9.59. It can be seen that after being given health promotion using BERDAZI media about stunting prevention, respondents' knowledge has increased by 3.31. This shows that health promotion using BERDAZI is effective in increasing knowledge of stunting prevention.

Based on table 3, it can be seen that before being given health promotion using BERDAZI media about stunting prevention (Pre-Test) the mean value is 24.50 and after being given health promotion using BERDAZI media about stunting prevention (Post-Test) the mean value increases to 29.66. It can be seen that after being given health promotion using BERDAZI media about stunting prevention, the respondents' attitudes have increased by 5.16. This shows that health promotion using BERDAZI is effective in increasing stunting prevention attitudes.

Table 4. Effectiveness of Health Promotion in Stunting Prevention to Increase Knowledge of Mothers of Toddlers Using BERDAZI (Smart and Nutritious Balls) Media in Sungai Baung Village, Sarolangun Regency

Ranks

		N	Mean Rank	Sum of Ranks
posttest – pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	32[b]	16.50	528.00
	Ties	0[c]		
	Total	32		

a. posttest < pretest

b. posttest > pretest

c. posttest = pretest

a. Negative Ranks or the difference (negative) between the results of the Effectiveness of Health Promotion in Stunting Prevention to Increase the Knowledge of Toddler Mothers Using BERDAZI Media (Smart and Nutritious Balls) in Sungai Baung Village, Sarolangun Regency for Pre-Test and Post-Test is 0, both in the N value, Mean Rank, and Sum Rank. This 0 value indicates no decrease (reduction) in knowledge from the Pre-Test value to the Post-Test value.

b. Positive Ranks or the difference (positive) between the results of the Effectiveness of Health Promotion in Stunting Prevention to Increase the Knowledge of Toddler Mothers Using BERDAZI (Smart and Nutritious Balls) Media in Sungai Baung Village, Sarolangun Regency for Pre-Test and Post-Test. Here there are 32 positive data (N), which means that 32 mothers of toddlers experienced an increase in the results of health promotion with BERDAZI to increase knowledge about stunting prevention in mothers of toddlers in Sungai Baung village, Sarolangun district from the Pre-Test value to the Post-Test value. Mean Rank or the average increase is 16.50 for knowledge, while the number of positive ranks or Sum of Ranks is 528.00 for knowledge.

c. Ties is the similarity of Pre-Test and Post-Test values, here the Ties value is 0, so it can be said that there are no equal values between Pre-Test and Post-Test.

Table 5. Effectiveness of Health Promotion in Stunting Prevention to Increase Attitudes of Mothers of Toddlers Using BERDAZI (Smart and Nutritious Balls) Media in Sungai Baung Village, Sarolangun Regency

Ranks

		N	Mean Rank	Sum of Ranks
posttest – pretest	Negative Ranks	0[a]	.00	.00
	Positive Ranks	32[b]	16.50	528.00
	Ties	0[c]		
	Total	32		

a. posttest < pretest

b. posttest > pretest

c. posttest = pretest

a. Negative Ranks or the difference (negative) between the results of the Effectiveness of Health Promotion in Stunting Prevention to

Improve the Attitude of Toddler Mothers Using BERDAZI Media (Smart and Nutritious Balls) in Sungai Baung Village, Sarolangun Regency for Pre-Test and Post-Test is 0, both in the N value, Mean Rank, and Sum Rank. This 0 value indicates no decrease (reduction) in attitude from the Pre-Test value to the Post-Test value.

b. Positive Ranks or the difference (positive) between the results of the Effectiveness of Health Promotion in Stunting Prevention to Improve the Attitude of Toddler Mothers Using BERDAZI Media (Smart and Nutritious Balls) in Sungai Baung Village, Sarolangun Regency for Pre-Test and Post-Test. Here there are 32 positive data (N) which means that the 32 mothers experienced an increase in the results of Health Promotion in Stunting Prevention to Improve the Attitude of Toddler Mothers Using BERDAZI Media (Smart and Nutritious Balls) in Sungai Baung Village, Sarolangun Regency from the Pre-Test value to the Post-Test value. The Mean Rank or average increase is 16.50 for attitude, while the number of positive ranks or Sum of Ranks is 528.00 for attitude.

c. Ties is the similarity of Pre-Test and Post-Test values, here the Ties value is 0, so it can be said that there are no equal values between Pre-Test and Post-Test.

DISCUSSION

3.2.1. Effectiveness of Health Promotion in Stunting Prevention to Increase Knowledge of Mothers of Toddlers Using BERDAZI (Smart and Nutritious Balls) Media in Sungai Baung Village, Sarolangun Regency

Based on the results of statistical tests using the Wilcoxon test, a significant value of p value = 0.000 <0.05 was obtained and it was known that the amount of increase between the pre-test and post-test on the respondents was 3.31. Based on these results it can be seen that with BERDAZI (Smart and Nutritious Balls) there is a significant increase in knowledge. In line with Syarifudin's research (2023) the results of statistical tests using the Wilcoxon test obtained ρ value = 0.000 <0,.05 which means that there is an effect of health education through modified quartet card game media on the level of knowledge about clean and healthy living behavior in students at SDN 1 Sukaraja Kuningan Regency.

This educational card media can help stimulate the sense of the eye (vision) during the educational process. This media has the advantage of being able to convey information in a more concrete way, rather than being conveyed without any tools in conveying information to children. The use of educational media is very helpful in the learning process. In addition to increasing motivation, educational media can also help improve students' understanding of the material presented (Khairuna et al., 2012)

Information provided with a simple approach through a game method with BERDAZI (Smart and Nutritious Balls) media also has an effect on respondents' knowledge in stunting prevention. The information sources delivered are packaged concisely and precisely. So that respondents can have broader knowledge based on the information conveyed.

Learning using the card emphasizes the mother's critical and creative thinking in solving questions according to what is on the BERDAZI card. BERDAZI (Smart and Nutritious Balls) media provides high capture power to respondents where cards stimulate the mother's sense of touch, sight and hearing because BERDAZI media is played with cards that can be held, read, heard and observed properly in understanding the concept of stunting prevention. Each mother was very focused in analyzing the card and her focus was always on the card she was holding.

3.2.2. Effectiveness of Health Promotion in Stunting Prevention to Increase Attitude of Mothers of Toddlers Using BERDAZI (Smart and Nutritious Balls) Media in Sungai Baung Village, Sarolangun Regency

Based on the results of statistical tests using the Wilcoxon test, a significant value of p value = 0.000 <0.05 was obtained and it was known that the amount of increase between the pre-test and post-test on the respondents was 5.16. Based on these results it can be seen that with interactive quiz media BERDAZI (Smart and Nutritious Balls) there is a significant increase in behavior. In line with Avissa's research (2023) the results of statistical tests using the Wilcoxon test obtained ρ value = 0.000 <0,.05 which means that there is an effectiveness of using Index Card Match media to increase the knowledge of fourth grade students about diarrhea at SDN 25 Koto Padang.

Attitude is a closed reaction from a person to a stimulus or object. Attitude is just a tendency to take action against an object in some way. So attitude is a person's views, opinions, responses or judgments and also feelings towards a stimulus or object accompanied by a tendency to act (Notoatmodjo, 2010).

The formation or factors that influence attitudes are personal experience, the influence of other people who are considered important, cultural influences, mass media, educational institutions, religion, and emotional factors. Attitude is a closed response in a person to a stimulus or object, and involves the opinion and emotional factors concerned (Azwar, 2012).

One of the factors that influence a person's attitude is knowledge. The knowledge that respondents have is the basis for determining attitudes. If the respondent's knowledge is good, the respondent's attitude will be positive, and vice versa, if the respondent's knowledge is poor, the respondent's attitude can also be negative (Nabillah, 2022).

After being given health education with healthy card media, almost all students experienced an increase in the average attitude score from before to after. This is because the use of healthy card media as educational media has an attractive design for the target age, namely at the age of growth and development where children are very active in moving and playing, cards are designed with attractive colors and images and by using simple language and games that do not take a long time so that children will not be bored.

CONCLUSION

The average score of stunting prevention knowledge is pre-test (6.28), post-test (9.59). The average results of stunting prevention attitudes are pre-test (24.50), post-test (29.66). There is a difference in the increase in knowledge scores and attitudes to prevent stunting in mothers of toddlers in Sungai Baung Village, Sarolangun Regency who are given health promotion through BERDAZI (Smart and Nutritious Balls) with a p value of 0.000 (p <0.05). Health Promotion with BERDAZI (Smart and Nutritious Balls) is effective in increasing knowledge and attitudes to prevent stunting in mothers of toddlers in Sungai Baung village.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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TRANSFORMATION OF HEALTH EDUCATION THROUGH AUDIOVISUAL MEDIA: ITS IMPACT ON FAMILY KNOWLEDGE IN SUPPORTING EXCLUSIVE BREASTFEEDING

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ABSTRAK

Background: *Breast milk is an important source of primary nutrition for infants as it contains complete nutrients and natural antibodies. Exclusive breastfeeding reduces infant morbidity and mortality, and provides long-term benefits for both mother and child. Economically, breastfeeding reduces household expenses because it does not require the cost of formula milk. However, exclusive breastfeeding coverage is still not optimal. WHO data for 2023 shows that global coverage has only reached 38%, Indonesia 55.5%, and Jambi Province 72.68%. In the Aur Duri Health Center working area, exclusive breastfeeding coverage in 2024 was only 51%, below the national target of 80%. One of the factors that influence the success of exclusive breastfeeding is family support. Increasing family knowledge can be done through video-based health education.*
Methods: *This research employed a quantitative method with a quasi-experimental design involving a pretest-posttest setup across two groups. A total of 62 participants were chosen through purposive sampling. Data were analyzed using the Wilcoxon test and the Mann-Whitney test.*
Results*: There was a significant increase in family knowledge scores after the educational video intervention, with a p=0.000 value. The average post-test score of the intervention group (8.61) was higher than the control group (7.16).*
Conclusion*: Delivering health education through video media has proven effective in enhancing family knowledge regarding support for exclusive breastfeeding within the Aur Duri Health Center service area.*

Keywords: *Exclusive breastfeeding, health education, video media, knowledge*

INTRODUCTION

Breast milk is a very important first food for newborns. Breast milk provides all the essential nutrients required for the optimal growth and development of infants, and has immune substances that protect babies from various diseases. Adequate and quality breastfeeding can help reduce morbidity and mortality rates, protect children from various infectious diseases, play a role in child growth and development, increase mother-child bonding and reduce the risk of maternal cancer. Optimal breastfeeding for children aged 0-23 months has the potential to save more than 820,000 children under the age of five each year. (WHO, 2020).

According to data from the World Health Organization (WHO) in 2020, the global exclusive breastfeeding rate has increased, but is still below the 50% target. In the 2015-2020 period, around 44% of infants aged 0-1 years received exclusive breastfeeding. This figure dropped to 38% in 2023, despite the global target of increasing exclusive breastfeeding to 50% by 2025 (Fitria, 2024).

Exclusive breastfeeding coverage in Indonesia in 2021 decreased to 56.9%, when compared to exclusive breastfeeding coverage in 2020, which was 66.06%. However, this achievement has exceeded the 2020 Strategic Plan (Renstra) target of 40% (Ministry of Health, 2021). Then, in 2022, the coverage of exclusively breastfed 6-month-old infants was

61.5% (Ministry of Health, 2022). However, in 2023, the figure decreased to 55.5%.

According to the Jambi province health profile in 2022, exclusive breastfeeding coverage in Jambi province was only 27.14%, which is still far from the target of 50%. However, in 2023, there was an increase of 74.14%, although it was still below the Sustainable Development Goals (SDGs) target of 80%. (Jambi Province Health Profile, 2023). Based on an initial survey conducted by researchers, the coverage of exclusive breastfeeding at the Aur Duri Health Center in 2024, only reached 51%, which is still far from the Jambi City achievement target of 85%.

In addition to its nutritional content and health benefits, breast milk also has economic advantages. In the midst of many Indonesians who are still in the middle to lower economic groups, breast milk is an economical choice to meet the nutritional needs of babies. Without the need for additional costs such as formula milk, breast milk can also reduce family expenses, including health costs. Fitriani & Wardani (2020) mentioned that exclusive breastfeeding supports household economic efficiency and the fulfillment of optimal nutrition, especially in families with financial limitations.

Several factors affect the success of exclusive breastfeeding, including the mother's knowledge, cultural myths or beliefs, the promotion of formula milk, and most significantly, the support provided by the family. To produce sufficient and quality breast milk, mothers need support from various parties. Support from others and those closest to them is very influential on the success of breastfeeding. This aligns with the findings of Lestari (2021), which indicate that a mother's ability to practice exclusive breastfeeding is greatly shaped by the support she receives from her family.

To increase family understanding of the importance of breastfeeding, one of the effective approaches that can be taken is through the delivery of appropriate health information. Audiovisual media is considered capable of conveying the content of messages in the media effectively to the audience (Rini, 2020). According to research conducted by Safitri et al,. in 2021, shows that education through video media has an effect on increasing the knowledge and attitude of mothers in providing exclusive breastfeeding. Video media has more effect on increasing knowledge and attitudes in counseling about exclusive breastfeeding compared to leaflet media (Maulida, 2020).

The educational video used in this study is a video made by presenting real images, thus providing a real and contextual picture of the importance of family support in exclusive breastfeeding. Respondents not only receive audio material, but also witness the important steps that need to be understood, so that information can be conveyed more thoroughly and effectively. (Yulyana, 2017). This study aims to determine the effectiveness of health education through audiovisual media on family knowledge in supporting exclusive breastfeeding.

METHODS

The target population of this study consisted of families of breastfeeding mothers who practiced exclusive breastfeeding within the Aur Duri Health Center's service area. The population of breastfeeding mothers in the area was 90 people. The sample size in this study was 31 people. Where, 31 for the intervention group and 31 for the control group. In this study, researchers used video media and instruments in the form of questionnaires. To measure the level of knowledge of respondents, a questionnaire consisting of 10 questions with true or false answer options was used.

The data used in this study included primary and secondary data. Primary data was obtained directly from respondents through

filling out questionnaires. Meanwhile, secondary data were obtained from various sources such as the Indonesian Ministry of Health, SKI, Jambi City Health Office, books,journals, literature, internet sites, previous research, and other related agencies.

The data in this study were analyzed univariately to see the characteristics and average knowledge before and after the intervention. Furthermore, bivariate analysis was carried out starting with a normality test to determine whether the data had a normal distribution or not. Based on the results of the normality test which showed that the data were not normally distributed ($p < 0.05$), the analysis of differences before and after the intervention using video media was carried out with the Wilcoxon Signed Ranks Test. To compare the control and intervention groups, a Mann-Whitney test was performed. Ethical approval for this study was granted by the Ethics Committee of the Jambi Ministry of Health Polytechnic under reference number LB.02.06/2/138/2025.

RESULTS AND DISCUSSION

3.1 Respondent Characteristics

Based on Table 1, the majority of respondents in the intervention and control groups were in the age range of 41-50 years, 35.5% and 38.7% respectively. In terms of gender, respondents were predominantly female in both groups, 71.0% in the intervention group and 74.2% in the control group. Based on education level, most respondents in both groups had a senior high school education (intervention: 45.2%, control: 41.9%). Meanwhile, the majority of respondents worked as housewives, 38.7% in the intervention group and 54.8% in the control group.

Respondents in this study consisted of family members of breastfeeding mothers, namely husbands, parents, in-laws and relatives.

Tabel 1. Distribution of Respondent Characteristics

Characteristics	Intervention		Control	
	n	%	n	%
Age				
21-30 years	3	9.7	6	19.4
31-40 years	8	25.8	4	12.9
41-50 years	11	35.5	12	38.7
51-60 years	9	29.0	9	29.0
Total	31	100	31	100
Gender				
Male	9	29.0	8	25.8
Female	22	71.0	23	74.2
Total	31	100	31	100
Education				
Primary School	4	12.9	5	16.1
Junior High School	7	22.6	11	35.5
Senior High School	14	45.2	13	41.9
Bachelor's Degree	6	19.4	2	6.5
Total	31	100	31	100
Occupation				
Unemployed	5	16.1	3	9.7
Housewife	12	38.7	17	54.8
Laborer	3	9.7	4	12.9
Trader	1	3.2	3	9.7
Private Employee	7	22.6	2	6.5
Civil Servant	1	3.2	2	6.5
Others	2	6.5	-	-
Total	31	100	31	100

Most of the respondents in this study were from the 41-50 years' age group, which reflects a population that is in the middle adulthood stage, where individuals generally have experience in caring for children and play an important role in the family structure. According to Darmayanthi and Lestari (2019), individuals in the middle adult phase have generally completed childcare responsibilities and have more mature emotional readiness in supporting family members. Fibriyana (2018) asserts that family support is closely related to increasing mothers' self-efficacy in breastfeeding, where family members are more experienced. The middle adult phase, generally has more life experience and an important role in the family, so it can provide significant practical and emotional support to breastfeeding mothers (Arsil et al., 2023).

The gender of the respondents is also an important factor that can influence the success

of health education and exclusive breastfeeding practices. In this study, the majority of respondents were female. This condition reflects that women still have a central role in terms of childcare and decision making related to breastfeeding. The dominance of women in the respondent group shows that women not only act as primary caregivers, but also as a source of emotional and practical support for breastfeeding mothers. This is in line with research conducted by Mariska (2022), which states that family support, especially from women in the household such as mothers or in-laws, has a major influence on mothers' decisions to provide exclusive breastfeeding. This support includes providing motivation, assistance in caring for the baby, and creating an environment that supports mothers to continue breastfeeding. Therefore, the presence of women as a major part of the family support network is an important factor in the success of the exclusive breastfeeding program.

Most of the respondents had a high school education, 45.2% in the intervention group and 41.9% in the control group. The level of education plays a role in influencing an individual's ability to absorb information. The higher the level of education, the broader the mindset and perspective in responding to various things around him. Education is an important factor in the formation of health behavior because the higher a person's education, the easier it is for them to accept new innovations or knowledge, including the importance of exclusive breastfeeding (Notoatmodjo, 2012). Research by Royaningsih and Wahyuningsih (2020) showed that the level of family education affects support in exclusive breastfeeding, where higher education tends to increase understanding and support for breastfeeding practices.

Most respondents worked as housewives, 38.7% in the intervention group and 54.8% in the control group. The presence of physically available family members at home is very important in assisting mothers in the breastfeeding process, both in terms of technical assistance and psychological support. Such support reflects the active involvement of husbands and family members in accompanying mothers during the breastfeeding period, thus contributing to the success of exclusive breastfeeding in infants aged 0-6 months (Laras et al., 2025).

3.2 Overview of Knowledge Before and After Education in the Control and Intervention Groups

Table 2. Overview of Family Knowledge Regarding Support for Exclusive Breastfeeding

Variable	Intervention Group (n-31)			Control Group (n-31)			P-Value
Knowledge	Mean	SD	Min - Max	Mean	SD	Min-Max	
Pre-Test	5.87	1.204	3-8	5.29	0.902	3-7	0,000
Post-Test	8.61	0.844	7-10	7.16	0.735	5-9	0,000

Based on the table above, the mean score of family knowledge about exclusive breastfeeding in the intervention group increased from 5.87 to 8.61, with the standard deviation decreasing from 1.204 to 0.844 and the score range from 3-8 to 7-10. In the control group, the score also increased from 5.29 to 7.16, with a decrease in standard deviation from 0.902 to 0.735 and a range of scores from 3-7 to 5-9. Although there was an increase, the result was still lower than the intervention group.

Family Knowledge After the intervention, the Wilcoxon test results showed a significant increase in the family knowledge score in the intervention group, with a p value = 0.000. In contrast, in the control group that did not receive the video intervention, there was also an increase, although the increase was not as high as the intervention group.

The results of this study are in line with Safitri's research (2021), which shows that breastfeeding education through video media significantly affects the increase in mothers' knowledge and attitudes about exclusive breastfeeding. The results of research from Fazira & Sari (2023) also state that the use of

educational videos is effective in increasing the knowledge of pregnant women about lactation management. Strengthened again by research by Damayanti et al. (2023) corroborated that educational videos on exclusive breastfeeding were able to significantly increase maternal knowledge in the working area of UPTD Puskesmas Krueng Sabee.

This difference in knowledge improvement shows that education through video media is more effective than leaflets in increasing family knowledge related to support for exclusive breastfeeding, although both provide an increase in knowledge. This is because according to Notoatmodjo, 2018 leaflets also have the advantage of presenting information in the form of sentences that are short, concise, easy to understand, and equipped with pictures that attract the attention of readers. However, health education delivered through video media not only involves the respondent's sense of hearing, but also utilizes the important role of the sense of sight in strengthening memory of the material provided (Muslim et.al, 2023).

According to Notoadmodjo, the more senses used to receive information, the clearer the message delivered (Mariati et.al, 2017). Delivery of education through audiovisual media has been shown to be more effective in increasing cadre knowledge compared to the use of E-leaflet media (Kurniasari et al., 2023). Thus, the use of video media that involves two main senses (vision and hearing) is more effective in increasing understanding and knowledge.

A person's knowledge can be influenced by various factors, including personal experience, level of education, verbal instructions or directions from others, type of work, age, and information obtained through various media (Muslim et al., 2023). Family knowledge about the importance of exclusive breastfeeding greatly influences behavior in providing support to breastfeeding mothers. When family members understand the benefits of breast milk for infants, as well as the long-term effects of not providing exclusive breastfeeding, the tendency to be actively involved in supporting the breastfeeding process will increase. In line with research conducted by Sari (2021), it was revealed that the increase in family knowledge, especially husbands and mothers of breastfeeding mothers, was directly proportional to the success of mothers in providing exclusive breastfeeding for the first six months of the baby's life.

Conversely, mothers who do not receive adequate support from their husbands, mothers, or other family members tend to switch to formula feeding more easily due to pressure or influence from the environment (Proverawati, 2019). Lack of support from the family can have an impact on maternal behavior (Wardiah et al., 2021). Research at Puskesmas Sumur Batu, Bandar Lampung, found that mothers who did not receive family support generally had a low level of self-efficacy in breastfeeding, thus affecting the success of exclusive breastfeeding (Anggraini, & Kartiningsih, 2020).

Research conducted by Wahyuni (2022) in Puskesmas Mamajang, Makassar City, confirmed that knowledge and family support play a crucial role in improving breastfeeding self-efficacy, especially in primiparous mothers. Sufficient knowledge helps mothers to be better prepared to face various challenges during the breastfeeding process, while family support provides emotional strength that strengthens the mother's confidence in carrying out her role as a breastfeeding mother. (Aniarti et al., 2025). Thus, the role of the family is very important in supporting the success of exclusive breastfeeding (Mirawat, 2021).

3.3 Effect of Health Education Using Audiovisual Video Media

Table 3. Effect of Health Education Using Audio Visual Video Media

Variable	Group		Mean	Min	Max	(Δ) Mean	*P Value*
Knowledge	Intervention	Post-Test	8.61	7	10	1,45	0,000
	Kontrol	Post-Test	7.16	5	9		

Based on the table, the average post-test knowledge score in the intervention group (8.61) is higher than the control group (7.16), with a difference of 1.45 points.

Table 4. Knowledge Score Improvement

Variable	Mean Rank		P-value
	Intervention Group	Control Group	
Increase in Knowledge Score	**43.58**	**19.42**	**0,000**

According to the results of the Mann-Whitney test, a significant difference was observed between the intervention and control groups in terms of increased knowledge and attitude scores, indicated by a p-value of 0.000. The average rank score for knowledge in the intervention group was substantially higher at 43.58, compared to 19.42 in the control group. These results indicate that education using video media has proven to be more effective in increasing family knowledge in supporting exclusive breastfeeding. This finding aligns with the study conducted by Meidiana et al. (2018), which demonstrated that video-based education can enhance knowledge and attitudes because it engages two primary sensory pathways—visual and auditory.

The improvement in knowledge confirms the effectiveness of video media, as it stimulates both the visual and auditory senses. This is consistent with the opinion of Heri (2009), who stated that audiovisual media is effective in enhancing understanding, with vision playing a central role in the information absorption process. Additionally, the study by Fadilah et al. (2020) showed changes in knowledge and attitudes about waste disposal before and after the intervention using educational video media (Uptd & Singaraja, 2024).

Videos fall under the category of audiovisual media as they can depict real-life situations related to the conveyed information, which generates a strong impact (Lasmini et al., 2022). The use of video media as a tool to disseminate the outcomes of innovations enables the integration of visual and audio elements, and can be developed in various formats, such as combining face-to-face communication with group communication, or integrating text, sound, and music (Nurwahidah et al., 2024). The use of a blended approach, including video screening, can strengthen understanding and more effectively enhance participants' knowledge (Rahmawati, 2024).

Daryanto, in his book *"*Learning Media", stated that video media is a highly effective tool in the learning process, as it clarifies complex information through the visualization of real situations or illustrations that reinforce understanding. In addition to accelerating the learning process, video media also contributes to increasing intelligence and encourages a shift in attitude from passive and static to more active and dynamic behavior (Lim et al., 2023). Video is considered an effective medium for delivering health education aimed at increasing knowledge.

Notoatmodjo (2010), in his book *"Health Promotion and Health Behavior"*, stated that knowledge serves as the first step in changing attitudes. It provides individuals with sufficient information to understand the reasons or benefits behind a particular action. With this knowledge, individuals are more likely to develop attitudes that support positive behavioral changes. Knowledge itself is the result of recognizing something through sensory experiences; for instance, when a person watches and listens to a video, their understanding of the information can improve (Fuad et al., 2017).

Family knowledge plays a significant role in the success of exclusive breastfeeding. Mothers of breastfeeding women, mothers-in-law, older sisters, or other family members considered experienced in breastfeeding often serve as references in making decisions about breastfeeding. Rangkuti (2022) explained that many mothers begin giving foods other than breast milk to infants aged 0–6 months due to influence or recommendations from family

members. Therefore, the importance of exclusive breastfeeding for six months needs to be conveyed not only to mothers with infants but also to their family members, so they can provide the necessary support to the mother in practicing exclusive breastfeeding for the full six months (Rangkuti, 2022). Emotional support from husbands and family is a key factor in the success of exclusive breastfeeding, as it provides motivational encouragement to mothers during the breastfeeding process. This support contributes to increased breast milk production, longer duration of exclusive breastfeeding, and influences the mother's decision to continue breastfeeding (Nugraheni, 2024).

Based on the research findings, there was an increase in knowledge after providing education through audiovisual video media. This indicates that each element in this study is interconnected and mutually influential. Advances in information technology, particularly in the use of audiovisual media, have significantly contributed to the growing public demand for easily accessible and understandable information. The ease of internet access also supports the public in obtaining information in various formats, including text and video. In line with previous studies, the results of this research demonstrate that video media is not only effective in enhancing knowledge but also plays an important role in shaping positive family attitudes in supporting exclusive breastfeeding.

CONCLUSION

Health education delivered through audiovisual media has proven to be effective in increasing family knowledge regarding support for exclusive breastfeeding in the working area of Puskesmas Aur Duri, Jambi City. This is evidenced by a significant increase in the average knowledge score from 5.87 in the pre-test to 8.61 in the post-test, along with statistical test results showing a significant difference between the intervention and control groups ($p = 0.000$), with the mean rank of the intervention group (43.58) being higher than that of the control group (19.42).

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CONFLICT OF INTEREST

All authors declare that there are no conflicts of interest.

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DEVELOPMENT OF A SAFETY RISK MODEL FOR OFFSHORE HELICOPTER OPERATIONS IN CRITICAL PHASES THROUGH A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Background: *Offshore helicopter operations are essential for the oil and gas industry, particularly for transporting personnel and supplies to offshore platforms. However, the critical phases of flight—approach, landing, and take-off—contribute to over 60% of helicopter-related aviation accidents worldwide. In Indonesia, these risks are amplified by extreme weather conditions, poor helideck infrastructure, pilot fatigue, and inconsistent regulatory enforcement. An effective, context-specific risk management model is therefore urgently needed.*
Method: *This study applies a Systematic Literature Review (SLR) approach to examine current research on risk management in offshore helicopter operations. A total of 38 relevant articles were selected from databases including Scopus, Web of Science, and Google Scholar. Thematic synthesis was used to extract insights related to risk factors, mitigation strategies, and modeling approaches.*
Result: *The review identified four major risk factors: adverse weather, helideck design flaws, human error, and pilot fatigue. Effective mitigation strategies include simulation-based pilot training, predictive technologies, UAV-based inspections, and compliance with international safety standards. Despite these advancements, challenges such as limited infrastructure, lack of standardization, and enforcement gaps remain, particularly in Indonesia. Modeling in this context refers to the use of analytical frameworks such as STPA, Bayesian Networks, SWARA-CoCoSo, and FMEA-BWM to represent, simulate, and prioritize safety risks.*
Conclusion: *This study proposes a predictive, data-driven risk model that combines international best practices with Indonesia's operational realities. The model aims to improve offshore aviation safety by enabling proactive decision-making, supporting policy development, and strengthening flight safety standards across critical phases.*

Keywords*: Offshore helicopter operations, aviation safety, critical phases of flight, risk management model, systematic literature review, predictive modeling, Indonesia, helideck safety, pilot training, weather-related risks.*

INTRODUCTION

Offshore helicopter operations play a vital role in supporting oil and gas industry activities, particularly in the transportation of personnel and logistics to offshore platforms. However, the critical phases of flight—such as approach, landing, and take-off—account for more than 60% of aviation accident incidents (Zhang et al., 2023). Countries like Norway and the United Kingdom have developed risk management models based on predictive technology and real-time data to reduce the risk of accidents. In Norway, the use of predictive analytics has succeeded in reducing risk by up to 40% (Hauge et al., 2021).

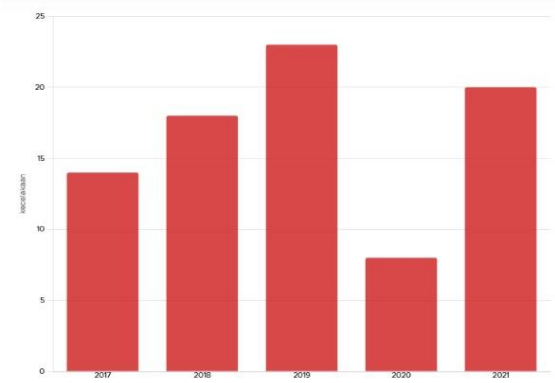


Figure 1. Airtraffic accidents in 2017 - 2022
https://data.goodstats.id/statistic/jumlah-kecelakaan-pesawat-sepanjang-periode-2017-2021-M07OR

Furthermore, in the European Union, the European Union Aviation Safety Agency

(EASA) has issued a series of stringent regulations governing helicopter safety. These include mandatory safety audits, the use of technology-based simulation for pilot training, and risk analysis at each stage of operations (EASA, 2022). In the United Kingdom, the British Helicopter Association (BHA) has also introduced a collaborative approach between helicopter operators and safety authorities to ensure that every helicopter mission—especially those involving offshore operations—is conducted with maximum safety standards (BHA, 2021).

Between 2017 and 2021, a total of 83 aircraft accidents occurred worldwide. According to data from the Aviation Safety Network, the highest number of incidents occurred in 2019, with 23 recorded accidents. These accidents resulted in 289 fatalities. The number of aircraft accidents over the five-year period fluctuated. A significant decrease was seen in 2020, with only 8 incidents, although the number of fatalities excluding ground casualties still reached 137. Looking at fatalities per year, the lowest number occurred in 2017, with 14 accidents resulting in only 59 deaths. In contrast, 2018 saw the highest number of fatalities, reaching 561.

In Indonesia, the Minister of Transportation Regulation PM 83 of 2017 has established operational standards for critical phases, but its implementation still faces technical and administrative challenges. According to the National Transportation Safety Committee (KNKT) report, from 2019 to 2023 there were 118 recorded aviation incidents, consisting of accidents and serious incidents, many of which occurred during critical phases of flight.

Airlines such as PT. P and PT. T face significant challenges during these phases, ranging from extreme weather conditions, non-standard helideck designs, pilot fatigue, to limitations in monitoring technology. Data-driven approaches and simulation-based training have become crucial for enhancing safety.

With the development of a more structured and collaborative risk management model, it is expected that a safer and more reliable offshore aviation system can be established in Indonesia.

PT. P faces significant challenges in offshore flight operations due to geographical conditions and extreme weather in remote areas such as Natuna and the Java Sea. Severe weather conditions such as strong winds, tropical storms, and low visibility are major causes of flight disruptions, with 40% of incidents linked to extreme weather (Peterson et al., 2023).

These challenges are further exacerbated by the suboptimal integration of real-time weather modeling technologies in operations, leading pilots to often make decisions based on inaccurate information.

Safety issues also arise from the condition of helidecks on several offshore platforms that do not meet international standards. Slippery surfaces, limited size, and poor lighting increase the risks during landing and take-off. The incident involving a PT. P helicopter skidding on a wet helideck in East Kalimantan in 2020 serves as a clear example of the need for improved helideck design and maintenance (Wood et al., 2023).

PT. T, which operates with a higher flight volume, faces risks related to pilot fatigue and human error during critical phases of flight. Around 30% of incidents involving PT. T are attributed to human error (Hauge et al., 2021), highlighting the importance of simulation-based training.

Although PT. T has implemented technologies such as weather radar and helicopter monitoring systems, the application remains uneven, particularly in remote locations (Chen et al., 2023).

Both airlines also encounter obstacles in implementing safety regulations, such as Regulation PM 83 of 2017, due to

administrative and technical barriers. The necessary solutions include data-driven analytical approaches for risk evaluation, more intensive crew training, and strong collaboration between operators, regulators, and technology providers.

With strategic investment in technology and training, PT. P and PT. T have the potential to become pioneers of offshore aviation safety in Indonesia.

METHODS

A Systematic Literature Review (SLR) is a comprehensive, structured, and methodical approach used to identify, evaluate, and synthesize the findings of existing research studies that are relevant to a clearly defined research question or topic. The main objective of an SLR is to minimize bias in the review process by following a transparent and replicable methodology. Unlike traditional or narrative literature reviews that tend to be more subjective and selective, SLRs are designed to be objective, rigorous, and focused on producing reliable and evidence-based conclusions. The process typically begins with the formulation of a specific and focused research question, often guided by frameworks such as PICO (Population, Intervention, Comparison, Outcome) or SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type), depending on the field of study.

After the research question is established, a review protocol is developed. This protocol includes important details such as the purpose of the review, the inclusion and exclusion criteria for selecting studies, the databases to be searched (e.g., Scopus, Web of Science, PubMed, Google Scholar), the keywords or search terms to be used, and the methods for screening and assessing the quality of the studies. A thorough and systematic search is then conducted to gather all relevant literature, including peer-reviewed journal articles, conference papers, reports, and sometimes grey literature such as theses and government documents. Each study retrieved is screened in stages, starting from the title and abstract, followed by a full-text review to determine its eligibility based on the established criteria.

Once the relevant studies are selected, they undergo a quality assessment using standardized tools or checklists (such as PRISMA or CASP) to ensure that the data synthesized is based on high-quality evidence. The next step is data extraction, where key information from each study—such as authorship, publication year, research design, sample characteristics, methods, and main findings—is systematically collected. The extracted data is then synthesized either qualitatively (e.g., through thematic analysis or narrative synthesis) or quantitatively (e.g., through meta-analysis, if applicable), depending on the type and consistency of the data.

Finally, the findings of the SLR are reported in a structured format, often following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. These reports typically include a flow diagram that outlines the study selection process, summary tables of included studies, and a comprehensive discussion of results, implications, limitations, and directions for future research. The systematic nature of this method ensures that the conclusions drawn are based on a complete and unbiased review of the existing literature. SLRs are widely used in fields such as medicine, psychology, education, business, and social sciences to inform practice, guide policy decisions, and identify research gaps for future studies.

RESULTS AND DISCUSSION

The offshore helicopter industry plays a crucial role in supporting oil and gas activities, particularly in remote and offshore locations. The critical phases of flight—

approach, landing, and take-off—are identified as the most hazardous, contributing to over 60% of aviation-related incidents (Zhang et al., 2023). Countries such as Norway and the United Kingdom have taken proactive measures using predictive models and real-time data to mitigate risks. In contrast, Indonesia faces persistent operational, environmental, and regulatory challenges including adverse weather conditions, limited infrastructure standards, and inconsistent enforcement of aviation regulations.

After narrowing down based on relevance, language, and publication year, 749 sources were shortlisted. Following further screening, 38 key articles were selected and synthesized thematically to extract insights on safety risks, mitigation strategies, and risk modeling in offshore helicopter operations.

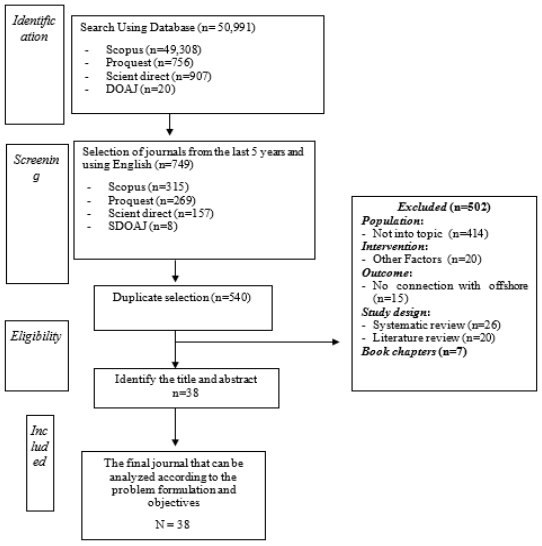


Figure 2. The stages of the Systematic Literature Review (SLR) process

This study utilized a Systematic Literature Review (SLR) approach, analyzing 50,991 records from Scopus, ProQuest, ScienceDirect, and DOAJ.

Among the prominent risks identified, environmental factors such as wind, fog, and storms dominate (Jin et al., 2020; Wang et al., 2022), alongside infrastructure limitations like inadequate helideck design and lighting (Wood et al., 2023). Human error, often caused by fatigue and limited situational awareness, remains a critical contributor to incidents (Hauge et al., 2021). Wang and Yan (2020) emphasize the integration of human factor variability into risk modeling frameworks to better understand operational hazards in sociotechnical systems.

In terms of modeling techniques, multiple studies highlight the application of System-Theoretic Process Analysis (STPA) for capturing system-software interactions (Svensson et al., 2022), and Bayesian Networks for dynamic, probabilistic modeling, particularly under conditions of uncertainty (Yang et al., 2021). The integration of fuzzy logic methods like SWARA-CoCoSo (Yousefi et al., 2021) and hybrid models such as FMEA with the Best-Worst Method (Karami et al., 2020) offer structured tools to prioritize risk factors where quantitative data may be limited or uncertain.

Key mitigation strategies discussed across the literature include simulation-based pilot training to reduce human error and improve decision-making under pressure (Ali et al., 2020; Østergaard et al., 2021), the use of UAVs for helideck and structural inspections (Mokhtari et al., 2022), and predictive maintenance systems employing AI for early fault detection and maintenance optimization (Chen et al., 2021). Health and Safety Management Systems (HSMS) are also promoted, particularly when they integrate organizational learning and stakeholder collaboration (Ghasemi et al., 2021).

Broader technological trends such as the use of drones (Beiranvand et al., 2021), artificial intelligence for operational decision support (Al-Hamed et al., 2022), and model-based safety analysis in LNG systems (Rahimi et al., 2022) suggest a move toward increasingly intelligent, autonomous safety infrastructures. Additionally, studies on resilience in emergency management (Johansen et al., 2021) and cybersecurity in maritime systems (Liu et al., 2020) reveal cross-sector

relevance that may inform offshore helicopter safety protocols.

This review provides a comprehensive understanding of how multiple risk factors converge in offshore aviation and how they can be addressed through strategic, evidence-based safety modeling. For Indonesia, adopting these global best practices—while considering local environmental, infrastructural, and regulatory conditions—is imperative. This includes establishing a nationally integrated safety framework involving predictive models, simulation training, regulatory enforcement, and stakeholder collaboration.

In conclusion, enhancing offshore helicopter safety requires a multidimensional approach that incorporates advanced risk modeling, human factors, and adaptive technologies. The review offers both theoretical and practical insights to guide the development of a robust safety risk model tailored to Indonesia's offshore operations. Future directions should explore the integration of AI-based forecasting tools, adaptive training systems, and real-time risk monitoring technologies to proactively manage the complexities of offshore aviation.

Key references include Zhang et al. (2023) on helicopter accident trends, Hauge et al. (2021) on predictive analytics, Wood et al. (2023) on infrastructure risk, STPA by Svensson et al. (2022), Bayesian networks by Yang et al. (2021), fuzzy risk prioritization by Yousefi et al. (2021) and Karami et al. (2020), UAV applications by Mokhtari et al. (2022), HSMS by Ghasemi et al. (2021), and human-AI interaction by Johansen et al. (2021).

CONCLUSION

The systematic review of 38 selected journal articles reveals that offshore helicopter operations are significantly influenced by a combination of extreme environmental conditions, inadequate infrastructure, human error, and limited integration of predictive technologies. The critical phases of flight—approach, landing, and take-off—are consistently identified as the most accident-prone, accounting for more than 60% of aviation-related incidents (Zhang et al., 2023).

Countries such as Norway and the United Kingdom have successfully implemented advanced, data-driven safety models including System-Theoretic Process Analysis (STPA), Bayesian Networks, and comprehensive simulation-based pilot training. Studies by Svensson et al. (2022) and Yang et al. (2021) highlight the utility of these modeling approaches in anticipating system failures under uncertainty. Complementary techniques such as fuzzy logic (SWARA-CoCoSo by Yousefi et al., 2021) and hybrid frameworks like FMEA-BWM (Karami et al., 2020) are proven effective in prioritizing risks where quantitative data is limited.

Mitigation strategies emphasized across the literature include simulation-based training (Ali et al., 2020; Østergaard et al., 2021), the use of UAVs for helideck and structural inspections (Mokhtari et al., 2022), and AI-based predictive maintenance (Chen et al., 2021). Moreover, the implementation of Health and Safety Management Systems (HSMS), particularly those emphasizing stakeholder collaboration and organizational learning, plays a pivotal role (Ghasemi et al., 2021).

Emerging technologies such as autonomous drones, AI-driven decision support, and model-based safety analysis are advancing the development of intelligent and autonomous safety systems. Cross-sectoral studies (Johansen et al., 2021; Liu et al., 2020) underline the relevance of organizational resilience and cybersecurity in offshore operations.

For Indonesia, the review recommends the adoption of a context-specific risk model that accounts for local environmental, infrastructural, and operational constraints. Strategic priorities should include standardized

simulation training, enhanced helideck compliance, real-time environmental monitoring, and integrated regulatory frameworks supported by multi-stakeholder collaboration.

In summary, the future of offshore helicopter safety lies in a multidimensional, proactive approach that integrates advanced risk modeling, adaptive training, and smart technologies. This review offers both theoretical insights and practical recommendations to guide the development of a robust, predictive safety risk model tailored to Indonesia's offshore aviation sector.

Based on the analysis of the selected journals through the Systematic Literature Review (SLR), it is evident that helicopter accidents in offshore operations are most frequently associated with the approach and landing phases, with a lesser but still significant number occurring during take-off. These phases represent the most critical segments of flight due to their operational complexity and the heightened interaction between environmental, technical, and human factors.

The approach phase is particularly hazardous as helicopters must navigate challenging weather conditions such as fog, low visibility, strong crosswinds, and turbulence, especially when nearing offshore platforms that may be in motion due to sea conditions. Pilots are required to make precise calculations and rapid decisions, often with limited spatial awareness and visual cues, increasing the likelihood of misjudgments or navigation errors.

During the landing phase, risks escalate further due to the need for precision in aligning with small, often moving helidecks on offshore platforms. Mechanical issues, such as rotor or landing gear failures, and operational miscommunication between the pilot and deck crew can lead to hard landings or accidents. Additionally, sea-induced motion of the platform and unpredictable gusts of wind can destabilize the aircraft just seconds before touchdown.

While the take-off phase is generally more controlled, it still presents safety challenges. Engine failure during the initial lift-off, improper weight distribution, and sudden changes in wind direction can compromise stability. However, pilots usually have slightly more room for corrective action compared to the critical timing required during landing.

In summary, the approach and landing phases are statistically and operationally the most accident-prone stages in offshore helicopter operations. The primary causes of accidents across these phases include severe environmental conditions, equipment malfunctions, and human errors—particularly in perception, communication, and decision-making. These findings highlight the need for targeted safety improvements, especially in flight procedures, pilot training, and helideck design, to enhance operational resilience and reduce accident rates in offshore environments.

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CONFLICT OF INTEREST

The author declares that this systematic literature review was conducted independently and is free from any conflict of interest. No financial, professional, or personal affiliations influenced the selection, analysis, or interpretation of the reviewed studies. All sources were objectively evaluated based on scientific merit and relevance to the research objectives, ensuring the integrity and impartiality of the findings presented in this study.

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DETERMINANTS OF ANEMIA OCCURRENCE IN FEMALE ADOLESCENTS IN HIGH SCHOOL IN MUARO JAMBI DISTRICT IN 2024

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ABSTRACT

Background: *Anemia in adolescent girls aged 15-24 years in Indonesia is one of the nutritional problems that need attention. The purpose of this study was to determine the factors associated with the incidence of anemia in adolescent girls*
Method: *This study used a cross-sectional design. It was conducted in September 2024 at Titian Teras High School, Muaro Jambi Regency, Jambi Province. The sample was 79 students in grades 10 and 11 aged 14-18 years. Sampling was carried out using the proportional sampling method, with the criteria, not menstruating when becoming a sample, not sick. This study used primary data through questionnaires, anemia status was measured using a portable Nessco Hb measuring instrument. Data was processed using a computer program. Data analysis was carried out using univariate and bivariate analysis with the chi-square test. to determine the significant relationship between the dependent variable (anemia status of adolescent girls) with the criteria of Hb levels <12 gr/dl) and the independent variables, namely knowledge, attitudes, and behavior of preventing anemia*
Result: *The results of the study showed that there was a significant relationship between knowledge, attitudes and behavior with the incidence of anemia with a p value = 0.000 (p < 0.05).*
Conclusion: *From the results of the study, there is a significant relationship between knowledge, attitudes and behavior towards the occurrence of anemia. It is expected that female adolescent students will always increase their knowledge about the causes of anemia, signs and symptoms and their impact on health and the need to increase iron intake and iron supplements to prevent anemia.*

Keywords: *knowledge, attitude, behavior, anemia*

INTRODUCTION

Adolescence is a transition between childhood and adulthood, at that time physical growth and reproductive maturation occur, so the need for nutritional intake is greater. According to WHO and the Indonesian Ministry of Health Number 25 of 2014, BKKBN (UNFPA) it is said that adolescents are aged 10-18 years. (Susanti and Erwani, 2020). Riskesdas data for adolescent girls aged 10-19 years have menstruated. The process of blood loss that occurs every month will cause a lot of red blood cells to come out, if the diet of adolescent girls is not considered, anemia will occur. The amount of physical activity, studying, at school also increases needs (Riskesdas Team 2018)

A teenage girl is said to have anemia if the hemoglobin (Hb) level is <12.0 g/dl. The function of Hb in the body is to carry oxygen throughout the body, if there is a lack of Hb, the function of sending oxygen throughout the body will be disrupted, so she will look tired, exhausted, and lethargic, impacting her productivity and creativity (Muthia, 2021)

Riskesdas Data, 2018 (Riskesdas Team 2018) The prevalence of anemia in Indonesia in 2013 was (37.1%), there was an increase to 48.9% in 2018, WHO's target in 2025 is to reduce the prevalence of anemia by half (50%) of the incidence of anemia in women of childbearing age (World Health Organization, 2017)

Various factors that cause anemia in adolescent girls are: lack of knowledge about anemia (Ahdiah, Heriyani and Istiana, 2018), Adolescent girls are less aware of anemia, its signs, effects, and how to prevent it (Astuti, 2023), adolescent girls do not know the types of foods that contain iron, especially animal foods such as liver, fish and meat (Linawati, Suhartini and ..., 2023) The cause of anemia is due to consumption of foods that do not contain iron (Tiaki, 2017) and consuming a lot of fast food, as a trigger for disrupted iron absorption, which can cause anemia (Ahdiah, Heriyani and Istiana, 2018)

Adolescent girls who experience anemia can have long-term impacts on reproductive health during pregnancy, difficult deliveries that do not go smoothly, the risk of giving birth to premature babies and low birth weight babies (LBW), so that it can interfere with growth, development and maternal and child mortality (Wahyudi and Gorontalo, 2023). Adolescent girls who suffer from anemia are more susceptible to stunting and will give birth to low birth weight babies (Ambado, 2022).

Implementation for anemia prevention includes paying attention to micronutrient-rich food intake, iron and folic acid supplementation (Amegah et al., 2019). (Ansari et al., 2021) Fortification of food ingredients by adding one or more nutrients (such as vitamins or minerals) to a food or beverage product to increase its nutritional content. (Sunarti, 2022), economic problems in society, not all teenagers can afford to buy and consume iron-rich foods because the price is relatively expensive, so they have to receive additional blood-boosting tablets to get iron (Jambi Provincial Health Office, 2022).

Giving iron tablets (TTD) is an effective way to overcome anemia problems. The purpose of giving TTD is to meet the iron intake of adolescent girls. Fulfilling iron intake as early as possible is expected to reduce the prevalence of anemia cases in pregnant women, minimize the incidence of bleeding during childbirth, prevent low birth weight, and reduce short toddlers (Fitriana and Dwi Pramardika, 2019)

This is also supported by the government through a program to provide iron supplements for young women as stated in the Regulation of the Minister of Health of the Republic of Indonesia No. 88 of 2014 concerning iron supplement standards for women of childbearing age and pregnant women11 and Circular Letter (SE) of the Ministry of Health of the Republic of Indonesia No. HK.03.03/V/0595/2016 concerning the Provision of iron tablets for young women and women of childbearing age. Iron supplement provision is generally carried out on junior high school (SMP)/equivalent and senior high school (SMA)/equivalent students (Amir and Djokosujono, 2019) and determines the day to take iron supplements on the same day and together (Tonasih, Rahmatika and Irawan, 2019).

The reasons given by adolescent girls for not taking/finishing the Fe tablets obtained from school include only taking them during menstruation (2.88%), forgetting (20.28%), unpleasant taste and smell (48.13%), side effects (7.11%), not having finished the dosage (0.57%), feeling it was not necessary (18.45%), and others (2.59%) (Ministry of Health of the Republic of Indonesia, 2018).

The implementation of TTD provision in the field has not gone well, including lack of knowledge, lack of socialization, lack of parental support, stakeholder collaboration, lack of teacher support, lack of facilities and infrastructure, including promotional media, TTD supplementation cards, leaflets, and brochures. (Ministry of Health of the Republic

of Indonesia, 2018) One of the efforts to improve knowledge, attitudes and behavior in preventing anemia and compliance of adolescent girls in consuming TTD is by providing health education. This study aims to determine the factors associated with the incidence of anemia in adolescents at SMA Titian Teras Muaro Jambi.

METHODS

This study used a cross-sectional design. It was conducted in September 2024 at Titian Teras High School, Muaro Jambi Regency, Jambi Province. The sample was 79 students in grades 10 and 11 aged 14-18 years. Sampling was carried out using the proportional sampling method, with the criteria, not menstruating when becoming a sample, not sick. This study used primary data through a questionnaire, anemia status was measured using an Hb measuring instrument, portable Nessco Data was processed using a computer program. Data analysis was carried out using univariate and bivariate analysis with the chi-square test. to determine the significant relationship between the dependent variable (anemia status of adolescent girls) with the criteria of Hb levels <12 gr / dl) and the independent variables, namely knowledge, attitudes, and behavior of preventing anemia. The instrument used was a questionnaire consisting of 10 questions tested for validity and reliability. Knowledge, attitudes, and behavior related to anemia are each said to be good if they have a score of ≥ 76%, and are said to be bad if they are <76%.

RESULTS AND DISCUSSION

RESULTS

3.1. The Relationship Between Knowledge of Adolescent Girls and The Incidence of Anemia At Titian Teras High School, Jambi City In 2024

The results of the analysis of knowledge variables with the incidence of anemia showed that as many as 48 respondents had poor knowledge, this can be seen from the adolescents who were anemic, there were 32 (66.7%) respondents, and there were 16 (33.3%) respondents who were not anemic. While good knowledge was 31 respondents, those who were not anemic were 26 (83.9%) and only 5 (16.1%) respondents were anemic. The p-value was 0.000 which means there is a significant relationship between knowledge and the incidence of anemia.

Table 1. Relationship between knowledge of adolescent girls and the incidence of anemia at Titian Teras High School, Jambi City in 2024

Knowledge	Kejadian Anemia				Total		*p value*
	Anemia		Tidak Anemia				
	f	%	f	%	n	%	
Kurang baik	32	66.7	16	33.3	48	100	0,000
Baik	5	16.1	26	83.9	31	100	
Total	37	46.8	42	53.2	79	100	

3.2. The Relationship between Attitudes of Adolescent Girls and the Incidence of Anemia at Titian Teras High School, Jambi City in 2024

Table 2. Relationship between attitudes of Adolescent girls and the incidence of anemia at Titian Teras High School, Jambi City in 2024

Attitude	Kejadian Anemia				Total		*p value*
	Anemia		Tidak Anemia				
	f	%	f	%	n	%	
Kurang baik	26	70.3	11	29.7	37	100	0,000
Baik	11	26.2	31	73.8	42	100	
Total	37	46.8	42	53.2	79	100	

The results of the analysis of the attitude variables of adolescent girls with the incidence of anemia showed that as many as 37 respondents had a bad attitude, this can be seen from the adolescent girls who were anemic, there were 26 (70.3%) respondents, and there were 11 (29.7%) respondents who were not anemic. However, there were 42 respondents

whose attitudes were good, there were 31 (73.8%) who were not anemic and only 11 (26.2%) respondents who were anemic. The results of the chi-square statistical test obtained a p value = 0.000 (p <0.05), this means that there is a significant relationship between the attitudes of adolescent girls and the incidence of anemia.

3.3. The Relationship Between The Behavior Of Adolescent Girls And The Incidence Of Anemia At Titian Teras High School, Jambi City In 2024

Table 3. Relationship Between Adolescent Girls' Behavior And The Incidence Of Anemia At Titian Teras High School, Jambi City In 2024

Behaviour	Kejadian Anemia				Total		*p value*
	Anemia		Tidak Anemia				
	f	%	f	%	n	%	
Kurang baik	26	76.5	8	23.5	34	100	
Baik	11	24.4	34	75.6	45	100	0,000
Total	37	46.8	42	46.0	79	100	

The results of the analysis of the attitude variables of adolescent girls with the incidence of anemia showed that as many as 34 respondents had bad behavior, this can be seen from 26 (76.5%) respondents, who had anemia, and there were 8 (23.5%) respondents who were not anemic. While good behavior was found in 45 respondents, who were not anemic 34 (75.6%) and only 11 (24.4%) respondents were anemic. The results of the chi-square statistical test obtained a p value = 0.000 (p <0.05), this means that there is a significant relationship between the behavior of adolescent girls and the incidence of anemia.

DISCUSSION

The results of the analysis show that there is a significant relationship between knowledge and the incidence of anemia. The results of this study are in line with research conducted by (Ahdiah, Heriyani and Istiana, 2018) that there is a relationship between knowledge and the incidence of anemia in female adolescents in grades X and XI at SMA Negeri 1 Polokarto, Sukoharjo Regency (ρ=0.03). Caturiyantiningtyas concluded that someone with less knowledge has a higher risk of developing anemia, this is due to the lack of information and lessons learned about anemia

From the analysis of attitude variables, there is a significant relationship between attitudes and the incidence of anemia, the study is supported by the results of the study (Ahdiah, Heriyani and Istiana, 2018). However, it is contrary to the research of Aryansih (2014) which states that there is no relationship between attitudes and the incidence of anemia in adolescents at the Yatama Mandiri Pallangga Islamic Boarding School, Gowa Regency, while the research of Caturiyantiningtiyas (2015) states that there is a relationship between attitudes and the incidence of anemia in adolescents at SMA Negeri 1 Polokarto, Sukoharjo Regency. Attitude is a response that is still closed to a stimulus or object (Izzara et al., 2023) but attitude will cause a person's tendency to act. Attitude is an encouragement that will be carried out by someone to lead to actions or practices directly consuming foods high in iron and drinking TTD which can increase hemoglobin levels, attitude is a factor that facilitates the formation of behavior to prevent anemia

The results of the analysis of behavioral variables show a significant relationship between behavior and the incidence of anemia. The study is in line with Caturiyantiningtiyas that there is a relationship between behavior and the incidence of anemia in female adolescents at SMA Negeri 1 Polokarto, Sukoharjo Regency. Good behavior in a high-iron diet, consuming TTD, avoiding consumption that inhibits iron absorption. Good behavior in female adolescents will reduce the risk of anemia.

CONCLUSION

The results of the study showed that there was a relationship between knowledge,

attitudes and behavior with the incidence of anemia. It is expected that female adolescent students will always increase their knowledge about the causes of anemia, signs and symptoms and their impact on health as well as the need to increase iron and iron supplement intake to prevent anemia.

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CONFLICT OF INTEREST

This study has no conflict of interest related to funding, including names in published articles, and the data collection process.

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THE EFFECT OF NUTRITIONAL INTAKE, DIET AND EXERCISE PATTERNS TO WORKERS' FITNESS IN OIL AND GAS COMPANY: A CASE STUDY

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ABSTRACT

Background: Poor health and fitness condition of field workers are suspected to be a triggering factor for fatalities caused by various noncommunicable diseases (NCDs) such as sudden heart attacks that have occurred several times in various oil companies in Indonesia. The purpose of this quantitative study is to determine the influence of nutritional intake, dietary patterns, and exercise habits on the health and fitness of workers.
Method: Data collection was conducted using 1 to 5 Likert scale questionnaires to 246 employees of PT. XYZ, an oil and gas company in Indonesia. This study used 22 manifest variables, 3 independent variables, and 1 dependent variable.
Results: Using the SEM AMOS version 22 and SPSS version 24, data processed resulted in 18 out of 22 manifests reflecting the latent variable, while 4 manifest variables did not reflect the latent variable, hence their exclusion.
Conclusion: This study indicated that diet, exercise patterns, and nutritional intake were mediating variables that had a statistically significant positive effect to the fitness of PT. XYZ employees. The implications of this research are to be a future reference for many researchers, as well as a quantitative basis for PT. XYZ to take corrective actions to improve their wellness program.

Keywords: Nutritional Intake, Dietary, Exercise, Workers Health, Structural Equation Modelling (SEM)

INTRODUCTION

In the last few decades, health and lifestyle has become a growing concern in various studies. According to the WHO, 60% of factors related to individual health and quality of life are correlated to lifestyle (Ziglio E. et al, 2004). Illnesses such as metabolic diseases, joint and skeletal problems, cardio-vascular diseases, hypertension, overweight, etc. can be caused by an unhealthy lifestyle (Farhud D., 2015).

Roth G.A., et al (2020) in their report paper, stated that CVD trends from 1990 to 2019 are increasing worldwide. Prevalent cases of total CVD nearly doubled from 271 million (95% UI: 257 to 285 million) in 1990 to 523 million (95% UI: 497 to 550 million) in 2019, and the number of CVD deaths steadily increased from 12.1 million (95% UI: 11.4 to 12.6 million) in 1990, reaching 18.6 million (95% UI: 17.1 to 19.7 million) in 2019 (Figure 1A). The global trends for DALYs and YLLs also increased significantly, and YLDs doubled from 17.7 million (95% UI: 12.9 to 22.5 million) to 34.4 million (95% UI: 24.9 to 43.6 million) over that period.

Based on data from the Institute for Health Metrics and Evaluation (IHME), deaths from heart or cardiovascular disease in Indonesia amounted to 251.09 per 100,000 people in 2019. This number also increased by 1.25% compared to the previous year which amounted to 247.99 deaths per 100,000 population. Additionally, *Survei Kesehatan Indonesia* Report 2023, a survey conducted by Ministry of Health, Republic of Indonesia found that every 5-years, the number of CVD cases increased drastically from 12.93 million cases in 2021 to 15.5 million cases in 2022. This upwards trend must be quickly anticipated, and the relationship between health and lifestyle must

be prioritized and intervened to improve health and fitness and to achieve a healthy life.

Considering that PT. XYZ's business engages in high-risk oil and gas operation that requires its workers to be healthy and fit in carrying out its high-risk operations, the company believes that these health issues are crucial to be resolved. Referring to company's data in 2023, approximately 60% of its workers were at risk of cardiovascular disease at the age of 40 - 58 years old. This reason led the company to feel obliged to make interventions by creating promotive and preventive activity programs, namely wellness programs, that focus in promoting healthy lifestyle to improving individual health and fitness.

In the last three years, wellness programs implemented by PT. XYZ focused on promoting exercise and diet to reduce CVD risk with various measurement indicators such as abdominal circumference, body weight, BMI, and blood lipid content. PT. XYZ's wellness program year after year has been satisfactorily in resolving these individual indicators, however, based on their reports, there are also individuals who were not successful in improving these indicators. Therefore, this study aims to find variables that have a significant effect to obtain empirical evidence in improving individual health based on 3 (three) factors: physical activity / sports, dietary, and nutritional intake. The results of this study are expected to provide useful insight for many companies in developing their employe health and fitness programs. Also, this study can be a future reference for other researchers concerned in health and lifestyle.

METHODS

The research model for this study is illustrated in Figure 1. To find out whether nutritional intake has a positive and significant effect on the health and fitness of workers, hypotheses were developed to explain the relationship between the variables, as shown by Table 1.

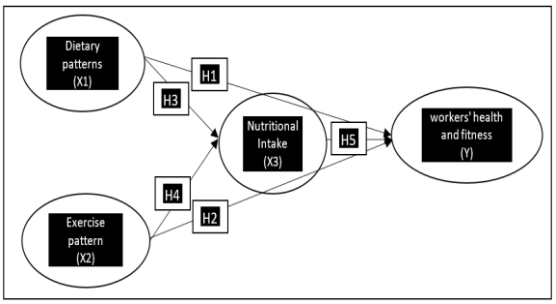


Figure 1. Research Conceptual Model

Table 1. Hypothesis Formulation

	Hipotesa
H1	Diet has a positive and significant relationship to the health and fitness of workers
H2	Exercise patterns have a positive and significant relationship to the health and fitness of workers.
H3	Diet has a positive and significant relationship to Nutrient Intake
H4	Exercise pattern has a positive and significant relationship with nutritional intake
H5	Nutritional intake has a positive and significant relationship with workers' health and fitness

The conceptual model in this study consists of 22 manifest variables grouped into 4 (four) latent variables, as follows:

- Dietary Patterns (4 factors):
  e1 : Food Serving Methods
  e2 : Knowledge
  e3 : Amount and Type of food
  e4 : Frequency
- Nutritional Intake (10 factors)
  e5 : Frequency
  e6 : Knowledge
  e7 : Food Serving Methods
  e8 : Nutrients
  e9 : Type of Food
  e10 : Facilities & Infrastructure
  e11 : Nutrition Counseling
  e12 : Nutrient content
  e13 : Nutritional status
  e14 : Motivation
- Exercise Pattern (4 factors)
  e15 : Exercise Intensity
  e16 : Knowledge
  e17 : Duration
  e18 : Frequency
- Worker's Health & Fitness (4 factors)
  e19 : Body Mass Index

e20 : Abdominal Circumference
e21 : Lipids
e22 : Medical Check Up Result

Questionnaires were distributed to collect the information needed to test the hypotheses. The target respondents were employees from various divisions that work daily following the work schedule set by PT. XYZ. The questionnaire contains a construction measurement model and 22 indicators grouped into four as previously described: Dietary Patterns (4 indicators), Nutritional Intake (10 indicators), Exercise Patterns (4 indicators), and Worker's Health and Fitness (4 indicators). The questionnaire uses a five-point Likert scale (ranging from strongly disagree to strongly agree) to indicate the level of agreement for each set of statements in this questionnaire.

To get as many respondents as possible, the questionnaire was distributed at one time during a management visit to the work site. Data from respondents were used for several statistical tests and analyses such as Confirmatory Factor Analysis, Validity and Reliability Test, and Structural Equation Model analysis using applications such as SEM AMOS and SPSS.

RESULTS AND DISCUSSION

RESULTS

The survey obtained 246 samples from 246 respondents, meaning all questionnaires returned to the researcher. Most respondents are male (80%), with an age distribution as follows: between 20-29 years old (25%); between 30-39 years old (36.5%); between 40-49 years old (30.5%); and 50 years and above about 8%. Furthermore, 2% of respondents have managerial positions, 40% are staff or middle management and 58% of the respondents are categorized as non-staff.

3.1. Confirmatory Factor Analysis

To test that the construct are consistent with a researcher's understanding of the nature of that construct, Confirmatory Factor Analysis was conducted. Four criteria were used in this study as summarized in Table 1. The first is RMSEA (Root Mean Square Error of Approximation). RMSEA is acceptable or good when the value is less than 0.080. The second is GFI (Goodness-of-Fit Index). GFI is acceptable or good when the value is greater than 0.900. A higher value indicates a better model fit. The third is RMR (root mean square residual). RMR is acceptable or good when the value is less than 0.050. The last criterion is CMIN/DF (Chi-Square Fit Index divided by Degrees of Freedom). CMIN/DF values in the range of 2 to 1 or 3 to 1 indicate an acceptable fit between the hypothetical model and the sample data. From table 1, the GFI value is greater than 0.900 so that the model has been fit and accepted.

Table 2. Goodness of Fit Results

Criteria	Cut Value	Value	Result
RMSEA	≤ 0.08	0,031	Good
GFI	≥ 0.90	0,930	Good
RMR	≤ 0.05	0,024	Good
CMIN/DF	$1 \leq X \leq 2$ or $1 \leq x \leq 3$	1,241	Good

Figure 2 shows the results of the SEM model of this study with a GFI >0.9 showing that this research model is good and consistent.

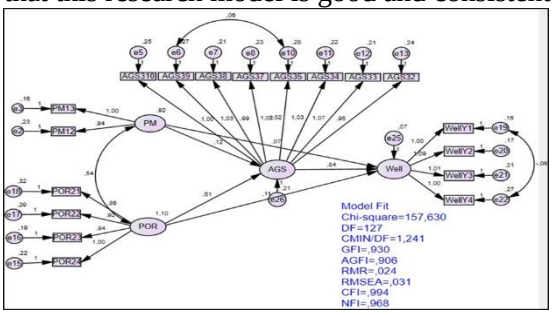


Figure 2. Confirmatory Factor Analysis for Research Concept Model

3.2. Validity and Reliability Test

To test the validity of questionnaire items, this study used standardized loading factor > 0.5. The results in the Table 2 shows that all items included in all variables are valid.

Table 3. Standardized Regression Weights

PM12	<---	PM	0.881
PM13	<---	PM	0.923
AGS310	<---	AGS	0.861
AGS39	<---	AGS	0.856
AGS38	<---	AGS	0.874
AGS37	<---	AGS	0.871
AGS35	<---	AGS	0.849
AGS34	<---	AGS	0.878
AGS33	<---	AGS	0.890

AGS32	<---	AGS	0.852
POR24	<---	POR	0.912
POR23	<---	POR	0.915
POR22	<---	POR	0.875
POR21	<---	POR	0.847
WellY1	<---	Well	0.913
WellY2	<---	Well	0.921
WellY3	<---	Well	0.890
WellY4	<---	Well	0.863
PM12	<---	PM	0.881
PM13	<---	PM	0.923

The internal reliability of the items is verified by the Average Variance Extracted (AVE) and Composite Reliability (CR) values. The literature suggests that the AVE value should be higher than 0.5 and the CR value should be higher than 0.7.

Table 4. Convergent Validity

Variabel Laten	AVE
Well	0.805
POR	0.788
AGS	0.751
PM	0.814

Tabel 5. Composite Reliability

Variabel Laten	CR
Well	0.999
PM	0.990
AGS	0.984
POR	0.943

Based on AVE and CR calculation results shown in table 3 and 4, all variables have an AVE value above 0.5 and CR above 0.7. This indicates that the construct is considered to have sufficient reliability. Additionally to examine the lower bound of the reliability of a construct, the Cronbach's Alpha value is measure using Statistical Package for the Social Sciences (SPSS), as presented in the following table:

Table 6. Cronbah's Alpha

Well	0.972
PM	0.974
AGS	0.972
POR	0.972

Ursachi et al (2015) states that if the Cronbach's Alpha value is <0.6 then the value is categorized as low; between 0.6 to 0.7 meaning the value is acceptable; and if > 0.80 then the reliability value is categorized very good. Likewise, Hassan et al (2019) state that if the Cronbach's Alpha value is <0.50 then the item can be eliminated; if <0.6, then the item can be improved; if 0.60 - 0.70, then the item is acceptable; if beetween 0.70 - 0.80 meaning good and acceptable; and lastly between 0.80 - 1.0 meaning the Cronbah's Alpha value is very good and consistent. Therefore, as this research has a Cronbah's Alpha value of higher than 0.60 to 0.70, data in Table 5 are categorized as very good and consistent.

3.3. Hypothesis Testing

The results of hypothesis testing are presented in table 6, with the following results:

1) Dietary Pattern has a positive and statistically significant effect on Workers' Health and Fitness (CR or critical ratio = 2.175, P < 0.05); thus hypothesis 1 is accepted;
2) Exercise Pattern has a positive and statistically significant effect on Workers' Health and Fitness (CR= 2.440, P < 0.05); thus hypothesis 2 is accepted;
3) Dietary Pattern (PM) has a positive and statistically significant effect on Balanced Nutrition Intake (AGS) (CR= 2.614, P < 0.05); so hypothesis 3 is accepted;
4) Exercise Pattern (POR) has a positive and statistically significant effect on Balanced Nutrition Intake (AGS) (CR= 12.604, P < 0.05), so hypothesis 4 is accepted; and
5) Nutritional Intake has a positive and statistically significant effect on Workers' Health and Fitness (CR= 12.613, P < 0.05), so hypothesis 5 is accepted.

Table 7. Hypotheses Testing Result

H	Std. Regression Weight	cr	P	Result
H1	0,076	2,175	0,030	Acc.
H2	0,135	2,440	0,015	Acc.
H3	0,134	2,614	0,009	Acc.
H4	0,759	12,604	***	Acc.
H5	0,793	12,163	***	Acc.

3.4. Sobel Test

Sobel test was carried out to test the significance of the mediation effect and to determine whether the relationship between

independent dependent variables has been significantly reduced after inclusion of the mediator variable. Haryono and Wardoyo (2013) and Haryono (2016) stated that there is an indirect effect if the standardized indirect effect's value of the independent variable on the dependent variable through the mediating variable is greater than the standardized direct effects value of the independent variable on the dependent variable.

Table 8. Standardized Direct Effects

	POR (X2)	PM (X1)
AGS (Z)	0.759	0.134
Well (Y)	0.135	0.076

Table 9. Standardized Indirect Effects

	POR (X2)	PM (X1)
AGS (Z)	0	0
Well (Y)	0.602	0.107

The Standardized Indirect Effects value of the PM / (X1) variable on variable Y through variable Z (0.107) > Standardized Direct Effects value of the PM / (X1) variable on Y / (Well) (0.076) concludes that there is an indirect effect, meaning that the PM / (X1) variable affects the Y / (Well) variable through the AGS / (Z) variable. Furthermore, Standardized Indirect Effects value of the POR/(X2) variable on the Y variable through the Z variable (0.602) > Standardized Direct Effects value of the PM/(X1) variable on Y/(Well) (0.135), concludes that there is an indirect effect, meaning that the POR/(X2) variable affects the Y/(Well) variable through the AGS/(Z) variable.

DISCUSSION

Based on the various statistical tests, the variables have a positive and significant influence on health and fitness. Hypothesis test one (1) has a probability value (P) of 0.030 <0.05 and a Critical Ratio (CR) value> 1.96 means that diet has a significant effect on worker's health and fitness. The results of this test support the opinions of (Dewi in Leviana S. and Agustina Y., 2024), (Hasrul et.al., 2019) and (Surijati et.al., 2021). However, indicators e1 and e4 were omitted from this study as they did not reflect dietary variables to support the influence of workers' health and fitness.

To test the second hypothesis, four (4) indicators have been prepared that can support the influence of exercise patterns on health and fitness where the results had a probability value (P) of 0.015 < 0.05 and a C.R. value 2.440 > 1.96 which shows that these indicators reflect exercise patterns to influence the health and fitness of workers. The results supports a previous research conducted by Juniarto M. et al, (2022). Likewise, the third hypothesis is that dietary pattern affect nutritional intake and indirectly affect the health and fitness of workers in the presence of nutritional intake variables. This result supports previous researches conducted by Putri R.V.I. and Rahman T.A. (2023), and (Aiyup A.R. et al, 2024) and (Nathaniel A., et.al., 2018).

Exercise patterns in this study also affect the need for nutritional intake and indirectly affect the health and fitness of workers with the latent variable of nutritional intake, this is evidenced by the probability value (P) *** < 0.05, meaning significant < 0.001 and the C.R. value of 2.440 > 1.96. These results support the previous researchers Yuliyanika H et al, (2024).

Lastly, the latent variable of nutritional intake shown by results in table 6 prove that this balanced nutritional intake can affect the health and fitness of workers, however, two indicators (e9 and e14) must be removed as they cannot reflect the latent variable of balanced nutritional intake. The results of this study on nutritional intake support the results of research conducted by Febriyanti A.R., et.al. (2021), but reject the findings of Pratama A.B. (2020) which states that nutritional status has no effect on the health and fitness of sailors as crew on board.

CONCLUSION

From the 22 manifest variables grouped into four latent variables, 2 variables were excluded as they did not reflect the dietary pattern variable: Food Serving Methods and Frequency; and 2 variables excluded because they did not reflect the nutritional intake variable: Type of Food and Motivation. However, it can be concluded that Dietary Patterns, Exercise Patterns and Nutritional Intake are proven to significantly influence the Health and Fitness of Workers.

Compared to the number of individuals invited to take part in this survey, the response rate or proportion of the respondent population in the study may not enough to represent overall population in PT. XYZ. Also, the determination of manifest variables or research indicators needs to be reviewed as, overall, indicators used in this study might not reflect latent variables or constructs. Both of those weaknesses can be improved by future researchers.

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CONFLICT OF INTEREST

Some of the authors are employees of PT. XYZ. These affiliations had no influence on the study design, data collection, analysis, or interpretation of the results.

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THE INFLUENCE OF THE SNAKES AND LADDERS GAME ON PREGNANT WOMEN'S KNOWLEDGE ABOUT STUNTING PREVENTION IN BETUNG ISLAND VILLAGE

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ABSTRACT

Background: *The World Health Organization (WHO) reports that the largest proportion of stunted toddlers comes from Asia, namely 58.7%. The results of the 2022 Indonesian Nutrition Status Survey (SSGI) show that 21.6% of toddlers are stunted in Indonesia. Stunting can cause stunted physical growth, mental development and health status in children. The impact of stunting can occur due to malnutrition during the first 1000 days of life (HPK). This research aims to determine the effect of playing snakes and ladders on pregnant women's knowledge about stunting prevention in Pulau Betung Village.*
Method: *Pre-experimental research method with one group pre test post test design. The population of pregnant women in Pulau Betung Village is 30 people. The sampling technique used was total sampling. The research was conducted from November to April 2023 using the Wilcoxon analysis test.*
Result: *The research results showed that all respondents experienced an increase in knowledge after playing snakes and ladders with a mean ranking of 15 and a p value of 0.000. The average knowledge of respondents before playing was 13.9. After playing snakes and ladders it increased to 17.7.*
Conclusion: *Statistically, it can be interpreted that stunting snakes and ladders influence pregnant women's knowledge about stunting prevention in Pulau Betung Village.*

Keywords: *Snakes and Ladders game, pregnant women, knowledge, stunting*

INTRODUCTION

Stunting is still a problem in Indonesia, including in Jambi Province. Based on the Indonesian Nutrition Status Report (SSGI), the prevalence of children under five years of age (toddlers) who experience stunting in Jambi Province is 22.4% in 2021 (Jambi Provincial Health Office, 2018:2).

Stunting in children is the impact of nutritional deficiencies during the first thousand days of life. This causes irreversible disruption to the child's physical development, resulting in a decline in the child's cognitive and motor skills and mental development (Hajijah, 2022:317). Stunting in toddlers needs special attention because it can cause delays in physical growth, mental development and health status in children. Recent studies show that children experiencing stunting are associated with poor school performance, low levels of education and low income as adults. Stunting conditions cause poor cognitive abilities, low productivity, and increased risk of disease resulting in long-term losses for the Indonesian economy (Setiawan et al, 2018:3).

Efforts to increase pregnant women's knowledge about stunting prevention are very necessary, considering that stunting will affect the child's intelligence level and health status as an adult. The consequences of malnutrition at 1000 HPK are permanent and difficult to repair (Paramashanti, Astria. 2021:81).

Counseling for pregnant women in pregnant women's classes is provided in order to increase knowledge about stunting and reduce stunting rates. The information that parents have received about stunting must be

digested and remembered by parents so that stunting prevention can be carried out (Rahmawati et al, 2019). Stunting can be prevented by improving the nutrition of pregnant women and by improving child rearing patterns (Pakpahan, 2021:246).

The role of health workers, especially midwives, is required to be able to provide MCH/KB services and women's health throughout their life cycle, both curative, preventive and promotive. One promotive effort that midwives can take to increase pregnant women's knowledge about preventing stunting is by implementing the snakes and ladders game in pregnant women's classes. The snakes and ladders game as a health promotion medium is an effective tool in providing information and is able to increase knowledge and attitudes (Widianti Lisda, 2020:3).

According to research conducted by Mulianigsih (2021:2), the snakes and ladders stunting game is an effective and fun way to provide health education to pregnant women. This game is a health education media created by the Ministry of Health of the Republic of Indonesia as an effort to prevent stunting in children. The process of receiving information using the snakes and ladders game will have a high intensity in perceiving information. When pregnant women play snakes and ladders, the senses used besides the eyes are the ears. All five senses are pathways for receiving information to the brain. The more senses used to convey information, the more information will be received and stored.

The prevalence of stunted toddlers in Batanghari district is 24.5%. One of the community health centers in Batanghari district is the Selat Community Health Center with reports of TB/U (short toddlers) weighing 40 people out of 1,063 toddlers with a percentage of 3.5%, which is a phenomenon that can lead to stunting (Batanghari Jambi Health Service, 2021:2). Betung Island Village is one of the working areas of the Selat Health Center which has a high incidence of stunting. Of the 40 stunted toddlers in the 8 working areas of the Selat Community Health Center, 7 people (17.5%) came from Pulau Betung Village.

Based on an initial survey conducted by researchers in November 2022 at the Selat Community Health Center using the FGD (focus group discussion) method during pregnancy class activities, it was found that out of 6 mothers there were 2 people (33%) who could mention preventing stunting and 4 people (Another 67%) do not know anything about preventing stunting, they have the principle that it is important to be healthy and rarely get sick and think that short children are hereditary.

Based on the above phenomenon, researchers will conduct research on the influence of the snakes and ladders game on pregnant women's knowledge about stunting prevention in Pulau Betung Village in 2023.

METHODS

The research method used in this research is pre-experiment with a One Group Pretest Posttest research design. The population of all pregnant women in Betung Island Village, Pemayung District, Batanghari Regency is 30 people. The sampling technique used was total sampling. The instrument used in this research was a validated questionnaire, to measure respondents' knowledge about stunting prevention before and after playing snakes and ladders. Data were analyzed using the Wilcoxon test.

The snakes and ladders used contain material regarding efforts to prevent stunting in accordance with Presidential Decree No. 42 of 2013. The snakes and ladders are the work of researchers which are made as interesting as possible so that respondents can more easily understand the information presented.

RESULTS AND DISCUSSION

RESULTS

1. Univariate Analysis

Table 1. Pretest Statistical Results

Knowledge	Amount	%
Good	8	26,7%
Enough	17	56,7%
Not Enough	5	16,7%
Total	30	100.0%

Table 2. Posttest Statistical Results

Knowledge	Amount	%
Good	28	93.3%
Enough	2	6,7%
Total	30	100.0%

2. Bivariate Analysis

a. Data Normality Results

Table 3. Normality Test Results

Variable	Mean	Test result
Pretest	0,029	Abnormal
Post Test	0,039	Abnormal

b. Wilcoxon Test Analysis of Knowledge

Tabel 4. Analysis of the Wilcoxon Test of Knowledge

Variable	Mean	Test result
Pretest	13,90	Abnormal
Post Test	17,73	Abnormal

DISCUSSION

Based on the results of this research, the majority of respondents had sufficient knowledge before playing stunting snakes and ladders. Respondents have insufficient knowledge because so far respondents have not received adequate information. This can be seen from the majority of respondents answering incorrectly on questions about frequency of prenatal check-ups with health workers, reasons for the importance of MP-ASI for babies after 6 months of age, and how to prevent stunting during pregnancy.

These results are in line with the results of research by Ika Sulistiyawati (2021:4), showing that some respondents had poor average knowledge about stunting prevention before intervention using snakes and ladders media, then their knowledge increased after being given intervention using stunting snakes and ladders media.

Based on the results of this research, before playing snakes and ladders, most respondents knew examples of clean and healthy living behavior such as washing their hands with soap and running water before eating, after defecating, after urinating and after traveling. However, only a small proportion of respondents knew about the frequency of pregnancy checks from health workers. This is because most respondents do not know the minimum standard for pregnancy frequency of 6 times (2 times at T1, 1 time at T2, and 2 times at T3). Respondents did not usually count the number of visits to health workers.

Stunting is a problem faced by Indonesian toddlers, including in Jambi Province, which is currently a priority for the government. Stunting in children is the impact of nutritional deficiencies during the first thousand days of life (1000 HPK). This causes irreversible disruption to the child's physical development, causing a decrease in cognitive and motor skills as well as a decrease in work performance (Setiawan et al, 2018:3). Therefore, stunting in toddlers needs special attention in preventing it. Stunting prevention can be done with appropriate health promotion methods.

The snakes and ladders game is a method of health promotion in small groups (Indunianingsih, 2021:39) which aims to provide information and be able to improve knowledge and attitudes (Sari, 2019:3).

According to Notoatmodjo (2018:44) knowledge is the result of knowing, which occurs after someone senses something. Someone who is exposed to information about a particular topic will have better knowledge than someone who is not exposed to information, as well as information about stunting prevention which is given to respondents through snakes and ladders media.

Mulianingsih (2021:6) in his research also stated that the snakes and ladders game has a high intensity in perceiving information. When

pregnant women play snakes and ladders, the senses used besides the eyes are the ears. All five senses are pathways for receiving information to the brain. The more senses used to convey information, the more information will be received and stored.

Pregnant women need to get information in the right way about preventing stunting so that pregnant women know what they should do and what they should avoid to prevent stunting, so that it can be applied in everyday life.

CONCLUSION

Pregnant Women's Knowledge About Stunting Prevention in Pulau Betung Village, Pemayung District, Batanghari Regency in 2023, before playing snakes and ladders, most respondents had sufficient knowledge with an average score of 13.9. Meanwhile, after playing snakes and ladders, most respondents had good category knowledge with an average score of 17.7. There is an influence of the Snakes and Ladders Game on Pregnant Women's Knowledge about Stunting Prevention in Pulau Betung Village, Pemayung District, Batanghari Regency in 2023. Suggestions were conveyed to the community health center and Pulau Betung village officials to carry out further education efforts using snakes and ladders stunting.

CONFLICT OF INTEREST

There is no conflict of interest in this manuscript.

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FAMILY EMPOWERMENT MODEL IN HANDLING STUNTING AND WASTING CHILD: A LITERATURE REVIEW

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ABSTRACT

Background: *Both stunting and wasting case, when occur in children leads into greater risk of morbidity and even mortality. Attempt to handle those case with empowerment in family setting were numerous and shows hindrance in several aspects. This study aimed to figure out which effort has the biggest impact with most effective way to address stunting and wasting in golden period.*
Method: *A literature search was conducted on electronic databases such as Scopus, ScienceDirect, ProQuest, and Google Scholar to identify relevant published articles from 2015, to 2025. Additional articles were identified from the reference lists and grey literature*
Result: *This review summarizes 4 empowerment domains with the greatest influence in handling stunting and wasting at the family level. Inherent socio-economic conditions and other family characteristics are indeed significant factors, but family empowerment in terms of increasing knowledge and skills, community support, complementary food availability and agricultural support are highlighted in most studies. Long-term and sustainable interventions were emphasized in determining the most appropriate approach.*
Conclusion: *Family empowerment is an important strategy in dealing with stunting and wasting in children. Optimizable functions of family in those features should be dealt with concern in family characteristics. High quality empowerment was significantly associated with a lower likelihood of childhood stunting and wasting. The findings suggest a need to incorporate targeted strategies for empowering family into child nutrition programs.*

Keywords: *stunting; wasting; family empowerment*

INTRODUCTION

Stunted children facing many potential barriers such as being vulnerable to disease (Muleta et al., 2021), having difficulty learning in school, being at risk of obesity (Scott et al., 2020), having lower incomes as adults, and being prevented from participating in their communities (Katoch, 2021). The severity of the condition causes 45% of children under five in the world to die from stunting each year (UNICEF et al., 2021). Whilst wasted children have weak immunity, are prone to long-term developmental delays and face an increased risk of death, especially in severely wasted children (Guesdon et al., 2021). The incidence of wasting is not as large as stunting, but it is still pesturbing because wasting contributes to 60% of deaths in children under five (Bailey et al., 2021). Stunting and wasting have risk factors from the womb to the postnatal period. Various risk factors and interactions develop over time, such as: poor food and feeding practices, disease infections, and environmental pollution. Both cases hinders children's potential with the consequences of increasing child mortality, exacerbating poverty, creating deep-rooted intergenerational losses and hampering the country's economic future (Chowdhury et al., 2020).

Consequences of stunting and wasting are similar, although the risk levels are different. Children who suffer from stunting have a risk of death 2.3-5.5 times higher than normal children (Song et al., 2021). Children with wasting have a risk of death 3.4-11.6 times higher than normal children, while children

who experience stunting and wasting simultaneously have a risk of death 12.3 times higher (Gayawan & Egbon, 2023). Stunting and wasting influence each other and have a negative impact on children's survival, so that preventive measures for complications and care for children with stunting and wasting are needed (Chowdhury et al., 2020; Myatt et al., 2018; Odei Obeng-Amoako et al., 2020).

Stunting mostly occurs between conception and the age of 24 months. In a comparative study, toddlers who experienced stunting at the age of 12 months had a 1.9 times greater chance of recovering their growth compared to toddlers who experienced stunting at the age of 6 months. The result stated that the older the toddler who experienced stunting, the greater the chance of recovering from stunting. This evidence indicates that malnutrition must be addressed as early as possible in children. Meanwhile, wasting is prone to occur in children aged 6 months-5 years because some are no longer breastfed. Nutritional improvements have a greater chance of recovery if carried out in the age period under 2 years (Odei et al., 2023).

Family affect nutritional status of toddlers, especially the role of the mother from before pregnancy to after childbirth (Eicher-Miller et al., 2023). The strongest influence of the family on health because the family acts as a provider of economic, social and psychological resources, tensions that can be a protector or threat to the health of family members. 80% of toddler deaths occur at home (with little or no contact with health workers)(Abera et al., 2019). Active participation of families and communities in caring for toddlers at home will ensure the survival of children, reduce morbidity and promote practices in order to improve child growth and development (Inbaraj et al., 2020). There is a relationship between the implementation of family roles and the incidence of malnutrition in toddlers. These things show the importance of interventions to increase family empowerment in improving the nutrition of stunted and wasted toddlers (Saleh et al., 2021).

Studies have identified that empowerment has a positive influence on child feeding practices and their growth and nutritional status (Ickes et al., 2018; Indanah et al., 2022; Na et al., 2015; Siddhanta & Chattopadhyay, 2017). Empowerment refers to a process that involves the ability to take charge of their own lives such as the power and control over decisions and issues that shape their lives and the lives of their children (Wassie et al., 2024). Many empowerment models have been implemented to overcome stunting and wasting in the family sphere. Each has its own constraints. Therefore, existing empowerment models need to be studied, and then adopted or combined so that they can have an impact on improving malnutrition in children. The aim of this literature review was to explore which empowerment model were most effective in overcoming stunting and wasting in children. Synthesis of the literature provides insight into this case, and guidance on developing strategies for improving nutrition in appropriate settings.

METHODS

A comprehensive literature search was conducted in the Sciencedirect, Scopus, Proquest, and Google Scholar scientific databases, from 2015 up to 2025, using the following search terms: “stunting”, “stunted”, “wasting”, “wasted” “family empowerment”, “effectiveness”. According to the eligibility criteria, the search has been restricted only to research studies, published last 10 years, investigating types and evaluation of family empowerment models application in the fight against stunting and wasting in childhood. Relevant literature was retrieved by the authors by looking through the references in original articles and reviews. The reference bibliographies of studies from such searches were thereafter hand-searched to identify additional eligible studies.

As presented in fig.1, from the conducted comprehensive literature search in the aforementioned scientific database, 348 articles were initially retrieved, while 29 additional studies were identified through manual search from reference lists. Of the initial 377 studies, 57 studies were excluded as duplicates. From the reaming 320 studies, titles and abstract were screened, and 126 were further excluded as irrelevant to the research aim underpinning the current review paper. Following a second criteria-based screening, from the reaming 194 full-text reviewed studies, 118 were excluded from the review, as the authors agreed that they did not provide accurate information concerning the under-search issue. The remaining 76 studies included in this study comprise 24 representative papers of family empowerment model on stunting, 12 studies of family empowerment model on wasting, and 40 studies reporting on empowerment effort on both cases.

Data Analysis

Each participating author independently evaluated the results of the literature search, extracted the most relevant knowledge, decided whether the search results were too diverse or too confusing to publish a comprehensive review of the area, and also authors checked the accuracy and completeness of the retrieved data, which were analyzed following a qualitative interpretation.

Ethical Statement

The authors would like to clarify that the present study, being a narrative literature review, and not epidemiological research conducted in human population, it was based on publicly available anonymized databases, and thus exempt from ethical compliance.

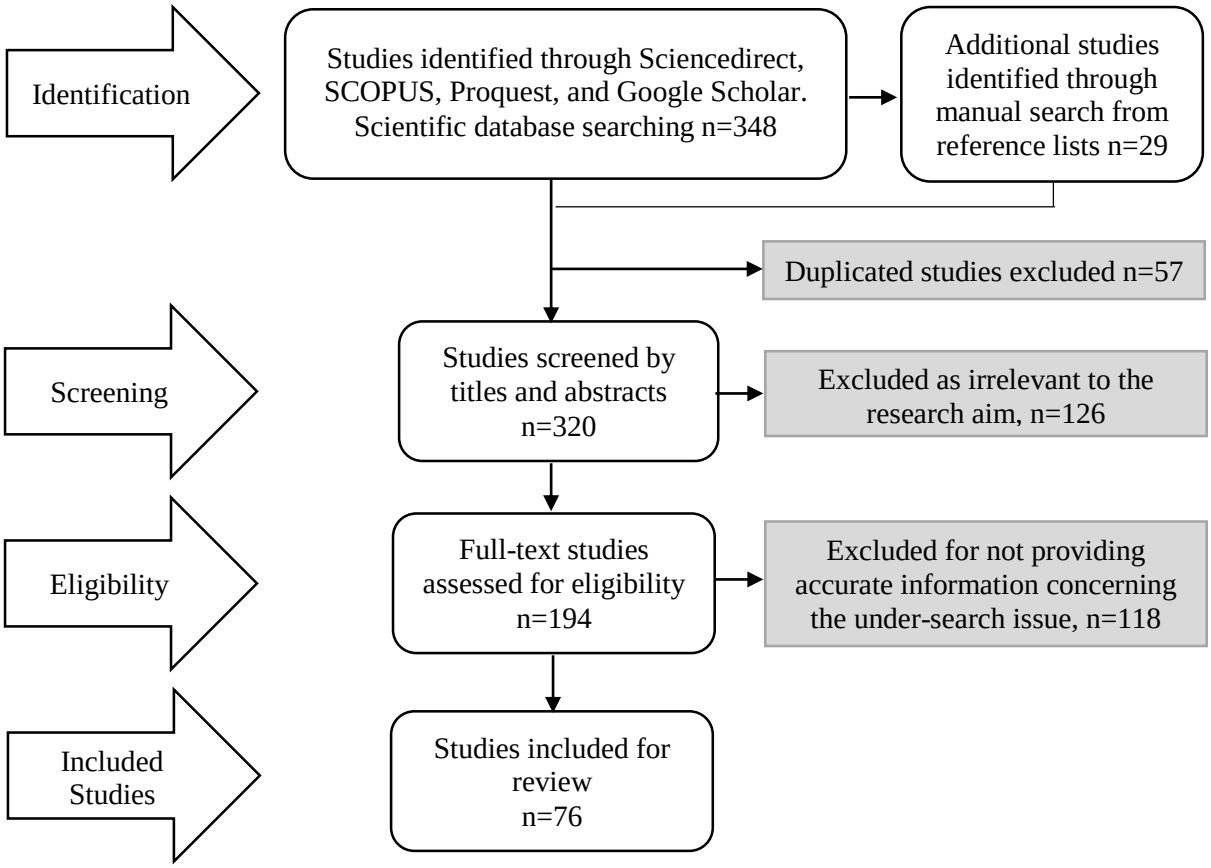


Figure 1. Flow diagram showing study selection process

Table 1. Summary of empowerment models for stunting and wasting

Type of empowerment	Country involved	Type of malnutrition	Outcome, Results
Improvin knowledge & skill	India, Indonesia, China, Rwanda, Africa, Ethiopia, Myanmar, Bangladesh, Sub-Saharan	Stunting (8 studies), wasting (6 studies), both stunting and wasting (15 studies)	Knowledge and ability to understand children's nutritional needs, nutritional value of food, food preparation, food processing, and feeding children, show a strong relationship with the incidence of stunting and wasting.
Community participation	Indonesia, Ghana, Afghanistan, Nepal, Sub-Saharan, African, Vietnam, China, Bolivia, Haiti, Malawi, Ethiopia	Stunting (10 studies), wasting (4 studies), both stunting and wasting (7 studies)	Involvement of the community by utillizing existing platforms, empowering community health workers, and implementing effective strategies, significantly reduce stunting and wasting rates in comunities
Provision of complementary food & supplement	Ethiopia, Burkina-Faso, Indonesia, Tanzania, Zambia, Uganda, Malawi, India, Colombia, China	Stunting (18 studies), wasting (5 studies), both stunting and wasting (28 studies)	Complementary food and supplements were effective in improving feeding practices and reducing child stunting, wasting, and anemia. Longer follow-ups to assess the effects on stunting and implementation of other effective interventions are needed to improve the nutritional status of children. Provision of complementary food program improved child growth patterns, with benefits, to health and diet.
Nutrition sensitive agriculture	Bangladesh, Africa, Vietnam, Kenya, Philipines, Malawi, Ethiopia, Uganda	Both stunting and wasting (14 studies)	This model improve child nutrition outcomes by ensuring food production, food access and agricultural income for nutrition-related expenditure.

RESULTS AND DISCUSSION

Efforts to improve nutrition in cases of stunting and wasting shown in table 1, all involve family participation. Family empowerment emphasizes the best opportunities in health care and child nutritional adequacy because of its high level of interaction (Escher et al., 2024). Families have a direct influence on children's nutritional status (Yani et al., 2023), therefore nutritional improvement interventions could be optimized (Tafese et al., 2020). Some studies only show treatment for one case, stunting or wasting, even though many children ultimately experience both in the development of their condition. The following are some programs that have the greatest impact on improving the nutritional status of stunted and wasted children.

Family empowerment by increasing knowledge and skills

Family is a collection of individuals who can cause or prevent health problems (Nursanti et al., 2021). A mother has a major role in the welfare of the family. Most women in the family are the primary caregivers for children including food preparation and storage, feeding, psychosocial care, and hygiene practices (Hastuti et al., 2024). This makes their empowerment can affect the nutritional status of their children. Limited influence of mothers in making decisions about caring for and fulfilling nutrition for children occurs due to the

influence of cultural factors. Poor parental food literacy and nutrition literacy increased the risk of household food insecurity and tendency for having stunted or/and wasted child (Hoteit et al., 2022). Empowering women and family through increasing knowledge and skills is meaningful in improving nutrition in stunted and wasted children (Jardí et al., 2021).

Community participation

Community involvement is crucial in addressing stunting and wasting by promoting awareness, enabling early detection, and supporting treatment efforts (Bailey et al., 2021). Community health workers, community groups, and platforms play a vital role in extending health and nutrition services, often serving as the first point of contact. By involving community members in planning and decision-making, programs can be tailored to local needs and ensure greater sustainability. By engaging communities in these multifaceted ways, stunting and wasting can be effectively addressed, leading to improved health outcomes for children (Ghodsi et al., 2021).

Provision of complementary food and supplements

Appropriate, adequate and timely nutrition during infancy and early childhood (between 0 and 2 years of age) constitutes a critical window of opportunity to ensure proper growth and development. Inadequate feeding in the first years of life could lead to malnutrition which has been shown to be associated with short-term adverse consequences such as retarded growth and increased child morbidity and mortality in addition to increased risk of adult Non-Communicable Diseases (NCD) (Cliffer et al., 2020). Complementary feeding is a critical step in child development, as it provides essential nutrients that breast milk alone cannot provide (Darcho et al., 2025). Studies have shown that complementary food and supplement can improve growth outcomes and reduce stunting and wasting in children (Ariyo et al., 2021). Provision of complementary or specialised nutritious food during pregnancy, the first six months of lactation, and for children up to two years of age, have proven to be more effective and holistic in targeting nutrient deficiencies in children (Kimere et al., 2022). Complementary feeding and supplementation should be part of a broader approach that includes nutrition education, health services, and addressing underlying causes of malnutrition. Interventions should be sustainable and culturally appropriate to ensure long-term benefits for children (Humphrey et al., 2019).

Empowering family with nutrition-sensitive agriculture

The agriculture sector can potentially play a crucial role in responding to the problem of undernutrition by directly addressing inadequate access to nutrient-rich food, which is a key underlying determinant of malnutrition (Sharma et al., 2021). Low and lower-middle-income countries (LMICs) depends on agriculture for their livelihoods. Nutrition sensitive agriculture, regarded as an effective approach, given the crucial role agriculture can play in the transition towards sustainable food systems and healthy diets, particularly in remote rural areas where market access to nutrient-rich food is limited (Ruel, 2019). This has been described as an inter-sectoral, multi-level food-based system approach intended to maximise agriculture's contribution to improved food security and nutrition (Di et al., 2022). It aims to narrow the gap between available and accessible food and the food needed for a healthy and balanced diet for all children. Agriculture interventions had positive effects on long-term out comes regarding dietary practices (food consumption, di etary diversity, and nutrient intake) and diseases (Wegmüller et al., 2022).

CONCLUSION

Many interventions have been implemented by various countries and regions

to address stunting and wasting through family empowerment. Integration of knowledge and skills, community participation, additional food and essential supplements, and strengthening of agricultural elements in the approach to addressing stunting and wasting must be considered.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest in this manuscript.

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CORRELATION OF NEUTROPHIL LYMPHOCYTE RATIO (NLR) AND PLATELET LYMPHOCYTE RATIO (PLR) IN CHILDREN WITH DENGUE HEMORRHAGIC FEVER (DHF) INFECTION IN NORTHERN KALIMANTAN

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ABSTRACT

Background: *Dengue fever is a viral infection transmitted to humans through the bite of an infected mosquito. This inflammation causes active immune cells such as neutrophils, lymphocytes, and platelets. When inflammation occurs, there will be a physiological response in the form of a decrease in the number of lymphocytes and an increase in the number of neutrophils. The ratio of neutrophils and lymphocytes is also called the Neutrophil Lymphocyte Ratio (NLR). This infection also causes a decrease in platelets and lymphocytes simultaneously. This can be worsening the patient's condition. The ratio of platelets and lymphocytes is also called Platelet lymphocyte ratio (PLR). NLR and PLR are important biomarkers of inflammation in supporting the diagnosis of DHF, allowing clinicians to immediately treat DHF cases, especially in children.*
Method: *This study used a retrospective observational study design with a cross sectional approach. The sampling technique used in this study was total sampling. The data collection technique in this study was observation of medical record data of DHF pediatric patients. To analyze the correlation between NLR and PLR in children with DHF infection, a correlation statistical test was used*
Result: *The results showed that the average value of NLR is 1,187 and PLR is 1536,74. And the results of this study also show a significant correlation between NLR and PLR with the correlation coefficient showing a strong positive correlation ($r > 0.70$, $p\text{-value} < 0.001$).*
Conclusion: *There is a significant correlation between NLR and PLR in children with dengue infection.*

Keywords: *DHF, NLR, PLR*

INTRODUCTION

Dengue fever (DHF) is a viral infection transmitted to humans through the bite of an infected mosquito. Dengue is widely found in tropical and subtropical climates around the world, mostly in urban and semi-urban areas. DHF can affect anyone including children. Children are at risk of DHF especially those under 15 years old because children often spend time at home playing, resting and living in a humid and unsanitary environment (Irma, 2023; Kemenkes RI, 2017; Sandra, dkk. 2019; WHO, 2023).

Dengue infection is often asymptomatic or only causes mild symptoms but the virus sometimes triggers more severe cases and even cause death. Dengue virus infection causes the release of inflammatory mediators such as cytokines (e.g., TNF-α, interleukin-6) and vasoactive factors. These pro-inflammatory cytokines could cause damage to capillary endothelial cells, resulting in increased vascular permeability. The increased of capillary permeability and in severe cases increased fluid and protein loss could trigger dengue shock syndrome (SSD), where blood flow decreases drastically resulting in significantly reduced blood volume, threatening oxygen supply to body tissues. When the immune response out of control, it leads to capillary leak syndrome and complications such as shock (Bhatt P Dkk, 2021; Cristina M, Padovani and Kingsley Yin.2024; Pongpayung, 2024; Solórzano Victor Edgar Fiestas, dkk,2021).

When dengue virus infects, there is a rapid activation of the innate and adaptive immune system. Immune cells such as macrophages will identify the virus and trigger the release of various signaling molecules such as cytokines and chemokines. In severe dengue infection, excessive release of cytokines, `known as "cytokine storm", can occur. This cytokine storm causes strong inflammation, and triggers blood vessel damage, increasing vascular permeability and causing plasma leakage (Marvianto, dkk., 2023; Navya PT, dkk.,2024).

This inflammation causes the activation of immune cells such as neutrophils, lymphocytes and platelets. Neutrophils play an important role in the initial response of identifying and eliminating pathogens. Lymphocytes function in modulating specific immune responses and increasing antibody production. During inflammation platelets will secrete substances that can attract neutrophils and lymphocytes to the site of inflammation. There fore causing interactions in the healing process and infection control (Navya PT, dkk.,2024; Tulk, S. E., & Conroy, A. L, 2019).

When inflammation occurs, there will be a physiological response in the form of a decrease in the number of lymphocytes and an increase in the number of neutrophils due to an imbalance in the inflammatory response. The ratio of neutrophils and lymphocytes is also called the Neutrophil Lymphocyte Ratio (NLR). This infection also causing a decrease in platelets and lymphocytes simultaneously. This could be worsen the patient's condition. The platelet and lymphocyte ratio is also called Platelet lymphocyte ratio (PLR) (Navya PT, dkk.,2024).

NLR and PLR are biomarkers of inflammation and prognostic markers in various diseases. In dengue, inflammation is caused by an excessive immune system response, where NLR has a role in identifying non-severe dengue cases. Whereas PLR shows effective accuracy in identifying severe cases. NLR is an active inflammatory component as well as lymphocytes as a regulatory and protective component (Solórzano Victor Edgar Fiestas, dkk, 2021).

NLR and PLR are important biomarkers of inflammation in supporting the diagnostic of dengue disease, are allowing the clinicians to immediately treat DHF cases, especially in children. To determine the number of NLR and PLR in the blood, routine hematology laboratory tests can be done (Hoffbrand, A dkk, 2016; Rodak, B. F, dkk. 2016; Navya PT, dkk.,2024).

The results of research by PT Navya et al in 2024 showed that the NLR and PLR can be used as biomarkers of inflammation and prognostic markers in various diseases. In dengue fever, inflammation occurs due to excessive immune system response, where NLR has a role in identifying cases of dengue fever that are not severe. While PLR shows effective accuracy in identifying severe cases. While research by Aisya Nailatul Ashma, et al in 2023 showed there was a significant positive correlation between NLR and hemocontrast in Dengue infection.

METHODS

This study used a retrospective observational study design with a cross sectional approach. The sampling technique used in this study was total sampling, where all respondents who met the inclusion and exclusion criteria. Inclusion criteria were pediatric patients aged 3 months - 14 years who had been diagnosed with DHF with NS1 (+) laboratory examination results, had complete examination data which included the number of neutrophils, lymphocytes, and platelets needed to calculate the NLR and PLR values. Exclusion criteria were no history of comorbid diseases, incomplete laboratory data, pediatric patients with DHF and positive tubex, and negative NS1 and laboratory results

with children who received immunosuppressant or corticosteroid therapy within 30 days before the study.

The data collection technique in this study was observation of medical record data of DHF pediatric patients. The data generated in this study were secondary data in the form of respondent characteristics data, NLR and PLR data. To analyze the correlation between NLR and PLR in children with DHF infection, the correlation statistical test was used. The results of the analysis will be presented in tables or graphs.

RESULTS AND DISCUSSION

The characteristics of respondents at the Nunukan Regency General Hospital, Tarakan City General Hospital, and Dr.H. Soemarno Sosroatmodjo Tanjung Selor Hospital were analyzed based on gender, age, Tourniquet test, and the presence of spontaneous bleeding. For age characteristics based on the data obtained, it is divided into 3 age groups of children, namely infants and toddlers <5 years, children 5-9 years and teenage 10-18 years.

An overview of the characteristics of respondents can be seen in the table below:

Table 1. Characteristics of respondents

Characteristics	Frequency	Percentage (%)
Gender		
Male	25	43,9%
Famele	32	56,1%
Age		
Infants and Toddlers (< 5 years)	8	14%
Children (5-9 Years)	29	50.9%
Teenegers (10-18 Years)	20	35,1%
Tourniquet Test		
Positive	100	100%
Spontaneous Bleeding		
Negative	45	78,9%
Positive	12	21,1%

The table above is showing the characteristics of respondents based on gender show that more women (56.1%) suffered from DHF than men (43.9%). In this study, the age characteristics were dominated by children (50.9%). The table above also shows that all respondents in pediatric DHF patients had positive tourniquet test results indicating fragile blood vessel wall permeability (the presence of petechiae or small red spots on the skin in the area where tourniquet pressure is applied, usually in the amount of more than 10 petechiae per square inch. These petechiae indicate capillary fragility and increased vascular wall permeability). As for the characteristic of spontaneous bleeding, only 21.1% of respondents showed positive results, which means that most respondents did not experience spontaneous bleeding despite indications of capillary fragility.

3.1. Overview of NLR and PLR in children with dengue infection

Table 1. Overview of NLR and PLR in children with dengue infection

Variable	n	Mean	Min	Max	Std. Deviation
NLR	57	1,187	0,08	8,51	1,388
PLR	57	1536,74	150,00	9367,09	1381,272

Based on the table above, it can be seen that the average value of NLR is 1,187 and the average PLR is 1536,74.

3.2 Correlation between NLR and PLR in children with dengue infection

Table 2. Correlation of NLR and PLR in children with dengue infection

Variable	n	Coefficient of correlation	P value
NLR	57	0,741	< 0,001
PLR	57		

The results showed a significant correlation between NLR and PLR with the correlation coefficient (r) showing a strong positive correlation ($r > 0.70$, p-value < 0.001). The p-value <0.001 indicates that the correlation between NLR and PLR is highly statistically significant, meaning that it is almost certain that the correlation does not occur by chance. The correlation between NLR and PLR in children with DHF infection is very important in the severity of dengue virus infection and its impact on the immune system.

DHF infection affects the number of blood cells in the body, including neutrophils, lymphocytes and platelets. These changes consistently affect the NLR and PLR values. This study is in line with research conducted by PT Navya et al, (2024). In a study conducted by PT Navya, et al on 99 DHF patients who were treated, had similarities in the average results with a range of minimum to maximum values. So the conclusion is that an increase in NLR followed by an increase in PLR indicates a significant inflammatory response in pediatric patients with dengue infection, where an increase in neutrophils and a decrease in lymphocytes and platelets contribute to changes in the value of these two parameters. Thus, NLR and PLR could be potential indicators in assessing the severity of inflammation in children with dengue infection.

This study found a close correlation between NLR and PLR values in children with DHF infection. This correlation can be explained by the pathophysiological mechanism of DHF which is characterized by tourniquet test (+) and spontaneous bleeding in children with DHF, immune dysregulation and significant changes in hematological parameters during the disease phase. NLR is an inflammatory parameter that reflects the balance between innate (neutrophils) and adaptive (lymphocytes) immune responses. Elevated NLR in children with DHF indicates a significant systemic inflammatory response due to dengue virus infection.

Meanwhile, high NLR reflects the interaction between thrombocytopenia and lymphocytosis, which is often found in DHF patients due to increased platelet destruction and release of proinflammatory cytokines. This study shows that the increase in NLR is directly proportional to the severity of dengue infection, where high NLR values are often found in patients with higher severity, such as dengue with dengue shock syndrome (DSS). Similarly, a significant increase in PLR reflects disturbances in hemostasis and immune hyperactivity that may contribute to the worsening of the patient's condition.

These two ratios are important indicators in monitoring the severity of dengue infection in children (Solorzano Victor Edgar Fiestas, 2021). So monitoring NLR and PLR can help in assessing the progressivity of DHF in children, especially in predicting the risk of worsening conditions and simple biomarkers in decision making related to patient management.

CONCLUSION

Based on the results of study conducted at the Nunukan Regency General Hospital, Tarakan City General Hospital, and Dr. H. Soemarno Sosroatmodjo Tanjung Selor Hospital, regarding the correlation between NLR and PLR in children with DHF infection, it can be concluded that the average NLR in children with DHF infection is 1.187 and the average PLR in children with DHF infection is 1536.74. There is a significant correlation between NLR and PLR in children with dengue infection with $r > 0.70$ and p-value < 0.001.

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CONFLICT OF INTEREST

The author declares there is no conflict of interest

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THE EFFECT OF MOBILE TRIGGERING METHOD ON MOSQUITO NEST ERADICATION BEHAVIOR

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ABSTRACT

Background: *Dengue hemorrhagic fever (DHF) occurs every year and takes its toll. People are not motivated and have not made PSN a culture. The problems encountered are how the process of developing, the feasibility, the stages, and the impact of the mosquito nest eradication educational model have on the knowledge, attitudes, and behaviors of the community. The purpose of this development is to produce an educational model "Triggering PSN Mobile," while the specific objectives are to describe the development process, determine feasibility, describe the stages, and find out the effect of the educational model for eradicating mosquito nests on the knowledge, attitudes, and behavior of the community.*
Method: *This research method is quantitative research with a research and development (R&D) design. This research uses a one-group pretest and posttest design. The focus of this study is to test the effectiveness of the educational model with the PSN reminder application in increasing the culture of eradicating mosquito nests in the city of Jambi. The variables studied include knowledge, attitudes, and behavior*
Result: *The results of this study resulted in the PSN Mobile Triggering educational model, which is a field triggering model followed by Android-based triggering, which has been declared feasible after going through the validation stages of 100% health promotion experts, 94.55% IT experts, 92% educational technology experts, and 80 practitioners. % and 93.85% one-on-one trials, 95% small group trials, and 96% large group trials. The PSN Mobile Triggering Product is effective in increasing the knowledge, attitude, and behavior of the jumantik rumah to 100% in the implementation of mosquito nest eradication*
Conclusion: *The conclusion obtained is that the educational model is feasible and effective to use to increase the knowledge, attitude, and behavior of Jumantik Rumah in carrying out the eradication of mosquito nests.*

Keywords: *Eradication of mosquito breeding grounds, triggering education, Android- based application, Dengue Hemorrhagic Fever (DHF)*

INTRODUCTION

Cases of dengue fever (DBD) in Jambi City are still high, where in 2024, Jambi City experienced a significant spike in the number of cases of Dengue Fever (DBD). The Jambi City Health Office recorded more than 600 cases of DBD until the end of December 2024, with one death.

The increase in the number of cases is compared to 2023, which recorded 312 cases with seven deaths. The spike in dengue cases in 2024 was mainly influenced by the rainy season which increased the population of Aedes aegypti mosquitoes, as well as low public awareness in carrying out Mosquito Nest Eradication (PSN)

Alam Barajo District in Jambi City experienced the highest number of Dengue Hemorrhagic Fever (DHF) cases. Data from the Rawasari Health Center and Kenali Besar Health Center showed that in 2023, Rawasari Health Center recorded 28 DHF cases, while Kenali Besar Health Center recorded 40 cases. The total number of DHF cases in Alam Barajo reached 68, with two of them resulting in death. In addition, in January 2024, the Jambi City Health Office reported 56 DHF cases (News, 2025).

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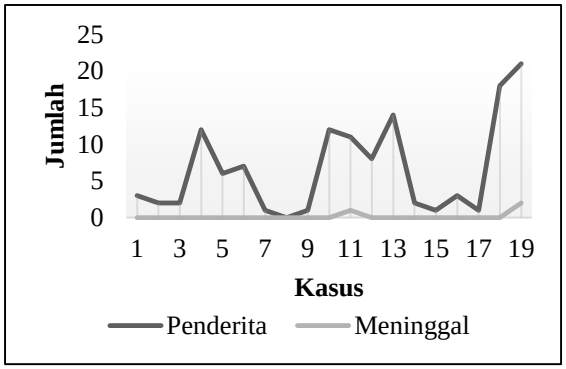


Figure 1. Dengue Haemorraghic Fever (DHF) Cases

The highest number of DHF cases can be seen in graph 1.1 in the Rawasari Health Center Work Area with a total of 21 cases, 2 of which died, while graph 1.2 shows that the highest number of cases is in Mayang Mangurai sub-district with a total of 17 cases and 1 of which died. The highest number of DHF cases in Mayang Mangurai sub-district is in RT 40 with 3 DHF cases.

Efforts to reduce DHF are not carried out in full PSN activities, PSN is not carried out allegedly because the community is not motivated to carry out PSN (Anandika, 2020), therefore in this study the researcher used a triggering method which was combined with mobile devices to arouse community behavior in carrying out PSN. PSN (Chandra, 2023).

METHODS

The statistical test in this study is the McNemar hypothesis test used to test the research hypothesis with a one group pretest-posttest design with the measurement scale of both variables being categorical.

Data were analyzed using univariate and bivariate methods. Univariate data analysis was conducted to determine the PSN culture in house mosquito larvae control. Bivariate analysis was conducted to determine the differences between before and after PSN triggering education was given.

The N-Gain Score test is carried out by calculating the difference between the pretest and posttest values or the gain score, based on these results, the effectiveness of implementing a particular method can be known. N-Gain is the last stage to determine the effectiveness of using Educational Products in improving the behavior of Jumantik Rumah N-Gain Results of respondents.

RESULTS AND DISCUSSION

RESULTS

Table 1. Respondent Behavior Results

	Number of Respondents answered correctly		
	≤ 10	11 - 20	≥ 21
Drain the water reservoir at least once a week	√	-	-
Closing the water tank	√	-	-
Folding used items such as used buckets and used cans	√	-	-
Add abate powder to the water tank that cannot be brushed properly once every two months.	√	-	-
Monitor all water containers or those that can hold water once a week	√	-	-
Installing wire mesh on air vents	√	-	-
Don't leave dirty clothes hanging behind the door	√	-	-
Keeping larva-eating fish	√	-	-
Spraying insecticide or using mosquito coils or using mosquito nets when sleeping or using long-sleeved clothes or mosquito repellent lotion regularly	√	-	-
Do not litter/recycle plastic, ceramics, cans etc. which have the potential to contain used water carelessly.	√	-	-

From the results of the questionnaire with a rating scale of 0 to 10, it is known that before the intervention, the jumantik had an average

attitude score of 1.57 with the lowest score of 0 and the highest score of 6. After the intervention, the average jumantik behavior score was 10, where all had the highest score, namely 10.

From the results of the Wilcoxon statistical test, a Probability value (P-Value) of 0.00 was obtained, which means that at 5% alpha there was a difference in the average behavioral scores of mosquito larvae before and after the intervention.

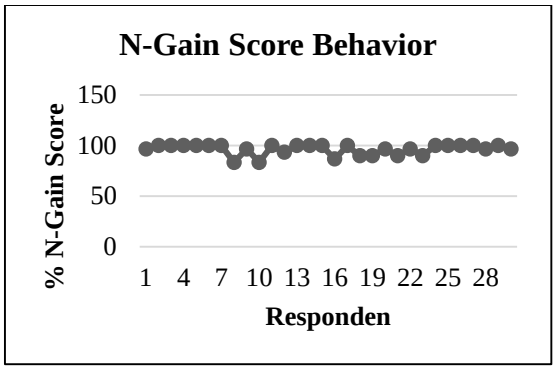


Figure 2. N-Gain Score Behavior

Based on the results of the N-Gain score test calculation, it shows that the average value of the N-Gain score on house mosquito larvae that were given health education using the PSN education model was 96.22 or 96.22%, this value is included in the effective category. With a minimum N-Gain score of 83.33% and a maximum of 100%. Based on the average N-Gain percentage results, it can be concluded that the PSN education model product is effective in improving the Behavior of House Mosquitoes

Based on the pre-test results, less than 10 respondents answered 10 questions correctly, the rest answered incorrectly.

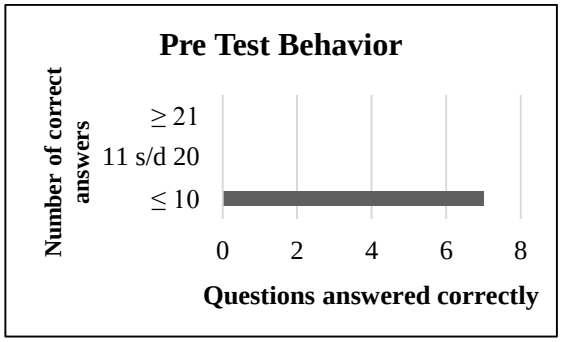


Figure 2. Pre Test Behavior

From the graph image 4.25, the Behavioral Results data obtained from all the respondents' correct answers during the pre-test were below 10 points, whereas after the post-test, all the answers were answered correctly by the respondents as can be seen from the graph image 4.26 below:

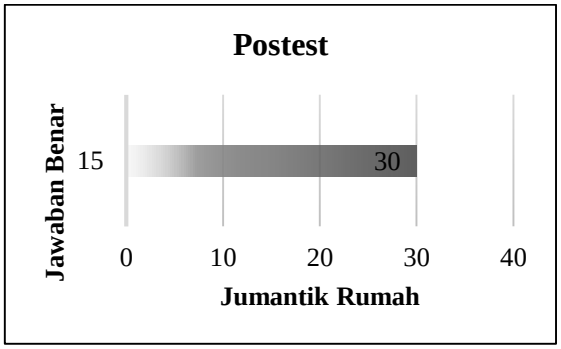


Figure 4. Pre Test Behavior

Based on the table above, it is known that the behavioral components of home Jumantik before and after the intervention experienced an increase, which can be seen in Graph 4.27.

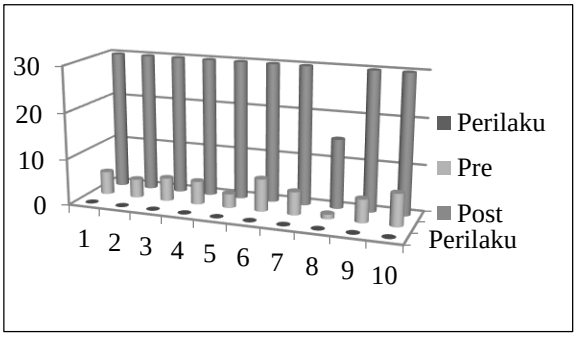


Figure 5. Respondents Behavior

The graph shows an increase in behavior before and after the intervention using the Mosquito Nest Eradication (PSN) education model. The worst behavior before the intervention was not keeping fish that eat larvae, which was 3.33% and the highest was installing wire mesh on air vents (23.33%), after the intervention all behaviors increased by 100% except keeping fish that eat larvae (50%).

Based on the results of the N-Gain score test calculation, it shows that the average value of the N-Gain score on house mosquito larvae that were given health education using the PSN education model was 96.22 or 96.22%, this value is included in the effective category. With

a minimum N-Gain score of 83.33% and a maximum of 100%. Based on the average N-Gain percentage results, it can be concluded that the PSN education model product is effective in improving the Behavior of House Mosquitoes

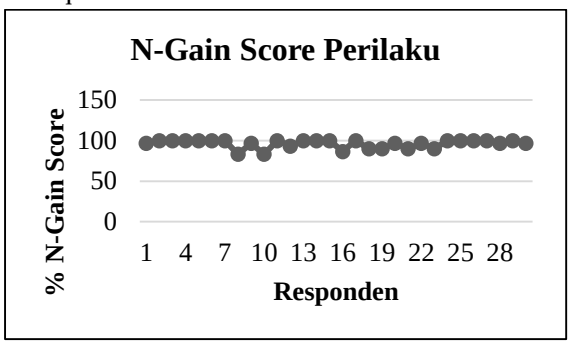


Figure 5. N-Gain Behavior Score

DISCUSSION

1. **Perceived behavioral strategies of PSN behavior**

After the intervention using the Dengue Fever (DBD) Prevention Education Model based on Triggering with Interactive Multimedia Mobile Learning on Mosquito Nest Eradication (PSN) behavior, the strategy for obtaining behavioral changes was felt to be grouped into 3 groups. (Indriyani et al., 2016) yaitu:

a. Giving strength/power or encouragement

In this case, behavioral changes are forced on the target or community so that they are willing to do (behave) as expected. This method can be taken by including regulations or laws regarding PSN that must be obeyed by house mosquitoes. By becoming one of the efforts to produce fast behavior, however, this change will not necessarily last long because the behavioral changes that occur are not or have not been based on self-awareness so that they are accompanied by triggers so that they are more effective for house mosquitoes. This is in accordance with research (Taniansyah et al., 2020) which in their research proved that policies/regulations are not factors that can change PSN behavior in the community. For the effectiveness of these encouragements and policies, house mosquitoes are also given encouragement from within themselves influenced by the elements of feeling that are created during the triggering process.

b. Providing information

By providing information about PSN and will increase public knowledge about Mosquito Nest Eradication Efforts in their respective home environments. With the knowledge embedded in the Dengue Fever (DBD) Prevention Education Model based on Triggering with Interactive Multimedia Mobile Learning on Mosquito Nest Eradication (PSN) behavior, it raises their awareness, and makes house mosquito larvae behave according to the knowledge they have, this is also proven by (Listyorini, 2016) that the higher the availability of information provided, the better the community's behavior will be.

c. Discussion and Participation

Perceived behavioral strategies and PSN behaviors are obtained from interventions at the stages of thinking about and trying new behaviors and continuing to carry out behaviors obtained from the content of Alarms, Checklists, Understanding DHF, How DHF is Transmitted, DHF Symptoms, Assistance for Sufferers, Life Cycle of DHF Transmitting Mosquitoes, Characteristics of Ae Aegypti Mosquitoes, Breeding Places and Prevention of DHF in the PSN Mobile Education Product.

d. Active towards PSN behavior

Jumantik Rumah after implementing the intervention of using the Dengue Fever (DBD) Prevention Education Model based on Triggering with Interactive Multimedia Mobile Learning on Mosquito Nest Eradication (PSN) behavior was triggered to carry out 3M Plus activities consisting of:

1) Draining/cleaning places that are often used as water reservoirs such as bathtubs, water buckets, drinking water reservoirs,

refrigerator water reservoirs and others.
2) Tightly closing water reservoirs such as drums, jugs, and so on.
3) Reusing or recycling used goods that have the potential to become breeding grounds for mosquitoes that transmit dengue fever.

The plus is other DHF prevention activities, such as:

a) Sprinkle abate powder on water reservoirs that are difficult to clean
b) Use mosquito repellent or mosquito repellent
c) Use mosquito nets when sleeping
d) Keep fish that eat mosquito larvae
e) Plant mosquito repellent plants
f) Adjust the light and ventilation in the house
g) Avoid the habit of hanging clothes in the house which can be a resting place for mosquitoes, etc.

This is in line with research (Budiman, 2016) in his research, community activities in PSN activities such as cleaning used buckets and cans will result in a high mosquito larvae free rate.

There is an impact on increasing knowledge, attitudes and behavior of the community after being given an education model for preventing Dengue Hemorrhagic Fever (DHF) based on Triggering with Interactive Multimedia Mobile Learning on Mosquito Nest Eradication (PSN) behavior, the community has better knowledge, attitudes and behavior, triggering is a method that has been proven successful in changing community behavior such as in the stunting prevention program (Directorate of Environmental Health, Ministry of Health and Millennium Challenge Account Indonesia, 2016; Ministry of Health, 2018) the stop defecating in the open program (Indriyani et al., 2016) and the Mosquito Nest Eradication program in preventing Dengue Hemorrhagic Fever. (Anandika, 2020; Chandra et al., 2022; Dikha Pistiyati Ramdani, 2016; Lacruz, 2014; Mangidi et al., 2019)

However, in its sustainability, it turned out that it was still not optimal, the community returned to behaving poorly because proper monitoring and monitoring were not carried out (Chandra et al., 2021), in this study, monitoring and monitoring were carried out in the form of direct private assistance to house jumantik through the PSN application alarm which reminds house jumantik every Sunday morning at 8 am, during the monitoring period by researchers assisted by health center cadres, it was proven that house jumantik consistently carried out PSN once a week.

The active indicator of behavior is obtained from the intervention at the stage of continuing to do behavior and celebrating success obtained from the content of Alarm, Checklist, Understanding DHF, How DHF is Transmitted, Symptoms of DHF, Assistance for Sufferers, Life Cycle of DHF Transmitting Mosquitoes, Characteristics of Ae Aegypti Mosquitoes, Breeding Places and Prevention of DHF in the PSN Mobile Education Product so as to increase knowledge, attitudes and behavior of PSN in home mosquito larvae.

CONCLUSION

1. There is an increase in behavior before and after the implementation of the Dengue Fever (DBD) Prevention Education Model based on Triggering with Interactive Multimedia Mobile Learning on Mosquito Nest Eradication (PSN) behavior
2. The PSN mobile Triggering Model is effective in improving the behavior of house jumantik
3. The results of this study are important to increase the motivation of house jumantik to implement PSN in their respective home environments, assisting the activities of Jumantik cadres at the Health Center so that the home environment is free from Mosquito Nests

4. Suggestions for Product Utilization
   The Dengue Fever (DBD) Prevention Education Model based on Triggering with Interactive Multimedia Mobile Learning on Mosquito Nest Eradication (PSN) behavior can be used by practitioners in the fields of Health Promotion and Environmental Health in an effort to improve PSN behavior in House Jumantik.

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My deepest gratitude to the author who realizes that without the help and guidance from various parties, the Head of Mayang Mangurai Village, the Head of RT 30 and the community in the RT 30 area of Mayang Mangurai Village

CONFLICT OF INTEREST

In implementing this research, the obstacles found were the lack of enthusiasm of the community and their lack of motivation to gather when socialization and field triggering were carried out.

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STUDY ON SCABIES AMONG SANTRI PONDOK KARYA PEMBANGUNAN AL-HIDAYAH JAMBI

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ABSTRACT

Background: *Scabies is a contagious skin disease that spreads rapidly in densely populated environments such as Islamic boarding schools, especially when personal hygiene is poor and living spaces are overcrowded. In 2022, Pondok Karya Pembangunan Al-Hidayah in Jambi City reported the highest number of scabies cases among 11 pesantren, indicating the need for further investigation.*
Method: *This quantitative study employed an observational survey approach, conducted from February to April 2024. A total of 56 respondents were selected from 130 scabies-infected students using Slovin's formula. Data were collected through structured questionnaires and direct measurements of room dimensions. Variables included personal hygiene behavior, contact history, and room occupancy density. Data analysis used univariate descriptive statistics.*
Result: *The study found that 67.9% of respondents had poor personal hygiene, 64.3% had a history of direct or indirect contact with scabies sufferers, and 63.3% of the rooms were categorized as overcrowded. These findings indicate a strong correlation between the prevalence of scabies and the three examined factors.*
Conclusion: *Poor personal hygiene, a history of contact with infected individuals, and high room occupancy density were significant contributors to the spread of scabies in the studied pesantren. It is essential to implement hygiene education, regular health monitoring, and structural dormitory improvements to reduce scabies transmission among students.*

Keywords: *Scabies; Personal hygiene; Contact history; Room occupancy; Boarding school*

INTRODUCTION

Scabies is a contagious skin disease caused by infestation of Sarcoptes scabiei var hominis, which often appears in crowded places with poor hygiene such as dormitories and boarding schools. According to the Indonesian Ministry of Health (2016), the prevalence of scabies in Indonesia ranges from 4.60% to 12.95%. The disease is closely related to personal hygiene and the living environment. Poor individual hygiene behavior, such as sharing towels or clothing, and living in highdensity housing are identified as key risk factors (Irjayanti et al., 2023; Edison et al., 2022).

In recent years, several studies have highlighted the increasing trend of scabies in Islamic boarding schools (pesantren), with contributing factors including personal hygiene habits, contact history with infected individuals, and room occupancy density (Wandira, 2022; Nilam Nur Sofiana, 2017). However, many pesantren still lack proper surveillance or data recording systems regarding scabies infections. Among several pesantren in Jambi City, Pondok Karya Pembangunan (PKP) Al-Hidayah has recorded the highest number of scabies cases with 130 infections from 1,210 students in 2022.

The originality of this research lies in its focus on combining personal hygiene behavior, contact history, and room occupancy density to understand the incidence of scabies. This combination of variables has not been comprehensively studied in previous literature within the local context of Jambi City.

Based on this background, the study aims to assess the level of personal hygiene, history

of contact, and room occupancy density in students infected with scabies at Pondok Karya Pembangunan Al-Hidayah Jambi.

METHODS

This research employed a quantitative method using an observational survey approach. The study was conducted at Pondok Karya Pembangunan Al-Hidayah, Kota Jambi, from February to April 2024. The population consisted of 130 santri (students) diagnosed with scabies. A total of 56 respondents were selected using Slovin's formula with a 10% margin of error.

Instruments used included a structured questionnaire to assess personal hygiene and contact history, and a measuring tape to assess room size for calculating room occupancy density. The personal hygiene variable consisted of indicators such as bathing frequency, towel usage, clothing change frequency, and bed hygiene. Contact history assessed both direct and indirect contact with infected individuals. Occupancy density was evaluated by dividing room area by the number of occupants, and the standards used referred to the Indonesian Ministry of Health regulation (Kepmenkes No. 829/Menkes/SK/VII/1999).
Data analysis used univariate descriptive statistics, with variables presented in frequency tables.

RESULTS AND DISCUSSION

3.1. Personal Hygiene

Based on the results, 38 respondents (67.9%) had poor personal hygiene while 18 (32.1%) had good hygiene. Key contributing behaviors included the use of shared toiletries, not changing clothes twice daily, not washing hands with soap, and sleeping together on shared beds. Poor hygiene supports parasite transmission, as scabies mites thrive in unclean environments (Irjayanti et al., 2023).

3.2. Contact History

The study showed that 36 respondents (64.3%) had a history of contact with scabies sufferers. In a densely populated dormitory setting, close physical interaction is common, increasing the risk of direct and indirect transmission. This finding aligns with previous research stating that close contact is a significant risk factor (Aurdhah & Umniyat, 2012).

3.3. Room Occupancy Density

From 30 rooms observed, 19 rooms (63.3%) were categorized as overcrowded based on the 8m² for 2 person's standard. High occupancy density facilitates the spread of skin diseases, as students sleep closely together, often without bed separation. The findings are in line with Kartika (2008) and Herrwati (2022), who reported overcrowding as a key driver of scabies transmission.

CONCLUSION

The study concluded that the majority of scabies cases among santri at Pondok Karya Pembangunan Al-Hidayah are associated with poor personal hygiene, a history of contact with infected individuals, and overcrowded room conditions. Improvements in personal hygiene education, regular monitoring, and structural dormitory improvements are necessary to reduce transmission.

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CONFLICT OF INTEREST

All authors declared that there was no conflict

of interest.

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THE IMPACT OF EDUMISEKI MEDIA ON THE KNOWLEDGE OF DIABETES MELLITUS PATIENTS IN THE SIMPANG IV SIPIN HEALTH CENTER WORK AREA

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ABSTRACT

Background: *A group of metabolic diseases known as diabetes mellitus is characterized by hyperglycemia, which can be caused by anomalies in insulin secretion, insulin activity, or both. The fifth highest number of countries with diabetes mellitus is Indonesia. In 2021, there were 19.5 million people with diabetes, and by 2045, that number is predicted to increase to 28.6 million. More specifically, in 2022, Jambi City had 21,127 people with diabetes mellitus, the most of all cities in Jambi Province. to overcome gangrene complications in diabetes patients, namely with foot exercises. foot exercises can improve blood circulation in. The purpose of this study was to improve the knowledge of diabetes patients through EDUMISEKI videos.*
Method: *The approach is quantitative. Pre-experimental study using a single group pre-test and post-test design is the methodology employed. 55 respondents made up the study's sample, which was selected using a stratified random sampling technique.*
Result: *The results of this study were an increase in knowledge from 8.76% to 13.89% and had a significant influence on knowledge about diabetes mellitus and foot exercises with a p-value of 0.00 (p<0.05).*
Conclusion: *The results of this study indicate the influence and increase in knowledge of diabetes mellitus patients. Diabetes foot exercises are being used to increase blood flow and prevent foot gangrene issues. As part of this program, stakeholders are encouraged to participate from a wider range of sectors to assure the activity's sustainability and growth.*

Keywords: *Diabetes Mellitus, Foot Exercises, Knowledge, Video Media*

INTRODUCTION

One of the chronic illnesses that is currently prevalent in society is diabetes mellitus (DM). The American Diabetes Association (ADA), 2020) defines diabetes mellitus as a collection of metabolic illnesses marked by hyperglycemia that results in abnormalities in insulin action, secretion, or both (Davies et al., 2022).

The International Diabetes Federation (IDF) estimates that 537 million people worldwide had diabetes in 2021, and that number is expected to rise to 783 million over the course of the next 24 years (IDF Diabetes Atlas, n.d. 2021). Globally, the anticipated prevalence of diabetes mellitus was 9.3% in 2019 (463 million people), 10.2% in 2030 (578 million people), and 10.9% in 2045 (700 million people). According to Saeedi et al. (2019), one in two (50.1%) diabetics are unaware that they have the disease.

The number of DM sufferers in Indonesia according to IDF in 2021 was around 8.4 million people in 2000 and is estimated to increase by 21.3 million people in 20230. The number of Indonesian people suffering from diabetes mellitus is 19.46 million people. There was an increase of 81.8 percent compared to the number in 2019. The total cases put Indonesia in fifth position with the highest number of diabetes sufferers in the world (JEC Eye Hospital, n.d., 2021).

Specifically, Jambi City ranks first with the highest cases of diabetes mellitus in Jambi Province with a total of 21,127 cases of diabetes mellitus sufferers from 20 existing health centers with the majority of patients aged over

15 years. According to data from the Jambi City Health Office, the Simpang IV Sipin Health Center ranks second with a total of 2,200 cases (Jambi City Health Office, 2023).

The further impacts of complications of diabetes mellitus are heart disease, stroke, kidney disease, eye damage, gangrene and others that can endanger personal health (Safira., 2021). Various factors that cause diabetes mellitus such as family history, unhealthy lifestyle, obesity, use of drugs that can change blood glucose levels which can contribute to an increase in the occurrence of diabetes mellitus (Rif'at et al., 2023).

Some cases where diabetes mellitus patients do not know how to prevent complications of diabetes mellitus. Therefore, to prevent complications of gangrene in diabetes mellitus patients, namely by doing foot exercises.

Patients with diabetes mellitus can prevent sores and improve blood circulation in their legs by engaging in diabetic foot exercises. Furthermore, it can overcome restricted movement of the leg joints and strengthen the thigh and calf muscles (Widianti & Proverawati, 2018). One strategy to control diabetes mellitus is to engage in physical activity. One of the cornerstones of managing diabetes is engaging in regular exercise and physical activity three to four times a week for thirty minutes (Ministry of Health of the Republic of Indonesia, 2020).

Diabetes can not be cured completely, but it can be managed and controlled blood sugar levels well. Therefore, the EDUMISEKI video is a combination of diabetes mellitus education and foot exercises and the illustrations in the video are real videos and foot exercises that have a tempo and rhythm that are easy for anyone to follow.

Video media as an intermediary to provide education on diabetes mellitus and foot exercises for diabetes mellitus patients. With the existence of effective educational media, especially in preventing disease, it is very important to improve the knowledge and skills of diabetes mellitus patients. As a study conducted by Ambarwati et al., 2023, it was found that health education using reflectivity and video media was effective in improving the ability of diabetes patients to do foot exercises. A similar study by Angelina et al. in 2021 found an increase in knowledge before and after health education using audio visuals. Learning using videos can be recorded repeatedly, the loudness or softness of the sound can be adjusted according to the needs of the respondents.

Based on the above phenomenon, the researcher is interested in conducting research on "The Impact of EDUMISEKI Video Media (Diabetes Mellitus Education and Foot Exercise) on the Knowledge of Diabetes Mellitus Patients in the Simpang IV Sipin Health Center Work Area".

METHODS

The research design is pre-experimental with a single group pretest and posttest, and the methodology is quantitative. 55 respondents participated in the survey, which was carried out over the course of one week and two sessions in April 2025 using stratified random sampling as the sample approach.

The criteria of the sample are people who live in the work area of Simpang IV Sipin Health Center, aged 20-79 years, diabetes mellitus patients diagnosed by a doctor, good coordination, respondents are willing and willing to be samples of this study. The data collection tool in the study of the influence of EDUMISEKI video media (Diabetes Mellitus Education and Foot Exercise) on the knowledge and skills of diabetes mellitus patients in the work area of Simpang IV Sipin Health Center is a questionnaire used to determine the level of knowledge and skills of diabetes mellitus patients.

This research has obtained a research Ethical Clearance letter with the number LB.02.06/2/189/2025.

RESULTS AND DISCUSSION

3.1 Respondent Characteristics

Table 1. Distribution of Respondent Characteristics

Characteristics	n	%
Age		
18-59 years	17	30.9
60>years	38	69.1
Total	**55**	100
Gender		
Male	16	29.1
Female	39	70.9
Total	**55**	100

**Data processing source 2025*

Table 1 shows that, at 69.1%, the majority of respondents are over 60. Although diabetes mellitus often affects the elderly, there is concern worldwide about the rise in diabetes incidence in both adults and children (Hadi, 2020).

Obesity, poor lifestyles, and genetic factors are some of the variables that contribute to diabetes mellitus in individuals. Children are more at risk due to genetic susceptibility, particularly if diabetes runs in the family. Another significant risk factor is obesity, which is linked to a diet heavy in fat and low in fiber, as well as inactivity. Imbalances in glucose metabolism, such as insulin resistance, can increase the risk, as can hormonal changes during puberty. Rapid economic growth, especially in developing countries, has led to significant changes in diet and lifestyle, contributing to the increase in cases of diabetes mellitus (Yunita, 2022). In terms of gender, respondents were dominated by women with 70.9% and men with 29.1%. Diabetes has a risk of occurring in both sexes.

3.2 Overview of Knowledge Before and After Intervention Using Edumiseki Video Media

Based on the table below, the average knowledge score of 55 respondents increased from 8.76 to 13.89, with the standard deviation decreasing from 2.036 to 0.737 and the score range from 4-12 to 12-15.

Table 2. Average Knowledge Overview

Knowledge Variable	N	Mean	SD	Min	Max
Pre-test	55	8.76	2.036	4	12
Post-test	55	13.89	0.737	12	15

***Data processing source 2025*

3.3 The impact of EDUMISEKI video media on the knowledge of diabetes patients

Table 3. The Impact of EDUMISEKI Video Media On Knowledge Before and After

Knowledge Variable	N	Min-Max	Mean	Mean Difference	p-Value
Pre-test	55	4-12	8.76	5.13	0.00
Post-test	55	12-15	13.86		

**Data processing source 2025*

With a mean difference of 5.13, the following data indicates that knowledge increased before and after the intervention. The EDUMISEKI video media has an effect on increasing respondents' knowledge about diabetes mellitus and foot exercises, according to the Wilcoxon test results, which show a significant increase in respondents' knowledge score after the intervention (p value = 0.000).

This is also supported by Hermawati et al., 2020 regarding the influence of health education through audio-visual media on knowledge of implementing diabetes mellitus foot exercises. There were 16 respondents who showed data analysis using the Wilcoxon test showing that health education about foot exercises had a significant influence on increasing the implementation of diabetes mellitus foot exercises in patients with a p-Value of 0.00 (p <0.5).

Notoatmodjo (2011) asserts that this is consistent with the findings of the study, which show that knowledge is acquired when an individual has experienced a specific object. The five human senses—sight, hearing, smell, taste, and touch—are used for sensing. The majority of human knowledge is acquired through the senses of sight and hearing. One of

the most crucial domain elements in the construction of an individual's actions is knowledge (Notoatmodjo, 2011).

The audiovisual method has a fairly high level of effectiveness, according to research, an average of above 60% to 80% to increase knowledge. Audiovisual methods in health education include sound, images and writing to clarify the message contained and audiovisual methods also involve thinking, hearing, seeing, psychomotor movements and make the atmosphere more enjoyable and interesting. Audiovisual images can facilitate understanding and improve memory (Vivit, 2023).

CONCLUSION

The results of the study on the effect of EDUMISEKI video media (Diabetes Education and Foot Exercise) on increasing the knowledge of diabetes mellitus patients in the Simpang IV Sipin Health Center work area concluded that most of the respondents in this study were women, namely 39 people (70.9%). Most of them were over 60 years old, namely 38 people (69.1%). Before the intervention using EDUMISEKI video media was 8.76%, after receiving the intervention it became 13.89%.

Furthermore, it can be inferred from data analysis and discussion that EDUMISEKI video media significantly increases diabetes patients' knowledge of diabetes mellitus and foot activity in the Simpang IV Sipin Health Center work area. A p value of 0.000 was achieved for the data analysis results using the Wilcoxon test, and this was derived from an increase in the average pre-test and post-test scores with a mean difference of 5.13%. Diabetes foot exercises are being used to increase blood flow and prevent foot gangrene issues. As part of this program, stakeholders are encouraged to participate from a wider range of sectors to assure the activity's sustainability and growth.

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EFFECTIVENESS OF STUNTING EDUCATION TO PEERS: A SCOPING REVIEW

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ABSTRACT

***Background**: Stunting is a public health problem that has a long-term impact on the quality of future generations. In this case, adolescent girls as future mothers play a strategic role in prevention efforts. The low knowledge and awareness of adolescent girls about nutrition can increase the risk of stunting in children in the future. Peer-based stunting education is considered effective because communication between friends is easier to accept and can create positive behavior change. The purpose of this scoping review is to analyze the effectiveness of stunting education to peers.*
***Methods:** The method used in this study is a scoping review by determining keywords using the PICO format, namely P (adolescents), I (peer education), C (zero), O (knowledge of stunting) which captures articles from national and international journals in English and Indonesian, using the PRISMA-ScR method. The databases used were PubMed and Google Scholar with the search limit of research study category and publication year 2015-2025. Found in the initial search as many as 1,598 articles and filtered so that 7 articles were synthesized.*
***Results:** Of the 7 studies identified, peer education was shown to increase knowledge about stunting by 34-65% and promote behavior change such as increased consumption of nutritious foods. Effective mechanisms include the use of digital media and participatory approaches. Key challenges include limited peer capacity in technical materials and infrastructure access gaps in remote areas.*
***Conclusion**: Stunting education conducted through a peer approach significantly improves adolescent knowledge.*

***Keywords:** Education, peers, stunting, adolescents, scoping review*

INTRODUCTION

Stunting remains a significant public health problem in Indonesia with a high prevalence of 21.5% by 2023 (Kemenkes RI, 2024). This problem not only affects children's physical growth, but also affects their cognitive development and future productivity (Kemenkes RI, 2020). Efforts to reduce stunting need to be made upstream to reduce the prevalence of stunting in order to prevent negative impacts in the future (Zakiyanpri et al., 2024).

Reducing stunting rates must begin with comprehensive and sustainable prevention efforts. Prevention of stunting is not only done when the child is born, but must start from adolescence, preconception, pregnancy, to the first thousand days of a child's life. Prevention steps include fulfilling optimal nutrition for adolescents, pregnant women, and toddlers, providing education about healthy eating patterns, and access to quality health services (Kemenkes RI, 2020). Adolescent girls play an important role in stunting prevention efforts, as they are future mothers who will influence the nutritional status of their children in the future (Nugraheni, 2024). One of the efforts that can be made in adolescent girls so that later the children they give birth to do not experience stunting is the fulfillment of good nutrition during adolescence and understanding of stunting (Zakiyanpri et al., 2024). However, there are still many adolescent girls who have not received adequate information and

education about nutrition and stunting. Efforts that can be made to increase adolescent understanding are to provide education (Nugraheni, 2024).

Peer-to-peer education is an effective strategy in improving adolescents' understanding of nutrition and stunting. This is because adolescents tend to receive information more easily from their peers who are considered to have similar experiences, language and perspectives. This approach creates a more relaxed and open communication atmosphere, allowing for more active and participatory discussions. In addition, peer education can also build mutual trust and encourage more natural behavior change (Black, R., 2013; Matahari & Suryani, 2022).

The increase in stunting knowledge through peers is reflected in the results of Suryani et al (2022), who found that the peer education method was effective in increasing the understanding of stunting and nutrition of adolescent girls, especially in the early stages of the intervention. Research by Lubis et al (2022) showed that health education interventions through peer group education methods were effective in increasing adolescents' knowledge about stunting. Research by Rasmaniar et al (2022) found a significant increase in aspects of knowledge, attitudes, and behavior of adolescent posyandu participants after being given peer education. Research by Fitraniar et al (2023) also found that peer education effectively increased awareness about stunting and its prevention among adolescents. Research by Pérez-Escamilla et al (2008) found peer-based nutrition education had a positive impact on dietary behavior and health outcomes among the Latino community. However, peer education methods also have disadvantages. One of them is the dependence on the quality and readiness of the peer educators themselves. If peer facilitators do not have a good understanding of the material or are not skilled in delivering information, the effectiveness of the intervention may decrease. In addition, not all adolescents have good self-confidence or communication skills, which can hinder optimal knowledge transfer (Jafar et al., 2018).

Previous researchers have examined various stunting education interventions through a peer approach in increasing knowledge about stunting. However, a more comprehensive study through a scoping review approach is still needed. This is due to the absence of a systematic review that thoroughly maps the scope, approach, results and context of various studies exploring peer education interventions on stunting. Through a scoping review, it is hoped to gain a full understanding of the development of research that has been conducted, as well as identify knowledge gaps that still need to be addressed by future studies. The aim of this study is to assess the effectiveness of stunting education through a peer approach among adolescents.

METHODS

The method used in this study is a scoping review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Review (PRISMA-ScR). The scoping review was conducted using an online electronic search engine from two databases, namely PubMed and Google Scholar. The databases were searched with keywords (“adolescents”), OR (“peer education”), OR (“knowledge about stunting”). data were filtered using inclusion criteria, namely 1) Articles were the results of primary research (quantitative) on stunting education interventions for peers; 2) The research subjects were adolescents; 3) Articles were available in Indonesian or English; 4) available in full-text; 5) Articles were published within the last 10 years (2015-2025); 6) Articles were published in scientific journals. While the exclusion criteria are 1) Articles in the form of narrative reviews, editorials, comments or literature reviews; 2) Studies that only discuss stunting without the involvement of peer

education interventions; 3) Articles that do not present results relevant to increasing knowledge related to stunting in adolescents; 4) Articles that cannot be accessed in full or are only available in abstract form.

The screening process began with a literature search on each database, namely PubMed and Google Scholar, using predetermined keywords. The articles obtained were then sorted to eliminate duplication with the help of Mendeley reference management software. After that, further exploration of the titles and abstracts of the articles was carried out to ensure the suitability of the topic to the focus of the study. This selection process refers to the previously established inclusion and exclusion criteria to ensure that only articles that are relevant to the topic of the effectiveness of peer education in improving stunting knowledge in adolescents are included in the review.

Articles whose titles and abstracts met the inclusion criteria then proceeded to the content identification stage by reading the complete article to assess the suitability of the substance to the focus of the study. After all articles were obtained and screened, a thorough recheck of the eligibility of the selected studies was conducted to ensure consistency and relevance. The entire article selection and screening process was documented systematically and visualized in the PRISMA flow chart presented in Chart 1.

The results of the initial search of articles through PubMed and Google Scholar databases with predetermined keywords resulted in a total of 1,598 articles. Next, a stepwise selection process was carried out which included the elimination of duplicates, screening by title and abstract, and full review of the article content according to the predetermined inclusion and exclusion criteria. After a rigorous selection process, only 7 articles met the criteria and were declared eligible for further analysis in the data synthesis process of this scoping review.

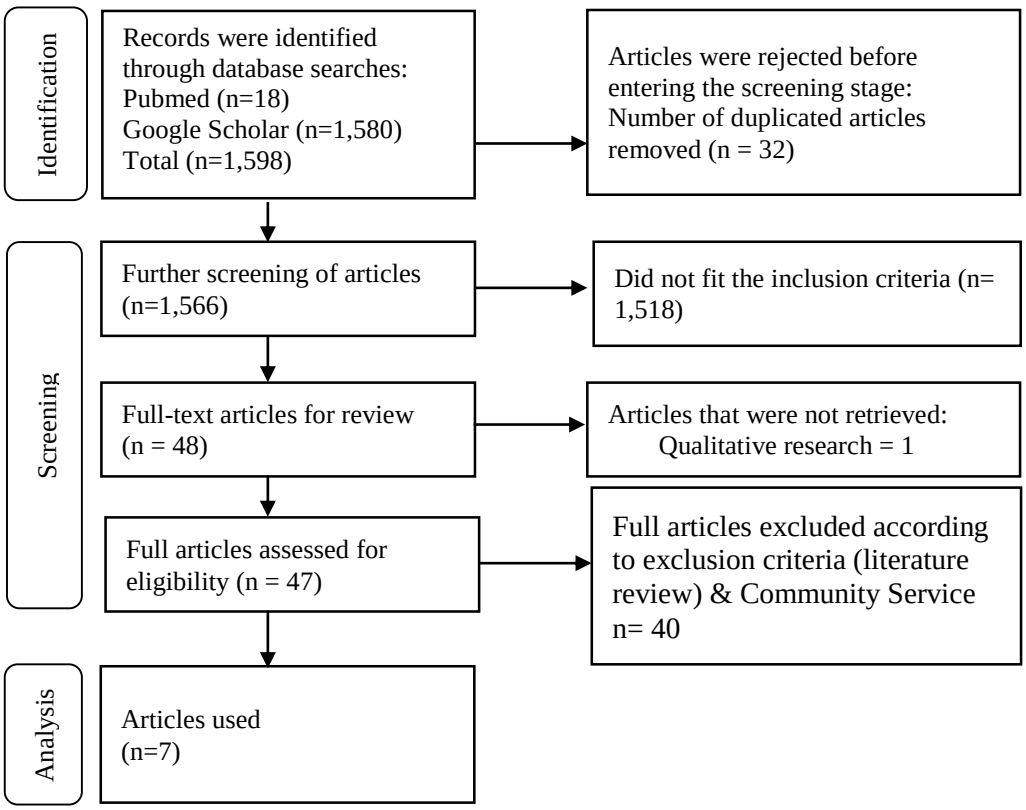


Figure 1. Flowchart

RESULTS AND DISCUSSION

Table 1 shows all articles included in this study and meeting the inclusion criteria published in the range 2015-2025 from various journal databases.

Table 1 Articles Included in Study

No	Author and Year	Methods Used	Sample	Results
1	Lubis et al (2022)	Quasi-experiment	60 students of Senior High School Negeri 1 Padangsidimpuan	Health education through peer intervention significantly improved adolescents' knowledge about stunting. The mean value of adolescents' knowledge increased significantly after the intervention, with a p-value <0.05. This indicates that health education through peer methods is effective in providing information about stunting, including its causes, impacts and prevention methods. This increase in knowledge is expected to help adolescents take responsibility for preventing stunting in the children they will give birth to.
2	Jafar et al (2018)	Intervention Study	40 students of State Senior High School 16 Makassar	Peer educator training was successful in improving students' knowledge of nutrition at Makassar High School 16. After the intervention, the percentage of students with good knowledge increased from 17.5% to 70%, while moderate knowledge decreased from 45% to 25%, and poor knowledge decreased from 37.5% to 5%. Statistical analysis showed a significant difference (p = 0.000) between knowledge before and after the training
3	Nurlaela & Rasmaniar (2023)	Quasi-experiment	80 students (40 treatment, 40 control)	After the intervention, there was a significant increase in knowledge, with 95% of adolescent girls in the treatment group (peer education) showing sufficient knowledge, compared to only 27.5% before the training. In addition, positive attitudes increased from 37.5% to 95%, while good practices also increased significantly. Statistical tests showed significant differences between the treatment and control groups, with a p-value <0.05. These findings confirm the effectiveness of the peer education method in increasing adolescents' awareness and behavior in preventing stunting.
4	Rasmaniar et al (2022)	Quasi-experimentn	100 adolescents	Before the training, most adolescents had poor knowledge, attitudes and behaviors. After the intervention, there were significant improvements in all these aspects, with many adolescents reaching the good category. Statistical analysis showed significant differences between pre-test and post-test results, confirming the effectiveness of peer education in improving understanding of nutrition and stunting.

No	Author and Year	Methods Used	Sample	Results
5	Saputri et al (2025)	Quasi-experiment	45 adolescent girls	There was a significant increase in knowledge about stunting, with a mean score of pretest 14.42 and posttest 19.36. The results of the analysis obtained p = 0.000, which indicates that health education is effective in increasing adolescent girls' knowledge about stunting.
6	Sriwiyanti et al (2022)	Quasi-experiment	50 adolescent girls	There was a significant increase in knowledge about stunting, with a mean pretest score of 14.42 and posttest score of 19.36. The results of the analysis obtained p = 0.000, indicating a positive effect of the educational intervention.
7	Suryani et al (2022)	Quasi-experiment	100 adolescent girls	There was a significant increase in adolescents' knowledge of stunting after the intervention. The mean knowledge score increased from the pre-test of 77% to 98% in the post-test in the first group, while the other groups also showed improvement although not as significant. Statistical tests showed p = 0.000, confirming the effectiveness of the intervention through peer education in improving knowledge about stunting.

Education about stunting should be provided early, especially during adolescence (Adam et al., 2022; Kurniatin et al., 2023). This is because adolescents are considered not fully aware of the importance of fulfilling nutritional needs and providing appropriate stimulation (Kurniatin et al., 2023). Education about stunting is also very important when a woman is getting married, planning a pregnancy, during pregnancy, and after becoming a mother or having children under five (Puspita et al., 2024). One of the effective educational approaches in preventing stunting in adolescents is peer education (Lubis et al., 2022).

The results showed that peer-based stunting education is an effective approach in improving adolescents' knowledge about stunting. Through this intervention, adolescents gain a better understanding of the concept of stunting, ranging from causes, long-term impacts, to prevention strategies. The peer delivery method was proven to create a more open and interactive learning atmosphere, which facilitated the process of receiving information. Adolescents tend to be more responsive to information delivered by peers due to a sense of equality and emotional closeness (Lubis et al., 2022; Sriwiyanti et al., 2022; Suryani et al., 2022).

Adolescents have a strategic role as agents of change in stunting prevention efforts, especially because they are in the transition phase to adulthood and future parents. This position makes adolescents a very important group to be empowered early on. Through proper education, adolescents are not only recipients of information, but also able to disseminate knowledge to their peers in their daily social environment. In the context of stunting education, adolescents can be the spearhead in shaping collective awareness about the importance of nutrition, healthy eating and preventive lifestyles from a young age. Their ability to communicate equally with their peers makes information easier to receive and understand. In addition, adolescents who are involved as peer educators are proven to be able to encourage positive behavior change, both individually and in groups (Siswati, 2018).

Indicators of success in peer education include not only increased knowledge, but also

changes in adolescents' attitudes and behaviors, often referred to as KAP (Knowledge, Attitude, Practice). Several studies have shown that increased knowledge on issues such as stunting goes hand in hand with positive changes in adolescents' attitudes towards health and nutrition. Moreover, these changes can contribute to better practices in daily life, such as healthier food choices and awareness of the importance of nutrition. The link between increased knowledge and long-term behavior change is significant, as better knowledge often encourages adolescents to adopt healthier lifestyles, which in turn can reduce the risk of nutritional problems and improve overall health (Jafar et al., 2018; Suryani et al., 2022).

Peer education has several advantages. Adolescents tend to be more receptive to information from peers due to emotional closeness, the use of a more relaxed language, and similarities in experience and social environment (Suryani & Lundy, 2022). Through this approach, health messages about the importance of balanced nutrition, healthy eating, and the role of lifestyle in stunting prevention can be more easily understood and applied. In addition, peer education also increases active participation of adolescents in disseminating information and building collective awareness, thus creating a more supportive environment for stunting prevention (Lin Khariyetni Lase et al., 2023). According to Sriwiyanti et al (2022), the peer education approach has several advantages in stunting prevention efforts. Peers are more easily accepted by the target group because they have similar age, experience, and a more relaxed and familiar communication style.

Using peer education has many benefits, mainly because this approach allows the delivery of information in a more relaxed, easy-to-understand and relevant way for the target group. This method increases participant engagement as they tend to be more comfortable discussing with peers than with formal authorities. In addition, peer education can also increase the effectiveness of learning as it uses more familiar language and experiences that are closer to everyday realities. It also encourages active participation, strengthens mutual trust and creates a supportive and non-judgmental learning environment (Lubis et al., 2022).

Through a peer education approach, adolescents can share information and experiences with each other, which makes the learning process more interactive and relevant to them. Research shows that when adolescents engage in peer-led education programs, they are more likely to understand and internalize information about the importance of balanced nutrition and the impact of stunting on their health (Nurlaela & Rasmaniar, 2023). In addition, interactions within peer groups create a supportive environment where adolescents feel more comfortable asking questions and discussing health issues, including stunting. Thus, peer education not only increases knowledge, but also builds collective awareness among adolescents about the importance of meeting nutritional needs to prevent stunting (Jafar et al., 2018).

While peer education has many benefits, there are drawbacks. One of them is the dependence on the quality and preparedness of the peer educators themselves. If the peer facilitator does not have a good understanding of the material or is unskilled in delivering the information, the effectiveness of the intervention may decrease. In addition, not all adolescents have good self-confidence or communication skills, which can hinder the optimal knowledge transfer process (Jafar et al., 2018). External factors, such as support from teachers, schools or health workers, also play a major role in the success of peer education programs. Without adequate support from both educational and health institutions, the program may not be able to achieve its goals optimally, given that collaboration and synergy between various parties is essential to create a supportive learning environment (Siswati, 2018).

While peer education has been shown to be effective in improving adolescents' knowledge about stunting, there are still a number of gaps in the research that need to be addressed. One of the main weaknesses is the lack of long-term studies that measure the sustained impact of these interventions on the direct prevention of stunting, particularly in later life phases such as pregnancy and birth. In addition, most of the existing studies are still centered on limited populations, such as secondary school students in specific regions, and therefore do not represent the full social, cultural and geographical diversity of Indonesia. Therefore, it is recommended that future studies expand the coverage area and target population, including adolescents in remote areas or communities with a high risk of stunting. Future studies should also use a more robust design, such as a large-scale controlled trial with long-term monitoring, to evaluate the effectiveness of the intervention more thoroughly and in-depth.

CONCLUSION

The peer education method has been shown to be effective in improving adolescents' understanding of stunting. This method is more easily accepted due to emotional closeness, more familiar language, and more effective communication compared to conventional approaches.

The government and educational institutions need to develop and expand peer education programs in the school curriculum as part of adolescent health promotion. Train more youth facilitators to disseminate information on the importance of nutrition and stunting more widely. Develop a digital platform or nutrition education application that can be accessed by adolescents to get information about healthy eating and stunting prevention.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in writing this article. The entire process of preparing and writing this scoping article was carried out independently without any influence from any party, either financially or non-financially, which could affect the results or interpretation of the study conducted.

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EFFECTIVENESS OF COUNSELING WITH ANIMATED VIDEO MEDIA ON INCREASING KNOWLEDGE OF DENTAL AND ORAL HEALTH MAINTENANCE IN GRADE V CHILDREN OF SDN 003/V KUALA TUNGKAL

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ABSTRACT

Background: *Dental and oral health is a crucial part of general well-being that enables individuals to perform essential functions such as eating, breathing, and speaking. However, lack of knowledge and awareness, especially among children, can lead to dental problems. One effective way to increase this awareness is through educational interventions using audio visual media. This study investigates the effectiveness of counselling with animated video media in increasing the knowledge of dental and oral health maintenance among fifth-grade students at SDN 003/V Kuala Tungkal.*
Methods: *This research used a quasi-experimental design with a two-group pre-test and post-test method. The sampling technique employed was simple random sampling with 32 students divided equally into treatment and control groups. The data collection instrument used was a validated knowledge questionnaire. Bivariate analysis was performed using the Paired T-Test and Independent T-Test statistical methods*
Results: *The average knowledge score in the treatment group increased from 6.56 before the intervention to 13.00 after being given animated video education. Meanwhile, in the control group (which received counselling through lectures), the score changed only slightly from 5.75 to 5.81. The statistical test showed a significant difference in knowledge improvement in the treatment group (p = 0.000), proving that animated video media is more effective than traditional lecture methods.*
Conclusion: *The use of animated video media in health education was found to be more effective in increasing knowledge of dental and oral health maintenance compared to lecture methods among fifth-grade students of SDN 003/V Kuala Tungkal.*

Keywords: *Animated Video, Dental Health Education, Oral Health Knowledge*

INTRODUCTION

Health is an essential aspect of life that supports optimal daily functioning. A healthy condition can be defined as a state of physical, mental, and social well-being free from disease, enabling individuals to carry out activities effectively. Achieving a high standard of health requires managing environmental factors and adopting a healthy lifestyle (Utami,2023).

Dental and oral health is a crucial part of general health and well-being. It is the condition of the mouth, teeth, and supporting structures that enables individuals to perform vital functions such as eating, breathing, and speaking, as well as psychosocial functions like self-confidence, social interaction, and working without discomfort or embarrassment (World Health Organization, 2022).

According to the 2023 Indonesian Health Survey (SKI), 56.9% of Indonesians have dental health issues, but only 11.2% seek treatment from healthcare professionals. While 95.6% of Indonesians report brushing their teeth daily, only 6.2% do it properly (Kementerian Kesehatan, 2023). This shows a significant gap in both knowledge and practice related to dental hygiene.

Dental health education is one of the key programs implemented at the primary healthcare level to address these issues. Through educational initiatives, individuals and communities can be motivated to adopt better oral hygiene practices. Knowledge plays

a vital role in shaping behavior. A lack of understanding often leads to poor habits, which contributes to oral health problems such as tooth decay, gum disease, and other related conditions (Budiharto, 2018; Pertiwisari,2023).

Children, especially those aged 6–12 years, are at a critical stage of dental development. During this period, primary teeth are replaced by permanent teeth. However, many children at this age lack proper knowledge about oral hygiene. This is often compounded by poor dietary habits and a lack of parental or institutional guidance (Meidina et al., 2023).

To effectively convey dental health information to children, the use of educational media is essential. One such media is animated video, which combines visual and auditory elements to enhance attention, comprehension, and retention. Video-based learning can increase motivation, simplify complex concepts, and positively influence behavior (Constantika et al., 2022; Nur Fadillah et al., 2021).

A preliminary survey conducted at SDN 003/V Kuala Tungkal revealed that most Grade V students had dental caries, likely due to poor oral hygiene practices and high consumption of cariogenic foods. The school had never previously implemented a structured oral health education program. Therefore, there is a need to develop an effective method to enhance students' knowledge and habits related to dental and oral health

METHODS

This study used a quasi-experimental design with a two-group pre-test and post-test approach. The research was conducted inMarch 2025 at SDN 003/V Kuala Tungkal. A total of 32 fifth-grade students were selected through simple random sampling and divided equally into two groups: a treatment group (received counseling using animated video) and a control group (received counseling through lectures). A 15-item multiple-choice questionnaire on dental and oral health knowledge was used as the instrument, administered before and after the intervention. Each correct answer scored 1 point; incorrect answers scored 0. Data were analyzed using paired t-test to compare pre-test and post-test scores within groups, and independent t-test to compare differences between groups. A Shapiro-Wilk test confirmed the data were normally distributed, allowing for parametric analysis.

RESULTS AND DISCUSSION

Research on the Effectiveness of Counseling with Animated Video Media on Increasing Knowledge of Dental and Oral Health Maintenance in Grade V Children of SDN 003/V Kuala Tungkal, which was conducted on March 8, 2025, with a sample size of 32 people obtained as follows.

3.1. Description of Research Sample Characteristics

This sub-chapter describes the characteristics of research respondents based on gender. The research sample consisted of 32 fifth grade students of SDN 003/V Kuala Tungkal who were divided into two groups: a group given counseling using animated videos (n=16) and a control group given counseling using lectures (n=16). In the animated video group, there were 9 male students (56.25%) and 7 female students (43.75%). Meanwhile, in the lecture group there were 7 male students (43.75%) and 9 female students (56.25%).

3.2 Univariate Analysis

Univariate analysis presents a picture of the knowledge score of dental and oral health maintenance before (pre-test) and after (post-test) counseling was given to both groups. The results showed that the average knowledge score before counseling in the animated video group was 6.56, while in the control group it was 5.75. After being given counseling, there

was a significant increase in the average knowledge score in the animated video group to 13.00. Meanwhile, in the control group, the average knowledge score only increased slightly to 5.81.

Table 1. Distribution of Knowledge Scores on Dental and Oral Health Maintenance before and after counseling with animated videos and control group with lectures at SDN 003/ V Kuala Tungkal

Group	Pre test				Post test			
	Mean	***SD***	**Min-max**	**95% CI**	***Mean***	***SD***	**Min-max**	**95% CI**
Treatment	66,56	0,964	5-8	6,05-7,08	13,00	1,506	10-15	12,20-13,80
Control	55,75	1,000	4-8	5,22-6,28	5,81	0,981	4-8	5,29-6,34

3.3 Bivariate Analysis

3.3.1 Normality Test

Before conducting bivariate analysis, a normality test was conducted using Shapiro-Wilk. The test results showed that the knowledge score data in the animation video group and the lecture group, both in the pre-test and post-test, were normally distributed ($p > 0.05$). Therefore, the bivariate analysis was continued using the paired sample t-test and independent t-test.

Table 2. Normality Test of Data on Knowledge of Dental and Oral Health Maintenance

Group	***Shapiro Wilk***		
	Statistic	**DF**	**Sig.**
Pretest animated video	0,892	16	0,061
Posttest animated video	0,932	16	0,264
Pretest Lecture	0,904	16	0,904
Posttest Lecture	0,909	16	0,114

3.3.2 Average Knowledge of Dental and Oral Health Maintenance Before and After Being Given Animated Video Counseling

The results of this study indicate that the average knowledge of dental and oral health maintenance in grade V children of SDN 003/V Kuala Tungkal increased from before being given counseling using animated video media by 6.56 and after being given counseling with animated videos to 13.00. This study is in line with research (Fione et al., 2021) which shows that there is an increase in knowledge of dental and oral health maintenance before and after being given counseling using animated video media from 9.97 to 12.00.

Health counseling is a combination of various activities and opportunities based on the principles of learning to achieve a state where individuals, families, groups, or society as a whole want to live healthy, know how, and know what can be done by asking for help individually or in groups (Tumurang,2018).

Utilizing media when conveying information is an effective way to promote dental and oral health in children. Video media is one of the media for promoting dental and oral health. The attraction of video media is the ability for images and sound, besides that video also provide information (Nur Fadillah et al., 2021).

3.3.3 Differences in Average Knowledge of Dental and Oral Health Maintenance in Fifth Grade Children Before and After Being Given Animated Video Media and Given a Lecture

The results of this study indicate that there is a difference in the average knowledge of dental and oral health maintenance in fifth grade children of SDN 003/V Kuala Tungkal before and after being given animated video media, namely from 6.56 to 13.00 with a difference in the average knowledge of dental and oral health maintenance before and after being given a lecture, namely from 5.75 to 5.81.

This study is in line with research (Yanti et al., 2012) which shows that there is a difference in the average knowledge of dental and oral health maintenance before and after being given an animated video, namely from 12.16 to 17.31 with a difference in the average knowledge of dental and oral health maintenance before and after being given a lecture, namely 12.16 to 12.20.

The use of animated video media further increases knowledge, this is because the use of the animated video playback method can attract students' attention more, and can increase motivation and help students remember, and accelerate student understanding. This is different from the lecture method which makes students bored more quickly during counseling. Knowledge and actions to care for teeth and mouth properly and correctly are very important to maintain good dental and oral health. Knowledge about dental and oral health should already be possessed when students start school, especially between 6-12 years old when the change from baby teeth to permanent teeth begins to grow, at this stage most children are not fully aware of the importance of maintaining dental and oral health (Pertiwisari, 2023).

3.3.4 Effectiveness of Animated Videos on Increasing Knowledge of Dental and Oral Health Maintenance

Based on table 4.5, it is known that the significant p-value of the experimental variable is 0.000 <0.05, so the results of dental and oral health maintenance counseling with animated videos on increasing knowledge of dental and oral health maintenance in grade V children of SDN 003/V Kuala Tungkal are effective.

The results obtained a sig value = 0.000 (p value <0.05), so it can be concluded that there is a significant difference between knowledge of dental and oral health maintenance before and after being given counseling using animated video media, thus the alternative hypothesis is accepted.

This study is in line with (Rejeki et al., 2023) which shows that the results of sig = 0.000 (p value> 0.05), it can be concluded that there is a significant difference between dental and oral health maintenance before and after being given counseling with animated video media. Animated video media can increase children's curiosity about what is being learned, so that the intent and purpose of the extension media can be conveyed optimally, the use of media is very important and has a function as an intermediary to channel interesting information so that the information conveyed is understood by respondents.

CONCLUSION

The results of the research that has been conducted regarding the Effectiveness of Counseling with Animated Video Media on Increasing Knowledge of Dental and Oral Health Maintenance in Grade V Children of SDN 003/V Kuala Tungkal, can be concluded that:

1. The average knowledge of dental and oral health maintenance in fifth grade students of SDN 003/V Kuala Tungkal increased from before being given counseling using animated video media by 6.56 to 13.00.
2. The difference in the average knowledge of dental and oral health maintenance in fifth grade students of SDN 003/V Kuala Tungkal before and after being given animated video media was: 6.56 to 13.00 with those given lectures, namely: 5.75 to 5.81.
3. Animated video media is more effective in increasing knowledge of dental and oral health maintenance in fifth grade students of SDN 003/V Kuala Tungkal, compared to lectures, in the statistical test results obtained Sig = 0.000 (p value <0.05).

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CONFLICT OF INTEREST

No conflict of interest.

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NUTRITION COMMUNICATION VIA TIKTOK AND IMPLICATIONS ON HEALTH PROBLEMS OF ADOLESCENT GIRLS IN MATARAM

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ABSTRACT

Background: *Anemia is one of the five main nutritional problems in Indonesia. Adolescent girls are a group that is prone to anemia. Anemia is a condition where the number of red blood cells or hemoglobin concentration in them is lower than normal. This study aims to determine the differences between TikTok and Leaflet video media in nutrition education on knowledge, attitudes about anemia, iron intake and adherence to consuming iron tablets among young women at SMA Mataram City.*
Methods: *This research is a quasi-experimental research. The research subjects were 64 people consisting of 32 treatment groups and 32 control groups. The instruments used were questionnaire forms and record forms to determine knowledge, attitudes about anemia, iron intake and compliance with consuming iron tablets or blood supplement tablets.*
Results: *Data were tested using the Wilcoxon and Mann Whitney U tests. Fe intake was obtained using the method of recording food consumption once every 24 hours. There are differences between TikTok and Leaflet video media in nutrition education on knowledge, attitudes with a p value of 0.000 (< α = 0.05) and compliance with iron tablet consumption with a p value of 0.027 (< α = 0.05) and there is no significant difference in iron intake (p value 0.707).*
Conclusion: *There are significant differences before and after treatment in the variables of knowledge, attitude and compliance with the consumption of iron tablets in both groups. And there were no significant differences before and after treatment using Tiktok and Leaflet media on the subjects' iron intake variables.*

Keywords: *Anemia, Adolescents, Tiktok*

INTRODUCTION

Anemia is a global health problem facing people around the world, especially in developing countries as the largest contributor (Kinyoki D et al., 2021). Several factors can cause anemia, such as vitamin A, vitamin B12, folate and iron deficiency, chronic inflammation, parasitic infections, and congenital conditions (WHO, 2021). Iron is necessary for the production of red bloodcells, iron deficiency anemia is the leading cause worldwide. Anemia can lead to an increase in pregnancy complications, such as low birth weight (BBLR), premature birth, neonatal death (Tesfaya et al., 2021). Anemia also negatively affects physical ability, development, performance and immunity, and has the potential to have a long-term impact on women of childbearing age, including adolescent girls (N.N et al., 2021). Previous research has shown that adolescents and women of childbearing age are more likely to suffer from anemia have the opportunity to suffer from anemia due to blood loss during menstruation and puerperium and this causes iron (Fe) in their red blood cells to be lost (J & K, 2014). Adolescent girls are a group that is susceptible to developing anemia based on the prevalence of anemia in the age group of 5 to 14 years and 15 to 24 years old by 26.8% and

32%, respectively 15 to 24 years old by 26.8% and 32%, respectivel (Health, 2018).

Adolescent girls experience a variety of psychological changes in addition to physiological changes, which can overall impact their body image and the way they react to social pressures. According to recent research, adolescent girls who experience early menarche may be more likely to communicate through social media than face-to-face socialization because face-to-face socialization allows them to offer a more ideal version of themselves (C. et al., 2021) (I. Y, 2019). Promotive and preventive efforts in overcoming anemia need to be intervened from early adolescence, namely when entering puberty so as to suppress the early continuation of anemia in later pregnancy. According to Rusdi et al. (2021), The impact of anemia on adolescent girls can be prevented by providing information about balanced nutrition so that it can be a guideline in eating, doing physical activity, and maintaining a normal weight (Rusdi et al., 2021).

Social media is a platform that can be used as a means of nutrition education because the targets achieved are more and are not limited by space and time. Social media with the internet has great potential in health promotion because it makes it easier to achieve goals at every level (Leonita & Jalinus, 2018) . One of the social media that can be used is TikTok. This application provides access to users in creating videos, editing, and can also share them easily which is equipped with supporting features. Based on the Business of Apps report, Tiktok's monthly active users in the second quarter of 2022 amounted to 1.46 billion active users worldwide, an increase of 62.52 percent compared to the previous year. Tiktok's active users have increased rapidly since the beginning of the pandemic in 2020. When compared to the previous five years, Tiktok users increased by more than 1.000 percent. A study conducted in Canada stated that social media use among adolescent girls is twice as great when compared to adolescent boys with a duration of more than two hours a day (Sampasa-Kanyinga et al., 2020). Health education in schools plays a major role in improving students' knowledge, attitudes, and practices (R. et al., 2020). In addition, questions of attitudes and practices related to anemia are used to identify the level of correct attitudes and practices towards health. Therefore, researchers want to conduct research on the influence of nutrition education through TikTok on changes in health problems in Mataram City.

METHODS

This study is a quasi-experimental research with a pretest posttest design with a control group, a pretest posttest design with an experimental group being educated using TikTok video media for two months and a control group being educated using Leaflet media. The subjects in this study were 64 students of SMAN 5 Mataram and SMAN 9 Mataram who were divided into two groups, namely 32 people in the treatment group and 32 people in the control group. This research was carried out in August-October 2022 where intervention activities were given for 2 months. This study took place at SMAN 5 Mataram and SMAN 9 Mataram, the sampling technique was purposive sampling, and the variables measured were knowledge, attitude, iron intake and compliance with consuming iron tablets (blood supplement tablets). In this study, the data analyzed was not normally distributed where the significance value was < 0.05 so that to see the difference between pretest and posttest in one group (paired data), namely the treatment group or control group, a study was conducted. using a non-parametric test, namely Wilcoxon Signed Test Rank and tests were carried out Nonparametric use of the Mann Whitney U test to determine the differences between the two media on knowledge, attitudes, Fe intake and adherence to consuming blood supplement tablets. This research has

been approved by the Ethical Approval Commission of the Health Polytechnic of the Ministry of Health of Mataram Number: LB.01.03/6/5788/2022.

RESULTS AND DISCUSSION

Subject Characteristics

Subject Characteristics in the treatment group, the majority of subjects aged 15-16 years were 24 people (75%), while in the control group aged 16-17 years, it was 16 people (50%).

Table 1. Subject Characteristics

Characteristics	Intervention		Control	
	N	%	N	%
Age				
15-16 years	24	75.0	16	50.0
17-18 years	8	25.0	16	50.0
Total	32	100.0	32	100.0
Family size (people)				
Small family (1-4)	18	56.3	11	34.4
Medium family (5-7)	14	43.8	20	62.5
Big family (≥ 8)	0	0.0	1	3.1
Total	32	100.0	32	100.0
Father's education				
Higher	24	75.0	16	50.0
Secondary	6	18.8	10	31.3
Primary	2	6.3	6	18.8
Total	32	100.0	32	100.0
Mother's education				
Higher	15	46.9	8	25.0
Secondary	14	43.8	14	43.8
Primary	3	9.4	10	31.3
Total	32	100.0	32	100.0
Father's work				
Civil servant	9	28.1	9	28.1
Entrepreneur	13	40.6	14	43.8
Private employee	7	21.9	4	12.5
others	3	9.4	5	15.6
Total	32	100.0	32	100.0
Mother's work				
Civil servant	3	9.38	3	9.4
Entrepreneur	5	15.6	4	12.5
Private employee	4	12.5	1	3.1
Housewife	20	62.5	19	59.4
Others	0	0.0	5	15.6
Total	32	100.0	32	100.0
Father's income (Based on the Minimum Wage of the People of Mataram City Rp.2.400.000.- in 2023)				
> UMR	14	43.8	15	46.9
< UMR	18	56.3	17	53.1
Total	32	100.0	32	100.0
Mother's income (Based on the Minimum Wage of the People of Mataram City Rp.2.400.000.- in 2023)				
> UMR	4	12.5	4	12.5
< UMR	28	87.5	28	87.5
Total	32	100.0	32	100.0

The subjects in the treatment group were mostly included in the small family category, which was 18 subjects (56.3%), while in the control group, the majority of subjects were included in the medium family category, which was 20 subjects (62.5%). In the treatment group, most of the subjects of father's education included higher education, which was 24 people (75%), while in the control group, the subjects were highly educated, namely 16 people (50.0%). The most fathers' jobs were in the self-employed category, which was 13 people (40.6%), and the most mothers' jobs were as housewives, which was 20 people (62.5). Meanwhile, in the control group, most of the fathers' jobs were self-employed, namely 14 people (43.4%) and the mothers' jobs were mostly as housewives as many as 19 people (59.4).

Parents' work has a direct influence on income or income in a family and is also closely related to what the family needs. Fathers' income was mostly under the UMR, which was 18 people (56.3%), and most of the mothers' income was under the UMR, which was 27 people (84.4%), while in the control group, the majority of fathers' income was under the minimum wage, which was 17 people (53.1%), and income above the minimum wage was 15 people (46.9%).

Based on table 2, it is known that in the intervention group, the majority of subjects have knowledge about anemia which is included in the adequate category those are 31 people (96.9%), after the treatment in the intervention group, the majority of subjects have knowledge. about anemia that is included in the good category. while in the control group

most of the subjects had knowledge about anemia which was included in the adequate category those are 30 people (93.8%) and after being educated, most of the subjects had knowledge about anemia which was included in the good category as many as 16 people (50%), and adequate knowledge about anemia as many as 15 people (46.9%).

Table 2. Distribution of variables based on treatment

Variable	Intervention				Control			
	Pre		Post		Pre		Post	
	N	%	N	%	N	%	N	%
Knowledge								
Good	0	0.0	25	78.1	0	0.0	15	46.9
Adequate	31	96.9	7	21.9	30	93.8	16	50.0
Poor	1	3.1	0	0.0	2	6.3	1	3.1
Attitude								
Good	0	0.0	31	96.9	0	0.0	29	90.6
Adequate	32	100	1	3.1	31	96.9	3	9.4
Poor	0	0.0	0	0.0	1	3.1	0	0.0
Iron Intake								
Above sufficiency	1	3.1	2	6.3	1	3.1	3	9.4
Normal	3	9.4	5	15.6	1	3.1	5	15.6
Mild level deficit	0	0.0	4	12.5	2	6.3	4	12.5
Moderate level deficit	2	6.3	5	15.6	5	15.6	2	6.3
Severe deficit	26	81.3	16	50.0	23	71.9	18	56.3
Compliance Consumption of blood supplement tablets								
Obedient	0	0.0	24	75.0	0	100	15	46.9
Disobedient	32	100	8	25.0	32	100	17	53.1

In the intervention group, the majority of subjects had an attitude about anemia in the adequate category, which was 32 people (100.0%), after the treatment in the intervention group, the majority of subjects had an attitude about anemia in the good category, namely 31 people (96.9%). Meanwhile, in the control group, the majority of subjects had attitudes about anemia which was included in the adequate category, namely 31 people (96.9%), and 3 people (3.1%) had attitudes about anemia which was included in the poor category afterwards. After being given nutrition education, most of the subjects had attitudes about anemia which was included in the good category, namely 29 people (90.6%).

The iron intake of the subjects in the treatment group was mostly in the severe deficit category, which was as many as 26 people (81.3%), after being given the treatment in the intervention group, most of the iron intake of the subjects still in the severe deficit category, but the number decreased to 16 people (50.0%). Meanwhile, in the control group, it was seen that the iron intake of most subjects was included in the category of severe deficit, namely 23 people (71.9%), after being given education, the iron intake of most subjects was still included in the category of severe deficit, namely 23 people (71.9%), in the category of severe deficit but the number decreased to as many as 18 people (56.3%).

Most of the subjects, both the intervention group and the control group, were included in the category of disobedient with taking iron tablets, namely 32 people (100.0%) each after being given the intervention. In the intervention group, most of the subjects were included in the category of obedient to taking iron tablets, which was 24 people (75.0%), while in the control group, it was seen that the majority of subjects were included in the category of disobedient with taking blood supplement tablets, namely 17 people (53.1%).

Comparison of mean values between the two groups.

Based on table 3, it is known that the results of the statistical test using the Wilcoxon Signed Rank Test in the intervention group obtained a significance value (p) = 0.000 smaller than $\alpha = 0.005$ so that the hypothesis is accepted, namely that there is a difference in knowledge scores before and after being given nutrition education using TikTok video media. Meanwhile, in the Wilcoxon test group, a significance value (p) = 0.000 was obtained smaller than $\alpha = 0.005$ so that the hypothesis was accepted, namely there was a difference in knowledge scores before and after nutrition education using leaflet media. There was an increase in two groups, namely the treatment group and the control group after being given the treatment. It can be said that there is an

increase in adolescent girls' knowledge about anemia after receiving nutrition education compared to before receiving nutrition education, this can be seen from the average results of pretest and post test scores that have increased.

The results of the statistical test of the use of TikTok and Leaflet media on knowledge and attitudes about anemia using the Mann Whitney U test showed that the value (p) was smaller than α = 0.05 so that the hypothesis was accepted, namely that there was a significant influence of differences. The results of the statistical test of the use of TikTok media in nutrition education for iron intake using the Wilcoxon sign rank test obtained a result (p) = 0.007 smaller than α = 0.05 so that the hypothesis is accepted, it's mean there is a difference in iron intake before and after being given nutrition education using TikTok video media.

Table 3. Average difference before and after education

Variable	Average ± Standard Deviation (Min-Max) Intervention	Control
Knowledge		
Before	71.3 ± 6.1 (52-57)	73.7 ± 5.4 (56-80)
After	92.3 ± 10.2 (72-110)	83.3±11 (80-108)
p-value (Wilcoxon Signed Test Rank)	0.000	0.000
P-value Mann Whitney U	0.003	
Attitude		
Before	57.5±3.5 (50-60)	58.1±3.5 (44-60)
After	71.2±5.7 (56-80)	67.5±7.2 (52-80)
p-value (Wilcoxon Signed Test Rank)	0.000	0.000
P-value Mann Whitney U	0.028	
Iron Intake		
Before	8.2±35.7 (4.8-20.3)	8.5±33.7 (4.3-19.2)
After	10.8±39.2 (5.1-22.5)	10.5±44.4 (4.5-21.3)
p-value (Wilcoxon Signed Test Rank)	0.007	0.051
P-value Mann Whitney U	0.707	
Compliance Consumption of blood supplement tablets		
Before	0.97±1.2 (0-4)	1.6±1.0 (0-4)
After	3.5±1.0 (0-4)	2.9±1.2 (0-4)
p-value (Wilcoxon Signed Test Rank)	0.000	0.000
P-value Mann Whitney U	0.021	

Meanwhile, in the control group (leaflet media), the Wilcoxon sign rank test p = 0.051 was bigger than α = 0.05 so that the hypothesis was rejected that there was no difference in knowledge scores before and after being given nutrition education using leaflet media. The results of statistical tests in the intervention and control groups using the Wilcoxon Signed Rank Test showed that the p result was less than α = 0.05 or there was a significant difference in the use of TikTok and Leaflet video media on the subject's compliance with taking iron tablets.

The age of 15-17 years is considered a teenager. At this time, adolescents are more comfortable with their own circumstances, like to discuss, begin to make friends with the opposite sex and draw up future plans. Table 1 shows that the characteristics between the intervention and control groups are not significantly different. However, there are significant differences in the big variables of family and father's education. The majority of adolescents in the intervention group lived with their families. Living with parents can influence adolescents to seek information about anemia through social media, electronic media, and the environment. In contrast, living in a dorm can limit access to social media and make them only dependent on information from the environment, such as friends and teachers. Therefore, teachers are expected to actively disseminate knowledge about anemia and its prevention. Health education has been an important part of increasing knowledge about anemia prevention (S. H. et al., 2012) (F. S. et al., 2016).

Health education is an important factor, as a basis for changing knowledge, attitudes and practices in preventing anemia (N.I. & F, 2021). A person's opinion or assessment of matters related to health services is the meaning of attitude, while practice is all activities of people in order to maintain health (Nation,

2014). Adolescent health behaviors depend on trustworthy sources (M.A. et al., 2013). The inability to access credible, reliable, and accurate information can negatively impact knowledge (D. & T, 2009).

This study was developed based on theoretical concepts and extensive literature searches and its content is comprehensive because it considers foods or drinks that can be consumed along with iron supplements such as fruits rich in vitamin C, as well as foods that must be avoided such as coffee, tea, milk, and rice when consuming iron or iron-rich tablets. food due to the promotion or inhibition of iron absorption. This research applies social media as a means of delivering interventions. Conveying educational interventions using mobile phone applications on the use of smart phones is increasing. The content of these interventions is presented in attractive infographics with clear animations and audio explanations to provide a better understanding compared to traditional health promotion methods.

Based on research conducted by Rusdi (2021), it explains the results that nutrition e-education using Instagram has an influence and is effective in changing knowledge about balanced nutrition in adolescent girls (R. F. Y. et al., 2021). According to Murdiningrum & Handayani's (2021) research, conventional lectures rank last on the list of the most effective nutrition teaching media, followed by social media such as Instagram, Whatsapp, and Twitter, as well as the combination of lectures with videos, games, and quizzes (M. S & H, 2021).

In addition, Khotimah (2019) research shows that there is a variation in the understanding of adolescent girls in Tebas Kuala Village about anemia before and after receiving nutrition counseling through social media. Protein intake varies between those who receive nutrition education through anemia Instagram and receive nutrition counseling through Instagram media. Likewise, with nutrition education through Instagram for their varied vitamin C intake (K. H et al., 2019). This study showed a change in improvement practices during the intervention. The reasons for behavioral changes to anemia are multifactorial and complex.

There are many possible factors that affect success in changing behavior, such as self-motivation, understanding in applying habits. In addition, the ideal time to improve behavior is six months or more (S.J. et al., 2013). Research conducted by Singh et al. explains that the most important strategy in preventing anemia is knowledge and practice. Supported by research conducted by Ghosh at al., despite having good knowledge and a positive attitude, very few practices are applied (G. S. et al., 2020). The educational methods and strategies used in this study are different from others. This study uses an interactive learning approach, which is basically a combination of limited face-to-face education and education on social media. Meanwhile, online education is carried out by disseminating nutritional information in the form of videos on social media such as TikTok in a structured and systematic manner. A systematic review by Lroche et al. (2020) found that social media may be considered as a means of communication to promote healthy lifestyle habits in organizations; However, some authors have recommended additional research on this technology to evaluate the additional impact of social media and promote a healthy lifestyle (E et al., 2020).

Another study conducted in Purwokerto, Indonesia showed an increase in nutrition knowledge, energy intake, and protein after social media-based nutrition education in rural and urban areas (I et al., 2019). A systematic review by Chau et al. (2018) found that social media is a promising nutrition intervention platform for adolescents and young adults (MM et al., 2018).

CONCLUSION

Based on the results of the study, most of the subjects are 15-16 years old, most of the subjects belong to the category of medium families, some of the subjects' fathers are higher education, while most of the subjects' mothers are secondary education, the father's job is mostly entrepreneur, and the parents' income is mostly under the regional minimum wage. There were significant differences in knowledge, attitudes and compliance consumption of blood-boosting tablets in the intervention group and the control group. There was no significant difference in the use of tiktok media or leaflets in iron consumption intake in the two treatment groups.

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CONFLICT OF INTEREST

The author declarate no conflict of interest.

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THE EFFECT OF BOOKLET MEDIA ON GENITALIA *PERSONAL HYGIENE* KNOWLEDGE IN ADOLESCENTS AT PANTI ASUHAN PUTRI AISYIYAH YOGYAKARTA

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ABSTRACT

Background: *Personal hygiene genitalia is a person's knowledge, attitudes, and behaviors that improve health, maintain the cleanliness of the reproductive organs, and prevent the onset of diseases. Common reproductive health disorders include urinary tract infections, vaginal discharge, pelvic inflammatory diseases, and cervical cancer. Genetically modified personal hygiene behavior is fundamental because it is related to the prevention of negative impacts on reproductive health. The purpose of this study is to determine the influence of booklet media health education on genitalia personal hygiene knowledge in adolescents at Panti Asuhan Putri Aisyiyah Yogyakarta.*
Method: *This study uses a quantitative method with a quasy experiment, one group pretest, and posttest design. The population and sample in this study were 39 young women at Panti Asuhan Putri Aisyiyah Yogyakarta. Data collection will be carried out in August 2024. The research instrument used a personal hygiene genitalia knowledge questionnaire and a personal hygiene genitalia booklet media in women. The results of the study were analyzed using the Wilcoxon test.*
Result: *The results of the study showed that genetic personal hygiene knowledge before being given health education was in the sufficient category (69.2%). Then, after being given health education, knowledge increased to the good category (97.4%). The results of the Wilcoxon test strengthened the data obtained with a value of p=0.000.*
Conclusion: *The booklet on media health education influences genitalia and personal hygiene knowledge in adolescents at Panti Asuhan Putri Aisyiyah Yogyakarta.*

Keywords: *Adolescents, Knowledge, Personal Hygiene Genetalia, Media Booklet*

INTRODUCTION

Adolescence is an important phase in individual development characterized by physical, psychological, and hormonal changes. At this stage, there is a maturation process that affects the overall health and well-being of adolescents (Octavia, 2020). However, not all adolescents have the same opportunity to grow up in a harmonious family environment. Many children face a variety of challenges, including orphans who have lost parents or do not have families who can provide support. These children are often in vulnerable conditions and experience a lack of the affection and attention they should receive (Ariyadri, 2021)

Reproductive health is an important aspect that must be considered, especially for adolescent girls. Reproductive health encompasses more than just physical problems; but it also relates to psychological and social well-being. Adolescent girls can face a variety of reproductive health problems, including early marriage, unsafe abortions, unexpected pregnancies, and premarital sexual intercourse (Yarza et al., 2019). One of the main problems that is often faced is the lack of knowledge about personal hygiene genetics, which functions to maintain the health of the reproductive organs and prevent the onset of diseases. Common reproductive health disorders among adolescent girls include urinary tract infections, vaginal discharge, and pelvic inflammatory disease (Putri et al., 2021).

According to data from the World Health Organisation, reproductive tract infections (ISR) are a significant global health problem, with a high prevalence among adolescent girls. In Indonesia, 75% of women report experiencing vaginal discharge at least once in their lives (WHO, 2021). Research by Maysaroh & Mariza (2021) shows that 45% of adolescent girls in Yogyakarta have experienced vaginal discharge, while Fariningsih et al., (2022) found that only 48.6% of adolescents have sufficient knowledge about vulvar hygiene during menstruation. These findings show that adolescent girls' knowledge of genital hygiene is still low, so efforts are needed to improve their understanding.

Knowledge is a key factor that influences an individual's health behavior. Knowledge about personal hygiene genitalia can help adolescents to maintain the cleanliness of the reproductive organs and prevent various health problems (Fitriani et al., 2023). Research shows that individuals with good knowledge of genital hygiene tend to have more positive behaviors in maintaining reproductive health (Rosa et al., 2020). However, many adolescents lack adequate information about this, which has the potential to increase their health risks (Nurwidyansyah et al., 2020).

Health education is one of the effective ways to increase adolescents' knowledge about personal hygiene genetics. Through structured health education, adolescents can learn about the importance of maintaining the cleanliness of the reproductive organs and recognize the associated health risks (Suheni et al., 2020). Media booklets, as a tool for health education, have been proven to be effective in conveying information in an engaging and easy-to-understand way (Mujito & Abiddin, 2022). Hidayati's research (2021) shows that the use of booklet media can improve adolescents' understanding of reproductive health, including genitalia hygiene.

A preliminary study conducted at Panti Asuhan Putri Aisyiyah Yogyakarta showed that the population of adolescent girls aged 12 to 18 years was 39 people, and no health education program discussed personal hygiene genitalia. This indicates that there is a gap in adolescents' knowledge and understanding of reproductive health, which is the basis for this study. The purpose of this study is to evaluate the influence of health education using booklet media on genitalia personal hygiene knowledge in adolescents in orphanages. By improving their knowledge, it is hoped that young women can better maintain their reproductive health and reduce the risk of future health problems.

METHODS

This study is a quantitative research with a quasy experiment, one group pretest, and posttest design. The population and sample in this study were 39 adolescents at Panti Asuhan Putri Aisyiyah Yogyakarta. Data collection will be carried out in August 2024. The research instrument used a personal hygiene genitalia knowledge questionnaire and a personal hygiene genitalia booklet media in women. The questionnaire contains 15 questions, which have been tested for validity and reliability. The media booklet is compiled from references related to personal hygiene genitalia. Validity testing was carried out by two expert judges in the field of health promotion and expert judgment in the field of reproductive health. The results of the study were analyzed using the Wilcoxon test.

This research has received ethical feasibility approval by the Research Ethics Commission of the Faculty of Health, Jenderal Achmad Yani University, Yogyakarta, with a research ethics permit number, namely Skep/388/KEP/VII/2024.

RESULTS AND DISCUSSION

3.1. Respondent Characteristics

Characteristics of respondents are presented in Table 1.

Table 1. Respondent Characteristics

Respondent Characteristics	Frequency (f)	Percentage (%)
Age (Year)		
12	9	23,1
14	7	17,9
15	8	20,5
16	11	28,2
17	2	5,1
18	1	2,6
20	1	2,6
Menarche (Year)		
9	2	5,1
10	3	7,7
11	10	25,6
12	13	33,3
13	9	23,1
14	2	5,1
Have *a mobile phone*		
Yes	19	48,7
No	20	51,3
Get personal hygiene genitalia information		
Yes	19	48,7
No	20	51,3
Resources		
None	19	48,7
Parents	1	2,6
Teacher	7	17,9
Medium mass	1	2,6
Peers	2	5,1
Health workers	9	23,1
Total	**39**	**100**

Based on Table 1, most of the respondents in this study were 16 years old as much as 28.2%, experienced menarche at the age of 12 years, as much as 33.3%, had a mobile phone as much as 100%, had never received personal hygiene information genitalia as much as 51.3%, and had never received personal hygiene information as much as 48.7%, their source of information was obtained by 23.1% from health workers.

3.2. Personal Hygiene Knowledge Before Being Given Health Education Using Media Booklet

Table 2. Personal Hygiene Knowledge Before Being Given Health Education Using Media Booklet

Pretest Knowledge	Frequency (f)	Percentage (%)
Poor	3	7,7
Average	27	69,2
Good	9	23,1
Total	**39**	**100**

Table 2 shows that most of the respondents, before being given health education using booklet media, mostly knew the average category as much as 69.2%.

This research is in line with the research of Fariningsih et al., (2022), which stated that as many as 48.6% of adolescents still do not know enough about vulva hygiene during menstruation, so efforts are needed to improve their knowledge. Conceptually, a person's knowledge is influenced by several factors, such as education, access to information, experience, culture, and socioeconomic status (Notoatmodjo, 2010). In this study, most of the respondents, 51.3%, had never received information related to personal hygiene genitalia, and only a small percentage got it from health workers. This indicates that there are limitations in the dissemination of relevant information in the orphanage environment. Health workers have an important role in bridging adolescents' information needs, not only as material presenters but also as emotional support providers who help adolescents make healthy decisions. With the right approach, health workers can improve adolescents' awareness and skills in maintaining their health (Suheni et al., 2020).

According to Notoatmodjo (2010), health education is an effort to change people's bad behavior in terms of health. This is because health education teaches people how to maintain their health, avoid or prevent things that have a bad impact on their health, and if they are sick, they must seek treatment. Health

education provides many benefits to the community by conveying messages and even increasing confidence so that individuals, groups, or communities can be aware, understand, and willing to apply the health knowledge that has been obtained through health education (Cholida & Isnaeni, 2022; Hasanah et al., 2024).

Information support for health education is provided not only by health workers but also by the school environment. Schools play an important role in providing health education through curriculum, extracurricular activities, and health awareness programs. The results of this study show that the most information obtained after health workers is through teachers (17.9%). With the collaboration of teachers, counselors, and peers, students receive comprehensive and relevant information that drives better health understanding and practice (Elsad & Widjaja, 2022).

The genetic personal hygiene health education that adolescent girls need to get certainly needs support from the orphanage. However, in this study, the Aisyiyah Orphanage does not have a health education program regarding personal hygiene genitalia. It can be proven that there is no source of information obtained by adolescents (48.7%). Information sources from health workers are very important in health education for adolescents, especially in the application of personal genitalia hygiene until they become adults. Accurate and reliable information helps health workers provide relevant and effective education to help adolescents understand the importance of personal genitalia hygiene and implement correct practices. With the proper knowledge, adolescents can manage their health better, prevent health problems in the future, and develop healthy habits that will last into adulthood (Suheni et al., 2020; Cholida & Isnaeni, 2022).

3.3. Personal Hygiene Knowledge After Being Given Health Education Using Booklet Media

Table 3. Personal Hygiene Knowledge After Being Given Health Education Using Media Booklet

Posttest Knowledge	Frequency (f)	Percentage (%)
Average	1	2,6
Good	38	97,4
Total	**39**	**100**

Based on Table 3, it was found that most of the respondents, after being given health education using booklet media, experienced an increase in knowledge in the good category by 97.4%. This is in accordance with Suheni *et al*., (2020), who state that health education has an impact on adolescent girls' understanding of vulva hygiene. In this study, young women showed a significant increase in knowledge.

Increasing knowledge will be an important factor that affects the management of genetically modified personal hygiene management. With better knowledge, adolescents can understand the importance of maintaining personal hygiene genitalia, recognize the risks and impacts of poor personal hygiene genitalia, and be encouraged to take proactive steps in maintaining their health. This can contribute to improved quality of life and long-term health (Susilowati et al., 2023).

The increase in knowledge in this study is related to the demographics of the respondents, where the largest percentage of respondents are included in the category of middle adolescents (15-17 years) with a percentage of (53.8%). This shows that adolescents at this age have the potential to have a deeper understanding of the importance of personal hygiene genetics and are able to apply information about the importance of personal hygiene genitalia in daily life. With increased knowledge, adolescents can make better decisions regarding reproductive health and personal hygiene.

Educational media has the advantage of arousing the interest and focus of adolescents so that it can increase their attention to health education. An interactive and creative approach can channel information in a more engaging and easy-to-understand way. This method allows adolescents to be more involved in the learning process so that they are able to remember and apply the knowledge gained. Thus, educational media plays an important role in supporting effective health education efforts (Hasanah et al., 2024)

In this study, the health education media used was a booklet. Booklets are printed media resembling books that contain information in the form of text and illustrations (Nurwidyansyah et al., 2020). The advantage of booklets over other media, such as leaflets and pocketbooks, is that information is presented more completely, more detailed, and clearer (Mujito & Abiddin, 2022)

3.4. The Influence of Media Booklet on Personal Hygiene Knowledge

Table 4. Data Normality Test Results

Category	*Shapiro-Wilk*		
	Statistic	***df***	***Sig.***
Pretest Knowledge	0,712	39	0,000
Posttest Knowledge	0,150	39	0,000

Table 4 shows that the results of the normality test of the data of this study obtained a significance value of both the pretest and posttest of this study of 0.000, so it can be concluded that the data is not distributed normally. Furthermore, the hypothesis test of this study uses the Wilcoxon test.

Table 5. Wilcoxon Test Results of the Effect of Media Booklet on Personal Hygiene Knowledge

	N	***Min***	***Max***	***Mean***	***Std. Deviation***	***P Value***
Pretest Knowledge	39	1	3	2,15	0,540	
Posttest Knowledge	39	2	3	2,97	0,160	
Posttest Knowledge Pretest Knowledge	39					0,000
Total	39					

Based on the table above, there is a significant change in the level of knowledge of respondents based on the results of the pretest and posttest. Before treatment, the average value of respondents' knowledge was only 2.15, with a standard deviation of 0.540, and the lowest value was 1, indicating that some respondents had very low knowledge. After being treated in the form of health education with booklet media, the average knowledge increased to 2.97 with a standard deviation of 0.160, and the minimum value increased to 2, indicating that there were no more respondents with very low knowledge. The Wilcoxon test obtained a value of p = 0.000, which proves that booklet media significantly improves personal hygiene genitalia knowledge in adolescents at Panti Asuhan Putri Aisyiyah Yogyakarta.

These results are in line with the research of Hasanah et al., (2024), which shows that the dissemination of leaflets and booklets in some media can increase awareness of menstrual hygiene. In this study, data analysis showed a significant increase in knowledge about personal hygiene genetics in adolescents. Most of the respondents before being given the intervention were in the category of sufficient knowledge, which was as much as 69.2%. After the intervention was given, most of the respondents were in the category of good knowledge, which was as much as 97.4%.

This improvement shows that the method used is effective in increasing adolescents' understanding of the importance of personal hygiene genetics. These results are in line with the research of Millenia et al., (2022), which found that structured health education initiatives greatly improve respondents' knowledge. Success in providing health education is highly dependent on appropriate and effective learning methods. The understanding and engagement of the younger generation can be improved through appropriate means by ensuring that information is well received. The booklet is used as a health education medium in this study.

Booklets contain not only illustrations but also writing, which allows the material to be developed based on specific topics and needs. In this way, readers can get a lot of information from the material presented through the booklet and can learn from the images displayed. In addition, booklets have additional advantages, such as not requiring electricity to function properly. One of the things that makes this booklet trustworthy is the fact that previous research has shown that booklets are effective as a means of learning (Sinaga et al., 2022). Research by Hidayati (2021) also states that health education media in the form of booklets is more effective and interesting to read, especially when equipped with animated images, so that it is easier for adolescent girls to understand. This study uses booklet media that is specifically designed to convey relevant and interesting information for adolescents. The booklet covers various topics, such as the definition of personal hygiene genitalia, the purpose of personal hygiene genitalia, the impact of poor personal hygiene genitalia, and how to maintain good personal hygiene genitalia.

CONCLUSION

Health education using booklet media has proven to be effective in increasing personal hygiene genitalia knowledge in adolescents at Panti Asuhan Putri Aisyiyah Yogyakarta.

Adolescents are advised to use the booklet as a guide to maintain personal hygiene. Teachers are expected to integrate booklets into interactive education. Parents or guardians can support open communication regarding reproductive health. Nurses are advised to make booklets as a routine counseling medium that is friendly to teenagers. Researchers can further develop more varied and interactive educational media, such as videos or mobile applications. The collaboration of all parties is important to forming clean and healthy living behaviors in adolescents, especially in the orphanage environment.

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CONFLICT OF INTEREST

The researcher stated that there was no conflict of interest in the implementation and reporting of this research. The entire research process was carried out independently without any intervention from any party that could affect the results or interpretation of the data. No financial, professional, or personal relationships can affect the objectivity of this research.

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COMPARATIVE EFFECTIVENESS OF PUMPKIN CREAM SOUP AND MORINGA LEAF JUICE IN REDUCING BLOOD GLUCOSE LEVELS

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ABSTRACT

***Background**: Blood glucose management is crucial for preventing complications related to diabetes. Nutritional interventions such as Moringa leaf juice and pumpkin cream soup have been proposed as functional foods to assist in glycemic control. This study aimed to evaluate the effectiveness of Moringa leaf juice and pumpkin cream soup compared to a control group in reducing blood glucose levels among adult participants.*
***Methods**: A quasi-experimental study was conducted involving three groups: Moringa leaf juice intervention (n=20), pumpkin cream soup intervention (n=20), and a control group (n=20). Blood glucose reduction was measured pre- and post-intervention. Data were analyzed using the Kruskal-Wallis test followed by post-hoc pairwise comparisons using the Mann-Whitney U test with Bonferroni correction. Effect sizes between groups were assessed using Cohen's d.*
***Results**: The Kruskal-Wallis test revealed significant differences in blood glucose reduction among the groups (p = 0.027). Post-hoc analyses indicated that both intervention groups (Moringa leaf juice and pumpkin cream soup) showed greater reductions compared to the control group; however, these differences were not statistically significant after Bonferroni correction. The comparison between Moringa leaf juice and pumpkin cream soup was not statistically significant (p = 0.950). Effect size analysis demonstrated small to moderate effects between the intervention groups and the control group, suggesting a clinically meaningful, though statistically non-significant, improvement in glucose control.*
***Conclusion**: Both Moringa leaf juice and pumpkin cream soup interventions exhibited potential benefits in lowering blood glucose levels compared to no intervention. The observed effect sizes highlight their potential as complementary dietary strategies for blood glucose management. Further studies with larger sample sizes and longer intervention periods are recommended.*

***Keywords**: Blood Glucose Reduction; Functional Foods; Pumpkin Cream Soup; Moringa Leaf Juice*

INTRODUCTION

Diabetes mellitus (DM) remains a significant global health challenge, with its prevalence escalating annually. Effective management of blood glucose levels is crucial to prevent complications associated with DM. While pharmacological treatments are standard, there's growing interest in non-pharmacological approaches, particularly dietary interventions, to complement traditional therapies.

Functional foods—those offering health benefits beyond basic nutrition—have garnered attention for their potential role in glycemic control. Ingredients like pumpkin (Cucurbita moschata) and moringa (Moringa oleifera) are rich in bioactive compounds that may aid in reducing blood glucose levels. For instance, a study demonstrated that constituents from Cucurbita moschata exhibit antidiabetic activities through multiple mechanisms, suggesting its potential as a functional food for diabetes management [Chang, et al., 2014].

Similarly, moringa leaves are known for their high antioxidant content and have been studied for their hypoglycemic effects. Incorporating such functional foods into the diet could offer a natural strategy to manage blood glucose levels, especially in individuals with type 2 diabetes mellitus (T2DM).

Recent research has explored various functional food interventions. A study on a high-fiber food bar made from corn and green beans showed a significant reduction in blood glucose levels among T2DM patients,

highlighting the efficacy of dietary fiber in glycemic control [Marbun et al., 2023]. Another investigation into a synbiotic yogurt containing banana flour indicated potential benefits in metabolic syndrome patients, although results were not statistically significant [Suhaema et al., 2023].

Despite these promising findings, comparative studies assessing the effectiveness of different functional foods on blood glucose reduction remain limited. This study aims to evaluate and compare the impacts of pumpkin cream soup and moringa juice interventions on blood glucose levels in individuals with T2DM, providing insights into their potential as complementary dietary strategies.

METHODS

A pre-post controlled experimental study involving three groups: Pumpkin Cream Soup (n = X); Moringa Juice (n = Y); Control Group (n = Z). Participants were adults with elevated blood glucose (pre-diabetic or diabetic range) and no recent anti-diabetic medication adjustments. Intervention are:

1. The pumpkin cream soup group received 200 mL of cream soup daily.
2. The moringa leaf juice group received 150 mL of fresh moringa juice daily.
3. The control group received no dietary intervention.

The intervention lasted for 7 days. Random blood glucose was measured before and after the intervention using a standardized glucometer. Data were analyzed using: Normality tests to determine appropriate statistical tests, Paired t-tests (within-group comparisons), Uji Post-hoc (Pairwise Mann-Whitney U Test) with Bonferroni correction and to evaluate the magnitude of the intervention effects on blood glucose reduction, Cohen's d was calculated for each pairwise comparison between the study groups. The interpretation of effect sizes followed Cohen's conventional thresholds: 0.2 (small), 0.5 (medium), and 0.8 (large). The use of Cohen's d in this context allowed for a better understanding of how meaningful the differences in blood glucose reduction were between the interventions, beyond statistical significance alone.

RESULTS AND DISCUSSION

Descriptive Analysis Results

A descriptive analysis was conducted to evaluate the change in blood glucose levels before and after the intervention across the three study groups. The Cream Soup and Moringa Juice groups demonstrated a noticeable reduction in both mean and median glucose levels, suggesting a positive impact of the dietary interventions. In contrast, the Control group showed only a slight decrease, which may reflect natural variation rather than a treatment effect. These patterns support further inferential analysis to assess the statistical significance of these changes.

Table 1. Descriptive Distribution of Blood Glucose Levels by Group (Pre- and Post-Intervention)

Group	Time Point	Mean (mg/dL)	SD (mg/dL)	Median (mg/dL)
Cream Soup	Pre	153.3	34.6	150.0
	Post	130.6	35.9	128.0
Moringa Juice	Pre	151.3	37.2	153.0
	Post	134.0	33.5	132.0
Control	Pre	141.8	28.7	140.0
	Pos	134.2	27.6	132.0

The **Pumpkin Cream Soup** group (n = 20) showed the greatest mean reduction in blood glucose levels, with a mean change of **25.60 mg/dL** (SD = 8.74). The median reduction was 24.00 mg/dL, with values ranging from 14.00 to 41.00 mg/dL. The **Moringa Leaf Juice** group (n = 20) had a slightly lower average glucose reduction, with a mean of **22.40 mg/dL** (SD = 5.94), a median of 23.00 mg/dL, and a range between 11.00 and 29.00 mg/dL. The **Control** group (n = 20) demonstrated the least improvement, with a mean change of **13.80 mg/dL** (SD = 7.08). The

glucose reduction ranged from 1.00 to 25.00 mg/dL, with a median of 12.50 mg/dL.

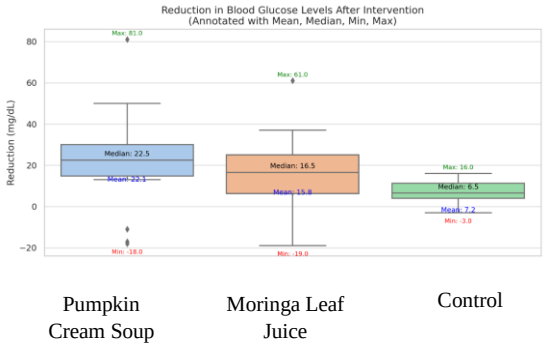


Figure 1. Reduction Blood Sugar

Both Pumpkin Cream Soup and Moringa Leaf Juice groups showed significantly greater reductions in blood glucose compared to the Control group**, suggesting that both interventions had a beneficial effect.** There was no significant difference between Pumpkin Cream Soup and Moringa Leaf Juice**, indicating they are** potentially equally effective in lowering blood glucose.

Differences in Blood Glucose Reduction Among Intervention Groups.

The results of the normality test are that one group is not normally distributed, so the non-parametric test is used. Difference Test Between Groups: Kruskal-Wallis Test Used to determine whether there is a significant difference between the three groups.

Table 2. Shapiro-Wilk Normality Test Results for Blood Glucose Reduction by Group

Group	Uji Normalitas (Shapiro-Wilk)	p-value (paired)
Pumpkin Cream Soup	0.943	0.227
Moringa leaf Juice	0.897	0.038*
Control Group	0.934	0.302

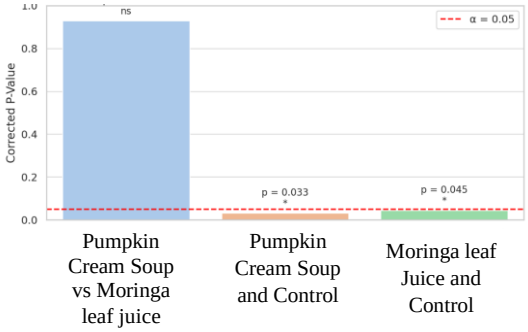
Table 3. Kruskal-Wallis Test for Differences in Blood Glucose Reduction Among Intervention Groups

Variable	Group Comparison	Test Statistic (H)	p-value
Blood Glucose Reduction	Cream Soup Labu Kuning vs Moringa Juice vs Control	7.17	0.027

Table 3 shows the Kruskal-Wallis test results comparing the reduction in blood glucose levels among the three intervention groups. A significant difference was observed ($p = 0.027$), suggesting that at least one group differed from the others in terms of blood glucose reduction.

Post-hoc Analysis Results

Post-hoc analysis using the Mann-Whitney U test with Bonferroni correction for multiple comparisons, we obtained the following results: The analysis revealed a statistically significant difference between the Pumpkin Cream Soup group and the Control group ($p = 0.033$), as well as between the Moringa Leaf Juice group and the Control group ($p = 0.045$), indicating that both functional food interventions were effective in reducing blood glucose levels compared to no intervention. However, no significant difference was observed between the Pumpkin Cream Soup group and the Moringa Leaf Juice group ($p = 0.930$), suggesting that both interventions yielded comparable outcomes in terms of glycemic improvement.



Note: The red dashed line indicates the significance threshold (α = 0.05). Bars below this line are considered statistically significant. Labels such as "" denote significance, while "ns" denotes non-significance.*

Figure 2. Post-Hoc Comparison (Mann-Whitney U with Bonferroni correction)

A **Cohen's d** of **0.91** between *Pumpkin Cream Soup* and *Control* indicates a **large effect size**, suggesting that the intervention with cream soup had a strong impact on lowering blood glucose levels compared to no intervention. The difference between *Moringa Juice* and *Control* yielded a **medium effect size (d = 0.64)**, indicating a moderate impact. The comparison between the two intervention groups (*Pumpkin Cream Soup* **vs** *Moringa*

Juice) resulted in a **small effect size (d = 0.31)**, implying that both interventions are similarly effective with only a slight advantage for Cream Soup.

Tabel 4. Effect sizes between groups were assessed using Cohen's d.

Comparison	Cohen's d	Effect Size Interpretation
Pumpkin Cream Soup vs Moringa Juice	0.31	Small effect
Pumpkin Cream Soup and Control	0.91	Large effect
Moringa Juice and Control	0.64	Medium effect

These results support the hypoglycemic potential of both pumpkin and moringa, aligning with recent studies that show their ability to regulate glucose via antioxidant, anti-inflammatory, and insulin-modulating pathways. Although both showed similar effectiveness, the **pumpkin cream soup** had a slightly greater mean reduction, potentially due to its fiber and polysaccharide content.

The present study demonstrates that both pumpkin cream soup and moringa leaf juice significantly reduced blood glucose levels compared to the control group. The pumpkin-based intervention showed the greatest mean reduction, consistent with previous studies that have highlighted the hypoglycemic potential of pumpkin due to its rich content of polysaccharides, flavonoids, and antioxidants [Liu et al., 2020]. Pumpkin pulp has been shown to modulate insulin sensitivity and reduce oxidative stress, which may explain the significant glycemic improvement observed in the intervention group [Zhou et al., 2021].

The moringa leaf juice also produced a moderate reduction in blood glucose, aligning with findings from recent trials on Moringa oleifera that report improvements in fasting blood glucose and HbA1c levels among prediabetic and diabetic individuals [Mekonnen et al., 2022]. Moringa leaves contain bioactive compounds such as quercetin and chlorogenic acid, which have been linked to enhanced glucose uptake and delayed glucose absorption in the gut [Siddiqui et al., 2023].

While both interventions were effective, the effect size measured by Cohen's d was larger in the pumpkin group (d = 0.91) compared to the moringa group (d = 0.64) when each was compared to the control. This suggests that pumpkin cream soup may offer greater glycemic benefits. However, the small effect size (d = 0.31) between the two intervention groups indicates a relatively similar clinical outcome, supporting the inclusion of both functional foods in dietary strategies for glycemic control.

These findings reinforce the growing interest in functional food-based interventions as complementary approaches for managing blood glucose levels. Compared to pharmacological strategies, such dietary interventions are safer, more accessible, and culturally adaptable.

CONCLUSION

Functional food interventions using pumpkin cream soup and moringa juice significantly reduced blood glucose levels. These findings suggest that incorporating such foods may offer a simple, natural, and effective dietary strategy to support glycemic control. Further long-term studies with larger sample sizes are needed to confirm these outcomes and assess clinical relevance.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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RELATIONSHIP BETWEEN GLYCIZED HEMOGLOBIN (HbA1c) AND SERUM GLUTAMIC OXALOACETIC TRANSMINASE (SGOT) ENZYME ACTIVITY IN PATIENTS TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: *Diabetes Mellitus (DM) is a complex metabolic disorder marked by persistent hyperglycemia—an elevation of blood glucose levels that surpasses normal limits. One effective method to monitor the long-term glycemic control in individuals with DM is through the assessment of Glycated Hemoglobin (HbA1c). This study seeks to explore the intriguing relationship between HbA1c values and Serum Glutamic Oxaloacetic Transaminase (SGOT) enzyme activity in patients with type 2 DM. Notably, SGOT serves as a crucial marker for liver cell damage.*
Method: *This study conducted a cross-sectional exploration focused on a diverse population of patients with type 2 DM aged 18 and older, who met specific inclusion criteria. Data collection was carried out in 2024, with data analysis using the Pearson and Spearman correlation tests.*
Result: *The results reveal an average HbA1c value of 7.8% alongside an average SGOT enzyme activity of 19.9 U/L. Data analysis yielded a significance value of 0.626 ($p > 0.05$), indicating no meaningful relationship between HbA1c levels and SGOT enzyme activity in patients with type 2 diabetes mellitus. This intriguing finding suggests that an elevation in HbA1c levels does not automatically lead to heightened SGOT enzyme activity, implying that not all individuals with type 2 diabetes suffer from liver dysfunction.*
Conclusion: *This finding implies that an increase in HbA1c levels does not necessarily correspond to an increase in SGOT enzyme activity, meaning that not all patients with type 2 diabetes experience impaired liver function. Given these insights, it is crucial for patients with type 2 diabetes to monitor their blood glucose and HbA1c levels regularly.*

Keywords: *Type 2 Diabetes Mellitus, HbA1c, SGOT*

INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disorder caused by high blood glucose levels. When the body does not use the hormone insulin normally, it will cause blood glucose levels to exceed the normal value limit (World Health Organization, 2019). Indonesia occupies the fifth position of DM cases worldwide with 19.46 million sufferers, an increase of 81.8% compared to 2019 (IDF, 2021). According to data from the Jambi Provincial Health Office, it was recorded that in 2022, in Jambi Province, there were 45,641 people with DM. Meanwhile, in Jambi City, there were 13,623 people with diabetes (Dinas Kesehatan Jambi, 2022). Among the health centers in Jambi City, the Pakuan Baru Community Health Center ranks 2nd in DM cases, with 925 patients.

DM is a chronic metabolic disease in the form of a persistent increase in blood glucose or hyperglycemia. The cause of the increase in blood glucose levels is the basis for grouping types of DM. DM can be divided into several types, including type 1 DM, type 2 DM, and gestational diabetes (Ministry of Health, 2020). DM is often known as the silent killer. This is due to the condition of chronic hyperglycemia, which can cause long-term damage, organ damage, especially to the eyes, kidneys, nerves, liver, and blood vessels (Inayatillah, 2016).

According to the American Diabetes Association (ADA), HbA1c examination provides a reliable measurement in chronic hyperglycemia conditions and is well related to the risk of long-term complications of diabetes; the higher the HbA1c in people with DM, the more at risk of complications (ADA, 2018). Continuous increases in blood glucose can cause auto-oxidation of glucose, protein glycation, and activity of the polio metabolic pathway, which further accelerates the formation of Reactive Oxygen Species (ROS) or the formation of oxidative stress. The presence of oxidative stress causes fre radicals in the body to increase. These free radicals can damage various body tissues, one of which is liver cells (Mohamed, J., et al, 2016).

The liver is an organ of the body that functions in neutralizing toxic substances that enter the body, as well as being the target of increased concentrations of free radicals. The concentration of free radicals that are not balanced with antioxidants can cause oxidative stress in the body. Oxidative stress in hyperglycemic conditions causes hepatic cell death (Mohamed, J., et al, 2016). Therefore, it is necessary to examine the liver function of patients with DM to determine abnormalities in the liver organ, which is a complication of DM disease, one of which is the examination of Serum Glutamic Oxaloacetic Transaminase (SGOT) activity. 30% SGOT is found in the cytoplasm of liver cells, and 70% is found in the mitochondria of liver cells. The high activity of SGOT is directly related to the amount of cell damage (Rosida, 2016).

Based on previous research conducted (Reza & Rachmawati, 2017), there is a significant difference in SGOT activity between DM subjects and those without DM. Likewise, research (Shahwan et al., 2019) states that there is a substantial relationship between DM patients (HbA1c > 7) who are not well controlled and SGOT. Research conducted by Kuswarini, S (2022) also states that more than 50% of DM patients experience an increase in SGOT enzyme activity. Meanwhile, research conducted by (SH, 2019) stated that higher SGOT activity was found in DM patients but no statistically observed relationship between increased SGOT activity and HbA1c. Based on the above problems, researchers are interested in researching the relationship between HbA1c values and SGOT enzyme activity in patients with type 2 DM.

METHODS

This study conducted a cross-sectional exploration focused on a diverse population of patients with type 2 diabetes mellitus (DM). The population for this study includes all patients with type 2 DM at Pakuan Baru Health Center, Jambi City, aged 18 and older, who met specific inclusion criteria. To ensure the integrity of our findings, we excluded individuals with a history of hepatitis A, B, or C, as well as those struggling with alcoholism or taking medications known to elevate liver enzyme levels. These medications included various antibiotics, such as ampicillin and carbenicillin; antihypertensives like methyldopa and guanethidine; narcotics and specific vitamins such as folic acid, pyridoxine, and vitamin A. By carefully defining our participant criteria, we aimed to enhance the reliability and relevance of our research outcomes.

HbA1c testing and SGOT enzyme activity assessments were expertly performed using the Afilas-10 (PT. BODITECH MED INDONESIA) and the Dialab Autolyser (Austria) ensuring precise and reliable results for optimal health insights.

RESULTS AND DISCUSSION

This study was conducted on patients with type 2 diabetes, with a total of 35 respondents. Respondents were then grouped based on respondent characteristics. An

overview of the characteristics of the respondents can be seen in the table below (Table 1).

Table 1. Respondent Characteristics

Characteristics	Frequency	Percentage
Gender		
Man	10	28.6 %
Woman	25	71.4 %
Age		
36-45	1	2.9 %
46-55	5	14.3 %
56-65	20	57.1 %
>65	9	25.7%
Long Suffering		
< 5 years	18	51.4 %
> 5 years	17	48.6 %
Total	35	100 %

The measurement results of HbA1C and SGOT are shown in Table 2.

Table 2. The Relationship Between HbA1c Values and SGOT Enzyme Activity in Patients with Type 2 Diabetes

Variabel	Mean	Median	SD	Min	Max	Sig.
HbA1c	7.8	6.800	2.369	4.4	15.0	0.626
SGOT	19.9	16.00	8.769	9	50	0.626

The results of this study indicated that most respondents were diagnosed with type 2 diabetes mellitus (DM) at the age of 5. The longer a person lives with diabetes, the more it contributes to the decline in pancreatic beta cell function, increasing the risk of DM-related complications (Simatupang, 2017).

The study found that the average HbA1c value among patients with type 2 diabetes was 7.8%, indicating uncontrolled diabetes. The HbA1c test is the gold standard for diagnosing and assessing diabetes control. A diagnosis of diabetes can be made if the HbA1c level exceeds 6.5%. The target for HbA1c levels in diabetes management is to keep them below 7%. Testing should occur every three months, or monthly for patients with HbA1c levels above 10%, to monitor therapy effectiveness and make necessary adjustments. For patients with stable blood glucose control, HbA1c examinations are recommended at least every six months (Perkeni, 2019).

Based on the research conducted, the average SGOT enzyme activity in patients with type 2 diabetes was found to be 19.9 U/L. This aligns with the findings of Alzahrani et al. (2017), which reported that among 25 tested samples, 3 patients (12%) exhibited increased SGOT enzyme activity. Prolonged high glucose levels (hyperglycemia) can lead to complications in type 2 diabetes.

The liver is particularly vulnerable to oxidative stress caused by hyperglycemia, which can damage liver tissue. This damage disrupts protein, carbohydrate, and lipid metabolism, leading to increased oxidative stress and triggering inflammation. Both oxidative stress and inflammatory responses act as destructive agents that worsen the pathological condition of diabetes (Pangestuningsih, M., & Rukminingsih, F., 2022).

Insulin resistance leads to a decreased sensitivity of body tissues, especially the liver, to insulin. As a result, glucose in the blood is not effectively processed into the body's cells (Guyton and Hall, 2007). The brain signals insulin-producing cells to increase insulin production, which raises insulin levels in the bloodstream. This increase in insulin also affects the synthesis of fatty acids, glycogen, and proteins in the liver. However, it should be noted that several other factors can also lead to increased SGOT enzyme levels in patients with type 2 diabetes (Kuswarini, S., 2020).

The study's findings indicated that the average SGOT enzyme activity was normal, suggesting that liver function in patients with type 2 diabetes was not impaired. Normal results in these patients may be influenced by the duration of their diabetes. Increases in SGOT enzyme activity among some individuals may occur due to factors such as the length of time they have had diabetes, their level of physical activity, or medication use.

Statistical analysis showed a P-value greater than 0.05, indicating no significant relationship between HbA1c values and SGOT enzyme activity. This finding contrasts with research by Shahwan et al. (2019), which

identified a significant association between poorly controlled type 2 diabetes (HbA1c > 7%) and SGOT enzyme activity. The lack of significant results in this study may be attributed to various other factors affecting SGOT enzyme activity, such as fatigue, poor sleep patterns, and medication use.

CONCLUSION

The research conducted offers intriguing insights into the relationship between HbA1c levels and SGOT enzyme activity in patients with type 2 diabetes mellitus (DM). The findings reveal that the average HbA1c value stands at 7.8%, accompanied by a standard deviation of 2.36%. Furthermore, the average SGOT enzyme activity in these patients is recorded at 19.9 U/L, with a standard deviation of 8.76 U/L.

Upon thorough analysis of the data, we arrive at a noteworthy conclusion: there exists no significant relationship between HbA1c values and SGOT enzyme activity in this specific population. The resulting p-value of 0.626 underscores the absence of a meaningful correlation. These findings pave the way for further exploration in understanding the complexities of diabetes management and its biochemical markers.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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ANALYSIS OF FACTORS ASSOCIATED WITH THE INCIDENCE OF STUNTING AMONG TODDLERS IN MARO SEBO DISTRICT A STRATEGY TO ACCELERATE STUNTING PREVENTION USING THE HOPE (*HUMANITY, LOVE, PEOPLE POWER*) APPROACH

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ABSTRACT

***Background**: Stunting is a condition of impaired growth resulting from chronic malnutrition and recurrent infections, which can hinder children's physical development and increase their risk of disease. This study aims to identify the factors contributing to stunting among toddlers at the Jambi Kecil Health Center, Muaro Jambi Regency.*
***Methods:** This research is a quantitative analytical study with a case-control design, conducted in Maro Sebo District to analyze the factors influencing stunting among toddlers. The sample consisted of 136 toddlers, comprising 68 cases and 68 controls, selected through purposive sampling. Data were analyzed using the Chi-square test, or Fisher's exact test when the assumptions of the Chi-square test were not met.*
***Results and Discussion:** The study found that stunting was more prevalent among toddlers who did not receive exclusive breastfeeding (63.8%), were born with low birth weight (62.3%), frequently experienced illness (67.3%), were malnourished (91.7%), had parents with low educational attainment (58.0%), and came from families with low economic status (59.8%). All of these factors were significantly associated with the incidence of stunting in the service area of the Jambi Kecil Health Center.*
***Conclusion:** Stunting among toddlers in the Jambi Kecil Health Center area is influenced by the lack of exclusive breastfeeding, low birth weight, frequent illness, inadequate nutritional intake, low parental education, and poor socio-economic conditions. These findings are expected to serve as a reference for the Health Center in developing strategies to address stunting and to strengthen cross-sector collaboration.*

***Keywords**: Factors, Stunting, Toddlers*

INTRODUCTION

Stunting is a condition characterized by failure to thrive in children, caused by chronic malnutrition. The problem of stunting in Indonesia is quite serious, as the number of children affected by stunting remains high (Beal et al., 2018). According to data from the Indonesian Ministry of Health in 2020, the prevalence of stunting among children under the age of five reached 27.7% (Devi et al., 2022).

The causes of stunting can vary, but some contributing factors include a lack of balanced nutrition, particularly protein and iron; chronic infections, such as recurrent diarrhea or respiratory infections; and poor sanitation. Additionally, limited access to healthcare, education, and quality food can also increase the risk of stunting in children (KemenkesRI, 2019).

To address the problem of stunting in Indonesia, the government has implemented various efforts, such as increasing access to health and nutrition services, raising public awareness about the importance of balanced nutrition, and improving the availability of nutritious and affordable food (Devi Artanti et al., 2022). Additionally, the government has launched programs such as the Supplementary Food Provision Program (PMT) and the Family

Hope Program (PKH), both of which aim to improve the nutrition and welfare of disadvantaged families (BPN, 2013).

Comprehensive efforts by the Jambi Provincial Government are needed, involving the community, as well as the private sector and community organizations. These efforts include increasing access to and consumption of nutritious food, raising public knowledge and awareness of the importance of good nutrition, improving access to health and nutrition services, and supporting the improvement of sanitation and environmental cleanliness (UNICEF, 2018). Additionally, a cross-sectoral approach involving the education, health, food, and sanitation sectors must also be implemented to reduce stunting rates in Jambi Province.

The Muaro Jambi Regency Government has shown a strong commitment to reducing stunting rates in Indonesia. The government plays a crucial role in implementing stunting prevention programs and facilitating various efforts to improve children's health and nutrition. With the commitment and continuous efforts of the local government, it is hoped that the stunting rate in Indonesia will continue to decline, allowing Indonesian children to grow and develop optimally.

HOPe (Humanity, Love, People, Power) service is an innovation in the health sector designed to facilitate behavioral changes and promote efforts to reduce stunting related to public health management. Health center staff can use this service to assist in implementing public health initiatives.

The use of the HOPe service is expected to encourage community participation in independent screening and prevention, while also increasing public awareness in optimizing health, thereby helping to minimize healthcare costs. This health service facilitates access and is consistently available to provide support to the community, with the goal of reducing the number of stunting cases

Jambi Kecil Health Center oversees 12 villages in the Muaro Sebo sub-district. One of its key efforts to reduce stunting is by providing health services for mothers and toddlers. The approach, known as HOPE (Humanity, Love, People, Power), is designed to deliver service activities that reach all community groups. At the same time, it emphasizes 'People Power' or community strength, as the main driver in implementing these activities. HOPE activities include promotive and preventive efforts and encompass all forms of service delivery aimed at accelerating the reduction of stunting within the Jambi Kecil Health Center’s service area.

METHODS

This study employed a quantitative observational analytic research design with a case-control approach. The population consisted of all toddlers who underwent examinations and had their data recorded at the Jambi Kecil Health Center. The total sample size was 136 toddlers, comprising 68 case samples and 68 control samples. The sampling technique used was non-random sampling with a purposive sampling method. Bivariate analysis was conducted using the Chi-square test; if the assumptions for the Chi-square test were not met, the Fisher’s exact test was applied.

RESULTS AND DISCUSSION

Research shows that stunting is more prevalent among toddlers who did not receive exclusive breastfeeding (63.8%), were born with low birth weight (62.3%), frequently experience illness (67.3%), are malnourished (91.7%), have parents with low educational attainment (58.0%), and come from families with low economic status (59.8%).

The results of this study indicate a significant relationship between a history of exclusive breastfeeding (p=0.009), low birth weight (p=0.035), history of infection

(p=0.002), poor nutritional status (p=0.000), low parental education level (p=0.020), and family economic status (p=0.004) and the incidence of stunting in the Jambi Kecil Health Center's service area.

Factors that contribute to stunting can be classified as either direct or indirect. Direct causes include inadequate nutritional intake and infectious diseases, while indirect causes include parenting practices, access to health services, food availability, cultural influences, economic conditions, and other related factors (WHO, 2014). Nutritional problems are often accompanied by infectious diseases that exacerbate the condition (UNICEF, 2020).

Malnutrition and bacterial infections of the digestive and respiratory tracts are serious public health concerns. The increased incidence and severity of infections in malnourished children are largely attributed to impaired immune system function (Rodríguez et al., 2011). Undernutrition, accompanied by chronically inadequate intake, can lead to weakened immunity in toddlers, making recurrent digestive infections (such as diarrhea) detrimental to the child's growth and development (Guerrant et al., 2014).

Infectious diseases are a leading cause of morbidity and mortality in developing countries, particularly among children. Increasing evidence suggests that protein-calorie malnutrition is a key factor contributing to the heightened susceptibility to infections in these regions. Moreover, certain infectious diseases can also lead to malnutrition, creating a vicious cycle (Rodríguez et al., 2011)

Poor nutritional status is a significant risk factor for the occurrence of acute respiratory infections (ARI). Toddlers with malnutrition are more susceptible to ARI compared to those with normal nutritional status, due to compromised immune system function. Infectious diseases can reduce a toddler’s appetite, leading to further malnutrition (Siddiq & Nuzul, 2018). Children who have experienced ARI often show symptoms such as colds, fever, and cough. This condition can affect their nutritional intake, which tends to be suboptimal during illness (Tadi et al., 2023).

Optimal nutrition during the first 1,000 days of life (from conception to the second birthday) is essential for the healthy development and lifelong well-being of infants. During pregnancy and the postpartum period, physiological changes, increased energy demands, and shifts in nutritional requirements are critical to supporting the optimal growth and development of infants and toddlers (Beluska-Turkan et al., 2019).

Exclusive breastfeeding is considered to reduce the risk of stunting because breast milk contains antibodies and calcium with high bioavailability, optimizing nutrient absorption, particularly for bone formation (Damayanti et al., 2017). The timing of introducing complementary foods (MP-ASI) and exclusive breastfeeding are factors associated with the incidence of stunting in toddlers.

Parents with low levels of education, such as those prevalent among the majority of the population in the Jambi Kecil Health Center's service area, typically have education levels equivalent to junior high or elementary school. This can influence their child-rearing practices, which in turn impacts child development. Research conducted by Hardinata (2023) indicates that parental education level is a crucial factor influencing the incidence of stunting in Indonesia. Higher levels of parental education can significantly reduce the risk of stunting in children.

The family’s economic status also influences the incidence of stunting in the Jambi Kecil Health Center's service area. According to UNICEF, low family economic status is linked to an increased risk of children experiencing low weight and height (UNICEF, 2020)

All of these factors are significantly associated with the incidence of stunting in the Jambi Kecil Health Center's service area.

CONCLUSION

Stunting among toddlers in the Jambi Kecil Health Center's service area is influenced by factors such as lack of exclusive breastfeeding, low birth weight, frequent illness, inadequate nutritional intake, low parental education, and poor socio-economic conditions. These findings are intended to guide the Health Center in developing strategies to address stunting and strengthen cross-sector collaboration.

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CONFLICT OF INTEREST

All author declarates no conflict of interest

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EDUCATIONAL GAMES AS AN INNOVATIVE HEALTH EDUCATION STRATEGY FOR STUNTING PREVENTION: A LITERATURE REVIEW

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ABSTRACT

Background: *Stunting is a significant public health issue in Indonesia, with a prevalence of 21.6% in 2022. It is primarily caused by chronic nutritional deficiencies, recurrent infections, and lack of psychosocial stimulation. One innovative and effective approach in stunting prevention education is the use of educational games as interactive and engaging learning tools. However, comprehensive studies on the effectiveness of educational games in the context of stunting prevention are still limited.*
Methods: *This study employed a literature review approach using the PCC framework (Population, Concept, Context). The population included mothers. The concept was the use of educational games, and the context was stunting prevention. Articles were sourced from databases such as PubMed, ScienceDirect, Google Scholar, and manual searching. Inclusion criteria included original research published in the last five years, open access, and relevance to educational games in health education*
Results: *Eight articles were reviewed, revealing a variety of games used, including snakes and ladders, puzzles, simulation games, board games, and mobile educational apps. Most studies reported significant improvements in participants' knowledge and engagement after game-based interventions. Educational games were found to be more effective than conventional educational methods. Implementation challenges included limited technological access, low digital literacy, scarce resources, and the need for cultural adaptation.*
Conclusion: *Educational games have the potential to be effective, enjoyable, and sustainable tools for health education in stunting prevention. To maximize effectiveness, local adaptation, facilitator training, and the development of context-specific media are essential. Games not only increase knowledge but also foster active participation and interest among communities, especially mothers and adolescents, in stunting prevention efforts.*

Keywords: *Educational games, Stunting, Health education*

INTRODUCTION

Stunting is a condition of impaired growth and development in children caused by chronic malnutrition, recurrent infections, and inadequate psychosocial stimulation. This condition significantly affects children's physical and cognitive development, ultimately impacting the quality of human resources in the future (Ministry of Health, Republic of Indonesia, 2023). According to the 2022 National Nutrition Status Survey, the prevalence of stunting in Indonesia remains high, reaching 21.6% (SSGI, 2022). Therefore, stunting prevention has become a national priority through various strategies, including community-based nutritional education.

Innovation in health education methods is essential to enhance the effectiveness of information delivery, particularly in the context of stunting prevention. One emerging approach is the use of educational games as an interactive learning medium. These games are designed to convey health messages in a more practical and user-friendly manner, encouraging participants to be more enthusiastic, engaged, and active in the learning process (Anggraeni et al., 2023). Educational games are expected to improve public knowledge and participation in preventing stunting.

Several studies have demonstrated the effectiveness of educational games in improving health knowledge. For instance, Alfiah et al. (2021) developed DEKAZI

Games, a web-based interactive educational tool aimed at enhancing children's nutritional knowledge in the digital age. The study reported an 18% increase in students' knowledge following the intervention, highlighting the tool's effectiveness. Similarly, Arini (2023) designed an early stunting education program at adolescent health posts using online game media. The results showed that game-based education effectively disseminated information about stunting.

The use of educational games as a health education medium has proven effective in enhancing awareness and understanding of balanced nutrition and stunting prevention. Therefore, the development and implementation of such innovations should be continuously promoted as part of a comprehensive strategy to address stunting issues in Indonesia.

METHODS

This study employed a literature review approach consisting of six stages, beginning with the identification of the research question: "How are game-based innovations applied as a health education medium for stunting prevention?" The review followed the PCC framework, with the Population being mothers, the Concept being educational games, and the Context being stunting prevention. Article searches were conducted through various databases including PubMed, ScienceDirect, Google Scholar, and manual handsearching techniques. Article selection was based on inclusion criteria: original research published within the last five years, full-text availability, open access, and relevance to the use of games in stunting-related health education. Articles deemed irrelevant or not meeting these criteria were excluded during the selection process.

RESULTS AND DISCUSSION

RESULTS

This review analyzed eight studies focusing on game-based innovations as health education media for stunting prevention. The types of games used varied. Two studies utilized *snakes and ladders* games (Mulianingsih et al., 2021; Rahmatullah et al., 2024), one study developed a *puzzle game simulation* (Sari & Nurannisa, 2023), and two others used *simulation games* and *board games* (Muharyani et al., 2025; Salamoon et al., 2023). One study employed general educational games to stimulate child development (Harsono et al., 2023), one combined a quiz-style game (*Ranking 1*) with a nutrition demonstration (Ifroh & Permana, 2021), and another introduced a mobile-based educational game application (Sosanya et al., 2024).

The target populations in these studies varied, including pregnant women (Mulianingsih et al., 2021; Rahmatullah et al., 2024), mothers of children aged 0–24 months (Muharyani et al., 2025; Sari & Nurannisa, 2023), young mothers and adolescents (Ifroh & Permana, 2021; Salamoon et al., 2023), adolescent mothers in rural Nigerian communities (Sosanya et al., 2024), and mothers of toddlers (Harsono et al., 2023). Overall, pregnant women and mothers of young children were the most frequently targeted populations, aligning with key stunting prevention strategies from early life.

All analyzed studies showed positive and significant outcomes in improving participants' knowledge and awareness of stunting prevention through educational games. Five studies used a pretest-posttest design and found statistically significant increases in knowledge scores post-intervention (Ifroh & Permana, 2021; Muharyani et al., 2025; Mulianingsih et al., 2021; Rahmatullah et al., 2024; Sari & Nurannisa, 2023). Simulation games, puzzles, and snakes and ladders were particularly more effective than conventional educational media

such as videos or booklets. Additionally, Harsono et al. (2023) and Salamoon et al. (2023) reported increased interest and active participation among respondents. Sosanya et al. (2024) demonstrated that a mobile game app designed for teenage mothers was more effective than verbal training in enhancing understanding of infant and child feeding practices.

DISCUSSION

Health education is a learning process aimed at empowering individuals and communities to maintain and improve their health status. In Indonesia, health education is defined as a participatory community empowerment effort, rooted in local social and cultural potential and supported by pro-health public policies (Marlina & Ismainar, 2021). Educational interventions are key to increasing public understanding of stunting and fostering preventive behaviors. The selection of appropriate educational media is critical, especially those offering enjoyable and interactive learning experiences, such as educational games (Rahmuniyati et al., 2023).

Educational Games in the Context of Stunting Prevention

Educational games offer a strategic and innovative way to convey health messages, especially in the context of stunting prevention. These games are interactive, engaging, and foster active participation (Sindi et al., 2023). Compared to traditional methods such as lectures or leaflets, game-based education is more easily accepted by young mothers, pregnant women, and children due to its simplicity and appeal (Pradipta et al., 2020). This is supported by studies that compared games with conventional education methods. For instance, Widita Muharyani et al. (2025) found the *EMPASI SEHATI* simulation game to be more effective than educational videos in improving maternal knowledge on complementary feeding and stunting. Similarly, Sari & Nurannisa (2023) found puzzle games superior to booklets in increasing mothers' understanding of nutrition and feeding patterns. Sosanya et al. (2024) also showed that their *BabyThrive* mobile game led to better outcomes than verbal training among adolescent mothers. These findings confirm that educational games are not only effective but also more engaging than passive learning methods.

Barriers and Challenges in Implementing Game-Based Education for Stunting Prevention

Despite their proven effectiveness, several challenges hinder the implementation of educational games in real settings. Key issues include limited financial and technological resources, as well as a shortage of trained facilitators (Yusuf, 2023). Harsono et al. (2023) and Sosanya et al. (2024) reported that access to technology and low digital literacy among rural populations, especially young mothers, limit the use of digital games. Budiarto et al. (2024) also emphasized that digital literacy remains low in many Indonesian villages, posing a challenge to tech-based health interventions.

To overcome these challenges, developers can design digital games that function offline. A successful example is *MANTRA* (Maternal and Neonatal Technologies in Rural Areas), an offline mobile educational game designed for low-literacy rural users. Mueller et al. (2020) showed that *MANTRA* significantly improved maternal and neonatal health knowledge, highlighting the importance of context-sensitive technology.

Other limitations include the physical and logistical demands of certain games. For instance, large-scale games like snakes and ladders or puzzles require physical materials that may be difficult to transport, replicate, or maintain, especially in remote areas (Mulianingsih et al., 2021; Sari & Nurannisa, 2023). Additionally, games such as board games or interactive quizzes require facilitators with not only content knowledge but also facilitation skills (Ifroh & Permana, 2021;

Salamoon et al., 2023). This presents a barrier in areas where trained facilitators are scarce, particularly at the community level.

To address these issues, Rahmawati et al. (2024) recommend training local health workers or community cadres to serve as independent facilitators. Community empowerment through such training is more sustainable than relying on external experts. Another suggested solution is the development of modular and portable games that are easier to deploy in various local contexts. Careful planning, needs assessment, and culturally appropriate design are essential for successful implementation.

Some studies also emphasized the need for cultural and educational adaptation of game content. For example, Muharyani et al. (2025) and Salamoon et al. (2023) noted that simulation and board games may be too complex for low-literacy participants. Therefore, game design should follow a participatory and iterative approach. Soekmono et al. (2021) employed a three-phase R&D framework: (1) preliminary research to understand user needs, (2) iterative development and prototyping, and (3) validation of game elements. This process is especially relevant in stunting-related game development, as it ensures that content is understandable and culturally aligned. By adapting language, visuals, and interaction styles, game-based health education becomes more accessible and impactful.

CONCLUSION

This review demonstrates that the use of educational games as a medium for stunting prevention is effective in enhancing public knowledge and awareness, particularly among pregnant women and mothers of young children. Various types of games such as *snakes and ladders*, simulation games, and mobile applications were found to be more effective than conventional educational media in delivering stunting-related information. Educational games not only improve knowledge but also foster active participation and interest among participants. However, real-world implementation faces several challenges, including limited resources, technological barriers, and differences in participants' cultural and educational backgrounds. Therefore, innovative approaches that are adaptable to local conditions and efforts to strengthen facilitator capacity are essential to ensure the effectiveness and sustainability of game-based educational interventions.

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ANTI-BACTERIAL POTENTIAL OF BIDARAUPAS EXTRACT AGAINST LIVER MACROPHAGE CELLS INDICATED BY TUBERCULOSIS

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ABSTRACT

Background: *Tuberculosis (TB) is a serious infection caused by Mycobacterium tuberculosis, mainly affecting the lungs and spreading through the air. Every year, around 10 million new TB cases are reported worldwide, with Indonesia ranking third in the highest number of TB cases. TB treatment faces challenges due to drug resistance, such as MDR-TB and XDR-TB, which is driving research on alternative therapies, one of which is Merremia mammosa extract, which is known for its antibacterial and immunomodulatory potential. This study aimed to evaluate the potential of Merremia mammosa extract in enhancing the immune response, especially through liver macrophages, in mice infected with Mycobacterium tuberculosis.*
Method: *Mice were divided into treatment and control groups, receiving the extract at varying doses after TB bacterial injection.*
Results: *The results showed that most of the groups with lower necrotic cell counts came from the group with low doses, such as P11, P12, P13, P14, and P15. However, groups such as P45, which exhibit a high number of necrotic cells, may suggest that higher doses of Merremia mammosa extract may trigger an excessive inflammatory response.*
Conclusion: *Low-dose administration of Merremia mammosa extract is effective in reducing liver cell necrosis due to Mycobacterium tuberculosis infection. The low-dose group showed better tissue protection than high-doses, which in turn has the potential to trigger excessive inflammation.*

Keywords: Tuberculosis, *Merremia mammosa, Liver Macrophages, Mycobacterium tuberculosis, Drug Resistance*

INTRODUCTION

Bacteria *Mycobacterium tuberculosis*, which mainly infects the lungs, although it can also affect other organs. TB is an infectious disease that spreads through the air when an infected individual coughs or sneezes, releasing bacterial particles into the surrounding air (Organization, 2023). According to the World Health Organization (WHO), about 10 million new cases of TB are reported worldwide each year, with a death toll of around 1.5 million people in 2021. In Indonesia, TB remains one of the main health challenges, with the country ranking third after India and China in terms of the highest number of TB cases (Lestari et al., 2023).

Current treatment for tuberculosis (TB) involves a combination of antibiotics over a period of 6 to 9 months, with primary drugs such as *rifampisin, isoniazid, pyrazinamide*and *ethambutol*. However, the therapy faces several challenges, including patient adherence to long regimens, serious side effects of medications, and the emergence of drug-resistant cases such as multidrug-resistant tuberculosis (MDR-TB) and extensively drug-resistant tuberculosis (XDR-TB) (Zumla et al., 2015), (Kim et al., 2020). Drug resistance to TB further complicates the treatment and control of the disease, as patients with MDR-TB and XDR-TB require longer, more complex treatments, generally involving drugs with more severe side effects.

Tuberculosis (TB) is an infectious disease that remains a global health problem, with a high number of cases and deaths in various countries. According to a report from the World Health Organization (WHO), it is estimated that around 1.7 billion people were

infected with TB in 2019 (Organization, 2022). Each year, there are about 10 million new cases of TB, with 1.2 million deaths among people who are not infected with HIV and 251,000 deaths among people with HIV. TB is also one of the main factors that exacerbate poverty and hinder social development (Opperman & Du Preez, 2023). In Vietnam, the WHO estimates that there were 174,000 new TB cases and 13,200 TB-related deaths in 2018. Currently, a serious problem is the increasing number of cases of drug-resistant tuberculosis (MDR-TB). According to a 2019 report from the National TB Program (NTP), the prevalence of MDR-TB among new patients reached 3.6%, while among patients receiving retreatment, it reached 17% (Van et al., 2024).

As drug resistance increases, the need for safer and more effective alternative and complementary therapies in the treatment of TB is becoming more urgent. In recent decades, several studies have focused on the use of traditional medicinal plants that have potential as natural antimicrobial agents and immunomodulators (Shishodia & Schofield, 2020). The use of medicinal plants has the potential not only as an adjunct therapy but also as a source of active compounds that can overcome drug resistance with a lower risk of side effects compared to chemical drugs. One plant that has attracted attention as a complementary therapy for tuberculosis is Merremia mammosa (*Merremia mammosa*), which has long been used in traditional medicine in Indonesia to treat a variety of infections, including respiratory tract infections (Putri & Sakinah, 2020).

Merremia mammosa It is known to contain a variety of bioactive compounds, such as flavonoids, alkaloids, saponins, and tannins, which exhibit a wide range of pharmacological activities, including antibacterial, anti-inflammatory, antioxidant, and immunomodulatory effects (Wulandari & Soleha, 2021). This compound is thought to help inhibit growth *Mycobacterium tuberculosis* and improve the immune response in the fight against infection. A study conducted showed that Esktrak *Merremia mammosa* may increase phagocytic activity of macrophages in infected mice *Mycobacterium tuberculosis*, exhibiting significant immunomodulatory effects. In addition, flavonoids in *Merremia mammosa* It is also known to have strong antioxidant activity, which can protect cells from oxidative damage caused by infections (Ani, 2020).

Macrophages are the main immune cells that play an important role in the innate immune response to TB infection. When *Mycobacterium tuberculosis* Entering the body, macrophages try to eliminate bacteria through the process of phagocytosis. But *Mycobacterium tuberculosis* has the ability to survive in macrophages by inhibiting phagolysosomal processes, which allow bacteria to multiply within cells and worsen infections (Kumar et al., 2014). Therefore, increasing macrophage activity in response to TB infection is an important approach in TB therapy. A study suggests that administering Merremia mammosa extract to an animal model infected with TB may increase the phagocytic activity of macrophages, potentially enhancing the immune response to transmission *Mycobacterium tuberculosis*.

The flavonoids found in Merremia mammosa are known to increase the activity of antioxidant enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase, which are important enzymes in the body. This antioxidant activity can help reduce oxidative stress caused by TB infection, which often causes damage to immune cells, including macrophages. By increasing antioxidant activity, *Merremia mammosa* can support the maintenance of normal macrophage function, allowing these cells to be more effective in eliminating *Mycobacterium tuberculosis* from the body. In addition, flavonoids are also known to inhibit the production of pro-inflammatory cytokines such as TNF-α, IL-1β,

and IL-6, which contribute to the chronic inflammation seen in TB.

In addition to flavonoids, the alkaloids contained in Merremia mammosa also have strong antibacterial potential, which can help inhibit growth *Mycobacterium tuberculosis*. Alkaloids work by damaging the structure of bacterial cell walls, which leads to leakage and bacterial death. Research shows that alkaloids can work synergistically with standard antibiotics, improving the effectiveness of TB treatment, potentially reducing the dose of antibiotics needed, and reducing the risk of drug resistance. An in vitro study also showed that the *Merremia mammosa* has significant bactericidal activity against *Mycobacterium tuberculosis*, further strengthening the potential of this plant as a complementary therapy in the treatment of TB (Sutriyawan et al., 2023).

Merremia mammosa has long been used in traditional medicine in Indonesia, particularly by people in Java and Sumatra, to treat various infectious and inflammatory diseases. The plant is usually prepared in the form of a decoction or extract that is consumed orally or used topically to treat open wounds. In traditional medicine, *Merremia mammosa* It is used to treat health problems such as respiratory infections, indigestion, and burns. Some ethnobotanical studies show that *Merremia mammosa* has a good reputation as a safe and effective medicinal plant, with few reports of side effects or toxicity at therapeutic doses (Lisum et al., 2022).

Merremia mammosa in traditional medicine, scientific research on its effectiveness and safety in the treatment of TB is still limited. This study aims to assess the potential of *Merremia mammosa extract* as a pharmacological agent and immunomodulator in the treatment of TB, focusing on its effect on hepatic macrophage activity in mice infected *with Mycobacterium tuberculosis*. The study will also evaluate different doses *of Merremia mammosa extract* to determine the optimal dose that provides the best immunomodulatory effect without causing toxicity. Based on this, this study aims to investigate the application of *Merremia mammosa extract* as a therapy to improve the quality of liver health in pulmonary TB patients. This study will examine the therapeutic effects of Merremia mammosa on the overall condition of the body, especially in increasing the activity of liver macrophages to eliminate *Mycobacterium tuberculosis*, strengthen immunity, and reduce inflammation caused by infection.

METHODS

This study is classified as an experimental laboratory, using 5 treatment groups, namely mice infected with *Mycobacterium tuberculosis*, whose liver organs are taken, cut, and stained with paraffin, then observed under a microscope through intraperitoneal injection. Similarly, 35 mice were randomly assigned into 5 groups, with each group containing 7 mice. Groups 1 to 5 are the observation groups, which are further divided into pre-observation (O1 to O5) and post-observation (O6 to O10). The P0 to P4 groups are treatment groups, namely:

a. K+ = Control group, given only *Mycobacterium tuberculosis bacteria*;
b. P1 = Treatment I (injected with *Mycobacterium tuberculosis* and given *Merremia mammosa extract* at 50 ppm);
c. P2 = Treatment 2 (injected with *Mycobacterium tuberculosis* and given *Merremia mammosa extract* at 100 ppm);
d. P3 = Treatment 3 (injected with *Mycobacterium tuberculosis* and given *Merremia mammosa extract* at 150 ppm);
e. K- = Control/comparative group that was not given *Mycobacterium tuberculosis* (P1, P2, P3 received a dose of 2 ml/200 grams of body weight extract orally).

The assessment of cell necrosis in this study used the Manja Roenigk scoring system, which provides a description of the quality of cell damage based on a scale from 1 to 4. Manja

Roennik's score is based on the following criteria:

I. Score 1: Shows normal cell count, with no damage or degeneration;
II. Score 2: Shows parenchymal degeneration, which is a structural change in the cell without any apparent cell death;
III. Score 3: Indicates hydropic degeneration, in which the cells swell due to fluid accumulation;
IV. Score 4: Indicates necrosis, or cell death due to severe damage to the cell structure, which can be caused by infection, inflammation, or other stressors;

RESULTS AND DISCUSSION

TB remains a major global health challenge, despite advances in treatment. In 2022, the WHO reported more than 10 million new TB cases, with high mortality rates, especially in developing countries. Drug resistance is a major problem in the treatment of TB, where *Mycobacterium tuberculosis* resistance to standard drugs further worsens the situation. Therefore, the development of new, more effective, and safer therapies is a priority in the treatment of TB (Farhat et al., 2024). One promising alternative is the use of traditional medicinal plants, such as *Merremia mammosa*, which is known to contain a variety of bioactive compounds with antibacterial and anti-inflammatory activity.

Previous research has shown that *Merremia mammosa* the extract can serve as an immunomodulatory agent that increases the activity of macrophages, which plays an important role in combating *Mycobacterium tuberculosis*. As part of the immune system, macrophages have the ability to ingest and destroy pathogenic bacteria, including *Mycobacterium tuberculosis*. Therefore, an increase in the number and function of macrophages can speed up the recovery of TB patients (Silva, 2022), (Zhou et al., 2022).

This research is particularly relevant because of its use *Merremia mammosa* as a complementary therapy for TB has not been explored in depth. As a traditional medicinal plant with antibacterial potential, *Merremia mammosa* It can be used as an adjunct therapy to reduce dependence on more expensive pharmaceutical drugs with potential side effects. It is also important to improve the effectiveness of TB treatment, especially with the increasing number of drug-resistant cases (Getachew et al., 2022), (Olatunji et al., 2021).

1. Necrosis in Mice Infected with Mycobacterium tuberculosis

Cell necrosis is the process of cell death due to irreversible cell damage, usually caused by factors such as infection, inflammation, or environmental stress. Tissue damage that causes necrosis can occur due to metabolic disorders, failure to maintain cellular homeostasis, or damage to critical organelles such as mitochondria, nucleus, and cell membranes. In the context of infectious diseases, especially tuberculosis (TB), cell necrosis is a major indicator of tissue damage caused by *Mycobacterium tuberculosis infection.* Infection by *Mycobacterium tuberculosis* triggers an inflammatory response that often leads to the formation of necrotic tissue in the liver. This study aimed to evaluate the rate of epithelial cell necrosis in the liver of mice infected with M. tuberculosis and to assess the potential *of Merremia mammosa* extract as a complementary therapy in repairing liver tissue damage caused by this infection.

Mycobacterium tuberculosis *infection* in the liver, both in mice and humans, often induces an intense immune response. Bacteria are able to survive inside macrophages and avoid destruction, which leads to chronic inflammation. The immune system responds by forming granulomas made up of immune cells such as macrophages, T lymphocytes, and dendritic cells, which try to isolate bacteria and

prevent their spread. Simultaneously, an excessive inflammatory response can lead to tissue damage, leading to necrosis. Cassatic necrosis is a typical form of necrosis observed in TB infections, in which the necrotic tissue has a soft cheese-like texture. This damage occurs as a result of a combination of cell death caused by bacterial infections, an overactive immune response, and a lack of oxygen in the granuloma area, causing the cells within the affected tissue to die.

2. Liver Cell Necrosis in Mice Infected with Mycobacterium tuberculosis

Necrosis of lung tissue due to *Mycobacterium tuberculosis infection* usually occurs in the form of granulomas, which are characteristic structures that form as part of the immune response to infection. These granulomas are made up of immune cells, such as macrophages, that seek to contain the spread of bacteria but can also cause tissue damage. This damage can progress to necrosis if the infection persists or if the immune response is insufficient to control the infection. In tuberculosis (TB), necrosis can occur in two main forms: cascade necrosis, in which some cells die and damage the surrounding tissue, and caseous necrosis, which occurs in the center of the granuloma, where the tissue becomes hardened and has a cheese-like texture. This necrotic process causes significant impairment of liver cell damage and impaired liver function.

In this study, the number of necrostic epithelial cells was measured in five high-power fields at 400x magnification for each mouse sample infected *with Mycobacterium tuberculosis*. Evaluation was conducted in a group of mice treated with *Merremia mammosa extract* and a control group that did not receive treatment. The data obtained showed significant variability in the number of necrotic cells between the groups receiving treatment of Merremia mammosa extract and those who were not treated. The following table presents the total number of necrotic cells and the average number of necrotic cells per field for each sample:

Table 1. Number of Cells That Undergo Necrosis in 5 Fields of View with 400X Imaging

Code	Total Necrosis Cell Count	Average Necrotic Cells	Group
K-1	30	6	
K-2	22	4,4	
K-3	22	4,4	K-
K-4	25	15	
K-5	27	13,2	
K+1	46	9,2	
K+2	40	8	
K+3	41	4,2	K+
K+4	43	8,6	
K+5	39	7,8	
P 11	9	1,8	
P 12	8	1,6	
P 13	4	0,8	P1
P 14	5	1	
P 15	6	1,2	
P 32	33	6,6	
P 21	35	7	
P 22	32	6,4	P2
P 43	36	9,2	
P 24	30	14,8	
P 26	56	7,2	
P 31	58	11,6	
P 34	65	13	P3
P 36	45	9	
P 45	72	14,4	

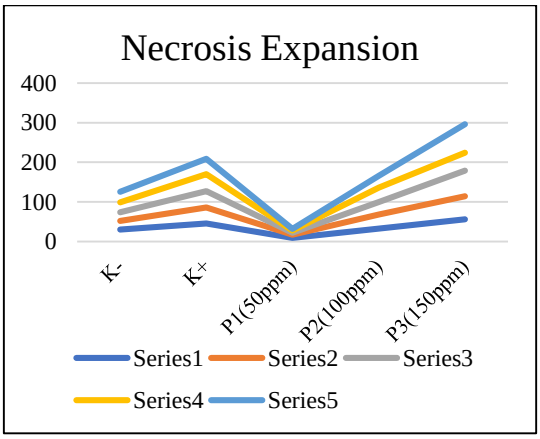


Figure 1. Necrosis Expansion Curve

2.1 Variability in the number of necrotic cells

In this study, the groups treated with Merremia mammosa extract, such as P26, P31, P34, P36 and P45, showed a higher

number of necrotic cells compared to the negative control (K-) group and the positive control group. The P26 group, which recorded 56 necrotic cells with an average of 7.2 necrotic cells per field of view, showed significant damage. This value was much higher than that of the negative control group (K-), which did not receive any treatment or infection and showed 56 necrotic cells in the observed field. This can be attributed to two main factors. First, more severe *Mycobacterium tuberculosis* infections in the P26 group may cause a more intense immune response, ultimately leading to more severe tissue damage.

Mycobacterium tuberculosis Infection can lead to the formation of granulomas, which serve to isolate bacteria from healthy tissues. However, in some cases, excessive inflammation can lead to caseous necrosis, a type of necrosis that occurs in the granuloma area due to tissue damage caused by inflammatory cytokines and oxidative stress (Ahmad, 2011). This condition often worsens liver tissue damage and hinders the healing process. In this study, higher doses of Merremia mammosa extract in some groups showed an impact on the rate of tissue damage. Although the compounds in Merremia mammosa extract have anti-inflammatory and antibacterial properties, giving too high a dose can affect the balance of the immune response, potentially worsening tissue damage (Collin et al., 2018).

In the treatment group (P1), the area of necrosis was only around ± 6.4 mm, meaning that bidara upas extract could reduce necrosis, but the P2 group averaged ± 33.2 mm and P3 ±59.2, this shows that *Merremia mammosa* extract cannot reduce liver cell necrosis. These results show that *Merremia mammosa* extract at a dose of 50mg/ml is able to provide a therapeutic effect in reducing liver tissue damage in mice infected *with Mycobacterium tuberculosis.*

2.2 Roennik's Spoiled Score and Necrotic Cell Count

The results of the study on the rate of lung cell necrosis in mice infected with Mycobacterium tuberculosis showed variation in the number of necrotic cells across treatment groups. The assessment of cell necrosis in this study was carried out using the Manja Roenigk assessment system, which provides an overview of the quality of cell damage based on a scale from 1 to 4. Using these scoring criteria, we were able to analyze the results of the study based on the average necrotic cell score for each treatment group, including the control group and *the smeared* Merremia mammosa extract.

From Table 1, significant differences in the mean number of necrotic cells between the group treated with Merremia mammosa extract and the control group can be observed. The following is a discussion of the results of the study, starting from the K-1 to P45 group, based on necrotic cell data calculated per field of view and the Manja Roenigk assessment system. This discussion aimed to delve deeper into the effects of treatment of Merremia mammosa extract on cell necrosis in the liver organs *of mice infected* with Mycobacterium tuberculosis.

Group P11

Total necrotic cells : 9

Average Necrotic Cells :1.8

The P11 group showed a total of 9 necrotic cells, with an average of 1.8 necrotic cells per field of view. This value indicates that the P11 group tends to be close to a score of 2, indicating the presence of parenchymal degeneration of lung cells, although necrosis is not as widespread in other groups. This score reflects significant cell damage in some lung cells, but there are still some normal cells. It is possible that *the treatment of Merremia mammosa* extract in this group still has a therapeutic effect, although not completely.

Group P12

Total necrotic cells : 8

Average Necrotic Cells :1.6

The P12 group showed a total of 8 necrotic cells, with an average of 1.6 necrotic cells per field of view. This value indicates that the P12 group tends to be close to a score of 2, indicating the presence of parenchymal degeneration of lung cells, although necrosis is not as widespread in other groups. This score reflects significant cell damage in some lung cells, but there are still some normal cells. It is possible that *the treatment of Merremia mammosa* extract in this group still has a therapeutic effect, although not completely.

Group P13

Total necrotic cells : 4

Average Necrotic Cells :0.8

The P13 group showed a total of 4 necrotic cells, with an average of 0.8 necrotic cells per field of view. This value indicates that the P13 group tends to be close to a score of 1, which indicates that more cells are normal than those that are degenerated or necrosis. In this case, treatment with Merremia mammosa extract showed quite positive results in repairing lung tissue damage caused by Mycobacterium tuberculosis infection. The P13 group can be considered a group that undergoes significant tissue repair, with minimal cell damage.

Group P14

Total necrotic cells : 5

Average Necrotic Cells :1

The P14 group showed a total of 5 necrotic cells, with an average of 1 necrotic cell per field of view. This value indicates that the P14 group is included in the score of 1, which indicates that more cells are normal than those that are degenerated or necrosis. In this case, treatment with Merremia mammosa extract showed quite positive results in repairing lung tissue damage caused by Mycobacterium tuberculosis infection. The P14 group can be considered a group that undergoes significant tissue repair, with minimal cell damage.

Group P15

Total necrotic cells : 6

Average Necrotic Cells :1,2

The P15 group showed a total of 6 necrotic cells, with an average of 1.2 necrotic cells per field of view. This value suggests that the P15 group tends to be close to a score of 2, which indicates the presence of parenchymal degeneration of lung cells, although necrosis is not as widespread in other groups. This score reflects significant cell damage in some lung cells, but there are still some normal cells. It is possible that *the treatment of Merremia mammosa* extract in this group still has a therapeutic effect, although not completely.

Group P32, P21, P22, P24, P26, P31, P34, P36, P45

In this group, there were P21 (35 necrotic cells) with an average of 7 necrotic cells per field of view. P22 (32 necrotic cells) with an average of 6.4 necrotic cells per field of view, P32 (33 necrotic cells) with an average of 6.6 necrotic cells per field of view, P34 (65 necrotic cells) with an average of 13, P36 (45 necrotic cells) with an average of 9, P45 (72 necrotic cells) with an average of 14.4, and P31 (58 necrotic cells) with an average of 11.6 necrotic cells per field of view. This value indicates that the group tends to be close to a score of 4, as well as other groups that have an average score of 4 or greater than 4. This indicates that there is severe necrosis in the liver. This could be caused by *a more severe* Mycobacterium tuberculosis infection or *a higher dose of Merremia mammosa* extract, which may lead to more intense inflammation of liver tissue. Increased necrosis scores in this group require further attention, including a review of doses or mechanisms that may contribute to increased necrosis.

Group K+ and Group K-

In all K+ groups and K- groups have an average of 4 or more necrotic cells. This indicates that there is severe necrosis in the liver. This could be caused by *a more severe* Mycobacterium tuberculosis infection or *a higher dose of Merremia mammosa* extract, which may lead to more intense inflammation of liver tissue. Increased necrosis scores in this group require further attention, including a review of doses or mechanisms that may contribute to increased necrosis.

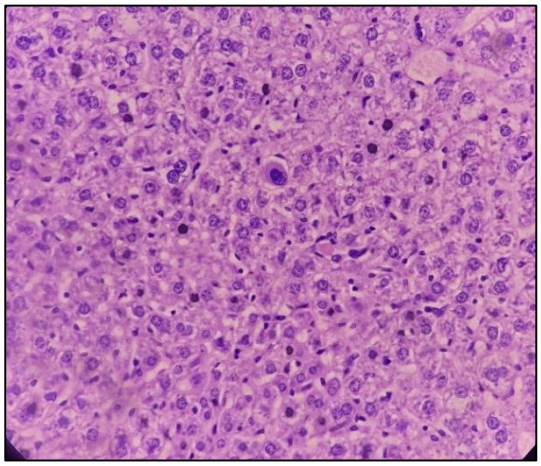


Figure 2. Histopathological Images Group 1.4

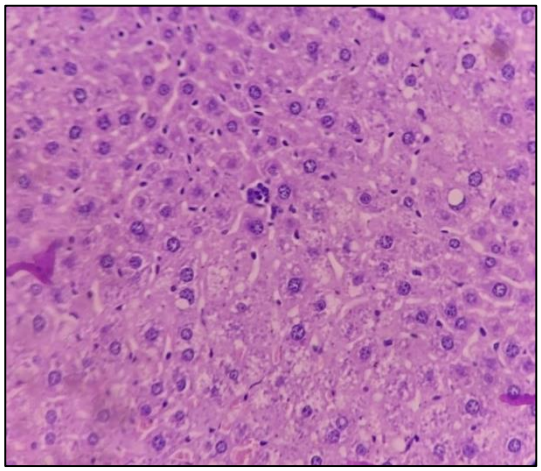


Figure 3. Histopathological Images Group 23

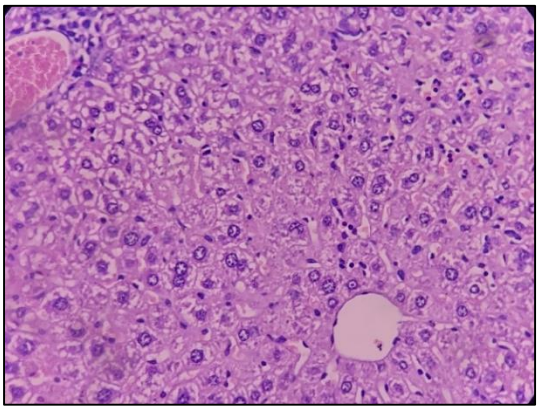


Figure 4. Histopathological Images Group 34

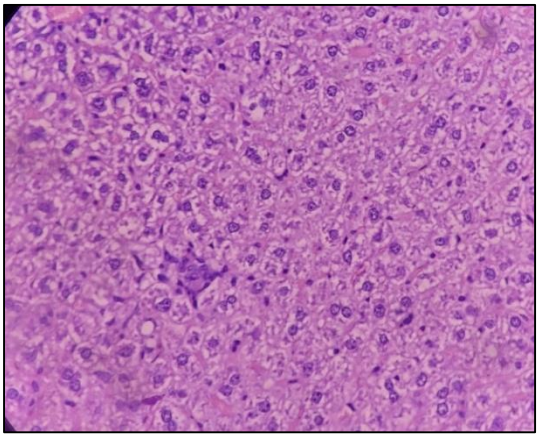


Figure 5. Histopathological Images Group 45

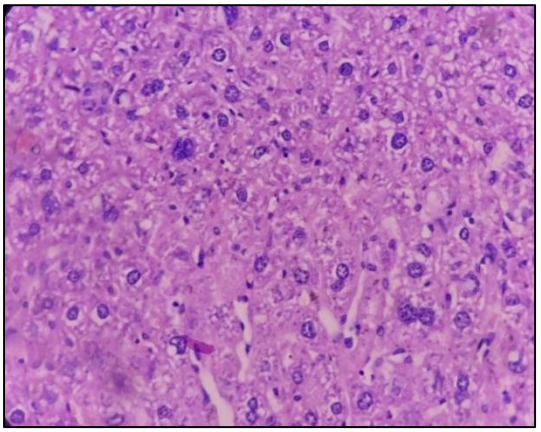


Figure 6. Histopathological Images of Group K+1

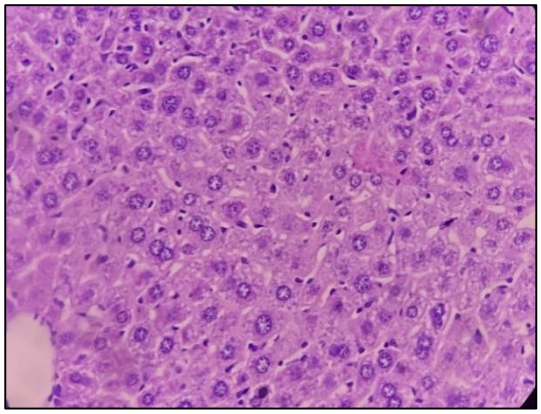


Figure 7. Histopathological Images of Group K-1

2.3 Dosage Response of Merremia mammosa Extract

The results showed that most of the groups with lower necrotic cell counts came from the group with low doses, such as P11, P12, P13, P14, and P15. Lower doses may be more effective in preventing further damage to liver tissue without causing side effects or an over-immune response. A significant reduction in cell necrosis in these groups suggests that proper dosing regulation can lead to substantial improvements in tissues damaged by bacterial infections. However, groups such as P45, which exhibit a high number of necrotic cells, may indicate that higher doses of *Merremia mammosa* the extract can trigger an excessive inflammatory response. It highlights the importance of dosage regulation in herbal therapy to ensure that optimal therapeutic effects are achieved without causing harmful side effects. The exact dosage of Merremia mammosa extract needs to be determined through further research to establish safe and effective tolerance limits for infected lung tissue (Kitagawa et al., 1997).

Active compounds in *Merremia mammosa* Extracts, such as flavonoids and saponins, are known to have antioxidant activity that can reduce oxidative stress caused by infection (Purwitasari & Agil, 2022). In addition, the antibacterial compounds in *Merremia mammosa* extracts can help inhibit growth *Mycobacterium tuberculosis*, thus directly reducing infection and tissue damage. *Merremia mammosa* It is recognized in traditional medicine for its therapeutic benefits, including wound healing, anti-inflammatory, and infection treatment. This plant is found in many tropical regions and has been widely used in traditional healing. Modern research has shown that *Merremia mammosa* contains active compounds with anti-inflammatory, antibacterial, and antioxidant properties, which have the potential to reduce tissue damage caused by infections, especially in tuberculosis (TB) caused by *Mycobacterium tuberculosis*. Several mechanisms may explain how Merremia mammosa extract works: First, it has anti-inflammatory potential that can reduce excessive inflammation. Chronic inflammation often causes damage to healthy tissues and worsens necrosis, especially in *Mycobacterium tuberculosis infection*. Anti-inflammatory compounds in *Merremia mammosa* It works by inhibiting the production of pro-inflammatory cytokines such as TNF-α and IL-1β, which contribute to inflammatory processes and tissue damage.

Second, Merremia mammosa extract functions as an antioxidant. The inflammatory process triggered by *M. tuberculosis* infection produces high oxidative stress, which damages healthy cells. The antioxidants in *Merremia mammosa* can reduce this oxidative damage, thus helping to protect liver cells from further damage and speeding up the healing process. In addition, the antibacterial compounds in Merremia mammosa extract can help suppress the growth of *Mycobacterium tuberculosis*. Although not as potent as conventional drugs such as rifampicin in killing bacteria, this extract can help inhibit the growth of bacteria, thereby reducing infection and further tissue damage. *Merremia mammosa* has been used in

traditional medicine, particularly in Indonesia, to treat a variety of health problems, including infectious diseases and inflammation. The roots, leaves, and stems *of Merremia mammosa* are often used to alleviate symptoms of respiratory illnesses, such as coughs, colds, and even tuberculosis. With its anti-inflammatory, antibacterial, and antioxidant properties, this plant can accelerate healing and repair liver tissue damaged by *Mycobacterium tuberculosis infection*.

To evaluate the effectiveness of herbal remedies, scoring systems such as the Manja Roenigk score are used to measure changes in infected tissues, especially in cases of cell necrosis caused by bacterial infections. Based on this study, *Merremia mammosa* extract showed varied results in reducing cell necrosis in liver tissue. Some groups treated with *Merremia mammosa extract* showed a reduction in cell necrosis, while others experienced a greater increase in necrosis, likely due to higher doses or more severe infectious conditions. Groups that did not show cell necrosis, such as P11, P12, P13, P14 and P15 showed better protection against liver tissue damage. This provides evidence that *Merremia mammosa extract* may help protect liver tissue from further damage, although results vary depending on the dose and individual body conditions.

CONCLUSION

The administration of *low-dose Merremia mammosa* extract is effective in reducing liver cell necrosis due to *Mycobacterium tuberculosis infection*. The low-dose group showed better tissue protection than high-doses, which in turn has the potential to trigger excessive inflammation. The active compounds in the extract, such as flavonoids and saponins, play a role through anti-inflammatory, antioxidant, and antibacterial mechanisms. These results confirm the potential of *Merremia mammosa* as an adjunct therapy in treating liver damage due to TB infection, with the need for further research to determine safe and effective doses.

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CONFLICT OF INTEREST

The author states that there is no conflict of interest.

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NUTRITION EDUCATION BASED ON THE 'MY T PLATE' MODEL ENHANCES ADOLESCENTS' KNOWLEDGE IN PREVENTING CENTRAL OBESITY

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ABSTRACT

Background: *Central obesity among adolescents aged over 15 years warrants serious attention, as approximately 80% of affected individuals are likely to remain obese into adulthood, thereby increasing their risk of developing non-communicable diseases (NCDs). A major contributing factor is the shift in dietary patterns, which is further exacerbated by limited knowledge regarding food choices and dietary diversity among adolescents. This study aims to analyzed the effect of the "My T Plate" animated video on adolescents' knowledge in the context of central obesity prevention.*
Method: *This study employed a pre-experimental design with a pre-posttest without control group approach. The study population consisted of adolescents aged 15–18 years attending SMAN 10 in Jambi City. A total of 40 participants were selected using purposive sampling Bivariate analysis was conducted using the Wilcoxon signed-rank test.*
Result: *The animated video intervention significantly improved participants' knowledge ($p < 0.0001$), attitudes, and dietary diversity related to the prevention of central obesity.*
Conclusion: *Animated educational videos are effective in enhancing adolescent knowledge, making them a promising strategy for central obesity prevention among adolescent.*

Keywords: *Adolescent, Animated, Prevention*

INTRODUCTION

Central obesity among adolescents has shown a rising trend, primarily driven by lifestyle changes and dietary shifts. These include low consumption of fruits and vegetables, increased intake of fast food (high in saturated fats, sugar, and salt), sugary beverages, and reduced physical activity (Putra et al., 2023).

In Indonesia, the prevalence of abdominal or central obesity among adolescents aged over 15 years has consistently increased, with rates of 18.8% in 2007, 26.6% in 2013, 31.1% in 2018, and 36.8% in 2023. Specifically, in Jambi Province, the prevalence of central obesity among adolescents reached 32.9%, which is approaching the national average (Ministry of Health, Republic of Indonesia, 2024).

Central obesity during adolescence is associated with several adverse health outcomes. Adolescents with central obesity are 4.2 times more likely to develop diabetes mellitus and 5.5 times more likely to develop hypertension compared to their non-obese peers (Sahoo et al., 2015). Moreover, central obesity can negatively impact academic performance, reduce productivity during adolescence and adulthood, and lower overall quality of life (Xie et al., 2019).

Nutrition education is one of the strategies that can be implemented to improve adolescents' knowledge about healthy eating

(Asri, 2022). Education has the potential to enhance an individual's knowledge, which in turn is expected to lead to positive changes in attitude and behavior (Putri, 2022).

Animated videos serve various purposes, including entertainment, advertising, and education (Ala et al., 2023). Animation is particularly effective in educational settings, as it can capture learners' attention, enhance motivation, and stimulate interest during the teaching and learning process (Sagitaa et al., 2022). In the context of nutrition education, animated videos can help adolescents more easily receive and comprehend the messages being conveyed. Barriers in delivering educational content can be overcome through the use of engaging, effective, and efficient learning media. Video-based media allow students to grasp educational messages more meaningfully, enabling a comprehensive understanding of the information presented (Meidiana et al., 2018).

Research by Julita et al. (2021) supports the effectiveness of animated videos in delivering information about obesity, including dietary patterns, recommended eating behaviors, and physical activities for individuals with obesity. The "T-plate" model promotes low energy density meals by increasing vegetable intake, which directly reduces total caloric intake. Therefore, the use of the My T-Plate animated video is expected to enhance adolescents' knowledge and support efforts to prevent central obesity.

METHODS

This study employed a pre-experimental design with a pretest-posttest approach. The participants total 41 were students aged 15–18 years enrolled at a public senior high school (SMAN) in Jambi City. Inclusion criteria included being physically and mentally healthy, actively enrolled in school, and possessing a smartphone. Exclusion criteria were students who were absent during the intervention sessions, did not complete all phases of the study, or had chronic illnesses such as diabetes mellitus, kidney disease, hypertension, or cardiovascular conditions.

Data collection was conducted after obtaining ethical clearance from the Research Ethics Committee of Poltekkes Kemenkes Jambi. The independent variable in this study was an animated educational video. The video content covered various aspects of obesity, including definitions, dietary causes, health impacts, and prevention strategies based on the "My T-Plate" model. The T-Plate model promotes balanced consumption of carbohydrates, proteins, fats, vegetables, and fruits. The animated video incorporated moving graphics, narration, text, and two animated characters, with a total duration of 3 minutes and 21 seconds. The video was delivered once per week for one month (a total of four sessions).

Nutritional knowledge was assessed using a structured questionnaire consisting of 10 multiple-choice questions, each with five answer options. The reliability of the questionnaire, as measured by Cronbach's alpha, was 0.685.

RESULTS AND DISCUSSION

The study revealed a significant improvement in participants' knowledge scores after the animated video intervention. The mean knowledge score increased from 5.78 at baseline to 8.52 post-intervention, reflecting a mean increase of 4.666 points.

Table 1. Bivariate Analysis

Variabel	$\bar{x}$	*z*	*SD*	*p*
Knowledge				
After	5.78	4.666	1.593	<0.0001
Before	8.52		1.240	

These findings are consistent with prior studies showing that animated video-based nutrition education effectively enhances adolescent knowledge and attitudes. For

example, a study by Meidiana et al. (2018) demonstrated that adolescent girls who received animated video education exhibited improved knowledge and attitudes related to anemia prevention. Similarly, research involving adolescents aged 12–15 years showed increased knowledge and positive attitudes regarding obesity after exposure to animated educational videos.

Additional studies support the effectiveness of this method. Nasyiba et al. (2023) conducted research at SMAN 98 Jakarta, while Adrianto et al. (2023) studied students at SMA PGRI 3 Bogor, both finding that animated videos significantly improved adolescents' understanding of obesity and overnutrition. Furthermore, Selvia and Magdalena found that animated nutrition videos provided to students at SMAN 3 Banjarbaru enhanced both knowledge and attitudes toward obesity prevention more effectively than conventional videos. Adolescents in these studies reported reducing portion sizes, limiting intake of high-sugar and high-carbohydrate foods, and increasing vegetable and fruit consumption to cover 50% of their plates during meals (Ramadhanti et al., 2022; Selvia, 2023).

Positive attitudes and behaviors toward healthy eating are more likely to form when individuals have adequate knowledge. Attitude is considered a latent response to a stimulus—such as information on obesity prevention—which can be effectively delivered through animated videos. These videos are known to capture attention, stimulate interest, and support behavioral change.

Since adolescents tend to think abstractly, media such as animated videos can visualize real-life scenarios and make learning experiences more engaging. This makes animated content especially suitable for educational interventions in this age group. According to Yudianto (2017), media serves as a compensatory, cognitive-attentional, and affective learning tool. Visual learning plays a dominant role in information retention, with 75% to 87% of knowledge being acquired through visual input (Saputri et al., 2017). Fujiyanto (2016) added that approximately 94% of messages are absorbed through visual and auditory channels, and individuals typically remember 50% of what they see, especially when presented in the form of video programs.

Animated videos offer a fast, efficient, and engaging method for delivering information, involving multiple senses and enhancing long-term memory retention (Sinor, 2011). Mega et al. (2020) also reported that adolescents preferred animated videos because they found them easier to understand due to the combination of text, graphics, and background music, which provided both educational content and entertainment value. A well-designed educational video should feel familiar and relatable to its audience.

Improved attitudes following the intervention were driven by increased knowledge, leading to greater awareness and motivation for positive behavioral change. These shifts in attitude may serve as a foundation for adopting healthier lifestyle practices aimed at preventing central obesity.

CONCLUSION

The animated video "My T-Plate" intervention significantly improved adolescents' knowledge and attitudes toward central obesity prevention. This medium shows promise as an effective health education tool for adolescents.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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THE PROPORTION OF STARCH TUBER CONSUMPTION PATTERNS AND PREVALENCE OF HYPERTENSION AND DIABETES MELLITUS

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ABSTRACT

Background: *Hypertension and diabetes mellitus are major health problems in Indonesia. Consumption of starch tubers, such as cassava and sweet potatoes, has the potential to affect blood sugar levels and blood pressure. This study aims to analyze the relationship between the proportion of starch tuber consumption and the prevalence of hypertension and diabetes mellitus based on data from the 2023 Indonesian Health Survey (IHS).*
Method: *This study used a cross-sectional design with aggregate data from 38 provinces in Indonesia. Bivariate analysis used the Spearman correlation test.*
Result: *The results showed that consumption of starch tubers > 1 time per day and < 3 times per month had a significant relationship with the prevalence of hypertension (p = 0.00; p = 0.00) and diabetes mellitus (p = 0.00; p = 0.00). On the other hand, consumption of 1–6 times per week did not show a significant relationship with both diseases. The higher the proportion of starch tuber consumption, the lower the prevalence of hypertension and diabetes mellitus.*
Conclusion: *This study concluded that the overall consumption of starch tubers in Indonesia is low. Especially consumption of starch tubers in weekly periods in urban areas on the incidence of hypertension and diabetes mellitus. A nutritional education program policy is needed to reduce the risk of non-communicable diseases.*

Keywords: *Diabetes Mellitus, starch tubers, Hypertension*

INTRODUCTION

Non-communicable diseases such as hypertension and diabetes mellitus are major health problems in Indonesia. According to the 2018 Basic Health Research, the prevalence of hypertension reached 34.1%, while the prevalence of diabetes mellitus in adults and the elderly aged 20 to 79 years was around 10.6% (Zaddana et al., 2021). This condition shows that NCDs (Non-Communicable Diseases), especially hypertension and diabetes mellitus, are major challenges for the health sector in Indonesia. Diabetes Mellitus (DM) is a collection of metabolic symptoms that arise in a person due to an increase in blood glucose levels that exceed normal limits. This disease is caused by impaired glucose metabolism due to insulin deficiency, either absolutely or relatively. This condition occurs when the pancreas cannot produce enough insulin or because the body cannot effectively use the insulin (Zaddana et al., 2021). People with diabetes generally also experience hypertension. Hypertension is the main cause of morbidity and mortality for individuals with diabetes (Ihsan & Adisasmita, 2023). Hypertension is still the most common disease suffered by the Indonesian people. Hypertension is included in one of the non-communicable diseases that are currently a priority in the world of global health, besides being one type of non-communicable disease, hypertension is a major risk factor for cardiovascular diseases such as stroke, heart failure, and myocardial infarction (Budiawan et al., 2024).

In Asia, including Indonesia, the prevalence of these two diseases is also increasing. In China, the prevalence of

hypertension is estimated at around 25%, while the prevalence of type 2 diabetes reaches 11.5% (Wang et al., 2024). In Indonesia, based on the 2022 SSGI report, the prevalence of hypertension reached around 34.1% and the prevalence of diabetes mellitus reached 6.3%. The prevalence of diabetes mellitus in Indonesia according to the International Diabetes Federation (IDF) in 2021 was 19.47 million people. IDF estimates that diabetes mellitus sufferers in Indonesia in 2045 could reach 28.57 million people. This estimate is greater than in 2021. The estimated cases of hypertension in Bengkulu province in 2023 are 4,687 people, (9.6% of whom are in the ≥15 year age range) (BKPK, 2023).

One of the significant risk factors for hypertension and diabetes mellitus is food consumption patterns, including carbohydrate intake such as tubers. Tubers such as cassava, sweet potatoes, arrowroot, gelimbi tubers, and other tubers are sources of carbohydrates that are commonly consumed in Indonesia. The glycemic index of these tubers varies; for example, cassava has a glycemic index of around 55, which is included in the medium category. Purple sweet potato has the lowest glycemic index value of 21.54 compared to yellow and red sweet potatoes, so purple sweet potatoes are a good food ingredient for consumption by people with diabetes mellitus (Zaddana et al., 2021). In the study Zaddana et al., (2021) stated that snack bars made from purple sweet potatoes also have very strong antioxidant activity because of their high anthocyanin content and low reducing sugar content so this snack bar is suitable for consumption by people with diabetes mellitus. However, consumption of tubers affects blood sugar levels which are closely related to blood pressure, especially in people with type 2 diabetes mellitus. Diabetes increases the risk of hypertension through physiological mechanisms involving insulin resistance and the Renin-Angiotensin-Aldosterone system (Farhan et al., 2024).Therefore, it is important to monitor and control blood sugar and blood pressure levels to maintain health.

In previous studies, it was said that purple sweet potato puff pastry with dragon fruit jam can be an alternative snack for diabetics because purple sweet potato flour is gluten-free flour. In addition, this purple sweet potato puff pastry does contain anthocyanin which can prevent increased blood sugar levels in the body. Consuming foods with a low to moderate glycemic index can help control blood sugar levels and blood pressure, thus potentially reducing the risk of diabetes mellitus and hypertension (Asnawi & Eliska, 2023). However, studies that specifically examine the proportion of starch consumption and its relationship to the incidence of hypertension and diabetes mellitus based on a doctor's diagnosis are still rare.

This study aims to describe and analyze 7 regional areas with the proportion of tuber consumption patterns with hypertension and diabetes mellitus based on doctor's diagnosis based on data from the 2023 Indonesian Health Survey (IHS). The results of this study, it is expected to provide recommendations regarding healthy eating patterns, especially tuber consumption, in preventing hypertension and diabetes mellitus in Indonesia. This study also aims to enrich the scientific literature on healthy diets.

METHODS

This study was conducted with a cross-sectional design using aggregate data from IHS 2023. This design allows us to determine the proportion of starch consumption patterns with hypertension and diabetes mellitus. The population used was all adolescents aged > 15 years in the provinces of Indonesia, the sample selected for this study was adolescents aged > 15 years in 38 provinces in Indonesia based on SKI 2023 data. The inclusion criteria were those aged > 15 years who experienced hypertension and diabetes mellitus. While the

exclusion criteria were those who had incomplete interview and examination data on all variables. The implementation of the 2023 Indonesian Health Survey (HIS) was carried out in August - October 2023 throughout Indonesia with 38 provinces, and 514 districts/ cities involving 568,000 households.

The independent variable in this study is the consumption pattern of starchy tubers while the dependent variables are hypertension and diabetes mellitus. Hypertension is said if blood pressure is > 140/90 mmHg while in diabetes mellitus, the results of blood sugar level examination using Point of Care Testing (POCT) in residents aged ≥ 15 years. Diabetes results if fasting blood glucose levels are ≥ 126 mg/dl; or blood glucose levels 2 hours after loading ≥ 200 mg/d. Calculated using the prevalence of DM based on examination (age ≥ 15 years) is the same as biomedical ART aged ≥ 15 years with the results of diabetes blood glucose levels divided by biomedical ART aged ≥ 15 years whose blood glucose levels are examined multiplied by 100%. In hypertension, it is calculated using the prevalence of hypertension based on a doctor's diagnosis equal to ART aged ≥ 15 years who have been diagnosed with hypertension by a doctor divided by ART aged ≥ 15 years who were interviewed multiplied by 100%.

All processes of collecting specific health data are carried out by data collectors with a minimum educational background in Diploma III health and have undergone training. The research instrument follows the existing procedures of IHS 2023, namely individual interviews conducted using a structured questionnaire instrument. Univariate analysis was carried out to describe the characteristics of each variable using the middle and variance measures (mean, standard deviation, maximum value, and minimum value). To analyze the relationship between the consumption of starchy tubers and the prevalence of hypertension and diabetes mellitus, a bivariate analysis was carried out using the Pearson correlation test if the normal assumption is met, but if the normal assumption is not met, the Spearman correlation test was carried out with SPSS version 22. This implementation has received ethical approval from the Health Research Ethics Commission Number HK.01.07/ MENKES/156/2023 to ensure that research procedures meet ethical standards applicable to health research.

RESULTS AND DISCUSSION

Table 1 shows that the highest proportion of daily starchy tuber consumption is in the Papua regional area (63.0%) and the lowest proportion of daily starchy tuber consumption is in the Sulawesi regional area (2.6%). The highest proportion of weekly tuber consumption is in the Sumatra regional area (62.5%) and the lowest proportion of weekly tuber consumption is in the Papua region (21.7%) and the highest proportion of monthly starchy tuber consumption is in the Sumatra regional area (59.0%) and the lowest proportion of starchy tuber consumption is in the Papua regional area (15.3%). The results of this study indicate that there are significant differences in the proportion of starch consumption and the prevalence of hypertension and diabetes mellitus between regions in Indonesia. In general, the proportion of starch consumption in Indonesia is still low with an average proportion of starch consumption in Indonesia for consumption >1 time/day at 9.6%, 1-6 times/week at 1.2% and <3 times/month of 38%.

The results of this study indicate that there are significant differences in the proportion of starch tuber consumption and the prevalence of hypertension and diabetes mellitus between regions in Indonesia. In general, the proportion of starch tuber consumption in Indonesia is still low, with a national average of >1 time per day 9.6%, consumption of 1-6 times per week at 1.2%, and consumption of <3 Times per month 3.8%.

This figure illustrates the low consumption of starch tuber foods which will have an impact on hypertension and diabetes mellitus. The proportion of starch tuber food consumption >1 time per day is highest in Papua while 1-6 times per week and <3 Times per month are found in Sumatra, while the lowest consumption of starch tubers >1 time per day is found in Sulawesi and consumption of starch tubers 1-6 times per week and <3 Times per month is found in Papua. This shows the inequality in access and consumption of starch tubers between regions in Indonesia which is influenced by geographical factors, culture, and the availability of food in each region. The low glycemic index has bioactive compounds such as water-soluble polysaccharides, dietary fiber, and diosgenin which can lower blood sugar (Setyaningrum&Adi,2022).

Table 1. Distribution of the Proportion of Starchy Tubers Consumption according

Region	>1 time/day			1-6 times/week			<3 times/month		
	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD
Sumatera	3.0	7.0	4.8±1.2	37.9	62.5	53.8±7.9	32.8	59.0	41.3±8.9
Jawa dan Bali	4.2	7.2	5.6±0.9	45.7	54.8	51.8±3.0	38.0	50.2	42.6±3.9
Nusa Tenggara	5.7	7.6	6.6±1.3	56.0	57.0	56.5±0.7	35.4	38.2	36.8±1.9
Kalimantan	3.8	7.9	5.3±1.9	45.3	62.7	52.4±7.2	33.6	50.8	42.2±6.9
Sulawesi	2.6	8.5	5.2±2.3	39.9	54.7	49.2±5.3	36.8	57.4	44.6±7.0
Maluku	15.1	19.1	17.1±2.8	54.5	57.1	55.8±1.8	23.8	30.4	27.1±4.6
Papua	11.9	63.0	29.3±22.8	21.7	57.7	44.0±14.	15.3	40.8	26.6±9.5
Indonesia	**2.6**	**63.0**	**9.6±12.2**	**21.7**	**62.7**	**1.2±8.2**	**15.3**	**59.0**	**3.8±9.3**

Indonesia has a wealth of diverse local food ingredients, including various sources of carbohydrates. Plants that are sources of carbohydrates generally produce starch, such as tubers, cereals, and nuts. Starch itself is a polysaccharide that acts as an energy reserve for plants in the metabolic process. Each source of starch has a different composition and characteristics. Tubers are known to be the highest source of starch, while cereals and nuts in addition to containing starch also have protein and fat. The protein and fat content makes the process of extracting starch from cereals and nuts more complicated than tubers because it requires a protein separation stage first. Some types of tubers that are widely cultivated in Indonesia include cassava, potatoes, and sweet potatoes.

Table 2. Distribution of Hypertension and Diabetes Mellitus Prevalence according to the 2023 Indonesian Health Survey

Region	Hypertension Based on Doctor's Diagnosis			Diabetes Mellitus Based on Doctor's Diagnosis			Hypertension Based on Measurement Results		
	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD
Sumatera	4.3	8.8	6.9±1.2	1.3	2.8	1.8±0.4	21.4	28.3	24.2±2.0
Jawa dan Bali	6.9	12.6	9.5±2.2	2.1	3.9	2.7±0.7	21.7	32.8	29.3±3.9
NusaTenggara	6.3	6.8	6.5±0.3	1.0	1.8	1.4±0.5	24.5	26.4	25.4±1.3
Kalimantan	7.2	11.1	8.4±1.5	1.7	3.1	2.1±0.5	28.0	38.7	31.8±4.5
Sulawesi	5.3	12.1	7.8 ± 2.3	1.4	2.7	2.0±0.4	26.5	29.5	27.7±1.1
Maluku	4.3	4.4	4.3 ± 0.0	0.9	1.2	1.0±0.2	20.8	25.6	23.2±3.3
Papua	2.2	7.0	5.0±1.9	0.2	1.8	1.2± 0.6	19.4	27.5	23.7±2.9
Indonesia	**2.2**	**12.6**	**7.3±2.2**	**0.2**	**3.9**	**1.9±0.7**	**19.4**	**38.7**	**26.7±3.9**

Tubers have very low protein and fat content, making it easier to isolate starch (Harni et al., 2022). Several previous studies have mentioned that consuming starch tubers has health benefits, especially in reducing the risk of metabolic diseases. A prolonged gap between energy intake and energy expenditure can increase the likelihood of non-communicable diseases, such as diabetes mellitus. It is important to determine the specific energy intake needed because energy or calorie needs vary from individual to individual (Amran et al., 2024). Starchy tubers, such as sweet potatoes, cassava, potatoes, and other tubers contain dietary fiber which can help control blood sugar levels and have a lower glycemic index compared to other carbohydrate sources such as white rice.

Table 2 shows that the prevalence of hypertension based on doctor's diagnosis is highest in the Java and Bali regions (12.6%) and the lowest prevalence of hypertension is in the Papua region (2.2%). The prevalence of diabetes mellitus based on a doctor's diagnosis is highest in the Java and Bali regions (3.9%) and the lowest prevalence of diabetes mellitus based on a doctor's diagnosis is in the Papua region (0.2%). For hypertension based on measurement results, the highest figure is in the Kalimantan region (38.7%) and the lowest figure is in the Papua region (19.4%). National figures show the prevalence of hypertension based on a doctor's diagnosis of 7.3% the prevalence of diabetes mellitus based on a doctor's diagnosis at 1.9% and hypertension based on measurement results of 26.7%.

Table 3. Relationship between the Proportion of Starch Tubers and the Prevalence of Hypertension and Diabetes Mellitus in Indonesia 2023

Consumption of Starch Tubers	Hypertension based on diagnosis	Hypertension measurement results	Diabetes Mellitus based on diagnosis
≥ 1 time per day			
Betta	-0.10	-0.14	-0.03
Constant	8.35	28.11	2.23
Correlation coefficient (r)	-0.58	-0.43	-0.55
p-value	0.00	0.05	0.00
1-6 times per week			
Betta	0.05	0.12	0.00
Constant	4.53	20.49	1.47
Correlation coefficient (r)	0.19	0.25	0.10
p-value	0.23	0.12	0.53
≤ 3 times per month			
Betta	0.14	0.15	0.04
Constant	1.63	20.88	0.01
Correlation coefficient (r)	0.59	0.35	0.64
p-value	0.00	0.02	0.00

The results of data analysis in Table 3 show that the proportion of starch consumption > 1 time per day is related to the prevalence of hypertension based on a doctor's diagnosis (p-value 0.00) and the prevalence of diabetes mellitus based on a doctor's diagnosis (p-value 0.00) and hypertension based on measurement results (p-value 0.05). Based on the beta coefficient value, it shows that the higher the consumption of starch > 1 time per day, the lower the prevalence of hypertension and diabetes mellitus. High consumption of starch > 1 time per day is moderately related to the prevalence of hypertension (r -0.58) and the prevalence of diabetes mellitus (r -0.55) based on a doctor's diagnosis and is moderately related to the prevalence of hypertension based on measurement results (r -0.43). On the other hand, the results of data analysis show that the proportion of starch consumption 1-6 times per week has no relationship to the prevalence of hypertension based on a doctor's diagnosis (p-

value 0.23) the prevalence of diabetes mellitus based on a doctor's diagnosis (p-value 0.53) and hypertension based on measurement results (p-value 0.12). Based on the beta coefficient value, it shows that the higher the proportion of starch tuber consumption, the higher the prevalence of hypertension, and the higher the proportion of starch tuber consumption, the lower the prevalence of diabetes mellitus. High consumption of starch tubers 1-6 times per week is very weakly related to the prevalence of hypertension (r 0.19) and the prevalence of diabetes mellitus based on a doctor's diagnosis (r 0.10) and is weakly related to the prevalence of hypertension based on measurement results (r 0.25). Data from the analysis of the proportion of starch tubers >3 times per month showed no relationship with the prevalence of hypertension based on a doctor's diagnosis (p-value 0.00) and the prevalence of hypertension based on measurement results (p-value 0.02) and the prevalence of diabetes mellitus based on a doctor's diagnosis (p-value 0.00). Based on the beta coefficient value, it shows that the higher the proportion of starch tuber consumption <3 times per month, the lower the prevalence of hypertension and diabetes mellitus. High consumption of starch tubers < 3 times per month is moderately related to the prevalence of hypertension based on a doctor's diagnosis (r 0.59) and the prevalence of diabetes mellitus based on a doctor's diagnosis (r 0.64) and is weakly related to the prevalence of hypertension based on measurement results (r 0.35).

Related to the prevalence of hypertension and diabetes mellitus, the data shows that the Sumatra region has the highest consumption of starch tubers 1-6 times per week (62.5%). The results of the analysis in Table 3 of the prevalence of hypertension based on a doctor's diagnosis show that the p-value 0.23, the prevalence of hypertension based on the results measurement of the p-value 0.12, and the results of the prevalence of diabetes mellitus with consumption of starch tubers 1-6 times per week obtained a p-value 0.53 greater than 0.05 which means that there is no relationship between the proportion of starch tuber consumption 1-6 times per week with the prevalence of hypertension and diabetes mellitus in the Indonesian region. This study is in line with research (Elmawati, 2019) that does not indicate that carbohydrate consumption, which is the main component in starch tubers, is not directly related to increased blood pressure in the population. Tubers, as a source of complex carbohydrates, have characteristics that can affect the risk of hypertension and diabetes mellitus, but in general starch, tubers do not have a direct relationship with hypertension and diabetes mellitus because each tuber has a glycemic index that can help maintain blood sugar levels in people with diabetes mellitus, if the carbohydrate content is low glycemic, such as sutoimo tubers and is rich in fiber which plays a role in controlling blood glucose levels and lipid profiles (Sukmawati, 2022). On the other hand, consumption of tubers affects blood sugar levels which are closely related to blood pressure, especially in people with type 2 diabetes mellitus. Diabetes increases the risk of hypertension through physiological mechanisms involving insulin resistance and the Renin-angiotensin-aldosterone system. Therefore, it is important to monitor and control blood sugar levels and blood pressure to maintain health (Farhan et al.,2024). The results of the study Sarifah & Siyam (2023) stated that hypertension is the most influential risk factor for the risk of type II diabetes mellitus. Hypertension is the most dominant factor associated with the incidence of type II DM at the Posbindu PTM in the Pegandon Health Center work area. There are several factors associated with hypertension and diabetes mellitus including age, gender, education, marital status, blood type, total cholesterol levels, HDL cholesterol levels, LDL cholesterol levels, triglyceride levels, smoking habits, occupation, physical activity, body mass

index (BMI), heredity of hypertension, heredity of DM, and duration of DM, and one of them is blood glucose levels (Damayanti et al., 2023).

The results in Table 3 show hypertension prevalence based on a doctor's diagnosis with consumption of starch tubers > 1 time per day (p-value 0.00), prevalence of diabetes mellitus based on a doctor's diagnosis (p-value 0.00), and prevalence of hypertension measurement results (p-value 0.05) and the results of hypertension prevalence based on doctor's diagnosis with consumption of starch tubers <3 Times per month (p-value 0.00) prevalence of hypertension based on measurement results (p-value 0.02) and prevalence of diabetes mellitus based on doctor's diagnosis results (p-value 0.00), there is a significant relationship between the proportion of starch tuber consumption > 1 time per day and the proportion of starch tubers < 3 times per month with the prevalence of hypertension and diabetes mellitus based on doctor's diagnosis in Indonesia. This study is not in line with the study Elmawati (2019) that does not indicate that carbohydrate consumption, which is the main component in starch tubers, is not directly related to increased blood pressure in the population. Although the consumption of starch tubers as a source of carbohydrates is not directly related to an increase in the prevalence of hypertension, a balanced diet with attention to fiber and potassium intake remains important in the management and prevention of hypertension. Consumption of diverse foods is closely related to systolic blood pressure. The most consumed food group by the subjects is starchy staple foods. The types of food in this food group that are most consumed are rice, noodles, lontong, and cassava (Izzati et al., 2022). Although tubers are an important source of carbohydrates and have nutritional benefits, excessive consumption without proper regulation can contribute to increased blood pressure. Therefore, it is important to maintain a balanced diet and regulate carbohydrate intake according to individual needs.

On the other hand, this study is in line with the findings Setyaningrum & Adi (2022) that the consumption of foods with a high glycemic index is significantly associated with increased blood sugar levels. Consumption of starchy tubers with a high glycemic index can contribute to an increased risk of diabetes mellitus, indicating that consuming foods with a high glycemic index is significantly associated with increased blood sugar levels at any time and 2 hours postprandial and in the results of the study (Mustikaningrum et al., 2021) showed that the high proportion of purple sweet potato increased the total anthocyanin Snack bar. Anthocyanins can inhibit α-amylase and α-glucosidase in digestion, indicating that the compound is slowly digested, thereby reducing the release and absorption of glucose in the intestine. Therefore, high consumption of anthocyanins can reduce the risk of diabetes mellitus, obesity, and cardiovascular disease. The amylose content contained in sweet potatoes greatly affects carbohydrate levels. Purple sweet potatoes contain high amylose (> 25%) which can reduce the rate of glucose absorption so that consuming purple sweet potatoes does not increase glucose levels significantly. Sweet potatoes that have high amylose content can reduce the metabolizability of starch in vitro. Decreased starch digestibility can confirm hypoglycemic activity, this occurs because it can produce little glucose and slow down glucose (Winayu et al., 2019). At the time of consumption of certain tubers can affect the risk of hypertension and diabetes mellitus, especially depending on the type of tuber, the content of simple carbohydrates that are easily digested and absorbed, which can cause an increase in blood sugar levels, and the method of processing it is not appropriate (Izzati et al., 2022). In the case of giving analog rice made from gembili tubers to type 2 diabetes mellitus rats, it has been proven to reduce triglyceride levels by 20-30. This states that analog rice from gembili tubers has the potential as an alternative diet for

people with diabetes mellitus in maintaining normal triglyceride levels (Eliana & Mustikaningrum, 2023). Factors that can cause diabetes mellitus due to consuming starchy tubers such as the glycemic index in food, dietary fiber content, and food processing methods. The research in Aek Godang Village, North Padang Lawas Regency in 2022 found that there was no relationship between consumption of high-carbohydrate foods and the incidence of DM in the elderly. The amount of carbohydrates consumed will affect blood glucose and insulin levels, because carbohydrates will be broken down and absorbed in the form of monosaccharides, especially sugar (Siregar, 2022). In the study Puspitaningrum & Kusmita, (2013) it was stated that kimpul tubers can lower blood glucose levels or as anti-diabetes mellitus suspected due to flavonoid content. Flavonoid and andrographolide content, are apparently significantly able to increase GLUT-4 protein translocation in thigh muscle cells and lower blood glucose levels in test animals induced by fructose and high-fat feed. Flavonoids are possible to increase glucose use in tissues by increasing tyrosine kinase phosphorylation on insulin receptor substrates so that there is an increase in the activity of the P1-3 kinase enzyme which will form and translocate GLUT-4 protein to the cell wall so that blood glucose levels decrease. In starch tubers such as cassava, and sweet potatoes, potatoes contain nutrients in the form of carbohydrates, fiber, potassium, and other nutrients. Potassium has an important role in electrolyte circulation, muscle contraction, nerve function, and blood pressure in the human body. This mineral can be found in all cells in the body and potassium levels are regulated by the kidneys. Potassium functions to smooth the balance of water and minerals in the body, and potassium also works with sodium to maintain normal blood pressure in the human body. Increasing potassium consumption can be a preventive effect against hypertension by increasing the amount of sodium secreted in the body and potassium contained in starch tubers such as potatoes is quite high, while the sodium content is low (Fina & Rindiani, 2024).

The results of this study indicate that limiting the proportion of starch consumption is an important step in reducing the incidence of hypertension and diabetes mellitus. Therefore, a nutritional education program is needed for the community and support for local farmers to increase food diversity. In addition, a more integrated policy between the health, education, and agriculture sectors is needed to overcome the problem of non-communicable diseases, such as hypertension and diabetes mellitus, in Indonesia.

CONCLUSION

This study shows that there is a significant relationship between the proportion of starch consumption <1 time per day with the prevalence of hypertension and diabetes mellitus. In contrast, starch consumption with a frequency of 1-6 times per week does not show a significant relationship with hypertension and diabetes mellitus. Meanwhile, starch consumption <3 Times per month has a significant relationship with the prevalence of hypertension and diabetes mellitus. The more often someone consumes tubers in the right amount, the lower the possibility of developing hypertension and diabetes. However, not all types of tubers have the same effect. This study concludes that overall starch consumption in Indonesia is low. Differences in tuber consumption between regions in Indonesia are also influenced by geographical, cultural, and food availability factors. For further research, more in-depth research is needed to explore the differences in the types of starch consumed and their impact on health, including clinical trials on the effects of glycemic index and bioactive content, and can expand the variables to be used.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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THE RELATIONSHIP BETWEEN PEANUT CONSUMPTION PATTERNS AND THE PREVALENCE OF HYPERTENSION AND DIABETES MELLITUS (INDONESIAN HEALTH SURVEY 2023 ANALYSIS)

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ABSTRACT

Background: *Hypertension and diabetes mellitus are major non-communicable diseases with a globally increasing prevalence, often influenced by dietary patterns. Nuts are known as a high-nutrient food source that can support the prevention and management of degenerative diseases such as hypertension and diabetes mellitus. This study aims to analyze the relationship between peanut consumption patterns and the prevalence of hypertension and diabetes mellitus.*
Method: *The study used a cross-sectional design with data aggregated on the results of the Indonesian Health Survey (IHS) 2023 by involving 38 provinces in Indonesia. Independent variables are the proportion consumption patterns of nuts. Dependent variables are prevalent hypertension and diabetes mellitus.*
Result: *The results obtained the consumption of nuts ≥1 time per day with the prevalence of hypertension based on diagnosis (p-value 0.02), the prevalence of hypertension based on measurement results (p-value 0.01), and the prevalence of diabetes mellitus based on diagnosis (p-value 0.00). There is no significant relationship between the proportion consumption of nuts 1-6 times per week with the prevalence of hypertension and diabetes mellitus. The proportion of bean consumption ≤ 3 per month significant relationship with the prevalence of hypertension based on diagnosis (p-value 0.00), the prevalence of hypertension based on measurement (0.03), and the prevalence of diabetes mellitus (p-value 0.00).*
Conclusion: *the results of the study show that increasing the frequency of consumption of legumes, especially in amounts that are more than three times per month, has the potential to reduce the prevalence of both diseases.*

Keywords: *Diabetes Mellitus, Hypertension, Peanuts*

INTRODUCTION

Human lifestyles due to urbanization, modernization, and globalization are one of the causes of the increase in Non-Communicable Diseases (NCDs)(Nugroho et al., 2019). One of the NCDs that occurs a lot is hypertension and diabetes mellitus; these two diseases are things that need to be considered because they can increase mortality.

Hypertension (high blood pressure) is a condition in which a person's blood pressure is ≥140 mmHg (systolic) and/or ≥ 90 mmHg (diastolic). This is due to various factors. Hypertension can be classified into two types, uncontrollable factors and controllable factors. Risk factors that cannot be controlled include genetics, age, gender, and race. Meanwhile, risk factors that can be controlled such as behavior or lifestyle such as obesity, lack of activity, stress, and food consumption (Insani & Ramadhani, 2022). The World Health Organization (WHO) in 2019 reported that 36% of the population aged 30-79 years was diagnosed with hypertension. The results of the 2023 IHS report show that the results of hypertension measurements reached 29.2% and from doctor's diagnoses, 8% of Indonesians have hypertension (BKPK, 2023).

Diabetes mellitus is a group of NCDs with signs of an increase in blood glucose levels (hyperglycemia) that occur due to abnormal

insulin secretion, insulin action, or both. The diagnosis of diabetes mellitus is clinically established based on a blood glucose test (fasting plasma glucose or FPG ≥126 mg/dl; or a plasma glucose test ≥ 200 mg/dl 2 hours after an oral glucose tolerance test or OGTT with an glucose load of 75 g; or a plasma glucose test or GDS ≥200 mg/dl) with the classic complaint of diabetes mellitus, or HbA1C ≥6.5% examination using methods standardized by the National Glycohaemoglobin Standardization Program or NGSP. According to the World Health Organization (WHO), there is an increase in cases of diabetes mellitus in the world, especially in countries with lower-middle-income (Briawan et al., 2021). In 2022, the World Health Organization (WHO) reported that 14% of adults aged 18 and over were living with diabetes, up from 7% in 1990. More than half (59%) of adults aged 30 and over living with diabetes were not taking medication for their diabetes in 2022. According to the 2023 IHS recording, there are 2.2% of diabetes mellitus cases in Indonesia (BKPK, 2023).

One of the significant risk factors for hypertension and diabetes mellitus is food consumption patterns, including the intake of nuts. Nuts, which are rich in fiber, protein, and minerals, have been shown to play a role in lowering the risk of hypertension and aiding glycemic control in people with diabetes mellitus. Previous studies have shown that consumption of mung beans as a plant-based protein source can improve cardiovascular health and help prevent other degenerative diseases (Ratnasari et al., 2021).

However, although the potential of nuts has been widely discussed in the literature, research related to the relationship between the consumption pattern of nuts and the proportion of hypertension and diabetes mellitus in Indonesia is still limited. Analysis based on the 2023 Indonesian Health Survey (IHS) offers an opportunity to understand public consumption patterns and their relationship with the prevalence of the two NCDs. The purpose of this study is to describe and analyze the relationship between the consumption pattern of nuts and the prevalence of hypertension and diabetes mellitus in the adult population in Indonesia. The results are expected to provide a scientific basis for more effective nutritional interventions in preventing and managing hypertension and diabetes mellitus.

METHODS

This study uses a cross-sectional research method. The data used is the aggregate data on the results of IHS in 2023. This research was conducted from August - October 2023 by involving 877,531 household members in 38 provinces and 514 districts/cities. This research was conducted by health workers with a minimum of D3 health education.

The population in this study is a population aged ≥ 15 years who experience hypertension and diabetes mellitus in the 2023 IHS data. The sample is the result of data from 38 provinces in Indonesia. The inclusion criteria are those who are at the age of ≥ 15 years have Hypertension and Diabetes Mellitus and are involved in interviews and examinations. Meanwhile, the exclusion criteria are those who have incomplete interview and examination data on all variables.

Independent variables were the consumption patterns of nuts diagnosed by doctors in Indonesia, which were taken using questionnaires. For the dependent variables, namely the proportion of hypertension and diabetes mellitus. Data was generated by measuring blood pressure and blood sugar and conducting interviews. Measurements can be made using a sphygmomanometer and point of care testing (POCT). The prevalence of hypertension was calculated by comparing the household members of ≥ age of 15 years who had been diagnosed with hypertension with the household members of ≥ age 15 years who were interviewed multiplied by 100%, the prevalence was categorized as hypertension when the systolic blood pressure was ≥ 140

mmHg and or diastolic blood pressure ≥ 90 mmHg in the population aged ≥ 15 years. The prevalence of diabetes mellitus was calculated by the formula of comparing household members aged ≥ 15 years who had been diagnosed with diabetes mellitus with household members aged ≥ 15 years who were interviewed multiplied by 100%, the prevalence was categorized as diabetes mellitus when fasting blood glucose levels were ≥126 mg/dl; or blood glucose levels 2 hours after loading ≥ 200 mg/dL.

The data analysis used was to first conduct a data normality test using the Kolmogorov-Smirnov test. Then if the data is normal, the meal will be continued using Spearman correlation bivariate analysis. The computer application used to help analyze the data is the SPSS version 22. This research has been approved and has ethics with the number HK.01.07/MENKES/156/2023

RESULTS AND DISCUSSION

Table 1 shows that the highest proportion of consumption of nuts and processed products according to the level of daily consumption is in the Java and Bali regions (50.4%) and the lowest in Sulawesi (4.9%). According to the proportion of consumption per week, Sumatra ranks first at 76.7%, while Kalimantan is the lowest with a proportion of 7.0%. The proportion of monthly consumption shows Papua (37.9) as the highest region while the lowest proportion of 4.2% is occupied by the Java and Bali regions.

The nutritional potential of nuts has made them a popular food choice for many people around the world. Nuts are known to contain a variety of nutraceuticals that are very beneficial in various roles in human and animal metabolism, these nuts are a source of protein, fiber, and minerals, and nuts are low in fat, making them suitable for energy-rich diets that can help meet nutritional needs. Nuts are also a good source of starch and a good candidate for prebiotics for the body (Semwal et al., 2023).

Nuts are one of the proteins that are very useful for the body, especially looking at the nutritional content in nuts, it is very possible to consume nuts to improve the body's digestive system. A legume type plant (leguminosa). Examples of legume crops include green beans, gude beans, kidney beans, tolo beans, soybeans, and peanuts. Almost all types of nuts can be processed from young to old plants. Usually, nuts in the form of seeds are used as ingredients for fresh vegetables, dried or frozen. Meanwhile, old nuts can be used in various kinds of food products, such as flour, milk, protein isolate, canned food, and others (Ratnasari et al., 2021).

Table 1. Distribution of Proportion of Consumption of Nuts and Their Processed Products by Region of Indonesia in 2023

Region	≥1 time per day			1-6 times per week			≤3 times Per month		
	Min	Max	X±SD	Min	Max	X±SD	Min	Max	X±SD
Sumatera	6.8	30.4	11.4±6.9	58.7	76.7	70.3±5.6	10.9	25.9	18.3±4.9
Jawa dan Bali	14.6	50.4	35.6±12.5	43.2	71.7	54.0±9.6	4.2	14.5	10.2±3.7
Nusa Tenggara	6.9	18.5	12.7±8.5	58.5	67.1	62.8±6.1	14.4	34.6	24.5±14.2
Kalimantan	7.0	24.4	12.2±7.0	7.0	74.3	56.6±28.1	13.7	21.6	18.3±3.5
Sulawesi	4.9	13.4	9.2±2.9	57.7	65.6	62.9±2.9	21	35.4	27.8±5.3
Maluku	11.5	15	13.2±2.4	56.3	59.9	58.1±2.5	25.1	32.2	28.6±5.0
Papua	12	18.3	14.4±2.2	46.8	63.6	55.4±6.5	23.2	37.9	30.2±5.5
Indonesia	4.9	50.4	16.5±11.6	7.0	76.7	60.8±12.4	4.2	37.9	20.9±8.5

From the results, it can be seen that the areas with low consumption of nuts come from the eastern region of Indonesia, this proves that there is still a gap in consumption patterns that occur in the Indonesian region. The results of the research show that food diversification significantly affects food insecurity in the eastern region of Indonesia (Baihaqi, 2025).

The results of research in one of the regions in the east also show that the consumption rate of vegetable protein sourced from legumes such as tempe and tahu is also still low, only 1-3 times per week (Muchtar et al., 2024).

The results of many research show that an unbalanced diet is related to the occurrence of diabetes mellitus and hypertension. The inseparability of life from modernization causes a lot of instant food which makes people prefer instant things because it is considered easier. Research shows that the group that has frequent consumption of instant food is 0.78 times more likely to experience hypertension than the group that rarely consumes instant food (Sirait & Ronoatmodjo, 2024). Other research also shows that the current population's diet contains a lot of sugar, which greatly affects the incidence of diabetes mellitus that occurs (Astutisari et al., 2022). The management of hypertension and diabetic mellitus can be divided into two, namely through medical measures such as medications and dietary arrangements with the right diet. Dietary regulation in the form of nutritional therapy is needed, especially in terms of maintaining and/or achieving normal nutritional status and helping to prevent and treat diseases (Halim et al., 2024). This therapy can be in the form of reducing food consumption that can worsen the condition of hypertension and diabetes mellitus such as foods high in salt and high in sugar. Regular and controlled feeding of nuts can be a good solution to help prevent and reduce the risk of hypertension and diabetes mellitus.

From the results of the research in Table 2 that has been carried out, it is found that hypertension based on diagnosis is highest in the Java and Bali regions (12.6%) and the lowest in the Papua region (2.2%), The prevalence of hypertension based on measurement results is highest in the Kalimantan region (38.7%) and the lowest in the Papua region (19.4%). This shows that the region has an influence on the incidence of hypertension related to access and daily life.

Diabetes mellitus is generally more common in developing countries than in developed countries (Astutisari et al., 2022). The incidence of hypertension is influenced by several factors such as physical activity habits, in people who often do sedentary behaviors such as sitting, there will be constriction starting from the main blood vessels in the lower legs, especially under the thighs. This can lead to an increase in peripheral resistance from blood vessels and there will also be fluid accumulation in the lower limbs. If the blood vessels have previously experienced atherosclerosis, then the blood vessels will become more rigid, and inelastic, so that their dilation is limited and there will be an increase in blood pressure (Lamangida et al., 2024).

Table 2. Distribution of Proportion of Consumption of Nuts and Their Processed Products by Region of Indonesia in 2023

Region	Hypertension based on diagnosis			Hypertension measurement results			Diabetes Mellitus is diagnosed		
	Min	Max	X±SD	Min	Max	X±SD	Min	Max	X±SD
Sumatera	4.3	8.8	6.9±1.2	21.4	28.3	24.2±2.0	1.3	2.8	1.8 ±0.4
Jawa dan Bali	6.9	12.6	9.5 ±2.2	21.7	32.8	29.3±3.9	2.1	3.9	2.7 ±0.7
Nusa Tenggara	6.3	6.8	6.5±0.3	24.5	26.4	25.4±1.3	1.0	1.8	1.4 ±5.7
Kalimantan	7.2	11.1	8.4±1.5	28	38.7	31.8±4.5	1.7	3.1	2.1 ±8.0
Sulawesi	5.3	12.1	7.8±2.3	26.5	29.5	27.7±1.1	1.4	2.7	2.0 ±7.4
Maluku	4.3	4.4	4.3±0.1	20.8	25.6	23.2±3.3	0.9	1.2	1.0 ±0.2
Papua	2.2	7.0	5.0±1.9	19.4	27.5	23.7±2.9	0.2	1.8	1.2 ±0.6
Indonesia	2.2	12.6	7.3±2.2	19.4	38.7	26.7±3.9	0.2	3.9	1.9 ±0.7

In other words, degenerative diseases such as hypertension and diabetes mellitus are influenced by modernization, where this modernization is able to provide easier access and make people want something instant so that there are many activities that make people less productive such as lack of bodily activity and a lot of junk food. The results of the study noted that people who often consume junk food have a greater risk of developing hypertension than people who rarely consume junk food (Insani & Ramadhani, 2022). People with an unbalanced diet are more likely to suffer from diabetes mellitus, whereas if a person with an unbalanced or excessive diet the consumption of staple foods increases the risk of suffering from diabetes mellitus (Zulkarnaini et al., 2023).

The prevalence of diabetes mellitus is highest in Java and Bali (3.9%) and lowest in Papua (0.2%). Prediabetes/diabetes in urban communities is on average caused by obesity and lack of activity. This happens to urban people because they have a sedentary lifestyle that is risky and often consume ready-to-eat foods or high-fat preserved foods, snack and drink ice, and do fewer activities. In rural areas, physical activity is more carried out than urban physical work. From this study, it is known that physical activities carried out by rural communities include hoeing, harvesting rice, lifting rice, planting rice, and others (Noventi et al., 2019). The food intake of rural communities is also better maintained than that of urban communities because many of the food sources of rural communities are still produced by nature. From the difference in physical activities in urban and rural areas, it can be seen that access to areas and habits has a great influence on the condition of the body. Diabetes is a disease that cannot be cured but has the potential to be prevented and controlled.

Table 3 shows a significant relationship between the proportion of bean consumption ≥1 time per day with the prevalence of hypertension based on diagnosis (p-value 0.02) the prevalence of hypertension based on measurement results (p-value 0.01) and the prevalence of diabetes mellitus based on diagnosis (p-value 0.000). Based on the beta coefficient value, it shows that the higher the proportion of bean consumption per day, the higher the prevalence of hypertension and diabetes mellitus. High daily consumption of nuts was weakly related to the prevalence of hypertension based on diagnosis (0.36) and hypertension prevalence based on measurement results (0.39) and moderately (moderate) was associated with the prevalence of diabetes mellitus (0.44).

Table 3. The Relationship of Nuts Consumption Patterns with the Prevalence of Hypertension and Diabetes Mellitus

Consumption Patterns of Nuts	Hypertension based on diagnosis	Hypertension measurement results	Diabetes Mellitus based on diagnosis
≥1 time per day			
Beta	0.07	0.13	0.02
Costan	6.11	24.51	1.42
Correlation Coefficient (r)	0.36	0.39	0.44
p-value	0.02	0.01	0.00
1-6 times per week			
Beta	0.00	-0.06	0
Costan	7.79	30.9	2.05
Correlation Coefficient (r)	-0.04	-0.21	-0.04
p-value	0.79	0.18	0.79
≤ 3 times per month			
Beta	-0.12	-0.16	-0.04
Costan	9.88	30.11	2.81
Correlation Coefficient (r)	-0.46	-0.34	-0.49
p-value	0.00	0.03	0.00

Table 3 shows no relationship between the proportion of bean consumption 1-6 times per week with the prevalence of hypertension based on diagnosis (p-value 0.79) and the prevalence of hypertension based on measurement results (0.18) and the prevalence of diabetes mellitus (p-value 0.79). There is a significant relationship between the proportion of nuts consumption ≤ 3 per month with the prevalence of hypertension based on diagnosis (p-value 0.000), the prevalence of hypertension based on measurement (0.03), and the prevalence of diabetes mellitus (p-value 0.000). Based on the beta coefficient value, it shows that the lower the proportion of bean consumption, the higher the prevalence of hypertension and diabetes mellitus. High consumption of nuts is moderately (moderate) related to the prevalence of hypertension based on diagnosis (-0.46) and is weakly related to the prevalence of diabetes mellitus (-0.49), and the prevalence of hypertension based on measurement results (-0.34) was weakly related.

In research on the consumption of nuts ≥1 time per day with the prevalence of hypertension and diabetes mellitus, it was found that the higher the proportion of nut consumption, the lower the prevalence of hypertension and diabetes mellitus, this can be caused by the processing of the nuts themselves, such as processed soybean products such as tempeh and tofu which are used as fried foods. Fried foods are various types of fried foods that are dipped in flour dough fried in hot oil. Hilma and friends showed that respondents in the study knew and consumed various fried foods such as tempeh and stuffed tofu, this study also showed that stuffed tofu is a fried food that is often consumed (Hilma et al., 2022). The Indonesian population mostly consumes fried foods that contain saturated fat, saturated fats commonly called bad fats that have the risk of clogging blood circulation (Yuningrum et al., 2022). Excess fat consumption is the most dominant or most risky variable for the incidence of hypertension in adolescents (Khikma & Sofwan, 2021). The consumption of fatty and sugary foods provides a significant association with the rate of diabetes mellitus, the addition of oil and coconut milk being a parameter in fatty foods. Oil and coconut milk are foods that have a fairly high fat content (Susilowati & Waskita, 2019).

From the research, it can be seen that the proportion of bean consumption ≥1 time per day with the prevalence of hypertension based on diagnosis and the prevalence of hypertension based on measurement results and the prevalence of diabetes mellitus based on diagnosis are related. The proportion of ≤ consumption of nuts per 3 months with the prevalence of hypertension based on diagnosis and the prevalence of hypertension based on measurements and the prevalence of diabetes mellitus are related. The results of the research also show that the higher the proportion of bean consumption, the lower the prevalence of hypertension and diabetes mellitus.

In terms of hypertension incidence, this study is in line with research by (Triandini et al., 2021) which states that the administration of soy-based products can reduce blood pressure with an average of 10.8/7.6 mmHg and the results of a significant statistical test, namely a p-value of < 0.05. Another study said that respondents' blood pressure after the intervention did not all drop, but some went up and some stayed. This condition is because most of the nutritional status of the respondents is overweight and obese, where the respondents have not been able to achieve the ideal weight and the respondents have sensitivity to salt as a result of this nutritional status (Halim et al., 2024).

In terms of the incidence of diabetes mellitus, this study is also in line with the research (Gultom & Melati, 2018) which states that there is no significant difference in the

decrease but there is a decrease in blood glucose levels This is also strengthened by research (Winarsi et al., 2022) where it was found that the administration of products made from tolo nuts, it is known that the content of tolo beans has phenolic antioxidants which can reduce blood glucose levels.

Nutrition is part of the substance of food and part of the substance of the human body. Nutritional status in the adult age group will affect work productivity. Adulthood is a productive age that requires optimal nutrients for life and activities. For adults, nutrients are needed to achieve optimal health and prevent chronic degenerative diseases with complex causes, especially obesity, cardiovascular disease, cancer, and diabetes mellitus, these degenerative diseases are the main causes of health disorders and premature death in people with an adequate economy (Nuryani et al., 2024).

Dietary consumption patterns are one of the things that can affect the incidence of non-communicable diseases (Nuryani et al., 2024), such as hypertension and diabetes mellitus. Wrong diets such as consuming excessive amounts of food, consumption of foods high in energy, high in fat, high in simple carbohydrates, and low in fiber without being balanced with balanced energy expenditure, one of which is physical activity or exercise is the trigger for cases of overweight (obesity). Obesity is one of the most frequent factors to cause an increase in blood sugar levels (Nugroho et al., 2019). People who are overweight can increase the potential for hypertension compared to respondents who have a normal weight (Lamangida et al., 2024).

The incidence of hypertension and diabetes mellitus is largely caused by food, this is related to unhealthy eating patterns causing an imbalance between carbohydrates and other nutrients needed by the body. As a result, the sugar in the body exceeds the working capacity of the pancreas, resulting in the occurrence of diabetes mellitus (Hariawan et al., 2019). Other research also shows that an irregular diet is a factor that plays a major role in the incidence of diabetes mellitus, because the more irregular the diet, the more likely it is for people to experience diabetes. An imbalance between energy intake and output results in weight gain, obesity appears in adolescence and tends to continue into adulthood, and the elderly (Sibagariang & Lumban Gaol, 2022). The results of the study by (Insani & Ramadhani, 2022) show that salt consumption, junk food consumption, salted food consumption, and burnt food consumption are risk factors that are significantly related to the incidence of hypertension. This change in diet leaves the concept of a balanced diet so that it has a negative impact on health. Eating habits that are high in saturated fat and sugar, and low in fiber cause obesity or overnutrition problems, and increase free radicals that trigger the emergence of various degenerative diseases (Zulkarnaini et al., 2023). Other studies have explained that hypertension and diabetes mellitus are not only caused by unhealthy eating patterns but also by various factors. According to (Lamangida et al., 2024) factors of age, gender, family history, obesity, and physical activity play a major role in the occurrence of hypertension. The risk factors for prediabetes/diabetes in the community are hereditary history and cholesterol. Hereditary factors, lifestyle, and environmental factors are factors that cause the high morbidity rate of diabetes mellitus over time. From the problems caused by this consumption pattern, looking for food alternatives that have the potential to be good is sought to overcome the incidence of hypertension and diabetes mellitus, one of which is by consuming types of nuts.

Nuts are known to lower the risk of developing cardiovascular diseases such as hypertension and diabetes mellitus, this can be seen through the positive impact on intermediate cardiovascular risk factors, including blood lipids, blood pressure, inflammation, and glycemic control markers.

Nuts are rich in unsaturated fatty acids, vegetable proteins, phytosterols, fiber, several minerals (including potassium, calcium, and magnesium), vitamins (vitamins E and B6), and phenolic and bioactive compounds, all of which can contribute to health-enhancing benefits for the body (Glenn et al., 2023). Legumes have good nutrients for a healthier lifestyle, legumes are an inexpensive and long-term source of protein, micronutrients, complex carbohydrates, and essential phytochemicals, and the composition is suitable for patients who reduce glucose. The variety and versatility of nuts can also be utilized in a variety of dishes, including soups, stews, curries, and salads.

Nuts are especially beneficial for people with hypertension and diabetes mellitus. As an example of pea consumption, a study (Kumar & Pandey, 2020). Whole pea flour and fractionated pea flour reduced fasting insulin levels by 13.5% and 9.8%, respectively, Consumption of bread with 17% pea peel fiber may reduce the glycemic response. Peanut fiber-enriched bread increases the duration of satiety. Fiber-rich foods are known to lower blood pressure levels, and inflammation and improve serum lipid levels and cardiovascular health (Kumar & Pandey, 2020). The results of other studies also show that nuts are high in fiber, antioxidant vitamins and minerals, phytonutrients, and Omega-3 fatty acids and that the combined blades have the effect of forming the Mediterranean Diet, and other plant-based diets, are highly effective in the prevention and modulation of obesity-related chronic diseases including cardiovascular disease. For example, the phytochemicals found in nuts are highly beneficial in improving blood cholesterol levels, and glycemic status, providing vascular protection and reducing markers of chronic inflammation.

CONCLUSION

The conclusion of this article shows that the consumption pattern of legumes has a significant relationship with the prevalence of hypertension and diabetes mellitus in Indonesia. Based on the beta coefficient value, it shows that the higher the proportion of bean consumption per day, the higher the prevalence of hypertension and diabetes mellitus. For further research, it is recommended to conduct a more in-depth longitudinal study with control for other lifestyle factors, such as salt intake, fat, physical activity, and body mass index. In addition, interventional clinical trials with the administration of specific amounts and types of nuts (e.g. soybeans, green beans, or almonds) can help understand the direct impact on blood pressure and blood sugar levels, to provide more targeted dietary recommendations for the prevention of hypertension and diabetes mellitus

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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GOOD PRACTICES OF SPECIFIC NUTRITION INTERVENTIONS IN REDUCING STUNTING PREVALENCE IN BENGKULU CITY

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ABSTRACT

Background. *The prevalence of stunting in Indonesia is third in Asia and has not met the target nationally. The decrease in the prevalence of stunting in Bengkulu City is very significant. It is necessary to examine the good practices that have been done in reducing the prevalence of stunting. This study aims to analyze the good practices of specific nutrition interventions in reducing stunting prevalence in Bengkulu City.*
Method. *The study used research on policy design in Bengkulu City from August to November 2023. Data collection uses Focus Group Discussion (FGD), in-depth interviews, and document review. The informants were selected by purposive sampling, with analysis using the SWOT analysis and content analysis methods.*
Result. *Good practice in reducing stunting in Bengkulu City is a strong commitment of the local government by including this program in the Regional Government Work Plan. Cross-sector collaboration between governments, non-governmental agencies, and local communities strengthens stunting efforts. Regular training for Nutrition Implementers and health cadres increases their knowledge in dealing with nutrition issues. In addition, counseling on nutrition at posyandu and schools, as well as adequate access to health services, supports monitoring children's growth. Stunting case audits are also applied for quick handling, while special interventions target vulnerable groups such as toddlers and pregnant women.*
Conclusion: *Strengthening cross-sector coordination and providing periodic training for health workers are essential. Increased budget allocations for monitoring and evaluation, enhanced public education on balanced nutrition, and improved health facilities are vital to sustaining progress in reducing stunting.*

Keywords: *Strategic policy study, implementation, stunting, research of policy*

INTRODUCTION

The current priority program of the Ministry of Health is stunting prevention and control, which is contained in the 2020-2024 National Medium-Term Development Plan (RPJMN), with a target of reducing stunting to 14% in 2024 (Kementerian Kesehatan RI., 2020). The prevalence of stunting in Indonesia is currently still higher than the normal limit set by the World Health Organization (WHO) of 20%. Data from the 2022 Indonesian Nutrition Status Study Survey (SSGI) shows that the prevalence of stunting is at 21.6%, down from 24.4% (SSGI 2021) and 27.7% (SSGI 2019), but has not reached the RPJMN target (Kemenkes, 2021). To achieve the target, the National Development Planning Agency (Bappenas) issued Decree Number Kep/42/M.PPNS/HK/04/2020 concerning the Determination of the Expansion of Regencies/Cities Focal Locations for Integrated Stunting Reduction Interventions in 2021. Bengkulu Province is one of 34 provinces designated as a priority area for handling stunting in 2021 (Kementerian PPN/ Bappenas, 2019). The results of the evaluation of the achievement of stunting prevalence in 2021 have not been optimal, so the Government has made policies in accelerating stunting reduction (PPS) through Presidential Decree of the Republic of Indonesia Number 72 of 2021 which is carried out in an integrated manner including specific and sensitive nutritional interventions with the approach of families at risk of stunting (Peraturan Presiden Republik Indonesia Nomor 72 Tahun 2021 Tentang Percepatan Penurunan Stunting, 2021).

The prevalence of stunting and nutritional problems in children under five in Bengkulu Province (19.8%) is lower than the national figure (21.6%), even among them, Kaur Regency (12.4%) and Bengkulu City (12.9%) have reached the 2020-2024 RPJMN target. The prevalence of stunting in Bengkulu Province (19.8%) is better than the national figure (21.6%), even Kaur Regency (12.4%) and Bengkulu City (12.9%) have reached the 2020-2024 RPJMN target (14% in 2024). The decrease in stunting prevalence in Bengkulu Province is very significant, from 22.1% (SSGI 2021) to 19.8% (SSGI 2022). The decrease in the prevalence of stunting in Bengkulu City is very significant (9.3%) from 22.2% (SSGI 2021) to 12.9% (SSGI 2022) (Kemenkes RI, 2023). This decrease in stunting prevalence is the result of specific and specific interventions. There has been no deep abomination of the driving and inhibiting factors for the implementation of PPS policies through specific nutrition interventions in Bengkulu Province.

The results of the study show that various stunting prevention and control programs face various obstacles, due to the sectoral ego of each OPD, socialization is not optimal, and understanding is not comprehensive (Fadlurrahman, 2014), The program has not been fully implemented, the scope of the program, its quality and targets are still low and the coordination between ministries and institutions has not been maximized, the policy has not fully reached the existing problems, the policy is dominated by the government, the role of the community is still very limited, and the lack of regulatory and budget support (Maulana et al., 2022), policy does not involve all cross-sectors, the KIA Regional Regulation has not been focused, not directly related, and has not involved all interventions to save 1000 HPK and stunting (Samsudrajat & Jati, 2018). Obstacles faced in policy implementation in terms of policies, budget, health, and human resources (Permanasari *et al.*, 2020; Rahman *et al.*, 2016). Some of the studies that have been conducted generally analyze the problems faced in policy implementation, limited to examining good practices carried out for the success of reducing stunting prevalence. A comprehensive study of the effectiveness of PPS policy implementation in Bengkulu City has never been conducted, so it is necessary to conduct a thorough study involving all relevant parties. The purpose of the study is to analyze the implementation of the PPS policy, as well as to find out the supporting and inhibiting factors in the implementation of the PPS policy.

METHODS

The research is a study of policy with a qualitative design, to find out the forms of PPS policies, analyze the implementation of PPS policies, especially specific interventions, and find out the supporting and inhibiting factors in the implementation of PPS policies in Bengkulu Province. A qualitative study was carried out in Bengkulu City from August to November 2023. The document review was carried out from data from the health offices of all districts/cities in Bengkulu Province. The informant of the in-depth interview is the Head of Public Health, Bengkulu City Health Office, and the Head of the Stunting Reduction Acceleration Team, BKKBN. FGD informants: Health Office (Nutrition Officer), Health Center Leaders (3 people), Nutrition Officers (3 people), Health Cadres (3 people). Data collection uses a qualitative approach with the Focus group discussion (FGD) method, in-depth interviews, and document review to collect primary and secondary data. The selection of informants uses purposive sampling techniques. The main informants were 10 heads of Public Health from Regencies/Cities related to the implementation of the PPS policy, key informants were 5 Nutrition Officers of Puskesmas in Bengkulu City.

The information that will be explored in this study is the driving and inhibiting factors for the implementation of the PPS policy. The policy analysis method uses SWOT analysis (strengths, weaknesses, opportunities, and threats related to the implementation of PPS policies). The instruments in this study are the researcher himself by conducting FGD and in-depth interviews using FGD and interview guidelines, voice recorders, stationery, and cameras. Data Analysis using content analysis. Before the study was carried out, it began with the submission of ethical clearance to the KEPK of the Bengkulu Ministry of Health Polytechnic No.KEPK.BKL500/09/2023. The data analysis method uses content analysis with the starting stages of Data Reduction, Data Display, and Conclusion Drawing.

Table 1. SWOT Analysis of the Implementation of Policies to Accelerate the Reduction of Stunting Prevalence Through Specific Nutrition Interventions in Bengkulu City

STRENGTH	WEAKNESS
1. Commitment from local governments, health workers, and the community 2. Budget availability for PPS policy implementation in Puskesmas 3. Availability of Health Facilities at the City/District Level 4. Provision of PPS programs in Related Agencies (BKKBN, Health Office, Education Office, Ministry of Religion, Agriculture Office) 5. Health workers are available with the competencies 6. Technical instructions and guidelines are available for the implementation of the PPS policy 7. There is a Foster Father/Mother Foster Child Stunting (BAAS) program involving the general public and local government officials 8. Data Analysis Master is available (stunting target data, coverage, PKH< supply data, etc.) to determine the stunting locus 9. A complete e-PPBGM application is available for program evaluation 10. An e-cohort with complete data on pregnant women is available to report ANC activities	1. Weak coordination between institutions. 2. Programs are still not integrated 3. Stunting data management is not yet optimal 4. Nutrition implementation personnel (NIP who go to the field are lacking, 1 health center only has 1-2 TPG, while there are many activities in the field 5. Posyandu activities are only for growth monitoring, immunization, vitamin A, and worms. No more pregnancy checks (ANC) and PMT for pregnant women in SEZs 6. There is no special budget for stunting services for toddlers at the health center; the health center only makes referrals to cases found 7. There are no incentives for posyandu cadres at the Puskesmas; there are no cemat/sub-district funds for cadre incentives in lieu of transportation, etc. 8. Posyandu cadres concurrently serve as TPK cadres, so cadres do not know the difference in duties between posyandu cadres and TPK cadres 9. Posyandu cadres are less active 10. There is a CERIA application (for Teen TTD), but it is not clear how to use it
OPPORTUNITY	**THREATH**
1. The participation of stakeholders and the community in the implementation of the PPS policy has been good 2. The availability of regional budgets at the Health Office, stakeholders (BKKBN), CSR funds from the private sector (ASTRA), village funds 3. The existence of an ELSIMIL application for bride-to-be screening, getting a certificate to get health services at the Puskesmas 4. Assistance from Basnas Kota distributes milk for stunted toddlers 5. Adequate access to clean water sanitation for Bengkulu City 6. Geographically, the city of Bengkulu is located in a coastal area with abundant sources of animal protein	1. Public understanding of stunting, handling, and prevention is still low 2. Low purchasing power of the community for the provision of food to the family 3. the ability of the community to process foodstuffs, especially animal protein sources so that nutritional intake is low. Families are less able to process food at home, so children often get processed food from outside the home. 4. The community rejects the existence of stunted toddlers, the existence of a stimulus that stunted toddlers is a disgrace in the family, so families who have stunted children are not taken to posyandu/puskesmas to receive health services. 5. Weighing coverage Community participation in posyandu (D/S) is still low 6. There is a negative public perception of immunization

1. Strength

The strengths in implementing the PPS policy include the commitment from the local government, healthcare workers, and the community; the availability of budget for the implementation of the PPS policy at the Puskesmas; the presence of health facilities at the city/district level; the provision of PPS programs by related agencies (BKKBN, Health Office, Education Office, Ministry of Religious Affairs, and Agriculture Office); the availability of qualified healthcare personnel; the existence of technical guidelines and necessary manuals for the implementation of the PPS policy; the presence of the Stunting Foster Parent Program (BAAS) involving the general public and local government officials; access to Master Data Analysis (data on stunting targets, coverage, PKH, supply data, etc.) to determine stunting loci; the availability of a comprehensive e-PPBGM application for program evaluation; and access to e-cohorts with complete data on pregnant women to report ANC activities.

2. Weakness

The weaknesses in implementing the PPS policy include weak coordination among agencies, non-integrated programs, and suboptimal management of stunting data. There is a lack of nutrition implementers (TPG) in the field, with only 1-2 TPG per Puskesmas, while there are numerous activities taking place. Posyandu activities are limited to growth monitoring, immunization, vitamin A distribution, and deworming, with no ANC or supplementary feeding programs for pregnant women. There is no specific budget for stunting services for toddlers at the Puskesmas, which only refers to cases identified. Additionally, there are no incentives for posyandu cadres, and no funds at the district/village level for transportation incentives. Posyandu cadres also serve as TPK cadres, leading to confusion about their distinct roles. Furthermore, posyandu cadres are less active, and although there is a CERIA application for adolescent health, its usage is not clearly defined.

3. Opportunity

Opportunities in implementing the PPS policy include good participation from stakeholders and the community in the policy's implementation, the availability of regional budgets from the Health Office and stakeholders (BKKBN), CSR funds from private entities (ASTRA), and village funds. There is also the presence of the elsimil application for screening prospective brides and grooms, which provides certificates for accessing health services at the Puskesmas. Additionally, support from Basnas Kota in distributing milk for stunted toddlers, adequate access to clean water and sanitation in Bengkulu, and the geographical advantage of being a coastal city with abundant animal protein sources contribute positively to the implementation of the policy.

4. Threat

The challenges faced by Bengkulu City in implementing the PPS policy include low public understanding of stunting prevention and management, low purchasing power for food supplies at the household level, and limited ability to process food, particularly animal protein sources, resulting in inadequate nutritional intake. Families struggle to prepare meals at home, leading children to often consume processed foods from outside. Additionally, there is a stigma surrounding stunted toddlers, perceived as a family shame, which discourages families from bringing their stunted children to posyandu or Puskesmas for health services. Furthermore, the coverage of weighing (D/S) remains low, and there are negative perceptions in the community regarding immunization.

The results of the study show that stunting prevention and control efforts in Bengkulu City are supported by several key factors. The commitment of all elements of

government in implementing Government Policies or Priorities focuses on and prioritizes reducing the prevalence of stunting. Strong policies and commitments from local governments in terms of human resources and infrastructure that support efforts to reduce stunting prevalence. There is financial support from the government and private sectors as well as CSR in stunting prevention activities. Collaboration between local governments, non-governmental organizations, the business world, and local communities can strengthen efforts to reduce stunting prevalence. There are complete human resources available for the implementation of PPS policies at the Regency/Sub-district and Village levels (posyandu cadres, TPK cadres). Only 1 health center out of 20 health centers for Nutrition Implementation Personnel is not from the Nutrition Science Field. Programs are available to achieve 11 specific nutrition intervention indicators. Nutrition action activities in schools in 20 health centers. Easy access to facilities and infrastructure (environmental sanitation, roads, information, transportation, and others) that reach the entire community. The availability and accessibility of balanced and nutritious food is essential. This includes policies to ensure access to nutritious food for low-income families. Good health facilities that are easily accessible are essential for monitoring children's growth, providing immunizations, and providing nutritional advice to parents. There are health centers that have BLUD (Durian Depun Health Center) that can become pilot health centers. The role of mothers in ensuring children's nutritional intake and taking care of their health is very important. Education and support programs for young mothers can help improve children's health. Special Intervention for Vulnerable Groups such as toddlers with malnutrition, children from poor families, children with certain health problems, and Pregnant Women of SEZ is essential. There is a Stunting Case Audit (AKS) in Bengkulu City, so that every stunting case is immediately followed up.

Inhibiting factors that may affect the implementation of policies to reduce stunting prevalence in Bengkulu City. The following are some possible inhibiting factors, namely the lack of budget to carry out supervision, monitoring, and evaluation (MONEV) from the Family Health and Nutrition Sector, which went to the field for data validation, so that MONEV activities have not been scheduled. The achievement data of specific nutrition intervention indicators have not been integrated. Data is available in each program. So that data management has not been synchronized. In 2022, there is no budget for stunting from the health office. Negative public perception of stunting. There are still people who do not agree with the immunization program. It is still found that people consider stunting as a family disgrace, so they do not bring growth monitoring and health checks to health facilities, there is still a traditional belief in the treatment of sick children. Not all mothers of toddlers bring their toddlers to the posyandu. The awareness of mothers of toddlers who do not bring their toddlers to be weighed at posyandu or in health services. Low public awareness and education of the importance of balanced nutrition or knowledge of how to process foodstuffs, and how to provide good nutrition to children, can be the main obstacle. Inequalities in the distribution of resources and access to quality health services and education can negatively affect vulnerable groups. Lack of coordination between government agencies, NGOs, and other stakeholders can make it difficult to implement policies, there are still sectoral egos in carrying out interventions. Low public awareness of the importance of monitoring the growth of Posyandu. After giving birth, the infant's mother does not come to the posyandu except when there is immunization. With various supporting and inhibiting factors, a policy

recommendation is needed to prevent new stunting cases in Bengkulu City.

The success of Bengkulu City in reducing the prevalence of stunting is supported by various key factors. First, a strong commitment of local governments to stunting prevention policies is crucial. Policies that focus on reducing stunting, both in terms of human resources and infrastructure, create a solid foundation for program implementation (Sunarto & Winarti, 2024). In addition, financial support coming from the government, private sector, and Corporate Social Responsibility (CSR) strengthens the financing of stunting prevention programs, allowing more planned activities and interventions (Hidayaturrahman and Harsono, 2023; Arifin *et al.*, 2025) Collaboration between various parties, including the government, non-governmental institutions, the business world, and local communities, is also a key driver in efforts to reduce stunting. This synergy ensures comprehensive support for various nutrition intervention programs (Fauziah & Novandi, 2021). The availability of trained Human Resources (HR), such as posyandu cadres and Family Assistance Teams (TPK), also plays an important role, with the majority of health centers having competent nutrition implementers (Fauziah & Novandi, 2021). Challenges in stunting prevention in Pandeglang Regency include the change of cadres which hinders the transfer of knowledge that has been obtained, resulting in less than optimal posyandu services. In addition, one cadre is involved in various activities, such as posyandu and early childhood education, making it difficult to focus. In this case, the village head can assess the competence of its citizens and determine the appropriate placement for each activity. The more people involved in government programs, the more knowledge is obtained, so that the village community will be more empowered (Candarmaweni & Rahayu, 2020). The implementation of stunting prevention policies in Malang Regency has experienced a lack of program synergy between OPDs which specifically has a slice of activities related to the prevention, management, and handling of stunting cases, including the involvement of elements of higher education, NGOs who are concerned about the problem to relevant NGOs (Agustino & Eko, 2022).

Access to good facilities and infrastructure, including sanitation and transportation, increases the effectiveness of nutrition programs by reaching a wider community. The availability of balanced nutritious food and policies that support access to healthy food for low-income families are also very important in overcoming nutritional problems (Pratiwi et al., 2023). In addition, health centers with the status of Regional Public Service Agency (BLUD), such as the Durian Depun Health Center, provide examples of best practices in health services.

The role of mothers in maintaining children's health and nutrition is crucial, so education and support programs for young mothers are an important component of this intervention. Through education and awareness-raising efforts, it is hoped that mothers can better understand the importance of good nutrition for their children (Yuliana et al., 2023). Finally, the existence of Stunting Case Audits (AKS), which is carried out periodically, allows the identification and handling of stunting

cases quickly and efficiently, thus supporting the success of the overall stunting prevention program in Bengkulu City.

In line with the results of research in Lenek Duren Village, Lenek District, East Lombok Regency, it shows that the implementation of the Stunting Reduction policy has been successful judging from the quality of the stunting handling program that touches every joint of the stunting problem, the healthy living community movement is carried out as a stunting handling program where the coordination of programs carried out between regional apparatus organizations is good, the first 1000 days of life movement as a stunting prevention measure set by the OPD is good, and nutrition education is provided as a form of service to the people of Lenek Duren village is considered optimal (Wididiati et al., 2022).

The factors that hinder the success of Bengkulu City in reducing the prevalence of stunting greatly affect the effectiveness of policy implementation. First, the lack of budget for supervision, monitoring, and evaluation from family health and nutrition makes this activity poorly scheduled (Setiawan et al., 2023). The absence of adequate funds causes the data validation process not to run optimally, so that information related to the achievement of specific nutrition intervention indicators is not integrated, and data management becomes out of sync (Dewi & Wati, 2022). In addition, the public's negative perception of stunting and immunization programs is also a big challenge. Some parents still consider stunting to be a family disgrace, so they are reluctant to bring their children for health checkups, which has an impact on the low level of growth monitoring in health facilities (Rahman et al., 2023). Low public awareness and education regarding the importance of balanced nutrition and knowledge in food processing also contribute to this problem, leading to a lack of attention to providing good nutrition for children (Fitria & Hidayah, 2024).

Inequality in the distribution of resources and access to quality health services and education can hurt vulnerable groups, making people increasingly marginalized in efforts to combat stunting (Anwar, 2022; Achmad *et al.*, 2024). Weak coordination between government agencies, Non-Governmental Organizations (NGOs), and other stakeholders is an additional obstacle, given the sectoral egos that are still strong in implementing interventions (Mastina and Mitra, 2023; Syamsuadi *et al.*, 2023; Febrian and Yusran, 2021). Low public awareness of the importance of monitoring growth in posyandu can also increase the incidence of stunting (Fauziah & Novandi, 2021)

The implementation of the stunting handling policy in Lenek Duren Village, Lenek District, East Lombok Regency is still not optimally implemented because there are inhibiting factors, namely the resources that hinder the implementation of the stunting handling policy in East Lombok Regency are human resources, the attitude of the implementing agent of the stunting handling policy in Lombok Tiimur Regency is not completely good, the communication that occurs between the implementing agent and the target community is still not going well, policy capacity in building the implementation process is still ineffective, and the lack of

access to drinking water and sanitation is inadequate as well as the culture of early marriage carried out by the people of Lombok in general (Wididiati et al., 2022). The implementation of prevention and control policies in Nagari Kajai, West Pasaman Regency, has not been optimal because the level of public knowledge about prevention has not increased significantly, and there has been no significant change in behavior by the community in providing nutritional intake. Inadequate facilities, lack of program supervision, and limited funds are also the causes of the program's suboptimal (Kinanti & Yusran, 2022).

The implementation of the stunting prevention policy by the Population Control and Family Planning Office of South-Central Timor Regency in Kie District has not been successful because, from the aspect of communication, the Population Control and Family Planning Office of South-Central Timor Regency has in principle socialized to the community regarding the impact of stunting on children, but the community thinks that stunting is due to hereditary factors and not due to malnutrition. Resources to implement this policy are quite available, but there is still a shortage of human resources in quantity and quality to conduct counseling, supervision, and control of stunting cases in Kie District. Meanwhile, from the aspect of disposition, policy implementers have good enough characteristics for the successful implementation of this stunting prevention policy, although there are still some extension workers who are indifferent to implementing the policy. The bureaucratic structure in the implementation of this policy also has a fairly strong foundation, but on the other hand, improvements must still be made in terms of regulations to be more decisive in dealing with stunting problems and eliminating sectoral egos between SKPDs who are responsible for preventing stunting problems in Kie District, South Central Timor Regency (Fallo, 2020).

CONCLUSION

The City of Bengkulu has implemented several good practices in stunting reduction, including a strong local government commitment by including this program in the Regional Government Work Plan. Cross-sector collaboration between governments, non-governmental agencies, and local communities strengthens stunting efforts. Regular training for Nutrition Implementers and health cadres increases their knowledge in dealing with nutrition issues. In addition, counseling on nutrition at posyandu and schools, as well as adequate access to health services, supports monitoring children's growth. Stunting case audits are also applied for quick handling, while special interventions target vulnerable groups such as toddlers and pregnant women.

Policy recommendations from the results of this study include strengthening cross-sector coordination for the integration of stunting management programs, as well as increasing periodic training for health cadres and Nutrition Implementation Personnel to improve their competence. In addition, the special budget allocation for monitoring and evaluation needs to be increased so that the implementation of the program can be monitored effectively. Public education on the importance of balanced nutrition and monitoring of children's growth must be strengthened through campaigns involving various parties. Finally, providing incentives to health cadres and improving health facilities

will encourage active community participation in efforts to reduce stunting.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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STUNTING IN CHILDREN IN KENDAL REGENCY: EVALUATION OF BREASTFEEDING AND COMPLEMENTARY FOOD PROVISION PATTERNS AS THE MAIN FACTOR

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ABSTRACT

Background: *Kendal Regency is one of the regions in Indonesia registered as a stunting handling locus in the National Development Planning since 2021. The Stunting Reduction Acceleration Team was formed by Regent Regulation Number 42 of 2021, but the prevalence is still high at 22.4%. This study aims to analyze the factors influencing stunting, especially the pattern of exclusive breastfeeding and the pattern of complementary feeding given by mothers in the first 1000 days of a child's life.*
Method: *The cross-sectional study analytical survey research method in the Cepiring Health Center work area, Kendal Regency, Central Java was conducted in March 2025. Data analysis was conducted univariately, bivariately, and multivariately using the Chi-square test (χ2) with a 95% confidence level (α = 0.05) and odds ratio.*
Result: *Children who do not receive exclusive breastfeeding have a 1.5 times greater risk of experiencing stunting with a ρ value of 0.003; OR 1.500 (CI 0.945 - 2.381), indicating a significant relationship between exclusive breastfeeding and stunting. Although children who are exclusively breastfed can still experience stunting, other factors, such as inappropriate patterns of complementary feeding (complementary feeding), contribute significantly to stunting. Children who receive inappropriate complementary feeding (late, with low nutritional quality) have a higher risk of stunting with a ρ value of 0.039 and OR 10.400 (CI 0.785 - 137.832).*
Conclusion: *To reduce the risk of stunting, it is important to educate parents about exclusive breastfeeding, the right complementary feeding pattern, and ensuring adequate nutrition for children from an early age.*

Keywords: *Kendal Regency, stunting, exclusive breastfeeding, complementary feeding*

INTRODUCTION

Stunting is a serious global problem with significant long-term health impacts, from reduced intelligence to loss of productivity. Children who experience stunting have higher rates of mortality and morbidity, experience cognitive and motor development deficits, and are at risk of chronic diseases in adulthood (WHO, 2015; de Onis & Branca, 2016). Ironically, Indonesia is one of the countries with a high prevalence of stunting. The Indonesian Health Survey in 2023 showed that the prevalence of stunting in Indonesia reached 21.5% of a total of 30.2 million toddlers, meaning that 6,477,000 toddlers experienced stunting (Ministry of Health of the Republic of Indonesia, 2024). The Indonesian government has been responsive in handling this case by preparing the National Strategy for the Acceleration of Stunting Prevention since 2018 with collaboration between institutions, ensuring the convergence of all stunting prevention programs and activities (Rokx et al., 2018; KemensetnegRI, 2020). However, the prevalence of stunting in Indonesia has not shown a significant decline.

Achieving adequate nutrition for children through optimal breastfeeding patterns and good eating patterns are priority factor for accelerating stunting management. This strategy emphasizes optimizing nutrition during the first 1,000 days of life, from pregnancy to age two (Baye & Faber, 2015). However, the obstacle that often occurs is an increase in stunting problems when the

complementary feeding period begins. This is due to inadequate maternal knowledge and practices, so that the energy and nutrient intake provided does not match the child's needs. Often, mothers or caregivers do not understand their child's hunger and satiety signals, causing irregular provision of adequate nutrition for children (Zeweter et al., 2017). Therefore, health services that reach more people with nutritional interventions that strengthen optimal feeding for children and integrate the promotion of responsive feeding behavior are needed.

Endeavors to handle stunting at the district or village level have the potential to be carried out and developed sustainably because they involve the community directly on a scale that is not too large, so that in the future, program monitoring will be more comprehensive and quickly improved. Kendal Regency is one of the regions in Indonesia that is registered as a locus for handling stunting in the National Development Planning since 2021. The Stunting Reduction Acceleration Team was formed in accordance with Regent Regulation Number 42 of 2021, and with this team, Kendal has succeeded in reducing the prevalence of stunting by 3.7%, to 17.5% in 2022 (BPSIndonesia, 2022). However, in 2023, the prevalence of stunting in Kendal increased significantly by 4.9%, reaching 22.4% (dp2kbp2pa.kendalkab.go.id/, 2024). This proves that even though Kendal has been designated as a locus for handling stunting, there are still many obstacles in efforts to overcome this problem. Therefore, a recent case study of factors influencing stunting is needed. This study aims to analyze the pattern of exclusive breastfeeding and diet given by mothers on the incidence of stunting in Kendal Regency. The results of this study can be used as a reference for improving the prevention and handling of stunting to be more effective and in accordance with conditions in the field.

METHODS

The type of research used is a cross-sectional study analytical survey. The study was conducted in the working area of the Cepiring Health Center, Kendal Regency, Central Java, in desember 2024. The dependent variables of this study are the pattern of exclusive breastfeeding and the pattern of complementary feeding. The independent variable of this study is the incidence of stunting. Data analysis was carried out univariately, bivariately, and multivariately with the Chi-square test ($\chi 2$) with a confidence level of 95% ($\alpha = 0.05$) and odds ratio. The population in the study was obtained by a purposive sampling technique using the inclusion criteria of being married and having toddlers, consisting of 34 respondents.

RESULTS AND DISCUSSION

Socioeconomic conditions play an important role in influencing the high prevalence of stunting. Factors such as family income level, parental education, and access to good health and nutrition services can determine the nutritional quality of children in a family (Azriani et al., 2024; Krisnana et al., 2020; Kustanto et al., 2024; Lee et al., 2021; Seran & Sengkoen, 2024; Siramaneerat et al., 2024). Children who grow up in low socioeconomic environments are more susceptible to stunting. The results of univariate analysis related to family characteristics consisting of mother's & father's age, mother's & father's education level, mother's & father's occupation, family income level, breastfeeding, and complementary feeding patterns can be seen in Table 1. The relationship between breastfeeding and complementary feeding patterns and the incidence of stunting is presented in Table 2.

Table 1 Respondent Characteristics

Characteristics	Respondents' Answers	
	n	Percentage (%)
Gender		
Man	19	55.9
Woman	15	44.1
Mother's Age		
20-35 years	27	79.4
>35 years	7	20.6
Father's Age		
20-35 years	22	64.7
>35 years	12	35.3
Mother's Education: Graduated		
Elementary school	0	0
Junior high school	7	20.6
High school	26	76.5
Academy / College	1	2.9
Father's Education: Graduated		
Elementary school	1	2.9
Junior high school	11	32.4
High school	21	61.8
Academy / College	1	2.9
Mother's Job		
Doesn't work	24	70.6
Laborer	3	8.8
Self-employed	1	2.9
Private employees	6	17.6
Father's occupation		
Doesn't work	0	0
Laborer	15	44.1
Self-employed	5	14.7
Private employees	14	41.2
Family Income		
<Rp. 1,000,000,-	11	32.4
Rp. 1,000,000 to Rp. 2,000,000,-	19	55.9
Rp. 2,000,000 to Rp. 3,000,000,-	2	5.9
>Rp. 3,000,000,-	2	5.9
Breastfeeding Pattern		
Non-exclusive breastfeeding	25	73.5
exclusive breastfeeding	9	26.5
Complementary Feeding Provision Pattern		
Not exactly	27	79.4
Appropriate	7	20.6
Stunting Incident		
Short	31	91.2
Very Short	3	8.8

Exclusive breastfeeding provides protection from stunting because its nutrients can strengthen the body's immune system, prevent infections and chronic diseases, and optimize children's growth and development (Rachmayanti et al., 2022). Breast milk contains Secretory Immunoglobulin A (SIgA), which provides the first defense against antigens in the baby's intestines. In addition, the supply of enzymes, active leukocytes, cytokines, oligosaccharides, lactoferrin, lysozyme, and lactoperoxidase, as well as immunological biological factors that prevent infectious and autoimmune diseases, are transferred from the mother through breast milk (Harmancıoğlu & Kabaran, 2019; Lokossou et al., 2022). Exclusive breastfeeding reduces the risk of diabetes mellitus infection (Alotiby, 2023)S, pneumonia, and asthma in children (Abate et al., 2025). CD8+ T immune cells in breast milk help protect infants from herpes-causing cytomegalovirus infection (Legg et al., 2024). Many studies have revealed the importance of exclusive breastfeeding, but in society, there are various obstacles that hinder its implementation, even though the World Health Organization (WHO) has recommended a minimum of 6 months of exclusive breastfeeding.

The results of the study showed that the pattern of non-exclusive breastfeeding correlated with the incidence of stunting; 25 children (100%) who did not receive exclusive breastfeeding experienced stunting with short stature. Meanwhile, in the group that received exclusive breastfeeding, only 6 children (66.7%) experienced "Short" stunting and 3 children (33.3%) experienced "Very Short" stunting. Statistical analysis showed a *ρ value* of 0.003 OR 1,500 (CI 0.945 -2.381), which indicated a significant relationship between exclusive breastfeeding and the incidence of stunting. This situation is worrying because children without exclusive breastfeeding have a 1.5 times greater risk of experiencing stunting. A study conducted by Damanik et al. (2025) proved that there are still many children who are not given exclusive breastfeeding; 87 out of 150 children suffer from stunting. Research by

Sari et al. (2021) confirmed that children aged 12-23 months who do not receive exclusive breastfeeding have a 3.1 times greater risk of experiencing stunting. Therefore, exclusive breastfeeding is very important. Hadi et al.'s (2021) research proves through their study in rural Eastern Indonesia, children who are exclusively breastfed, even from low-income families, are 20% less likely to experience stunting compared to children who are not exclusively breastfed.

Table 2 Relationship between Breastfeeding and Complementary Feeding Patterns and Stunting Incidence

Independent Variable	Stunting Incident				Total		*ρ*	OR (95% CI)
	Short (n)	Percentage (%)	Very Short (n)	Percentage (%)	(n)	Percentage (%)		
Breastfeeding Pattern								
Not exclusive breastfeeding	25	100	0	0.0	25	100	0.003	1,500 (0.945 - 2.381)
Exclusive breastfeeding	6	66.7	3	33.3	9	100		
Complementary Feeding Provision Pattern								
Not exactly	26	96.3	1					
Appropriate	5	71.4	2					

The provision of exclusive breastfeeding but short and very short stunting occurs due to other influencing factors, including the pattern of providing complementary feeding. Non-exclusive breastfeeding plus the pattern of providing complementary feeding with low energy and protein intake has a significant effect on increasing stunting cases. The results of the study in the inappropriate group of providing complementary feeding showed that 26 children (96.3%) experienced "Short" stunting and 1 child (3.7%) experienced "Very Short" stunting. While in the appropriate group of providing complementary feeding, only 5 children (71.4%) experienced "Short" stunting and 2 children (28.6%) experienced "Very Short" stunting. The pattern of providing complementary feeding with the incidence of stunting has a *ρ value* of 0.039 with an OR of 10,400 (CI 0.785 - 137,832), which indicates a fairly significant risk. The pattern of providing complementary foods that are not timely has a 4.44 times higher risk of causing stunting, while not meeting the minimum frequency of complementary foods has a 2.30 times higher risk of causing stunting (Guirindola et al., 2021). The provision of complementary feeding is currently often not timely, with low protein adequacy quality and less attention to quantity (Aguayo, 2017; Hijra et al., 2016; Amalia et al., 2022; Waqiyah et al., 2023). A study conducted by Rukmawati et al. (2020) added that 16 out of 22 respondents were short because they did not get the nutrients and energy from the complementary feeding given. Complementary feeding needs to be given when the child is 6 months old because breast milk only provides ½ of the child's nutritional needs, and when the child enters the age of 12-23 months, breast milk only meets 1/3 of the child's nutritional needs (Rukmawati et al., 2020).

The presence of stunting cases in the appropriate group for complementary feeding is influenced by socio-economic conditions. In this study, respondents were predominantly in the lower middle economy with incomes of <1,000,000 to Rp. 2,000,000,-. Low socio-economic status often affects the factors of children's nutritional adequacy, diversity, and frequency of complementary feeding, hygiene practices, and oral hygiene of children. A study conducted by Santika et al. (2016) proved that children from families with high economic status tend to receive exclusive breastfeeding at the age of 6 months and continue it until the age

of 1 year. They also get more diverse foods, rich in iron and fortified. Conversely, low socio-economic status groups tend to consume more grains and less diversity of food consumed. Children from low socioeconomic families also show poorer oral hygiene habits, such as less frequent visits to the dentist and high consumption of sweet foods, which contribute to poorer dental health conditions (Almajed et al., 2024; Theristopoulos et al., 2024). Thus, education on complementary feeding patterns and the use of appropriate complementary feeding ingredients for parents needs to be intensified.

CONCLUSION

Exclusive breastfeeding has been shown to play an important role in preventing stunting in children. Research shows that children who do not receive exclusive breastfeeding jhave a 1.5 times greater risk of experiencing stunting with a ρ value of 0.003; OR 1.500 (CI 0.945 - 2.381), indicating a significant relationship between exclusive breastfeeding and the incidence of stunting. Although children who are exclusively breastfed can still experience stunting, other factors, such as inappropriate patterns of providing complementary feeding (Complementary Foods), contribute significantly to the incidence of stunting. Children who receive inappropriate complementary feeding (late, with low nutritional quality) have a higher risk of stunting with a ρ value of 0.039 and OR 10.400 (CI 0.785 - 137.832). In addition, socio-economic factors also influence the provision of exclusive breastfeeding and appropriate complementary feeding. Families with low socio-economic status tend to have problems in meeting their children's nutritional needs, as well as having poor hygiene and oral health habits. Therefore, to reduce the risk of stunting, it is important to educate parents about exclusive breastfeeding, the right complementary feeding pattern, and ensuring adequate nutrition for children from an early age.

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CONFLICT OF INTEREST

There was no conflict of interest in the manuscript.

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RELATIONSHIP BETWEEN THE CONSUMPTION OF MILK, FAT, AND OIL WITH HYPERTENSION AND DIABETES MELLITUS IN ADOLESCENTS

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ABSTRACT

Background: *The prevalence and hypertension of diabetes mellitus (DM) in Indonesia continue to increase, mainly due to unhealthy lifestyles, including uncontrolled consumption of milk, fat, and oil. Teenagers, as the next generation, are at high risk if their diet is unbalanced. This research explores the influence of milk, fat, and oil consumption on the risk of hypertension and DM in adolescents, to provide new insights into prevention efforts. The aim is to analyze the relationship between the proportion of milk, fat, and oil consumption on hypertension and diabetes mellitus in adolescents based on doctor's diagnosis by province*
Method: *This type of research is quantitative research with a cross-sectional approach based on secondary data. The research sample was teenagers selected through a stratified random sampling method, to ensure a more accurate representation according to the characteristics of the population.*
Result: *This study revealed that milk consumption did not have a significant relationship with hypertension and diabetes mellitus, while fat and oil consumption was shown to be significantly related to an increased risk of these two diseases in various provinces*
Conclusion: *Milk consumption does not show a significant relationship with hypertension and Diabetes Mellitus (DM). In contrast, the consumption of fats and oils was significantly associated with an increased risk of both diseases. These results highlight the need for education and nutritional interventions to reduce the control of fat and oil consumption in adolescents to prevent hypertension and DM in various provinces.*

Keywords: *Diabetes Mellitus, Hypertension, Diet, Adolescents*

INTRODUCTION

Hypertension is a medical condition characterized by an increase in systolic blood pressure ≥ 140 mmHg and diastolic ≥ 90 mmHg, exceeding the normal limit. As a major risk factor for cardiovascular disease, hypertension is often not recognized by sufferers, so it is nicknamed the "silent killer". Many individuals experience hypertension without showing clear symptoms, so this condition is often ignored until it causes serious complications (Khikma & Sofwan, 2021). Diabetes mellitus (DM) is a metabolic disease characterized by chronic hyperglycemia, caused by disorders in the insulin mechanism, insulin secretion, or both. This condition can trigger various complications if not well controlled. Typical symptoms of diabetes include polyuria (frequent urination), polydipsia (frequent thirst), polyphagia (frequent hunger), and unexplained weight loss. A diagnosis of DM can be made if a person experiences classic symptoms accompanied by random plasma glucose levels ≥200 mg/dL, fasting plasma glucose ≥126 mg/dL, 2-hour plasma glucose after the Oral Glucose Tolerance Test (OGTT) ≥200 mg/dL, or HbA1c levels ≥6.5% as examined using standardized methods (Damayanti et al., 2023).

According to the World Health Organization (WHO), hypertension is one of the leading causes of premature death worldwide, affecting more than 1.28 billion adults. Several studies have shown that many adolescents are unaware that they have a history

of hypertension so this condition continues into adulthood, this can increase the risk of morbidity and mortality (Diana & Hastono, 2023). Meanwhile, WHO also reports that more than 422 million people live with diabetes, with the majority suffering from diabetes mellitus type 2 caused by an unhealthy lifestyle. Diabetes mellitus can cause cardiovascular disorders which are quite serious diseases if not treated immediately so they can increase hypertension (Lestari et al., 2021). Non-communicable diseases such as hypertension and diabetes mellitus (DM) are increasingly becoming a serious concern in Indonesia, along with the increasing prevalence in recent years. Based on (Riset Kesehatan Dasar (Riskesdas), 2018), the prevalence of hypertension in the population aged ≥18 years has experienced a significant spike, from 9.4% in 2013 to 34.11% in 2018. A similar trend is also seen in diabetes mellitus, where the prevalence in the population aged ≥15 years increased from 1.5% in 2013 to 2.0% in 2018. This increase reflects changes in people's lifestyles, such as consumption of foods high in fat and sugar, lack of physical activity, and increasing other risk factors (Riskesdas, 2013).

Modern lifestyle has become an inseparable part of people's lives, including in daily consumption patterns. In this practical era, food choices are often based more on ease and speed of serving, the progress of the fast food industry along with the development of the era with the existence of an online application that provides services for ordering food and very teenagers consume fast food and cause changes in eating behavior (Sumartini, 2022). A diet high in fat, salt, and sugar is increasingly dominant, increasing the risk of various degenerative diseases, especially hypertension and diabetes mellitus. This unhealthy change in eating patterns is one of the main factors in the increasing prevalence of both diseases in society. If not balanced with awareness of the importance of consuming healthy foods and an active lifestyle, this condition becomes one of the causes of the increase in degenerative diseases, one of which is hypertension and diabetes mellitus (Yuantari, 2022). Dairy products contain many components with potential anti-diabetic effects, including calcium, vitamin D, magnesium, and protein. However, the benefits of these components may be offset by the diabetogenic effects of the saturated fatty acids in dairy products (Atmarita et al., 2017). Observational study findings have been mixed for the association between total dairy intake and the risk of type 2 diabetes mellitus (T2DM). Several studies have suggested that the consumption of dairy products is protective against the incidence of T2DM. Gloria Kang GJ et al.'s study found a modest but statistically significant inverse association between dairy intake, particularly daily milk intake, and the risk of T2DM. Consumption of yogurt and fermented products was cross-sectionally associated with lower odds of developing T2DM. In addition, yogurt consumption was associated with lower glucose and TAG levels, as well as lower systolic blood pressure and insulin resistance (Eussen et al., 2016). Finally, full-fat dairy products, non-fermented dairy products, and milk were positively associated with T2DM (Brouwer-Brolsma et al., 2018).

Based on the facts and theories that have been explained, most of the saturated fat intake in young adults or adolescents in Prungahan Kulon Village is included in the excessive category. This is because respondents more often consume foods that are sources of saturated fat (meat) and sources of vegetable fat (palm oil and coconut milk) (Khoirunnisa et al., 2024). Previous studies also showed that consumption patterns of foods high in saturated and trans fats are associated with an increased risk of hypertension and DM. However, these studies were mostly conducted in developed countries, so the results do not necessarily follow the social and cultural context of Indonesian society (Sacks et al., 2017). This study is important to conduct because

adolescents are an age group that is vulnerable to changes in consumption patterns due to urbanization and lifestyle changes. In addition, this study analyzes local consumption data and evaluates the relationship between certain types of food and chronic diseases, especially in provinces that have unique characteristics in consumption patterns and disease prevalence.

This study aims to analyze the relationships between the proportion of milk, fat, and oil consumption with hypertension and diabetes mellitus (DM) in adolescents, analyze the prevalence of hypertension and DM based on region, and provide new insights into dietary patterns that affect their health. This study also uses a quantitative approach with a cross-sectional design. Data were collected through a dietary survey using a validated food frequency questionnaire (FFQ), as well as blood pressure measurements. Data analysis was performed using logistic regression to evaluate the relationship between milk, fat, and oil consumption with the risk of hypertension and DM.

METHODS

This study used a quantitative design with a cross-sectional approach. The data used were secondary data from the 2023 Indonesian Health Survey (IHS) which was conducted in the period August to October 2023. The cross-sectional approach was applied to analyze the relationship between milk, fat, and oil consumption and the risk of hypertension and diabetes mellitus (DM) in adolescents based on doctor's diagnoses in various provinces.

The population of this study included adolescents in all provinces of Indonesia who met the inclusion criteria, namely those aged 15-18 years, had complete data on milk, fat, and oil consumption, and had blood pressure and blood sugar levels. Meanwhile, the exclusion criteria included adolescents with a history of chronic diseases other than hypertension and diabetes mellitus, adolescents who were on a special diet that affected fat and oil consumption patterns, and incomplete or invalid data. The independent variables in this study were milk, fat, and oil consumption, while the dependent variables were hypertension and diabetes mellitus.

Data on milk, fat, and oil consumption patterns were collected using a Food Frequency Questionnaire (FFQ) that has been tested for validity. Meanwhile, data on hypertension and diabetes mellitus diagnoses were obtained from medical records documented in the 2023 SKI. Blood pressure measurements were carried out using a digital tensiometer, while blood sugar levels were measured using the Accu-Chek rapid detection device. Body weight measurements were carried out using a digital scale with an accuracy of 0.1 kg, while height or body length was measured using a height-measuring device with an accuracy of 1 mm. This weight and height data were then used to calculate the Body Mass Index (BMI). High or low BMI can contribute to the risk of hypertension and diabetes mellitus with the formula: BMI = Body weight (kg) / height (m)2. How to determine the number of respondents who have hypertension over 18 years old X with the number of residents aged 18 years: 100%. BMI classifications are underweight, normal, overweight, Obesity I, and Obesity II. The research procedure included blood pressure measurements conducted twice with a 5-minute interval in a sitting and quiet condition, blood sugar level measurements in a fasting condition for at least 8 hours, and data collection on milk, fat, and oil consumption through a FFQ questionnaire filled out by the respondents. The data obtained were analyzed to see the relationship between milk, fat, and oil consumption and the incidence of hypertension and DM.

Data analysis was carried out through univariate analysis to describe sample characteristics and data distribution, bivariate analysis with chi-square test to test the

relationship between independent and dependent variables, and multivariate analysis using logistic regression to determine the most influential factors on the incidence of hypertension and DM. Data processing was carried out using SPSS version 26 and Microsoft Excel. The Indonesian Health Survey (IHS) has obtained an ethics clearance letter from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023.

RESULTS AND DISCUSSION

Table 1 shows that the highest proportion of daily milk and food consumption is in the Java and Bali region (15.3%), indicating that most of the population in this region consumes milk and its processed products every day. On the other hand, the lowest proportion of daily milk and its processed products consumption is in the Nusa Tenggara region (5.2%), indicating limited access or differences in consumption habits. Furthermore, the highest proportion of weekly milk and its processed products consumption is in the Sumatra region (39.0%), reflecting a more common weekly milk consumption pattern compared to other regions, while the lowest weekly consumption is in the Java and Bali region (20.7%), despite having the highest daily and monthly consumption levels. In addition, the proportion of monthly milk and its processed products consumption peaks in the Java and Bali region (70.7%), further confirming the dominance of this region in overall consumption frequency, while the lowest proportion of monthly consumption is in the Maluku region (48.0%), indicating less frequent consumption habits in the region. Nationally, when averaged across all regions in Indonesia, the proportion of milk and food consumption is recorded at 8.8% for daily intake, 30.5% for weekly intake, and 60.6% for monthly intake, illustrating a tendency toward less frequent consumption among the majority of the population.

These differences reflect the social, economic, and cultural influences that contribute to the eating habits of people in each region. Factors such as access to food sources, purchasing power, and inherited habits play a role in these consumption patterns (BPS, 2023).

Table 1. Distribution of Proportion of Milk Consumption and Its Foods by Region of Indonesia 2023

Region	≥ 1 time per day			1-6 times per week			≤ 3 times per month		
	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD
Sumatera	6.3	10.0	7.3 ± 1.1	25.9	39.0	29.9 ± 3.7	54.5	66.7	62.6 ± 3.6
Jawa dan Bali	6.1	15.3	10.5 ± 3.2	20.7	34.3	27.4 ± 5.6	50.3	71.7	62.0 ± 7.8
Nusa Tenggara	5.2	5.9	5.5 ± 49	24.9	28.9	26.9 ± 2.8	63.5	69.9	67.6 ± 3.2
Kalimantan	6.0	13.4	8.6 ± 2.8	30.1	38.8	34.6 ± 3.3	55.1	59.7	56.7 ± 1.7
Sulawesi	5.3	9.7	7.3 ± 1.6	27.2	36.4	30.7 ± 3.3	53.9	67.0	61.9 ± 4.5
Maluku	9.6	13.4	11.5 ± 2.6	33.1	38.7	35.9 ± 3.9	48.0	57.3	52.6 ± 6.5
Papua	7.7	13.4	11.1 ± 2.0	22.8	38.0	31.3 ± 5.2	48.6	65.1	57.4 ± 5.8
Indonesia	5.2	15.3	8.8 ± 2.6	20.7	39.0	30.5 ± 4.67	48.0	71.7	60.6 ± 5.7

The high daily milk consumption in Java and Bali can be attributed to better access to dairy products, wide distribution, and higher levels of economic well-being. In contrast, the low consumption in Nusa Tenggara may be due to limited local milk production, less affordable prices, and a consumption pattern that relies more on other protein sources such as fish and seafood (Ummah, 2022). Interestingly, weekly consumption patterns show a different trend, with Sumatra having the highest weekly milk consumption rate. This could be due to people's preference for consuming milk not daily, but in a periodic consumption pattern, perhaps due to price factors or the availability of other alternatives. In contrast, the low weekly

consumption in Java suggests a possible difference in consumption habits, with people more likely to consume milk regularly in small amounts rather than consuming it in larger weekly frequencies.

Table 2. Distribution of Proportion of Oil and Fat Consumption by Region of Indonesia 2023

Regional	≥ 1 time per day			1-6 times per week			≤ 3 times per month		
	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD	Min	Max	$\bar{X} \pm$ SD
Sumatera	30.6	49.6	41.5 ± 6.48	32.9	43.7	37.8 ± 3.66	14.1	29.4	20.5 ± 4.5
Jawa dan Bali	40.0	66.0	54.2 ± 10.0	22.9	34.9	29.9 ± 4.22	7.0	27.8	15.9 ± 6.9
Nusa Tenggara	34.3	50.3	42.3 ± 11.3	32.4	34.7	33.5 ± 1.62	15.0	33.3	24.1 ± 12.9
Kalimantan	39.8	56.0	45.7 ± 6.37	30.3	44.2	37.5 ± 5.37	13.7	20.8	16.7 ± 2.6
Sulawesi	26.7	51.5	37.6 ± 8.46	29.6	46.1	39.5 ± 6.07	18.9	28.1	22.8 ± 3.0
Maluku	33.8	39.5	36.6 ± 4.03	34.8	37.8	36.3 ± 2.12	22.7	31.4	27.0 ± 6.1
Papua	25.1	43.6	31.7 ± 7.97	31.0	48.3	39.7 ± 7.14	25.4	30.6	28.5 ± 2.1
Indonesia	22.9	48.3	36.4 ± 5.78	7.0	33.3	21.2 ± 6.31	25.1	66.0	42.2 ± 10.1

Table 2 shows that the highest proportion of Fat and Oil consumption per day is found in the Java and Bali regional areas (66.0%) and the lowest proportion of Fat and Oil consumption is found in the Papua regional area (25.1%), for the highest proportion of Fat and Oil consumption per week is found in the Papua regional area (48.3%) and the lowest proportion of Fat and Oil consumption is found in the Java and Bali regional areas (22.9%), the highest proportion of Fat and Oil consumption per month is found in the Nusa Tenggara region (33.3%) and the lowest proportion of Fat and Oil consumption is found in the Java and Bali regional areas (7.0%), Nationally the proportion of Fat and Oil consumption in Indonesia is average for daily consumption of 36.4%, weekly 21.2% and monthly 42.2%. The Nusa Tenggara region showed the highest daily consumption figures, which is likely influenced by the habit of cooking with a lot of oil, such as frying or using coconut milk in various traditional dishes. In contrast, lower fat and oil consumption in Maluku may be associated with a diet that is more based on boiled, grilled, or roasted foods, as well as the availability of oil which may be more limited compared to other regions.

Table 3. Distribution of Hypertension and Diabetes Mellitus Prevalence by Region of Indonesia in 2023 based on doctor's diagnosis

Regional	Hypertension based on diagnosis			Hypertension measurement results			Diabetes Mellitus based on diagnosis		
	Min	Max	X±SD	Min	Max	X±SD	Min	Max	X±SD
Sumatera	4.3	8.8	6.9±1.2	21.4	28.3	24.2±2.0	1.3	2.8	1.8 ±0.4
Jawa dan bali	6.9	12.6	9.5 ±2.2	21.7	32.8	29.3±3.9	2.1	3.9	2.7 ±0.7
Nusa Tenggara	6.3	6.8	6.5±0.3	24.5	26.4	25.4±1.3	1.0	1.8	1.4 ±5.7
Kalimantan	7.2	11.1	8.4±1.5	28.0	38.7	31.8±4.5	1.7	3.1	2.1 ±8.0
Sulawesi	5.3	12.1	7.8±2.3	26.5	29.5	27.7±1.1	1.4	2.7	2.0 ±7.4
Maluku	4.3	4.4	4.3±0.1	20.8	25.6	23.2±3.3	0.9	1.2	1.0 ±0.2
Papua	2.2	7.0	5.0±1.9	19.4	27.5	23.7±2.9	0.2	1.8	1.2 ±0.6
Indonesia	2.2	12.6	7.3±2.2	19.4	38.7	26.7±3.9	0.2	3.9	1.9 ±0.7

Table 3 shows that the highest prevalence of hypertension according to diagnosis occurs in the Java and Bali regional area (12.6%) and hypertension according to the highest measurement results occurs in the Kalimantan region (38.7%) while the lowest prevalence of hypertension occurs in the Papua regional area (2.2%). The highest prevalence of diabetes mellitus occurs in the Java and Bali regional area (3.9%) and the lowest prevalence of diabetes mellitus occurs in the Papua regional area (0.2%). National figures show a

prevalence of hypertension of 7.3% and a prevalence of diabetes mellitus of 1.9%.

Human lifestyle due to urbanization, modernization, and globalization is one of the causes of the increase in Hypertension and Diabetes Mellitus. Hypertension and diabetes mellitus are degenerative diseases that often occur due to unhealthy diet and lifestyle (Ifalahma et al., 2023). Therefore, preventive efforts through nutrition education, implementation of a healthy diet, and physical activity are crucial steps in reducing the risk of chronic diseases in the future. Increasing public awareness of the importance of a healthy lifestyle, including consuming a balanced nutritious diet, sufficient physical activity such as simple to heavy physical exercise such as walking around the yard, jogging using a running machine, and maintaining eating habits by implementing 3j (amount, type, and time of eating), is the key to reducing the incidence of diabetes mellitus in Indonesia (Suryawan et al., 2023). Government policies and community-based health programs also play an important role in supporting the prevention and management of this disease effectively.

Table 4 shows the results of the analysis of the proportion of the relationship between milk consumption, whether daily, weekly, or monthly, did not have a significant relationship with the prevalence of hypertension or diabetes mellitus in adolescents. In the consumption pattern ≥ 1 time per day, no significant relationship was found with the prevalence of hypertension based on the diagnosis p-value 0.192, hypertension based on measurement (p-value 0.985), and diabetes mellitus (p-value 0.152). In the consumption pattern of 1-6 times per week, there was no significant relationship with the prevalence of the disease for hypertension based on diagnosis (p-value 0.972), for hypertension based on measurement (p-value 0,957), and for diabetes mellitus (p-value 0,588), with a very small beta coefficient, indicating that milk consumption at this frequency has almost no effect on the prevalence of hypertension or diabetes mellitus. Likewise, in the consumption pattern ≤ 3 times per month, no significant relationship was found for hypertension based on diagnosis (p-value 0.520), for hypertension based on measurement (p-value 0,961), and for diabetes mellitus (p-value 0.815). Overall, the consumption pattern of milk and its derivatives is not strongly or significantly related to the prevalence of hypertension and diabetes mellitus, either in daily, weekly, or monthly consumption.

Table 4. Relationship between the Proportion of Milk Consumption and its Processed Products with the Prevalence of Hypertension and Diabetes Mellitus in Indonesia in 2023 based on doctor's diagnosis

Milk and milk product consumption patterns	Hypertension based on diagnosis	Hypertension measurement results	Diabetes Mellitus based on diagnosis
≥ 1 time per day			
Beta	0.180	-0.005	0.062
Kostan	5.707	26.774	1.373
Koefesien korelasi (r)	0.213	0.003	0.234
p-value	0.192	0.985	0.152
1-6 times per week			
Beta	0.003	0.008	-0.014
Kostan	7.216	26.498	2.346
Koefesien korelasi (r)	0.006	0.009	0.089
p-value	0.972	0.957	0.588
≤ 3 times per month			
Beta	-0.042	-0.006	-0.005
Kostan	9.848	27.069	2.220
Koefesien korelasi (r)	0.106	0.008	0.039
p-value	0.520	0.961	0.815

Based on the data above, indicates that milk consumption is not the main factor influencing the risk of both diseases. Milk and its processed products are food sources that contain high levels of calcium, protein, magnesium, potassium, zinc, and phosphorus per calorie (Badzlina & Triyanti, 2019). Previous research by Anwar R. showed that milk can contribute to maintaining normal blood pressure because milk is a good source of calcium, but to prevent hypertension, low-fat milk should be chosen (Anwar, 2014) Although there is no significant direct relationship, various epidemiological studies support that adequate consumption of milk and its processed products, even at moderate levels, can help reduce the risk of diabetes (Zong et al., 2014). Milk contains various important nutrients such as high-quality protein, calcium, magnesium, and bioactive fatty acids, which can play a role in improving glucose metabolism and insulin sensitivity.

The results of the analysis in Table 5 can conclude that fat and oil consumption patterns have a significant relationship with the prevalence of hypertension and diabetes mellitus. In the consumption pattern ≥ 1 time a day, a significant relationship was found with the prevalence of hypertension based on the doctor's diagnosis (p-value 0.001), the prevalence of hypertension based on measurement (p-value 0.004), and diabetes mellitus (p-value 0.005). The beta coefficient indicates that the higher the consumption of fats and oils per day, the prevalence of hypertension and diabetes mellitus tends to increase. The strength of the relationship showed a fairly strong relationship between fat and oil consumption and the two diseases on the frequency of daily consumption.

Table 5. Relationship between the Proportion of Fat and Oil Consumption and the Prevalence of Hypertension and Diabetes Mellitus in Indonesia in 2023 based on doctor's diagnosis

Fat and Oil Consumption Patterns	Hypertension based on diagnosis	Hypertension measurement results	Diabetes Mellitus based on diagnosis
≥ 1 time per day			
Beta	0.114	0.178	0.031
Kostan	2.488	19.228	0.621
Koefesien korelasi (r)	0.510	0.454	0.437
p-value	0.001	0.004	0.005
1-6 times per week			
Beta	-0.127	-0.207	-0.033
Kostan	11.919	34.268	3.122
Koefesien korelasi (r)	0.321	0.300	0.264
p-value	0.046	0.064	0.105
≤ 3 times per month			
Beta	-1.465	-0.289	-0.053
Kostan	31.907	32.876	3.047
Koefesien korelasi (r)	0.527	0.458	0.463
p-value	<0.001	0.003	0.003

The results of the analysis also showed that there was a significant relationship between the proportion of fat and oil consumption patterns 1-6 times per week with the prevalence of hypertension based on doctor's diagnosis (p-value 0.046) and hypertension based on measurement (p-value 0.064), but not significantly related to the prevalence of diabetes mellitus (p-value 0.105). The correlation coefficient indicates a weak relationship. There was a relationship between the proportion of fat and oil consumption patterns ≤ 3 times per month with the prevalence of hypertension based on diagnosis (p-value <0.001), hypertension based on measurement (p-value 0.003), and diabetes mellitus (p-value 0.003). The correlation coefficient suggests a strong relationship, that

infrequent consumption of fats and oils can contribute to a decrease in the prevalence of hypertension and diabetes mellitus.

According to research by Susilowati & Waskita, the consumption of fatty and sweet foods has a strong relationship with the increasing prevalence of diabetes mellitus. The use of oil and coconut milk in food is the main factor that contributes to the high levels of fat in the daily consumption pattern (Susilowati & Waskita, 2019). Meanwhile, other studies show that the habit of consuming excessive fat is also closely related to increased blood pressure. High-fat intake can increase levels of LDL (low-density lipoprotein) cholesterol in the blood, which over time will accumulate on the walls of blood vessels and form atherosclerotic plaque. This accumulation causes the narrowing of blood vessels, reduced elasticity, and impaired blood flow, which ultimately triggers hypertension. This condition can also increase blood volume and pressure in the circulatory system, thereby worsening the risk of hypertension and other cardiovascular diseases (Wijaya et al., 2020).

CONCLUSION

This study shows that consumption of milk and processed foods has no significant relationship with the incidence of hypertension and diabetes mellitus in adolescents. In contrast, consumption of fat and oil has a significant relationship with an increased risk of both diseases. These findings underline the importance of nutritional education and intervention policies to reduce excessive consumption of fat and oil to prevent hypertension and diabetes mellitus from adolescence. Therefore, efforts to increase awareness of healthy eating patterns must continue to be encouraged through targeted education and regulation programs.

This study has several advantages that make it relevant in understanding the relationship between milk, fat, and oil consumption with hypertension and diabetes mellitus in adolescents. One of the main advantages is the use of data from the 2023 Indonesian Health Survey (IHS) which covers a national scope so that the results of this study can represent the condition of food consumption patterns and the prevalence of metabolic diseases in various regions of Indonesia. However, this study also has several weaknesses that need to be considered in interpreting the results. One of the main limitations is the cross sectional study design, which only observes the relationship between variables at one point in time without being able to determine a direct cause and effect. relationship. To understand the long-term impact of milk, fat, and oil consumption on hypertension and diabetes mellitus, further research with a longitudinal design is needed.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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OPTIMIZING INDONESIA'S HEALTHCARE RESPONSE TO PREDIABETES: A LONGITUDINAL PERSPECTIVE

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ABSTRACT

Background: *Prediabetes is an intermediate stage between normal blood glucose levels and Type 2 diabetes mellitus (T2DM), characterized by elevated blood glucose that does not yet meet the criteria for diabetes. It significantly increases the risk of progressing to T2DM, highlighting the importance of early intervention. In Indonesia, addressing modifiable risk factors is crucial to reducing the prevalence of prediabetes.*
Methods: *Longitudinal data from 3548 respondents who met the study criteria were taken from the Bogor Cohort Study on NCD Risk Factors. In six observations, Generalized Estimating Equations (GEE) were used to analyze the factors influencing the transition from normoglycemia to prediabetes.*
Results: *The analysis identified several factors significantly associated with prediabetes risk. Protective factors included maintaining a BMI <25, waist circumference <80 cm (women) or 90 cm (men), regular physical activity (≥10 minutes daily walking/cycling), optimal lipid levels (total cholesterol ≤200 mg/dL; triglycerides ≤150 mg/dL; HDL ≥40 mg/dL [men] or >50 mg/dL [women]), non-sedentary behaviour, and systolic blood pressure <140 mmHg. Conversely, factors like a family history of diabetes and age >40 years significantly increased prediabetes risk.*
Conclusion: *While non-modifiable factors like age and family history of diabetes increase susceptibility, the study highlights the importance of modifiable lifestyle factors like maintaining BMI and waist circumferences, maintaining optimal lipid levels, controlling blood pressure, and participating in regular physical activity and an active lifestyle in lowering the risk of prediabetes.*

Keywords: *Prediabetes Risk Factors; Lifestyle; Central obesity; Generalized Estimating Equations*

INTRODUCTION

Prediabetes, a transitional phase between normal glucose metabolism and type 2 diabetes mellitus (T2DM), has become a serious public health threat in Indonesia. The data of Riset Kesehatan Dasar (Balitbangkes, 2018) shows that 15.3% of adults in Indonesia are classified as prediabetes, with the highest percentage recorded in urban areas such as Jakarta and Bogor. This condition not only increases the risk of developing type 2 diabetes by 5-10% each year (American Diabetes Association, 2020);but is also associated with cardiovascular complications, kidney disorders, and a decline in economic productivity due to high healthcare costs. In Indonesia, the increase in the prevalence of prediabetes by 10.6% in the adult population is caused by urbanization. Urban lifestyles, such as high-sugar, low-fibre diets, and lack of movement (sedentary lifestyle), along with obesity incidents supported by specific genetic and sociodemographic factors, are causing the high prevalence of prediabetes. (Balitbangkes, 2018).

Prediabetes is characterized by impaired fasting blood glucose and is a critical phase where, if detected early and lifestyle modifications are made, it can halt the progression of the disease from prediabetes to T2DM.(Balitbangkes, 2018; IDF, 2021; Widiasari et al., 2021). The government must prioritize the prevention of prediabetes and T2DM. Primary prevention is aimed at groups

with risk factors and potential to suffer from prediabetes and T2DM. Knowledge about the risk factors for the occurrence of prediabetes is essential for effective prevention and control because the longer it is known, the greater the risk of developing prediabetes. The existing prevention and control efforts are considered less effective.(Indrahadi et al., 2021; Perkeni, 2021).

Most studies on the risk factors for prediabetes and T2DM use cross-sectional data, and there are still few studies that use longitudinal data. This study utilizes longitudinal data from the Bogor Cohort Study on Non-Communicable Disease (NCD) Risk Factor, conducted over 10 years with six measurement points. Using Generalized Estimating Equations (GEE), this longitudinal technique tracks changes in fasting blood glucose (FBG) levels and analyzes risk factors from normal FBG (normoglycemia) to prediabetes. Generalized Estimating Equations (GEE) is an analysis of multivariate, classified, and sequential data, allowing for the measurement of all variables involved in the study. Generalized Estimating Equations (GEE) have become a methodological innovation that addresses the weaknesses of conventional regression models. (Hosseinzadeh et al., 2020).

This research aims to use longitudinal analysis to identify risk factors that are modifiable and non-modifiable in order to stop prediabetes from developing in Indonesia. The development of evidence-based strategies can lead to a more optimal response from the health system when the risk factors have been identified. The results of this study's clinical and sociodemographic variable analysis are intended to inform the development of effective prediabetes preventive measures in line with Indonesia's epidemiological transition, thereby reducing the national burden due to diabetes.

METHODS

This study uses a quantitative design with an observational approach and analyzes longitudinal data, which is data from the same subjects collected at several points in time, allowing for the observation of changes occurring in individuals or groups over a specific period. This study's data comes from the Bogor Cohort Study on Non-Communicable Disease (NCD) Risk Factor, which was conducted over 10 years with 6 measurement points.

The original study included 5,330 participants, with 4,036 (75.74%) completing ≥3 measurements. Participants in this study had normal FBG levels at baseline, but increased in subsequent measurements, indicating prediabetes. There were 3548 respondents (88%) who matched the requirements of this study.

The dependent variable of this study is FBG levels, and the independent variables are Body Mass Index (BMI), waist circumference, diabetes family history, physical activity, smoking status & alcohol consumption, blood pressure, lipid levels, stress, and socio-economic factors. The analysis was conducted using the Generalized Estimating Equations (GEE) approach with the SPSS application to identify significant factors affecting the change in FBG level from normoglycemia to prediabetes.

RESULTS AND DISCUSSION

The objective of this study is to examine the risk factors for prediabetes based on FBG levels using longitudinal data from the Bogor Cohort Study on NCD Risk Factor, which was done over 10 years. The longitudinal approach was used to investigate differences in FBG levels at six time periods in individuals at risk of prediabetes, thereby providing new insights or predictions concerning the way changes in

risk factors over time affect FBG levels.(De Gaetano et al., 2024).

One of the novelties in this study is the use of GEE to investigate the influence of risk factors in a complicated and simultaneous manner while considering the interrelationship between risk factors. Generalized Estimating Equations (GEE) is a statistical method for analyzing correlated data where individuals may have different numbers of measurements at different points in time.(Low et al., 2023) The results of the GEE analysis in this study are shown in Table 1.

3.1 Individual Characteristics

3.1.1 Risk factor

The study found that age, education, DM family history, and insurance ownership are risk factors for prediabetes ($p<0.05$). After controlling for confounding factors, based on previous research, age significantly affects the increased risk of prediabetes, and this is consistent with the study's findings. Previous research revealed that those under 40 easier to lose weight, so they have better glucose metabolism compared to those over 40. (M. Chen et al., 2024) According to another study, the elderly (60-80 years) have a significantly higher risk of prediabetes than the middle-aged (40-59 years) ($p < 0.001$). (Yan et al., 2023)

Individuals with higher education levels mostly have a better understanding of prediabetes and can control their blood glucose levels themselves. Previous research results have found that higher education levels in middle-aged (40-59 years) and elderly (60-80 years) increase the risk of prediabetes and diabetes.(Yan et al., 2023)

Family history is a significant predictor of FBG levels. Previous studies have shown that the average FBG level in the group with a family history of DM is 99.30 mg/dL, significantly higher ($p=0.03$) than the group without a family history (97.55 mg/dL). (Denton & Cedillo, 2023) In line with the results of this study, the FBG levels of individuals without a family history are significantly lower than those with a family history ($p<0.001$).

The study found a significant relationship between insurance ownership and FBG levels as well as prediabetes status. This is in line with previous studies, which found that insurance holders who have access to blood sugar testing facilities and prescription reimbursements (either partially or totally) are significantly associated ($p=0.04$) with FBG levels. Individuals with insurance have more frequent blood sugar tests, leading to better control (Marvin & Powe, 2023).

Tabel 1. Results of GEE Analysis of Fasting Blood Glucose with Risk Factors

No	Parameter	B	Std. Error	95% Wald Confidence Interval		Wald Chi-Square	Sig.
				Lower	Upper		
1	Male	-0.003	0.0069	-0.017	0.011	0.195	0.659
2	Age < 40*	-0.101	0.0057	-0.112	-0.090	311.571	0.000
3	Marital Status	-0.089	0.0692	-0.224	0.047	1.638	0.201
4	Higher Education*	-0.020	0.0063	-0.033	-0.008	10.078	0.002
5	Has no family history of DM*	-0.039	0.0084	-0.056	-0.023	21.646	0.000
6	Alcohol Free	-0.068	0.0676	-0.201	0.064	1.028	0.311
7	Insurance ownership*	-1.188	0.0716	-1.329	-1.048	275.193	0.000
8	Skor SRQ < 6	-0.003	0.0623	-0.125	0.119	0.002	0.963
9	0 cigarettes	-0.010	0.0185	-0.046	0.026	0.293	0.588
10	Smoking < 200 cigarettes	-0.005	0.0195	-0.043	0.034	0.055	0.815
11	Smoking 200-600 cigarettes	-0.006	0.0189	-0.043	0.031	0.099	0.753
12	Never Smoking	-0.008	0.0063	-0.20	0.005	1.515	0.218
13	BMI $\leq$ 27*	-0.075	0.0068	-0.088	-0.061	119.736	0.000
14	BMI $\leq$ 25*	-0.067	0.0060	-0.078	-0.055	124.502	0.000

No	Parameter	B	Std. Error	95% Wald Confidence Interval		Wald Chi-Square	Sig.
				Lower	Upper		
15	Waist Circumferences < 80 cm/90 cm*	-0.084	0.0058	-0.095	-0.073	208.044	0.000
16	Cholesterol Total ≤ 200 mg/dL*	-0.057	0.0068	-0.071	-0.044	70.096	0.000
17	Triglyceride ≤ 150 mg/dL*	-0.069	0.0091	-0.087	-0.051	56.881	0.000
18	LDL ≤ 100 mg/dL*	-0.019	0.0079	-0.003	0.034	5.613	0.018
19	HDL ≥ 40 mg/dL / 50 mg/dL*	-0.018	0.0062	-0.030	-0.006	8.211	0.004
20	Systolic Blood Pressure < 140 mmHg*	-0.054	0.0100	-0.074	-0.035	29.706	0.000
21	Diastolic Blood Pressure < 90 mmHg*	-0.033	0.0100	-0.053	-0.014	11.209	0.001
22	High-Intensity activity*	-.059	.0104	-.079	-.039	32.146	.000
23	High-Intensity activity > 75 min/ week*	-.043	.0062	-.055	-.031	47.913	.000
24	High-Intensity Exercise	-.034	.0209	-.075	-.007	2.662	0.103
25	High-Intensity Exercise > 75 min/ week	-0.032	0.0269	-0.084	0.021	1.387	0.239
26	Moderate activity*	-0.692	0.1150	-0.918	-0.467	36.236	0.000
27	Moderate activity > 150 min/ week*	-0.475	0.0843	-0.640	-0.309	31.681	0.000
28	Moderate-Intensity Exercise *	-0.115	0.0502	-0.213	-0.017	5.246	0.022
29	Moderate-Intensity Exercise >150 min/week	-0.108	0.0839	-0.272	0.057	1.642	0.200
30	Walking/cycling at least 10 min/day*	-0.049	0.0071	-0.063	-0.035	46.921	0.000
31	Walking/cycling > 150 min/week*	-0.016	0.0069	-0.030	-0.003	5.471	0.019
32	Sedentary < 8 hour/day*	-0.027	0.0059	-0.039	-0.015	20.911	0.000

3.1.2 Not a Risk Factor

The study found that gender, marital status, stress or emotional mental disorders, smoking behaviors, and alcohol consumption are not risk factors for prediabetes (p>0.05). In this study, gender was not found to be a risk factor for prediabetes. This contradicts previous studies that state the risk of T2DM increases in women with impaired fasting glucose, but not in males.(Sasaki et al., 2021) Another study explains that males with prediabetes have a testosterone hormone that affects glucose metabolism, but not women.(Leutner et al., 2022) This finding could explain why gender has no effect on prediabetes status in this study.

In this study, marital status was not associated with prediabetes status. This contradicts previous research, which revealed marriage to be an independent risk factor for prediabetes among people aged 20 – 37, mediated by triglyceride (TG) levels. Based on prior studies, young adult couples' eating patterns are at risk of increasing TG levels, which affect blood sugar levels and the risk of prediabetes.(Y.-H. Chen et al., 2024) In this study, other variables have a bigger influence on FBG levels than marital status, hence, the two are not statistically associated.

This study found no significant association between stress or mental emotional disorder and FBG levels (p>0.05). The theory states that stress raises cortisol levels, a glucocorticoid hormone generated by the adrenal glands during the stress response. Cortisol might stimulate gluconeogenesis, inhibit glucose uptake by muscles and adipocytes, and cause insulin resistance, all of which are considered risk factors for prediabetes. Although stress contributes to increased cortisol levels, more evidence is needed to recognize cortisol as the primary cause of prediabetes. The relationship between elevated cortisol levels and glucose metabolism disorder indicates that stress plays an essential role in the development of prediabetes, as well as the possibility of developing T2DM.(Abdulraheem Jabbar & Jalal Majeed, 2020)

This research contradicts previous studies, which showed that low alcohol consumption is associated with a lower risk of T2DM in women, whereas high-risk drinkers have a greater possibility of developing T2DM compared to non-drinkers. (Wu et al., 2021)

Another study found a significant association between alcohol intake and FBG levels, but not with other prediabetes parameters. The relationship between consumption of alcohol and blood sugar levels, as measured by FBG, HbA1c, and other indicators, is inconsistent. (Reed et al., 2025) In this study, respondents' alcohol consumption habits were not associated with the risk of developing prediabetes (p>0.05). According to previous research, this could be due to bias and the presence of other more dominant factors. The data on alcohol consumption habits in this study was obtained through respondents' reports, which introduced a high level of bias and resulted in a less accurate analysis.(Wu et al., 2021) Furthermore, FBG levels of respondents can be influenced by the existence or absence of a diabetes family history, as well as their BMI. (Reed et al., 2025).

The smoking habit in this study is not significantly associated with FBG levels (p>0.05), which is consistent with previous research that found no meaningful and significant causal relationship between smoking habits and FBG levels, even though smokers' average FBG is 0.003 higher. Many other factors, such as diabetes family history and BMI, influence FBG levels, as well as alcohol consumption. (Reed et al., 2025).

3.2 Obesity status

3.2.1 Body Mass Index (BMI)

According to the study's findings, having a BMI greater than 25 or 27 is strongly connected with an elevated risk of prediabetes (p=0.000). Previous research has shown that higher BMI increases the risk of prediabetes and T2DM.(Par et al., 2025; Yan et al., 2023) The increased risk of prediabetes is higher in the group with BMI >30 (OR=2.38, 95% CI=1.96-2.87) compared to the group with BMI > 25 (OR=1.63, 95% CI=1.38-1.93), however, there is a negative correlation for those with underweight (OR=0.19, 95% CI=0.07-0.51).(Par et al., 2025)

3.2.2 Waist Circumferences

In this study, central obesity as measured by waist circumference has a significant association with a higher risk of prediabetes (p=0.000). Previous studies have found a strong correlation (p<0.05) between increased waist circumference and the risk of prediabetes. A waist circumference increase of >5% raises the risk of prediabetes in all genders. (Zhen et al., 2022)

3.3 Cholesterol and Blood Pressure

3.3.1 Total Cholesterol, Triglycerides, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL)

The study found that higher levels of cholesterol, triglycerides, and LDL, as well as lower levels of HDL, increase the risk of prediabetes (p<0.05). This is consistent with previous studies showing that high HDL levels are associated with a reduced risk of prediabetes. Another study shows that a high triglyceride-to-HDL ratio (TG/HDL) is associated with an increased risk of prediabetes. As a result, lower HDL levels have triggered the development of prediabetes. (Shimodaira et al., 2024; Tohidi et al., 2023)

The study's LDL level analysis results are consistent with previous research, which found that individuals with higher LDL levels have greater correlations with prediabetes than those with lower LDL levels. According to the study's findings, LDL can be a risk factor in prediabetes. (Ruan et al., 2024)

3.3.2 Blood Pressure

The study revealed that having high systolic and diastolic blood pressure increases the risk of GDP rise (p<0.001). Previous research has shown that high systolic blood pressure increases the risk of prediabetes by 45% (OR = 1.45; 95% CI=1.11-1.90; p<0.05) compared to normal blood pressure. High diastolic blood pressure increases the risk of prediabetes by 53% (OR=1.53; 95% CI=1.21-1.94; P<0.05) compared to those with normal blood pressure. (Zhang et al., 2022)

3.4 Physical Activity & Sedentary Lifestyle

3.4.1 Physical Activity

The study found that moderate to high physical activity significantly reduces the risk of prediabetes ($p < 0.05$). This is consistent with earlier research. Physical activity has a diverse influence on insulin resistance, affecting various pathways implicated in metabolic dysfunction. In addition to anti-inflammatory effects, physical activity improves pancreatic beta cell function and insulin secretion. (Małkowska, 2024)

Another study found that increasing the number of daily steps has a significant impact on lowering fasting plasma glucose levels. (Kalampoki et al., 2025) The previous study result is consistent with the study results, where the habit of walking or cycling for at least 10 minutes per day considerably affects the occurrence of prediabetes ($p = 0.000$).

3.4.2 Exercise

The study's findings indicate that moderate-intensity exercise ($p<0.05$) has a significant impact on lowering the risk of prediabetes. Previous research has shown that regular exercise improves cellular lipid metabolism, insulin sensitivity, β cell function, and glucose homeostasis. A variety of exercises, including aerobic, weight training, and high-intensity interval training, have been shown to improve beta cell activity and insulin sensitivity. (Małkowska, 2024)

3.4.3 Sedentary Life Style

Sedentary lifestyles or physical inactivity lasting more than 8 hours per day are linked to higher blood sugar levels ($p=0.000$). Previous research has shown that a sedentary lifestyle causes mitochondrial dysfunction, leading to tissue damage, an increased burden on the pancreatic islets, and insulin resistance. A sedentary lifestyle also impairs glucose metabolism and alters glucose homeostasis. Oxidative stress and inflammation that cause a decrease in antioxidant enzyme activity also occur when individual has a sedentary lifestyle. (Małkowska, 2024).

CONCLUSION

According to the research findings, not all risk factors for prediabetes are modifiable. Modifiable prediabetes risk variables can be utilized to develop policies that improve the effectiveness of Indonesian healthcare services in preventing prediabetes. The prediabetes prevention program should focus on activities that encourage the community to engage in more physical activity and exercise, leading to BMI, waist circumference, lipid profile, and blood pressure that are within reference ranges. Improving facilities for routine health monitoring, such as prediabetes screening, is just as vital as providing public-use sports facilities. Health initiatives promoting a healthy lifestyle are projected to minimize the prevalence of prediabetes and reduce Indonesia's T2DM burden in the future.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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ANALYSIS OF PREVALENCE TRENDS OF STUNTING, WASTING, AND UNDERWEIGHT IN TODDLERS IN INDONESIA 2021-2023

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ABSTRACT

Background: *Malnutrition in toddlers, especially stunting, wasting, and underweight, is still a public health challenge in Indonesia. Although various interventions have been implemented, the trend of growth disorders still shows regional differences. This study aims to analyze the trend of changes in the prevalence of stunting, wasting, and underweight in toddlers in regional Indonesia from 2021-2023.*
Method: *This study used a descriptive design with a trend analysis approach. Data were obtained from the 2021-2022 Indonesian Nutrition Status Study (INSS) and the 2023 Indonesian Health Survey (IHS). The sample included toddlers aged 0-59 months who had complete anthropometric data. The analysis was conducted based on seven regional areas in Indonesia using descriptive statistical methods to identify patterns of changes in prevalence.*
Result: *The study showed that the prevalence of stunting decreased from 24.4% in 2021 to 21.5% in 2023. Wasting increased from 7.1% to 8.5% in 2023. Underweight showed a downward trend from 17% to 15.9%.*
Conclusion: *The highest prevalence of Stunting, Wasting, and Underweight during 2021-2023 was in the Eastern Indonesia Region, namely Nusa Tenggara and Maluku. Community-based interventions contributed to the reduction of stunting and underweight, but wasting remains a challenge that requires special attention. Policies that are more focused on improving food security and access to health services are needed to address nutritional disparities between regions.*

Keywords: *"Malnutrition, Toddlers, Trend Analysis, Stunting, Wasting, Underweight*

INTRODUCTION

Malnutrition is an imbalance between nutritional needs and intake that can cause deficiencies or excesses of energy, protein, and macro and micronutrients, which hurt children's growth and development. This condition is known as the double burden of malnutrition (Alfarisi et al., 2023). Stunting, wasting, and underweight are three key indicators of malnutrition that have a major impact on a child's overall growth and health. These three conditions often occur together, reflecting the dual nutritional challenges, especially in developing countries. Stunting occurs when a child is shorter than their age due to prolonged malnutrition. Wasting refers to a body weight that is disproportionate to their height, usually due to a short period of malnutrition or illness. Meanwhile, underweight indicates a child's weight that is not appropriate for their age, which can be a sign of both chronic and acute malnutrition (Bahar et al., 2024).

UNICEF data in 2020 reported that around 149 million children under the age of five are stunted, 45 million are wasted, and 38.9 million are underweight worldwide. This condition not only affects children's physical growth but also has an impact on cognitive development and productivity in the future (UNICEF, WHO and Bank, 2020). Indonesia is a country with stunting rates that are still above WHO standards and is ranked fifth in the world in terms of stunting prevalence (Meri Agritubella et al., 2023). The results of the 2013 Basic Health Research reported that 19.6% were undernourished and severely malnourished (wasting), 37.2% were very short

and stunted, and 12.1% were very thin and underweight. While in 2018, 17.7% were undernourished and severely malnourished, 30.8% were very short and stunted, 10.2% were thin and severely underweight (Ministry of Health of the Republic of Indonesia, 2018). These data show that the wasting and underweight trends are still fluctuating from year to year. Although the stunting rate has decreased, the target of the National Medium-Term Development Plan (NM) to reduce wasting to 7% and stunting to 14% by 2024 has not been fully achieved.

Many studies have been conducted, but there is still inconsistent data on wasting, stunting, and underweight trends in Indonesia. A study conducted in India showed that wasting and stunting clusters often persist in a region for several years. This also occurs in several provinces in Indonesia, where areas with high stunting and wasting rates in previous years still show the same trend until 2023 (Singh et al., 2022). Although some regions have experienced a downward trend in growth disorders, this pattern does not occur evenly throughout Indonesia. According to Susianto and Sudaryanto (2024) and Khoiriyah and Nadhiroh (2024) There are still disparities between regions, with some areas showing significant improvements, while others are still facing increasing rates of wasting and underweight. A study by Meri Agritubella et al (2023) and Muliyati et al (2021) Shows that although there is a national downward trend in stunting and underweight, the prevalence of wasting in several regions is still increasing or fluctuating.

Further analysis is needed to understand the trend patterns of wasting, stunting, and underweight prevalence that occur as material for evaluating interventions that have been carried out in the Indonesian Region. This study aims to analyze the trend of wasting, stunting, and underweight prevalence in toddlers in Indonesia in 2021-2023, and to provide data-based recommendations to improve the effectiveness of prevention and intervention programs in addressing nutritional problems in children. By analyzing the trend of stunting, wasting, and underweight prevalence, this study is expected to provide a deeper understanding of the factors that influence the nutritional status of toddlers, as well as evaluate the effectiveness of government policies and programs in addressing nutritional problems in Indonesia. The findings of this study can also be the basis for designing more targeted intervention strategies to improve the nutritional quality and welfare of toddlers in the future.

METHODS

This study uses a descriptive study design with a trend analysis approach to evaluate changes in the prevalence of stunting, wasting, and underweight in toddlers in Indonesia in 2023. This study uses aggregate data from 38 provinces from the 2021 Indonesian Nutrition Status Study (INSS), 2022 INSS, and the 2023 Indonesian Health Survey (IHS) with the population in this study covering all toddlers in Indonesia recorded in the 2021-2022 INSS and 2023 IHS. The samples in the INSS and IHS were selected using a stratified two-stage sampling technique based on predetermined inclusion and exclusion criteria, with inclusion criteria including toddlers who have valid anthropometric data, recorded in the 2023 INSS and IHS, and have complete information on nutritional status. Exclusion criteria include toddlers who have incomplete or invalid data and those who experience certain medical conditions that can affect growth, such as chronic diseases. In this study, the sample was 38 provinces that had complete data related to the prevalence of wasting, stunting, and underweight.

The research variables are the prevalence of wasting, stunting, and underweight toddlers. Toddlers are categorized as stunting if the Z-score of Height/Age <-2 SD, wasting if

Height/Age <-2 SD, and underweight if the Z-score of Weight/Age <-2 SD. The prevalence of stunting, wasting, and underweight is calculated using the formula of dividing the number of toddlers experiencing stunting, wasting, and underweight problems by the number of toddlers aged 0-59 months multiplied by 100%. The research instruments used were the 2021-2022 Indonesian Nutrition Status Study (INSS) and the 2023 Indonesian Health Survey (IHS) questionnaires which included data on height and weight, age, and gender of toddlers aged 0-59 months. Anthropometric measurements were carried out by trained enumerators with a minimum educational background of Diploma III Health to ensure the accuracy of the data obtained. Measurements were carried out by following the standard operating procedures (SOP) that had been set by the 2021-2022 Indonesian Nutrition Status Study (INSS) and the 2023 Indonesian Health Survey (IHS)teams. The data collection process was carried out by direct interviews and anthropometric measurements of each individual selected as a sample. Weighing using a digital scale with a precision of 0.05 kg, while measuring body length using a body length measuring tool with a precision of 0.1 cm, and measuring height using a stadiometer with a precision of 0.1 cm. The research procedure begins with the collection of secondary data from the 2021-2022 Indonesian Nutrition Status Study (INSS) and the 2023 Indonesian Health Survey (IHS), then the collected data is selected based on the inclusion and exclusion criteria that have been set. After that, the data is processed using statistical software and analyzed to see changes in the trend of the nutritional status of toddlers from 2021-2023. The statistical analysis used in this study is a descriptive analysis to see the trend of the prevalence of wasting, stunting, and underweight toddlers in seven Indonesian regions (Sumatra, Java-Bali, Sulawesi, Kalimantan, Nusa Tenggara, Maluku, and Papua) from 2021-2023. The data analysis process uses SPSS software version 27 and Microsoft Excel to visualize data trends in the form of tables and graphs. The implementation of the Indonesian Health Survey has received approval and an ethical clearance letter from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023.

RESULTS AND DISCUSSION

The problem of malnutrition, especially stunting, wasting, and underweight, remains a major challenge in Indonesia. The results of the study showed that although there was an improvement in the prevalence of growth disorders in toddlers, especially in terms of stunting and underweight, the wasting trend still showed significant fluctuations. Inequality between regions is still visible, with the Nusa Tenggara Region still having the highest prevalence. This shows that despite improvements on a national scale, there are still challenges in equalizing access to nutritious food throughout Indonesia. These findings are in line with government policies in strengthening specific and sensitive nutrition interventions, including a national program to reduce stunting rates (Sugianti and Devianti Putri, 2022). Nutrition improvement programs implemented by the Indonesian government have contributed to a decrease in the prevalence of stunting through direct intervention at the community level and government policy support, the prevalence of stunting has decreased significantly (Wulandari et al., 2021).

Various factors contribute to the high rate of malnutrition in toddlers in Indonesia. Factors such as low birth weight (LBW), short birth length, child age, gender, infectious diseases, and family socio-economic status have significant relationships with the incidence of stunting, underweight, and wasting. Research shows that children with LBW have a higher risk of stunting than

children with normal birth weight (Abimayu and Rahmawati, 2023). Other factors also show that food security and food diversity are some of the factors causing malnutrition (Socadevia and Nadhiroh, 2024). In addition, the mother's education level plays an important role in determining the nutritional status of the child. A study in West Java showed that children from mothers with low education have a higher risk of stunting and being underweight (Coal., 2024).

Table 1. Shows the trend of stunting prevalence in toddlers in Indonesia decreasing in 2021-2023. The Java-Bali Region with stunting prevalence decreased from 19.7% to 18.1%, the Sumatra Region decreased from 22.8% to 19.2%, in contrast to the Region which showed an increase from 27.8% to 31% and the Nusa Tenggara Region remained the highest although it decreased from 34.6% to 31.2%.

Table 1. Stunting Prevalence Trend Analysis in Toddlers Aged 0-59 Months Based on Indonesian Regions in 2021-2023

Regional	2021			2022			2023		
	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$
Sumatra	17.6	33.2	22.8±4.5	15.2	31.2	20.0±4.8	13.5	29.4	19.2±4.9
Java-Balinese	10.9	24.5	19.7±5.0	8.0	20.8	17.0±4.5	7.2	23.9	18.1±5.3
Southeast	31.4	37.8	34.6±4.5	32.7	35.3	34.0±1.8	24.5	37.9	31.2±9.4
Kalimantan	22.8	30.0	27.5±2.9	22.1	27.8	25.0±2.3	17.4	24.7	22.5±2.9
Sulawesi	21.6	33.8	28.6±4.0	20.5	35.0	27.0±0.2	21.3	30.4	27.1±3.2
Maluku	27.5	28.7	28.1 ±0.8	26.1	26.1	26.1±0	23.6	28.4	26.0±3.3
Papua	26.2	29.5	27.8±2.3	30.0	34.6	32.3±3.2	24.8	39.3	31.0±6.1
Indonesia	**10.9**	**37.8**	**24.4±5.5**	**8.0**	**35.3**	**21.6±6.3**	**7.2**	**39.3**	**21.5±6.7**

Figure 1 shows that during the 2021-2023 period, the prevalence of stunting experienced a significant decline except for the Papua Region. The Nusa Tenggara Region with the highest prevalence of stunting during the 2021-2023 period.

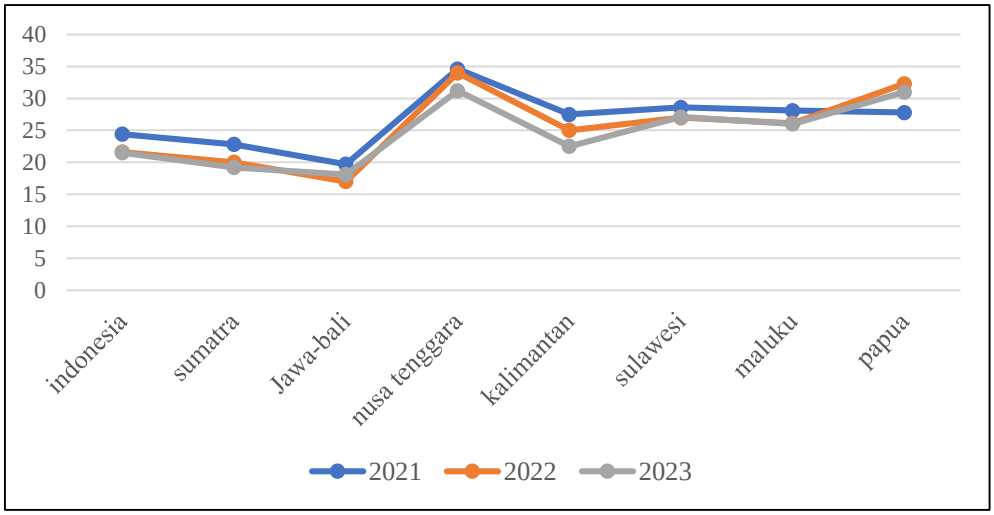


Figure 1. Stunting Prevalence Trend Analysis in Toddlers Aged 0-59 Months Based on Indonesian Regions in 2021-2023

Based on the results of the analysis of the Indonesian Nutritional Status Survey (Ministry of Health of the Republic of Indonesia, 2021, 2022) and the 2023 Indonesian Health Survey (Ministry of Health of the Republic of Indonesia, 2023), shows that Indonesia has experienced a decline in stunting prevalence from 24.4% in 2021 to 21.5% in 2023. The Nusa Tenggara Regional Region has had the highest prevalence rate for the past 3 years, although the figure has decreased. In several regional areas of Indonesia, there has been a

significant decline and is already below the Indonesian average (21.5%), namely the Sumatra Regional Region (19.2%) and Java-Bali (18.1%) but is still above the national target (14%) so it still needs to be considered. Meanwhile, in the Eastern Indonesia region, it is still above the Indonesian average and still above the WHO target (20%). This decline shows the effectiveness of the government's community-based intervention program. The theory of community-based nutrition programs states that interventions tailored to local needs are more effective than policies that are simply implemented from the center (Febriati et al., 2024). The results of this study are in line with research conducted by Wulandari et al., (2021) and Jamaluddine et al., (2020) which shows that community-based nutrition improvement programs, especially in schools, can have a significant impact on reducing stunting rates. This supports the claim that community-based interventions can have a major impact on reducing stunting rates in more difficult-to-reach areas. Sensitive nutrition interventions contribute greatly to reducing stunting, a study conducted in Banyumas by Devi Sari (2023) shows that there is a significant decrease in the prevalence of stunting from 30.2% to 16.6% in 2022. This is different from the results of research on the implementation of sensitive and specific nutritional intervention programs conducted by The Last Supper (2023) in Karo district, West Sumatra, which shows that this program has not been effective in reducing stunting. This study also contradicts the results of research conducted in India by Pavithra et al., (2019) and in Guatemala by Juarez et al., (2021) which states that despite improvements in some child nutrition indicators, there was no significant reduction in the prevalence of stunting in poorer areas. The study suggests that socio-economic constraints economic, food security, low maternal education levels, and limited access to quality health services reduce the impact of community-based interventions.

Table 2 shows that the prevalence of wasting during the period 2021-2023 experienced a significant increase. The Maluku Regional area has the highest prevalence rate (14.5%). Meanwhile, the Sumatra Regional area (8.4%) and the Java-Bali Regional area (7.3%) are below the Indonesian average (9.2%) in 2023.

Table 2. Wasting Prevalence Trend Analysis in Toddlers Aged 0-59 Months Based on Indonesian Regions in 2021-2023

Regional	2021			2022			2023		
	Min	**Max**	$\bar{X} \pm SD$	**Min**	**Max**	$\bar{X} \pm SD$	**Min**	**Max**	$\bar{X} \pm SD$
Sumatra	5.0	0.7	7.8±1.6	5.5	11.3	7.5±1.6	6.3	13.6	8.4 ±2.1
Java-Balinese	3.0	6.9	5.7±1.3	2.8	8.0	6.7±1.8	3.6	10.2	7.3 ±2.2
Southeast	7.5	10.1	8.8±1.8	8.7	10.7	9.7±1.4	8.6	13.6	11.1±3.5
Kalimantan	6.8	10.3	8.5±1.5	6.5	10.1	8.9±1.4	8.7	13.3	10.7 ±2.0
Sulawesi	6.2	10.2	7.7±1.6	6.6	11.3	8.7±1.6	9.1	12.9	10.9±1.8
Maluku	10.6	12.0	11.3±0.9	11.1	11.9	11.5±0.5	13.6	15.4	14.5± 1.2
Papua	8.8	10.8	9.8±1.4	10.5	11.8	11.1±0.9	10.9	18.2	13.8 ± 2.3
Indonesia	**3.0**	**12.0**	**7.1±1.9**	**2.8**	**11.9**	**7.7±2.0**	**3.6**	**18.2**	**8.5±3.0**

Figure 2 shows that during the period 2021-2023 the incidence of wasting increased significantly across all regions of Indonesia during 2021-2023. The Maluku Region occupied the highest point followed by the Papua Region which was in second place. The Java-Bali Region was at its lowest point during the period 2021-2023. The phenomenon of the increasing trend of wasting prevalence that occurred in Indonesia between 2021 and 2023 highlights a more dynamic challenge in dealing with malnutrition in toddlers. The prevalence of wasting continues to increase from 2021 (7.1%) to 2023 (8.5%). The Maluku region was

recorded as having the highest prevalence, at 14.5%, while Java-Bali had the lowest prevalence at 7.3%, below the national average of 8.5%. On the other hand, Sumatra was also recorded below the national average with a prevalence rate of 8.5%. This is associated with unstable food security factors, climate change, and limited access to nutritious food. This phenomenon supports the theory of food security which states that environmental, economic, and social changes greatly affect the stability of the nutritional status of the community (Amalia et al., 2023). Research conducted by Muliyati et al., (2021) also shows that low birth weight and family income levels are closely related to wasting in toddlers. Japan is one of the countries that has succeeded in dealing with malnutrition in its country, based on data from the Global Nutrition Report, the prevalence of wasting in Japan is 2.3%. This figure is lower than the Southeast Asian average of 8.9%. This is because Japan has succeeded in developing the Shokoiku program based on nutrition education, in addition, Japan also focuses on building adequate sanitation infrastructure and encouraging good hygiene practices (Kurotani et al., 2024). A study conducted in Bangladesh by Mumuni and Joseph Aleer (2023) and in Africa by (Wolfle and Channon, 2023) showed that seasonality and climate variation significantly influence wasting prevalence. Sharp decreases or increases in wasting prevalence are often related to seasonal changes, which are related to the quality of access to nutritious food, and this factor is also seen in Indonesia, where fluctuations in wasting prevalence appear to be related to unstable food security and climate change. Research by Wang, Yuan and Tang (2021), which discusses food security strategies and environmental sustainability, states that although food security strategies are implemented in environmental sustainability efforts, there is no significant impact seen in several regions related to the influence of climate change on the prevalence of wasting. This study argues that the effectiveness of strategies such as reducing food waste and waste management often does not have a clear impact on reducing wasting at the regional level.

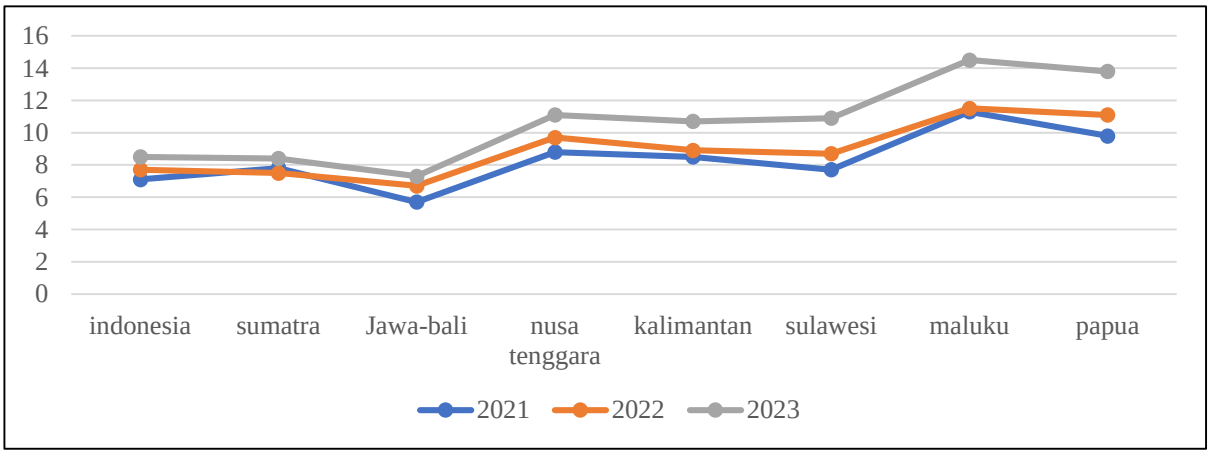


Figure 2. Wasting Prevalence Trend Analysis in Toddlers Aged 0-59 Months Based on Indonesian Regions in 2021-2023

Table 3 shows that the trend of underweight prevalence in Indonesia has decreased in the period 2021-2023, namely from 17% to 12.9%. The highest prevalence is in the Nusa Tenggara Region (25.2%) and the lowest is in the Java-Bali Region (13.3%).

Table 3. Underweight Prevalence Trend Analysis in Toddlers Aged 0-59 Months Based on Indonesian Regions in 2021-2023

Regional	2021			2022			2023		
	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$
Sumatra	12.9	23.8	16.6±3.1	12.2	24.3	15.9±3.4	8.9	22.6	13.9±3.8
Java-Balinese	7.0	16.5	13.5±3.2	6.6	17.6	14.0±3.8	5.6	17.7	13.3±3.7
Southeast	22.4	29.3	25.8±4.8	24.2	28.4	26.3±2.9	20.8	29.7	25.2±6.2
Kalimantan	16.2	24.3	20.3±3.6	17.3	23.0	20.5±2.2	15.3	21.6	18.7±2.6
Sulawesi	14.1	23.8	20.5±3.6	13.4	25.0	20.7±3.9	14.3	24.4	21.2±3.7
Maluku	22.4	26.4	24.4±2.8	23.0	23.4	23.2±0.2	20.9	25.1	23.0±2.9
Papua	19.3	19.9	19.6±0.4	18.7	22.7	20.7±2.8	15.4	23.9	20.3±2.8
Indonesia	**7.0**	**29.3**	**17.1±4.7**	**6.6**	**28.4**	**17.1±4.7**	**5.6**	**29.7**	**15.9±5.0**

Figure 3 shows that during the period 2021-2023, the incidence of Underweight tends to decrease in several parts of Indonesia during 2021-2023. The Nusa Tenggara region is at the highest point during the period 2021-2023. The Java-Bali region is at the lowest point and below the Indonesian average.

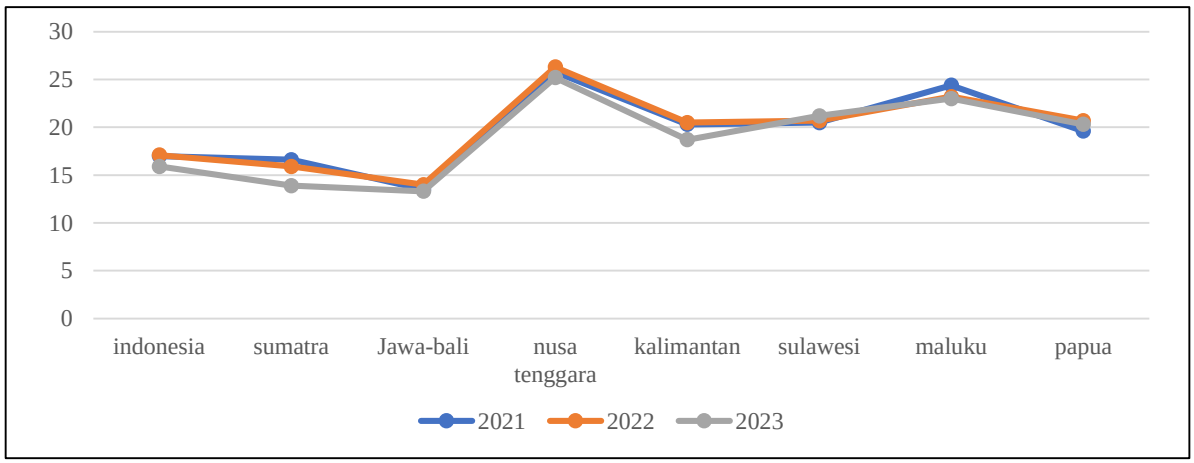


Figure 3. Underweight Prevalence Trend Analysis in Toddlers Aged 0-59 Months Based on Indonesian Regions in 2021-2023

A similar trend is also seen in the prevalence of underweight in several regions in Indonesia. Data shows a downward trend in underweight in the last three years, from 17% to 15.9%. The Sumatra Regional area recorded a significant decline from 16.6% to 13.9% and the Java-Bali Regional area was recorded as the Region with the lowest prevalence of 13.3%, both of these Regional areas are already below the national average. This decline was driven by increased public awareness of healthy eating patterns and more targeted social assistance program interventions. Although this study focused on stunting, the results showed that social assistance programs had a significant impact on the nutritional status of toddlers. This supports the importance of socio-economic interventions in efforts to reduce nutritional problems in children (Sahara et al.,2024). This finding supports the theory of health disparities which states that the gap in nutritional status between regions can be reduced through awareness-raising programs and effective food distribution (Yahya and Ihwal, 2024). A study by Putri (2022) found that a nutrition counseling intervention combined with cash transfers significantly reduced the risk of underweight in children in developing countries. The counseling provided information on children's feeding and nutrition practices, as well as antenatal and postnatal care. The results showed an increase in height for age (H/A) and a decrease in the risk of underweight in the group that received the intervention. Other

studies have also shown that a combination of sensitive and specific interventions is key to success in reducing stunting and underweight. This approach has been proven effective in countries such as India, Peru, Senegal, Ethiopia, Nepal, and Myanmar. The programs involve various sectors and focus on improving nutrition and socio-economic conditions of the community (Sugianti and Devianti Putri, 2022)

This study has several advantages that make it a comprehensive study in analyzing growth disorder trends in Indonesian toddlers. This approach allows the study to provide an overview of the effectiveness of interventions that have been carried out and highlight areas that still face challenges in reducing malnutrition rates. In addition, this study uses secondary data from the Indonesian Nutritional Status Study (INSS) and the Indonesian Health Survey (IHS), which are national data with valid and standardized anthropometric measurement methods. By using verified data, the results of this study have a high level of reliability in describing the nutritional conditions of toddlers in Indonesia. Not only that, this study also provides an analysis based on seven regional areas, so that it can identify gaps between regions and become the basis for more targeted and specific policies. By highlighting stunting, wasting, and underweight trends, this study can provide input for the government in efforts to achieve national and global targets in reducing malnutrition rates. The results of this study also support the effectiveness of community-based interventions that have been implemented, especially in efforts to reduce stunting and underweight rates in several regions.

The main limitation of this study is the research period which only covers the period 2021-2023, so it does not allow for long-term analysis of the effectiveness of the nutrition intervention program. Focusing on a specific area, the results of this study do not yet fully reflect conditions throughout Indonesia. Socioeconomic factors, such as family income, maternal education level, and access to health facilities, have not been fully studied in depth in this study.

CONCLUSION

This study shows that there is a significant change in the prevalence of stunting in toddlers in Indonesia during the period 2021-2023. The decreasing trend in the prevalence of stunting and underweight indicates the effectiveness of the nutritional interventions that have been implemented, although wasting still shows fluctuations in some regions. Regional disparities remain a challenge, especially in the Nusa Tenggara Region which has a high malnutrition rate. New findings show that community-based interventions are more effective in reducing malnutrition rates than general approaches. Fluctuations in wasting indicate the important role of food security and socio-economic conditions in children's nutritional status. These results strengthen the theory that sustainable nutrition interventions that are tailored to local conditions are more effective.

Suggestions for the government include strengthening nutrition policies by ensuring equitable distribution. Access to nutritious food and health services across the region, especially in areas with high malnutrition prevalence. Community-based intervention programs that have proven effective should be expanded with adequate budget and health workforce support. In addition, a multisectoral approach involving the agriculture, education, and social welfare sectors is needed to improve food security and family nutrition education. Suggestions for further research include expanding the time span to evaluate long-term malnutrition trends. A more in-depth analysis of socio-economic factors, food security, and climate change is needed to understand the causes of wasting fluctuations. In addition, an approach that combines secondary and primary data will provide a more comprehensive picture of the

effectiveness of various nutrition interventions in various regions.

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CONFLICT OF INTEREST

The authors have no conflictsof interest related ti the material presented in this reserch.

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YELLOW SWEET POTATO (YSP) ENHANCES INSULIN SENSITIVITY AND REDUCES TYPE 2 DIABETES RISK IN OBESE RATS

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ABSTRACT

Background: *YSP (Ipomoea batatas) shows potential as a rice substitute due to its lower glycemic index, higher fiber content, and reduced caloric density. This study aimed to evaluate the effects of a YSP-based diet on biomarkers of insulin resistance in obese rats.*
Method: *A randomized controlled trial was conducted using 28 rats, all rendered obese through a high-fat diet for 3 weeks, resulting in a Lee index greater than 310 g. The rats were then divided into four dietary groups and treated for an additional 3 weeks. The control group (K−) received standard AIN-93M feed. The positive control group (K+) received a modified standard feed in which 100% of the corn starch was replaced with rice. Group K1 was given 100% steamed YSP, while group K2 received 100% twice-steamed YSP. Blood samples were analyzed using SPSS software version 25.0. The K2 group demonstrated the most significant improvements across all measured parameters.*
Results: *Total antioxidant levels increased by 5.11 U/mL, while HOMA-IR and glycated albumin decreased by 5.67 and 3.83 pmol/mL, respectively. Post-prandial glucose levels also dropped significantly by 184 mg/dL. Furthermore, the K2 group exhibited the highest concentrations of GLUT4 (25.12 ng/mL), acetic acid (150.31 mmol/L), propionic acid (53.20 mmol/L), and butyric acid (27.18 mmol/L). Levels of PPAR-α and PPAR-γ were also highest in the K2 group at 1.94 ng/mL and 0.78 ng/mL, respectively. In contrast, glucose-6-phosphatase (G6P) reached its highest level in the K− group at 9.91 mIU/mL.*
Conclusion: *A twice-steamed YSP diet significantly improved insulin sensitivity in obese rats. These findings suggest that YSP may serve as a functional food promoting metabolic health.*

Keywords: *Antioxidant, post-prandial glucose, GLUT4, Glycated albumin, HOMA-IR, PPAR, Insulin resistance, SCFA, Obese rats, Yellow Sweet Potato*

INTRODUCTION

The incidence of obesity in developing countries has tripled over the past 20 years, with Southeast Asia experiencing one of the highest increases in obesity rates(Askari et al., 2022). Central obesity, in particular, is associated with an elevated risk of non-communicable diseases such as type 2 diabetes mellitus, cardiovascular disease, cancer, and osteoarthritis, all of which contribute to increased morbidity and mortality(Harbuwono et al., 2018) (Yumuk et al., 2015) (Awasthi et al., 2023). According to the Diabetes Prevention Program (DPP), type 2 diabetes mellitus can be prevented in high-risk populations through weight loss and lifestyle modifications, including dietary regulation and increased physical activity(National Institute of Diabetes and Digestive and Kidney Disease, 2021).

One of the major consequences of central obesity is insulin resistance, a condition in which the body's cells become less responsive to insulin. Adipose tissue stores lipids in the form of triacylglycerols, derived from chylomicron absorption, and releases non-esterified fatty acids to meet increased energy demands. A prolonged positive energy balance results in fatty acid accumulation that exceeds the adipose tissue's storage capacity, leading to dysfunction. This impairment reduces the availability of insulin needed to facilitate

triacylglycerol uptake and suppress endogenous lipolysis. As a compensatory mechanism, insulin secretion increases, resulting in hyperinsulinemia. Excess fatty acids subsequently accumulate in peripheral tissues such as muscle, liver, and pancreas due to impaired lipid buffering(Pramono, 2020). The accumulation of fatty acids and elevated blood glucose levels induce oxidative stress, which arises from an imbalance between the production and neutralization of reactive oxygen species (ROS). Excessive ROS damages cellular components, including proteins, lipids, and DNA. Inadequate antioxidant defenses further exacerbate oxidative stress(Mahat et al., 2019).

To measure insulin resistance**,** several biomarkers and assessment tools are available. One widely used method is the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR), which estimates insulin sensitivity and β-cell function based on fasting glucose and insulin levels. Central obesity is strongly associated with elevated HOMA-IR values, even in individuals not yet diagnosed with diabetes(Pramono, 2020) (Kurniawan et al., 2020) (Mayerhofer et al., 2020). In addition to HOMA-IR, glycated albumin (GA) is a valuable marker of insulin resistance. Unlike hemoglobin A1c (HbA1c), GA is unaffected by hemoglobin metabolism disorders and reflects glycemic control over the previous 2–4 weeks(Kohzuma et al., 2021).Post-prandial glucose levels also play a critical role in identifying individuals at risk of developing diabetes and its complications. The utility of fasting plasma glucose and HbA1c, with 2-hour post-prandial plasma glucose serving as a primary criterion for diagnosing prediabetes and diabetes(Fauziah et al., 2017).

Despite the availability of these biomarkers, dietary interventions targeting insulin resistance have yielded mixed results. Although numerous studies have explored the effects of diet on insulin resistance in both animal models and humans, many interventions have proven to be less effective or difficult to implement in real-world settings. For instance, a study by Utari et al. (2019) demonstrated that low-calorie and low-glycemic index diets were ineffective in significantly reducing insulin resistance (as measured by HOMA-IR), primarily due to limited monitoring of dietary intake among participants(Utari et al., 2019).

Given these limitations, there is a growing interest in identifying local, accessible food sources that are rich in fiber, have a low glycemic index, and can serve as viable alternatives to staple foods like rice. One such candidate is sweet potato (*Ipomoea batatas*), which contains approximately one-third the calories of rice, a lower glycemic index (46 vs. 79.6), ten times more fiber, and bioactive compounds such as β-carotene that possess antidiabetic properties(Kementrian Kesehatan Republik Indonesia, 2018) (Houston, 2023) (Nayar and Madhu, 2020).

Therefore, this study aims to investigate the potential of yellow sweet potato as a functional food to improve insulin resistance and oxidative stress in obesity. Specifically, we evaluate the effects of yellow sweet potato consumption on total antioxidant capacity, insulin resistance (HOMA-IR), glycated albumin (GA), post-prandial glucose, GLUT4 expression, glucose-6-phosphatase (G6P), short-chain fatty acids (SCFA), and the expression of peroxisome proliferator-activated receptors (PPAR-α and PPAR-γ).

METHODS

Materials

Yellow sweet potatoes (*Ipomoea batatas L.*), Sari variety, were obtained from CV Arindo Makmur, Malang, East Java, Indonesia. The tubers were harvested at 3–4 months of age and certified under variety purification certificate No. Ubjl.R.3514010.0288.0068/PV. For the steamed yellow sweet potato (SYSP) preparation, the tubers were peeled, sliced into 4 cm pieces, and steamed at approximately

70°C for 15 minutes. Meanwhile, for the resistant starch-rich SYSP (SYSP-RS), the sweet potatoes underwent steaming for 15 minutes at 70°C, followed by cooling at 4°C for 24 hours, and were subsequently re-steamed for 15 minutes under the same temperature condition. The processed sweet potatoes were then incorporated into the experimental diet.

Biochemical analysis of steamed yellow sweet potato

Proximate composition and functional components of the steamed yellow sweet potato and SYSP-RS were analyzed in duplicate following standard methods by AOAC. The nutrient composition of the steamed yellow sweet potato (SYSP) and the high-resistant starch yellow sweet potato (SYSP-RS) diets was calculated based on their formulated feed ingredients (Table 1).

Table 1. Composition of Standard Feed Ingredients AIN 93(26) and Yellow Sweet Potato Feeding

Material	Standar Feed (%)	Feed High Fat (%)	SYSP (%)	SYSP-RS (%)	Rice Feed (%)
Corn Starch-dextrin	62	1,6	-	-	-
Dextrin	-	15,5	15,5	15,5	15,5
Casein	14	14	14	14	14
Sucrose	10	10	10	10	10
Powdered cellulose	5	5	5	5	5
Soybean oil	4	46,9	4	4	4
AIN-93 mineral mix	3,5	3,5	3,5	3,5	3,5
AIN 93 vitamin mix	1	1	1	1	1
Choline bitartrate	0,25	0,25	0,25	0,25	0,25
L-cystine	0,18	0,18	0,18	0,18	0,18
t-Butylhydroquinone	0,0008	0,0008	0,0008	0,0008	0,0008
Cholesterol	-	2	-	-	-
Rice	-	-	-	-	46,6
Total	99,93	99,93	100,03	100,03	100,03
Energy (kcal)	4000	6241	4004	4004	4004
Protein (%)	14	14	14	14	14
Fat (%)	4	48.9	4	4	4
Carbohydrate (%)	77	32	77.1	77.1	77.1

Animal Handling

This study utilized male Sprague Dawley rats aged approximately 8 weeks. All animals were obtained in a healthy and active condition and were maintained in individual cages to monitor dietary intake and avoid feed competition. The animals underwent a 7-day acclimatization period under controlled conditions, including a room temperature of 25°C, 12-hour light/dark cycle, and free access to water and standard AIN-93M chow. During acclimatization, behavioral observations were performed to assess animal health status. Inclusion criteria included a Lee Index >310, indicating an obese phenotype, while exclusion criteria were mortality or abnormal behavioral signs during the acclimatization and intervention period.

Ethical approval

All experimental procedures involving animals were conducted at the Animal Experiment Laboratory of the Center for Nutrition and Food Studies, Universitas Gadjah Mada. The study protocol was reviewed and approved by the Health Research Ethics Committee of the Faculty of Medicine, Diponegoro University, Semarang, Indonesia. Ethical approval was granted under the reference number 075/ECH/KEPK/FK-UNDIP/VII/2024. All research activities were conducted in accordance with the principles outlined in the Declaration of Helsinki and the guidelines set forth by the Council for International Organizations of Medical Sciences (CIOMS).

Experimental design

The minimum number of animals per group was determined using the Federer formula, resulting in six rats per group, with an additional rat included per group as a reserve (n=7). After acclimatization, obesity was induced using a high-fat diet administered for three weeks, composed of 48.9% fat, 32% carbohydrates, and 19.1% protein. Cholesterol powder (Sigma-Aldrich) was used as the primary lipid source. Rats were randomly assigned into four experimental groups. Group K1 (Treatment Group 1) was provided with a diet in which 100% of the corn starch was substituted with steamed yellow sweet potato. Group K2 (Treatment Group 2) received a diet where all corn starch was replaced by yellow sweet potato rich in resistant starch, processed using a steam–cool–steam method. The K+ group (Positive Control) was given a diet with complete replacement of corn starch by rice (Platinum Raja brand), while the K− group (Negative Control) was maintained on a standard AIN-93M chow diet. All diets were provided at a fixed quantity of 15 g/rat/day, and water was available ad libitum throughout the intervention period. Body weight and naso-anal length were recorded weekly to calculate the Lee Index as a measure of obesity progression and intervention efficacy.

Blood and caecum samples collection

Blood samples were collected on Day 0 and Day 22 of the intervention period. Rats were anesthetized using ketamine (60 mg/kg BW) during the light phase, and approximately 3 mL of blood was drawn via the orbital sinus using glass capillary tubes. Samples were centrifuged at 4000 rpm for 15 minutes at 4°C to separate the serum. The supernatant was aliquoted and stored at –80°C for further biochemical analyses. At the end of the intervention, rats were sacrificed, and both cecal contents and adipose tissue were collected. Luminal contents of the caecum were obtained by rinsing with phosphate-buffered saline (1X PBS, pH 7.4) and stored at –80°C for short-chain fatty acids (SCFAs) analysis using gas chromatography. Adipose tissue samples were preserved for post-intervention evaluation of insulin signaling and metabolic-related protein expressions.

Biomedical analysis of blood and caecum samples

Fasting blood glucose was measured using an enzymatic photometric test based on the glucose oxidase-peroxidase (GOD-PAP) method (Glucose GOD FS, DiaSys Diagnostic Systems GmbH, Germany). Serum insulin levels were determined using a sandwich ELISA kit (FineTest® Rat Insulin ELISA Kit, Wuhan Fine Biotech Co., Ltd., China). HOMA-IR was calculated using the formula: (fasting glucose (mg/dL) × fasting insulin (µU/mL)) / 405, with HOMA-IR values above 3.9 considered indicative of insulin resistance in rats. Glycated albumin was analyzed using the FineTest® Rat GA QuickTest ELISA Kit (Wuhan Fine Biotech Co., Ltd., China). Total antioxidant capacity (TAC) was evaluated using the Trolox Equivalent Antioxidant Capacity (TEAC) method with ABTS (2,2-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid) as the radical source, and absorbance was measured using a UV-Vis spectrophotometer (Genesys 150, Thermo Fisher Scientific, USA). Post-prandial glucose levels were assessed 120 minutes after feeding on Day 0 and Day 22 using the same GOD-PAP enzymatic method. The normal post-prandial glucose level for rats was set at 5.65 mmol/L (218.5 mg/dL). SCFAs including acetate, propionate, and butyrate were analyzed from the caecum samples after the intervention. The concentrations were measured using gas chromatography.

Protein Expression Analysis for GLUT4, G6P, PPAR-α, and PPAR-γ

The expression levels of GLUT4 and PPAR-γ proteins were analyzed from adipose tissue samples, while G6P and PPAR-α proteins were measured from liver tissue. All protein expression levels were determined using sandwich enzyme-linked immunosorbent

assay (ELISA) kits (FineTest® Rat ELISA Kits: GLUT4, G6P, PPAR-α, and PPAR-γ; Wuhan Fine Biotech Co., Ltd., China), following the manufacturer's protocols.

Statistical analysis

Statistical analysis was performed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA), while graphical illustrations were generated using GraphPad Prism version 9.0 (GraphPad Software Inc., USA). All data were expressed as mean ± standard deviation (SD). The normality of data distribution was assessed using the Shapiro–Wilk test, considering that the number of subjects in each group was fewer than 50. For intra-group comparisons, the paired t-test was used for normally distributed data. Between-group comparisons were conducted using one-way ANOVA, followed by Bonferroni or Tamhane's T2 post hoc test depending on the homogeneity of variance based on Levene's test results. Non-normally distributed variables were analyzed using the Kruskal–Walls test followed by the Mann–Whitney U test for pairwise comparisons. Correlations between variables after the intervention were assessed using Spearman's rank correlation test. A p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

RESULTS

Baseline characteristics

A total of 28 Wistar rats with diet-induced obesity were included in this study, with seven rats in each group. No significant differences were observed at baseline among the groups for body weight, Lee index, antioxidant total, glycated albumin, and post-prandial glucose levels ($p > 0.05$). However, a significant difference was found in HOMA-IR values between groups at baseline ($p = 0.026$), although the overall mean values remained indicative of insulin resistance in all groups (Table 2).

Effects of SYSP intervention on lee index

The Lee index, was significantly affected by the intervention across all groups. As presented in Table 1, the K1 and K2 groups exhibited markedly lower Lee index values post-intervention compared to both control groups. Specifically, the K1 group showed a Lee index of 309.59 ± 3.03, while the K2 group demonstrated an even lower value of 308.02 ± 2.47. In contrast, the negative control (K−) and positive control (K+) groups maintained higher indices of 331.16 ± 1.36 and 331.02 ± 2.00, respectively. The change (Δ) in Lee index post-treatment was −13.55 in the K1 group and −17.35 in the K2 group, indicating a significant reduction in body fat accumulation compared to the K− ($\Delta = 5.44$) and K+ ($\Delta = 5.32$) groups. The statistical analysis confirmed that these differences were highly significant, with $P < 0.000$ for both within-group and between-group comparisons. These findings suggest that the intervention effectively reduced adiposity in a dose-dependent manner, with the greatest improvement observed in the K2 group.

Effects of SYSP intervention on antioxidant total, glycated albumin, homa-ir, and post-prandial glucose

The effect of the intervention on antioxidant status and metabolic parameters was evaluated by comparing post-intervention values among groups.

As shown in Figure 1A, total antioxidant levels were significantly higher in both intervention groups (K1 and K2) compared to the negative control (K−) and positive control (K+). The K2 group exhibited the highest antioxidant capacity (6.69 ± 0.10 U/mL), followed by K1 (5.93 ± 0.20 U/mL), with both showing statistically significant differences from K− and K+ ($P < 0.0001$). There was also a significant difference between K1 and K2, indicating a dose-dependent effect.

Table 2. Baseline characteristics

Parameter	Group				p
	K-	K+	K1	K2	
Bodyweight (g)	275.00±11.31	265.85±21.58	269.14±16.92	270.57±23.56	0.839
Lee index	325.72±1.43	325.70±2.26	323.14±3.32	325.37±3.18	0.238
Antioxidant total (U/mL)	1.59±0.01	1.56±0.04	2.57±0.03	1.58±0.03	0.545
HOMA-IR	9.32±0.14	9.29±0.21	9.06±0.08	9.14±0.20	0.026
Glycated albumin (%)	7.34±0.34	7.33±0.49	7.34±0.27	7.33±0.37	0.901
Post-prandial Glucose (mg/dL)	290.61±2.11	289.43±3.13	289.08±2.62	288.26±1.53	0.357

Data were expressed as mean ± standard deviation (SD) and measured before the treatment period; K1 (Treatment Group 1): normal diet + 100% of corn starch replaced by SYSP; K2 (Treatment Group 2): normal diet + 100% of corn starch replaced by SYSP-RS; K+ (Positive Control): normal diet + 100% of corn starch replaced by rice; K− (Negative Control): standard AIN-93M chow; n: 7; p< 0.05 was considered significant with One Way ANOVA test.

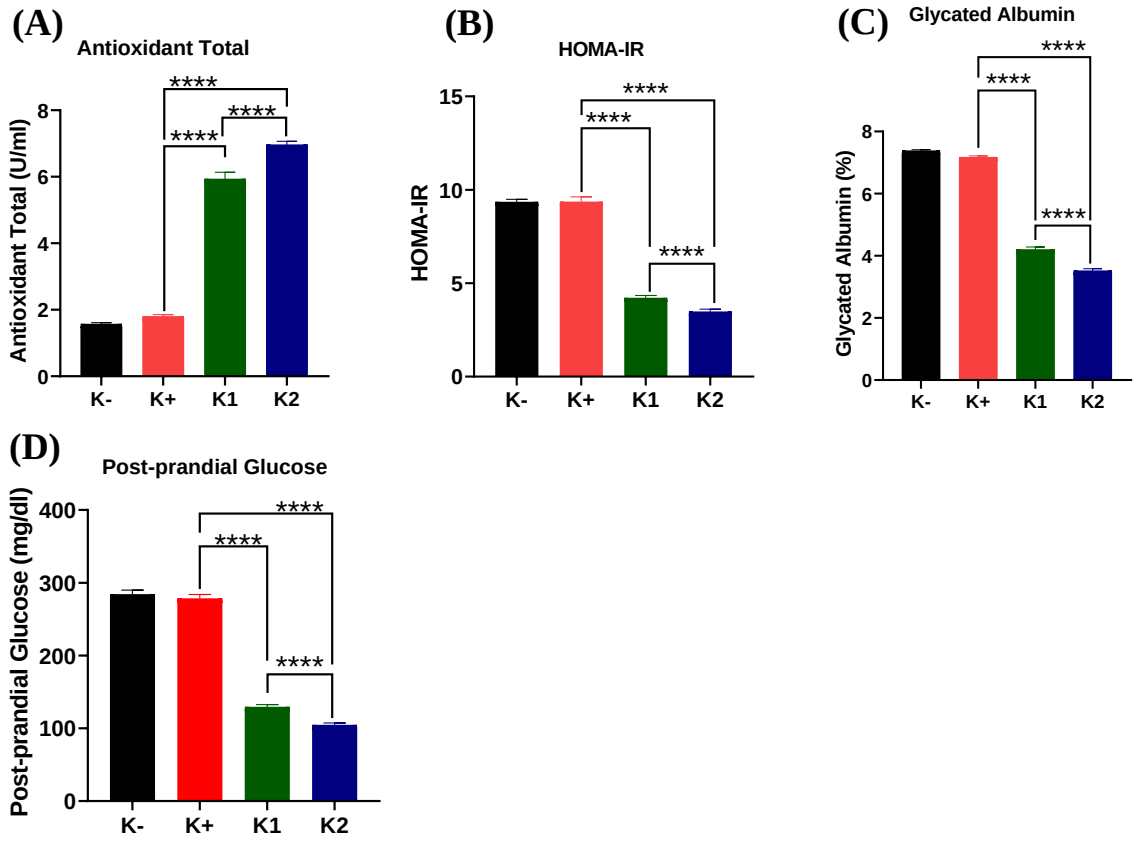


Figure 1. Effects of SYSP on antioxidant capacity and metabolic parameter. (A) Total antioxidant capacity, (B) HOMA-IR (insulin resistance), (C) Glycated albumin (%), and (D) Post-prandial glucose levels (mg/dL) in each experimental group after the intervention. Data are presented as mean ± SD. Significant differences were observed between the positive control group (K^+) and both intervention groups (K1; K2), as well as between K1 and K2, as indicated by **** ($P < 0.0001$). One-way ANOVA followed by Tukey's post hoc test was used for statistical analysis.

In terms of insulin resistance (Figure 1B), post-intervention HOMA-IR values were markedly lower in the K1 (4.21 ± 0.13) and K2 (3.47 ± 0.12) groups compared to K− (9.35 ± 0.13) and K+ (9.36 ± 0.26) groups ($P < 0.0001$). Furthermore, K2 demonstrated significantly lower HOMA-IR than K1, suggesting a more pronounced improvement in insulin sensitivity with higher intervention dose. Similarly, glycated albumin levels (Figure 1C) were significantly reduced in K1 (4.20 ± 0.79%) and K2 (3.51 ± 0.66%) groups

compared to the control groups (K−: 7.38 ± 0.31%; K+: 7.17 ± 0.45%), with $P < 0.0001$ for all comparisons. K2 group exhibited the lowest level of glycated albumin, indicating better long-term glycemic control. Post-prandial glucose concentrations (Figure 1D) were also substantially decreased in both intervention groups. The K2 group had the lowest glucose level (104.55 ± 2.75 mg/dL), followed by K1 (129.41 ± 3.30 mg/dL), both of which were significantly lower than the values observed in K− (284.19 ± 5.65 mg/dL) and K+ (278.49 ± 5.36 mg/dL) groups ($P < 0.0001$). The reduction in post-prandial glucose was greater in K2 compared to K1, highlighting a dose-dependent glycemic-lowering effect.

Effects of SYSP intervention on adipose tissue GLUT4 and PPAR-γ

The SYSP intervention significantly altered the expression levels of GLUT4 and PPAR-γ in adipose tissue across all treatment groups (Figure 2A–B).

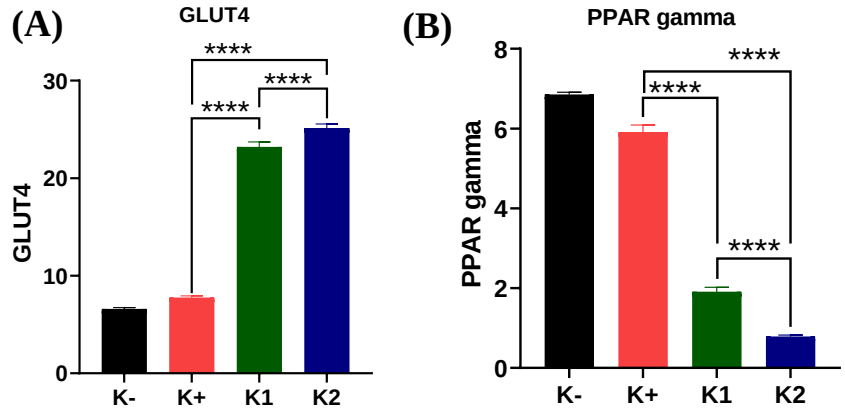


Figure 2. SYSP intervention modulates expression of glucose transport and insulin sensitivity markers in adipose tissue. (A) GLUT4 and (B) PPAR-γ expression levels post-intervention. Data are shown as mean ± SD. SYSP treatment significantly increased GLUT4 expression and decreased PPAR-γ expression in a dose-dependent manner, with **** indicating $P < 0.0001$ for comparisons between K^+ and K1/K2, and between K1 and K2. Statistical analysis was performed using one-way ANOVA followed by Tukey's post hoc test.

Post-intervention analysis revealed a marked increase in GLUT4 expression in the K1 and K2 groups compared to both the negative control (K−) and positive control (K+) groups. Specifically, GLUT4 levels were significantly higher in K1 (23.19 ± 0.51) and K2 (25.12 ± 0.43) groups than in K− (6.58 ± 0.15) and K+ (7.74 ± 0.18) groups ($P < 0.000$). Notably, the highest GLUT4 expression was observed in the K2 group, suggesting a dose-dependent effect of the SYSP intervention (Figure 2A). Conversely, the expression of PPAR-γ was significantly reduced in the K1 and K2 groups compared to the K− and K+ groups. The PPAR-γ levels in the K2 group (0.78 ± 0.03) were significantly lower than in K1 (1.90 ± 0.11), K+ (5.90 ± 0.17), and K− (6.84 ± 0.06) groups ($P < 0.000$), with the K2 group showing the most substantial suppression (Figure 2B). These findings suggest that SYSP intervention may enhance insulin sensitivity and glucose transport activity in adipose tissue via upregulation of GLUT4 and downregulation of PPAR-γ in a dose-dependent manner.

Effects of SYSP intervention on liver tissue G6P and PPAR-α

Post-intervention analysis demonstrated significant differences in liver G6P and PPAR-α levels across all groups (Figure 3A–B). G6P expression was markedly decreased in the K+ group (0.80 ± 0.02) compared to the K− group (9.91 ± 0.48). Interestingly, administration of SYSP in both treatment groups (K1 and K2) restored G6P levels to values significantly higher than K+ (7.76 ± 0.22 and 8.67 ± 0.41,

respectively; $P < 0.000$), although not fully to the level of the K− group (Figure 3A). Among the treatment groups, K2 exhibited the highest G6P level, indicating a possible dose-dependent effect of SYSP intervention. In contrast, hepatic PPAR-α levels were significantly downregulated in the K1 and K2 groups (2.93 ± 0.11 and 1.94 ± 0.08, respectively) when compared to K− (9.38 ± 0.08) and K+ (8.06 ± 0.25) groups ($P < 0.000$). The lowest expression was observed in the K2 group, suggesting that the SYSP intervention suppressed PPAR-α more effectively at the higher dose (Figure 3B). This pattern may reflect a modulatory role of SYSP in hepatic lipid metabolism through downregulation of PPAR-α expression.

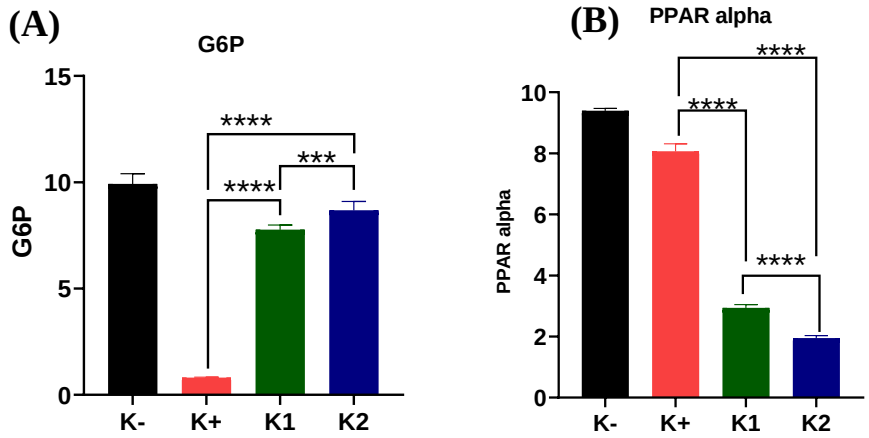


Figure 3. Liver expression of G6P and PPAR-α following SYSP intervention. (A) G6P and (B) PPAR-α levels post-intervention. Data are expressed as mean ± SD. SYSP treatment restored G6P levels and suppressed PPAR-α expression significantly, with K2 showing the most prominent effect. Asterisks (****) indicate $P < 0.0001$ for all significant group comparisons (K^+ vs K1/K2 and K1 vs K2). One-way ANOVA with Tukey's post hoc test was applied.

Effects of SYSP intervention on Caecum SCFAs

Post-intervention analysis revealed significant differences in caecal short-chain fatty acid (SCFA) concentrations among groups ($P < 0.000$), as shown in Figures 4A–C.

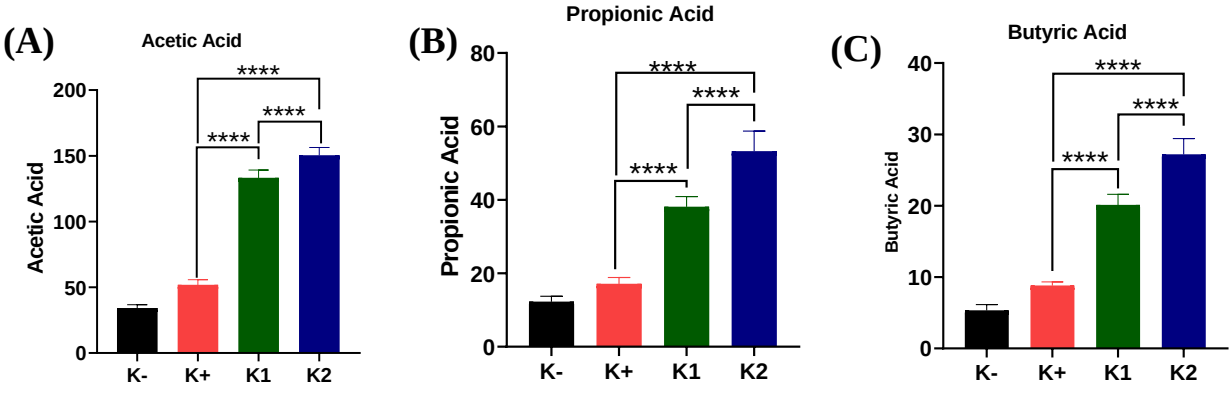


Figure 4. SYSP enhances caecal SCFA concentrations in a dose-dependent manner. Concentrations of (A) Acetic acid, (B) Propionic acid, and (C) Butyric acid measured in caecal samples post-intervention. Results are presented as mean ± SD. SYSP intervention significantly increased SCFA levels, particularly in the K2 group. Significant differences between K^+ and both K1/K2, as well as between K1 and K2, are denoted by **** ($P < 0.0001$). Data were analyzed using one-way ANOVA with Tukey's post hoc test.

The K2 and K1 groups, which received SYSP intervention, exhibited markedly higher levels of acetic acid, propionic acid, and butyric acid compared to the K− and K+ groups. Specifically, acetic acid levels were highest in the K2 group (150.31 ± 6.08 mmol/kg),

followed by K1 (133.16 ± 5.98 mmol/kg), K+ (51.82 ± 4.01 mmol/kg), and K− (34.18 ± 1.06 mmol/kg) (Figure 4A). A similar trend was observed for propionic acid, with concentrations in K2 (53.20 ± 5.54 mmol/kg) and K1 (38.10 ± 2.78 mmol/kg) substantially surpassing those in K+ (17.09 ± 1.75 mmol/kg) and K− (12.23 ± 1.52 mmol/kg) (Figure 4B). Likewise, butyric acid levels were significantly elevated in the SYSP-treated groups, with the highest level observed in K2 (27.18 ± 2.23 mmol/kg), followed by K1 (20.09 ± 1.50 mmol/kg), K+ (8.80 ± 0.52 mmol/kg), and K− (5.32 ± 0.81 mmol/kg) (Figure 4C). These findings suggest that SYSP supplementation enhances microbial SCFA production in a dose-dependent manner, particularly in the caecum.

DISCUSSION

The present study provides compelling evidence that supplementation with SYSP significantly enhances insulin sensitivity and improves glycemic control, as evidenced by reductions in glycated albumin, fasting glucose, and post-prandial glucose levels. These findings contribute to a growing body of literature supporting the metabolic benefits of dietary interventions targeting gut microbiota metabolites and host metabolic pathways. In this discussion, we examine the mechanistic underpinnings of these effects, focusing on the role of short-chain fatty acids (SCFAs) in the caecum and the regulation of key metabolic genes, including GLUT4, PPAR-α, PPAR-γ, and G6P.

The reduction in fasting glucose and post-prandial glucose levels following SYSP administration clearly indicates improved glucose homeostasis. Fasting glucose reflects the baseline regulation of hepatic glucose production and peripheral glucose uptake, while post-prandial glucose levels are influenced by both insulin secretion and tissue insulin responsiveness(Jorgensen et al., 2021). Glycated albumin, a marker of short-term glycemic control over 2 to 3 weeks, further substantiates the effectiveness of SYSP in reducing circulating glucose levels(Kohzuma et al., 2021).

The amelioration of these glycemic indices strongly suggests an improvement in insulin sensitivity. Insulin resistance, characterized by impaired insulin signaling in skeletal muscle, adipose tissue, and liver, is a hallmark of type 2 diabetes mellitus (T2D)(Wondmkun, 2020). Thus, the observed improvements highlight the potential of SYSP to function as a therapeutic agent for preventing or managing insulin resistance and early-stage T2D.

One of the notable findings in the current study is the increased concentration of SCFAs in the caecum. SCFAs, including acetate, propionate, and butyrate, are the primary end-products of microbial fermentation of dietary fibers in the colon(Vinelli et al., 2022). These metabolites are critical in modulating host energy metabolism, gut barrier integrity, and immune responses.

Increased SCFA levels have been associated with improved insulin sensitivity through multiple mechanisms. Butyrate, for instance, serves as an energy source for colonocytes and exhibits anti-inflammatory properties, thereby reducing metabolic endotoxemia—a contributor to systemic insulin resistance(van Deuren et al., 2022). Propionate and acetate also influence hepatic gluconeogenesis and lipid metabolism, partly through the activation of G-protein-coupled receptors (GPR41 and GPR43)(Lee et al., 2024).

Furthermore, SCFAs enhance the secretion of glucagon-like peptide-1 (GLP-1) and peptide YY (PYY), which play roles in satiety signaling and insulin secretion. GLP-1, in particular, enhances glucose-dependent insulin secretion and delays gastric emptying, thereby improving post-prandial glucose control(Jalleh et al., 2024). Therefore, the increased caecal SCFA concentration observed in this study likely played a pivotal role in

improving insulin sensitivity and glycemic control.

The observed upregulation of GLUT4, PPAR-α, PPAR-γ, and G6P protein in response to SYSP administration provides mechanistic insight into the pathways through which SYSP exerts its metabolic effects. These genes are critical glucose and lipid metabolism regulators and are closely linked to the pathophysiology of insulin resistance and metabolic syndrome. GLUT4 is an insulin-responsive glucose transporter expressed in adipose tissue and skeletal muscle. It facilitates glucose uptake into cells, a process impaired in insulin-resistant states(Chadt and Al-Hasani, 2020). Upregulation of GLUT4 suggests enhanced peripheral glucose disposal, contributing to improved glycemic control. Prebiotic and polyphenol-rich diets have previously been shown to upregulate GLUT4 expression via AMPK and PPAR signaling(Fotschki et al., 2022). PPAR-α is primarily involved in hepatic lipid metabolism. Its activation promotes fatty acid β-oxidation, reducing lipid accumulation in tissues and ameliorating lipotoxicity-induced insulin resistance. SYSP-induced PPAR-α upregulation may reduce hepatic steatosis and improve systemic metabolic parameters. PPAR-γ regulates adipocyte differentiation and lipid storage and maintains insulin sensitivity(Bougarne et al., 2018). The ability of SYSP to modulate this pathway suggests a potential for similar benefits with a more favorable safety profile. G6P catalyzes the final step in gluconeogenesis and glycogenolysis, influencing hepatic glucose output. While overactivation may contribute to hyperglycemia, its regulation in this study may indicate a balanced adaptation in response to improved peripheral glucose uptake(Rajas et al., 2019). Additional studies are warranted to characterize the context-specific role of G6P modulation by SYSP.

The gut-metabolic axis offers a framework through which microbiota, dietary components, and host metabolism interact. SYSP appears to modulate this axis favorably by enhancing SCFA production and regulating host gene expression. This dual mechanism improves systemic metabolism and reinforces intestinal integrity, reducing low-grade inflammation—a known contributor to insulin resistance(Ariyoshi et al., 2021).

Recent studies suggest that microbial shifts induced by dietary interventions can influence host gene expression via epigenetic and metabolite-mediated pathways(Gerhauser, 2018). SYSP may promote the growth of beneficial bacterial taxa, such as *Akkermansia muciniphila* and *Faecalibacterium prausnitzii*, associated with improved mucosal health and metabolic outcomes(Verhoog et al., 2019). Future metagenomic and metabolomic studies are necessary to delineate these microbial shifts and their impact on host physiology. Unfortunately, in this study, we did not analyze the gut microbiome, which might be interesting to be studied further.

Compared to pharmacological agents like metformin or thiazolidinediones, SYSP offers a promising dietary approach with potentially fewer side effects. While traditional medications remain foundational in T2D treatment, adjunctive nutritional strategies that target both the microbiota and host metabolic genes hold great promise(Vandeputte, 2020).

Interventions that modulate PPARs and GLUT4 expression have demonstrated synergistic benefits in metabolic disease models(Loza-Rodríguez et al., 2020). The multifactorial effects of SYSP underscore its potential as a holistic intervention targeting diverse aspects of metabolism. However, translating preclinical findings into clinical practice necessitates rigorous trials to assess long-term safety, efficacy, and optimal dosing in human populations.

Despite the strengths of this study, several limitations warrant discussion. First, the causal relationship between SCFAs and the regulation of genes involved in glucose and lipid metabolism has not yet been directly

established. Although the association is biologically plausible, future studies involving receptor antagonists or germ-free models could validate causality.

Second, the active compounds within SYSP responsible for these effects remain to be identified. It is unknown whether the observed benefits stem from specific polysaccharides, polyphenols, or their fermentation products. Isolation and characterization of these components would enhance reproducibility and therapeutic targeting.

Third, the analysis focused on gene expression without measuring protein abundance or activity. Since gene transcription does not always correlate with protein function, complementary proteomic and phosphoproteomic analyses are needed to fully understand SYSP's effects on insulin signaling and glucose metabolism.

CONCLUSION

This study demonstrated that consumption of steamed yellow sweet potato, particularly when steamed twice to enhance its resistant starch content, significantly improved metabolic health in obese rats. The intervention led to increased total antioxidants, GLUT4, and SCFAs, while reducing insulin resistance (HOMA-IR), glycated albumin, post-prandial glucose, and PPAR-α/γ levels. These results highlight the potential of yellow sweet potato as a functional food for improving insulin sensitivity and reducing metabolic risk factors, suggesting its use in dietary interventions aimed at managing obesity and related conditions.

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IRREGULAR MENSTRUAL CYCLE IN PT X WORKERS IN TASIKMALAYA CITY

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ABSTRACT

Background: *Women workers have their own challenges in the workplace because in addition to being workers, women have great responsibilities in the family. Many reproductive health problems may occur in female workers, one of which is menstrual cycle disorders.* Objective: *The purpose of this study was to determine the prevalence and factors that influence menstrual cycle disorders in garment workers of PT X Tasikmalaya City.*
Methods: *Quantitative research with a cross-sectional approach on 134 female workers at PT X, sampling technique using simple random sampling, data collected using questionnaires, analyzed using univariate and bivariate with chi square.*
Results: *The results showed that the prevalence of amenorrhea 76 (56.7%), oligomenorrhea 3 (2.2%) and polymenorrhea 3 (2.2%). Factors affecting menstrual cycle disorders are age (<0.001), parity (<0.001), BMI (0.308), work division (0.075), work stress (0.021) and birth control methods used (<0.001).*
Conclusion: *The most common menstrual cycle disorder in PT X Tasikmalaya City workers is amenorrhea, and the most influential factors are worker age, parity, work stress and contraception methods used.*

Keywords: *irregular, menstruation, cycle, female, worker*

INTRODUCTION

The increase in women's involvement in the labor force can be seen from the growing recognition that they make substantial contributions in various fields of employment. According to the National Labor Force Survey (SAKERNAS) in 2022 the female workforce in Indonesia reached 52.74 million workers out of 143.72 million workers, around 35.57% worked in the formal sector and 64.25% worked in the informal sector(Badan Pusat Statistik, 2022; BPS.go.id, 2023; Survei Angkatan Kerja Nasional (Sakernas), 2024).

Women workers have many challenges in employment, the existence of gender bias causes an imbalance of opportunities, wage discrimination and promotional opportunities which ultimately affect the achievement of success. Vulnerability to discrimination in women workers continues to be sought to be eliminated through various policies and programs. Internationally, the regulation of women workers' rights is contained in the CEDAW Convention (Convention on the Elimination of All Forms of Discrimination Against Woman). One of the rights that must be obtained by women is the right to reproductive health. (*Convention on the Elimination of All Forms of Discrimination against Women New York, 18 December 1979*, n.d.).

Women's reproductive health is different from men; women have a more complex reproductive cycle. This is certainly a challenge in the workplace because in addition to being a worker, women have great responsibilities in the family such as taking care of the household and childcare. The natures attached to them are menstruation, pregnancy, childbirth and breastfeeding so that female workers need good health maintenance and protection. The multiple roles of women as individuals,

workers, wives and parents certainly require a balance of work and life roles.(Feeney & Stritch, 2019).

Many problems occur in female workers in Indonesia, especially reproductive health, based on the results of research as many as 63.3% of female workers experience reproductive health problems, 60.6% of workers experience menstrual disorders and 20.2% experience pregnancy disorders. Reproductive health is strongly suspected to be related to work stress, temperature, and work shifts (Martiana et al., 2019). In addition, Chronic Energy Deficiency (CED) and Iron Nutritional Anemia in women are also significant problems. These conditions cause women to take more leave than men, a study revealed that around 45.2% of female workers reported absenteeism due to the menstrual cycle with an average absence of 5.8 days in one year (Ponzo et al., 2022). Menstrual cycle regularity is one of the important indicators of reproductive health in female workers because it is associated with an increased risk of premature death from cancer and cardiovascular disease. (Y. X. Wang et al., 2020).

Menstruation is a physiological process that occurs every month in women of childbearing age that indicates the performance of a healthy reproductive system. The normal menstrual cycle ranges from 21 to 35 days with the duration of menstruation between 2 to 7 days. (Park et al., 2021). Even so, some women experience problems with their menstrual cycle, such as polymenorrhea (menstrual cycles of less than 21 days), oligomenorrhea (menstrual cycles of more than 35 days), and menorrhagia (menstruation that lasts more than a week) (Güngör Semiz & Hekimsoy, 2024).

The female menstrual cycle is closely related to physiological, psychological, chemical and biological factors (Ok et al., 2019; Shim et al., 2024). Menstrual cycle disorders in female workers are influenced by length of work, work shifts, work stress, and job characteristics. (Ok et al., 2019; Sonata & Sianipar, 2023). In addition, the use of contraceptive methods and BMI also affect menstrual cycle disorders (Jung et al., 2017; Mardhika et al., 2021).

Identifying the determinants of menstrual cycle disorders in female workers is important to improve reproductive health and increase work productivity, therefore the purpose of this study is to identify the prevalence and analyze the factors that influence menstrual cycle disorders in workers at PT X, a garment company in Tasikmalaya City.

METHOD

This research is a quantitative study with a cross-sectional study conducted on female workers at PT X Tasikmalaya City in December 2024. The population in this study were female workers who had worked for more than 5 years as many as 220 people, the sample size was 134 people calculated using the Slovin formula (5% significance), sampling using simple random sampling.

The dependent variable in this study was menstrual cycle disorders, while the independent variables were age, parity, BMI, work division, work stress and contraceptive methods used. Data collection was done using a closed question questionnaire including age, parity, work division, contraceptive method used. BMI variables by filling in body weight and height, menstrual cycle by measuring the cycle for the last 3 months, while work stress variables are measured using the internationally validated DASS 42 questionnaire. Univariate data analysis was conducted to determine the frequency distribution of each variable, bivariate analysis with Chi Square test, testing using IBM SPSS Statistic 27 software.

RESULTS AND DISCUSSION

RESULTS

The results of research conducted on 134 female workers of PT X Tasikmalaya City who have worked for more than 5 years. Table 1 presents the frequency distribution of worker characteristics.

Table 1. Characteristics of Workers at PT X Tasikmalaya City

Characteristics	Frequency	Percentage (%)
Age		
20-29	67	50
30-39	55	41
40-49	12	9
Parity		
Nulipara	37	27,6
Primipara	16	11,9
Multipara	77	57,5
Grandemultipara	4	3
BMI		
Underweight	14	10,4
Normal	108	80,6
Overweight	12	9
Work Division		
Admin	6	4,5
Cutting	9	6,7
Finishing	7	5,2
QC	10	7,5
Sewing	102	76,1
Work Stress		
Mild	14	10,4
Medium	84	62,7
Heavy	36	26,9
Contraceptive Method Used		
Not Used	36	26,9
IUD	10	7,5
Implant	2	1.5
3 month injection	76	56,7
1 month injection	10	7,5

Source: Primary Data, 2024

Table 1 shows that the majority of workers' age is in the age range of 20-29 years at 67 people (50%), the most parity is multipara at 77 people (57.5%), the most BMI is normal at 108 people 80.6%, the most work division is sewing at 102 people (76.1%), the majority of work stress is moderate 84 (62.7%) and the most family planning method is 3-month injections at 76 people (56.7%).

Table 2. Frequency Distribution of Menstrual Cycle Disorders of Workers at PT X Tasikmalaya City

Irregular Menstruation	Frequency	Percentage (%)
Amenorea		
No	59	43,3
Yes	76	56,7
Oligomenorea		
No	131	97,8
Yes	3	2,2
Polimenorea		
No	131	97,8
Yes	3	2,2

Source: Primary Data, 2024

Table 2 shows that the majority of workers experienced amenorrhea 76 (56.7%), while only 3 (2.2%) experienced oligomenorrhea and polymenorrhea.

Table 3. Chi-Square Test of Worker Characteristics with Menstrual Cycle Disorders

Characteristics	Irregular Menstruation Cycle				*p*
	Yes		No		
	n	%	n	%	
Age					
20-29	22	32,8	45	67,2	<0,001
30-39	52	94,5	3	5,5	
40-49	8	66,7	4	33,3	
Parity					
Nulipara	5	13,5	32	86,5	
Primipara	9	56,3	7	43,8	<0,001
Multipara	64	83,1	13	16,9	
Grandemultipara	4	100	0	0	
BMI					
Underweight	6	42,9	8	51,7	
Normal	69	63,9	39	36,1	0,308
Overweight	7	58,3	5	41,7	
Work Division					
Admin	5	83,3	1	16,7	
Cutting	5	55,6	4	44,4	
Finishing	7	100	0	0	0,075
QC	8	80	2	20	
Sewing	57	55,9	45	44,1	
Work Stress					
Mild	5	35,7	9	64,3	
Medium	46	58,2	33	41,8	0,021
Heavy	31	75,6	10	24,4	
Contraceptive Method Used					
Not Used	5	13,9	31	85,1	
IUD	0	0	10	100	
Implant	1	50	1	50	<0,001
3 month injection	76	100	0	0	
1 month injection	0	0	10	100	

Source: Primary Data, 2024

Table 3 shows the interpretation of the above table that the results of the Chi-Square test between the characteristics of female workers on menstrual cycle disorders obtained that the age of workers ($p < 0.001$), parity ($p < 0.001$), work stress (p 0.021) and birth control methods used ($p < 0.001$) have a significant influence with a p value < 0.05. While BMI (p 0.308) and work division (0.075) did not have a significant influence on menstrual cycle disorders with a p value >0.05.

DISCUSSION

This study aims to determine the prevalence and factors associated with menstrual cycle disorders among PT X workers in Tasikmalaya City. The results of the Chi-Square test showed that the factors of worker age, parity, work stress and birth control method used had an influence on irregular menstrual cycle.

The results showed that the age of workers was mostly in the age range of 20-29 years (50%) with an average age of 29.76 years. Based on cross sectional analysis, the age of workers has an influence on menstrual cycle disorders ($p < 0.001$). The highest age range who experienced menstrual disorders both amenorrhea, olimenorrhea and polymenorrhea were in the age range of 30-39 years. This can be caused by hormonal disorders caused by the use of hormonal contraceptives, fatigue, sleep duration, environmental factors and stress (Kennedy et al., 2022; Li et al., 2023).

A study revealed that the average menstrual cycle length tends to shorten with age until around the age of 50, then becomes longer and the variability increases after that age. The lowest cycle variability was found in the 35-39 age group (Li et al., 2023). The menstrual cycle is an interdependent series of cyclic physiological events. In a typical cycle, the hypothalamus releases pulses of gonadotropin-releasing hormone, which causes the release of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) from the pituitary gland. During the follicular phase, FSH stimulates the growth of ovarian follicles. As the follicle develops, it secretes increasing levels of estradiol, which stimulates endometrial proliferation (Ana K. Rosen et al., 2025)

As women age towards menopause, they begin to experience a decline in follicular reserve and fluctuations in reproductive hormones such as FSH, estrogen, and progesterone. This leads to inconsistent ovulation and instability of the endometrial lining, resulting in various forms of menstrual irregularities such as oligomenorrhea and intermenstrual bleeding (Kim et al., 2025). A study found that women aged ≥30 years had shorter cycles and follicular phases compared to younger women, indicating that age is associated with menstrual cycle disorders (Najmabadi et al., 2020)

Menstrual cycle disorders are also influenced by parity, a total of 64 workers (86.1%) with multiple parities experienced menstrual disorders ($p<0.001$). Menstrual cycle disorders due to parity involve many things, both hormonal changes and caregiving stress. Hormonal changes in women due to pregnancy childbirth and breastfeeding often cause temporary irregularities such as prolonged cycles or oligomenorrhea (infrequent periods). However, parity is cumulative meaning that giving birth more than once can lead to long-term adaptations such as decreased ovarian reserve or persistent hormonal imbalances that increase susceptibility to menstrual cycle disorders. Women of multiparity also often have to balance caregiving responsibilities with work responsibilities which creates chronic stress that increases cortisol levels causing GnRH inhibition resulting in decreased FSH/LH resulting in anovulation or irregular ovulation (Song et al., 2022; Thiyagarajan et al., n.d.; Vinet & Zhedanov, 2011). A study found that nulliparous women aged ≥30 years had shorter cycles and follicular phases compared to younger nulliparous women,

indicating that age and parity jointly affect menstrual cycle characteristics (Najmabadi et al., 2020)

The results also showed that work stress has an influence on menstrual cycle disorders in workers ($p < 0.001$). A total of 48 people (52.6%) experienced moderate work stress. Work stress is one of the psychosocial factors that can affect the menstrual cycle. Chronic or excessive stress can disrupt the hormonal balance that regulates the menstrual cycle, causing menstrual cycle irregularities, such as heavier or lighter menstrual periods, even amenorrhea (no menstruation). The main mechanism involves activation of the hypothalamic-pituitary-adrenal (HPA) axis which increases stress hormones such as cortisol and CRH (corticotropin-releasing hormone), which then suppresses the production of reproductive hormones. (Yu et al., 2017). The more severe the level of work stress is at risk of experiencing menstrual cycle disorders such as oligomenorrhea, polymenorrhea and even amenorrhea. (Sonata & Sianipar, 2023).

A study in women under the age of 55 also showed that those with menstrual cycle irregularities had significantly worse scores on the Beck Depression Inventory scale compared to those who reported regular menstrual cycles. (Toffol et al., 2014). The findings from this study proved to be consistent with previous studies reporting that mental health problems such as psychological stress and depressed mood are associated with menstrual problems. However, on the other hand, menstrual cycle irregularities may lead to psychiatric disorders. Women with polycystic ovary syndrome who exhibit menstrual cycle irregularities as a hallmark of the disease have a significantly increased risk of developing psychiatric disorders including depression. Parity was found to have minimal differences in ovulation rates, with a slight increase in ovulatory cycles among parous women compared to nulliparous women. Therefore, mental health problems and menstrual cycle irregularities may be intertwined and influence each other (Cesta et al., 2016; Prior et al., 2015). A study found that levels of depressive symptoms, perceived stress, physical or mental fatigue, anxiety, and sleep problems were significantly higher in women with cycle disorders than in women with regular cycles. (Nam et al., 2017; Song et al., 2022).

This study also found that in addition to age, parity and work stress, the use of contraceptive methods in workers had an influence on menstrual cycle disorders ($p < 0.001$). Users of 3-month injectable hormonal contraceptive methods totaled 76 people (100%) experienced menstrual cycle disorders. 3-month injectable contraceptives can lead to changes in the menstrual cycle, a descriptive study revealed that 60.4% experienced amenorrhea, 31.3% experienced spotting hemorrhagea (Mardhika et al., 2021)

The use of hormonal contraceptives including combined pills, hormone injections, implants, and hormonal IUDs is associated with menstrual cycle disorders such as irregular bleeding (spotting), amenorrhea, changes in menstrual duration, and dysmenorrhea. These disorders mainly occur in the early phase of use due to the body's adaptation to synthetic hormones that modify endogenous hormonal regulation. Menstrual cycle disorders are part of the side effects of using hormonal contraceptives. The synthetic hormones in contraceptives alter the secretion of GnRH and LH/FSH gonadotropins so that ovulation is prevented or downregulated while the endometrial lining becomes thinner and vascularization is altered causing vascular fragility and intermenstrual bleeding. Depo Medroxyprogesterone Acetate (DMPA) contraceptives significantly increase the incidence of amenorrhea due to strong suppression of the hypothalamic-pituitary-gonadal axis which inhibits ovulation, depot estradiol cypionate and medroxyprogesterone acetate appear to be associated with more

irregular bleeding (Khadilkar, 2018; Oshodi et al., 2019).

Another finding of this study is that there is no influence between BMI and work division on menstrual cycle disorders (p> 0.05). This is not in accordance with previous research, a Korean study stated that menstrual cycle disorders are closely related to higher BMI (p < 0.001) (Jung et al., 2017). Another study reported that the risk of menstrual cycle disorders was higher among those who were obese than those with normal BMI (OR=1.751, 95% CI=1.234-2.485). Obese women with a BMI of 27 kg/m2 had a higher risk of having a long cycle, which was associated with an increased follicular phase and decreased luteal phase length in heavier women. Obesity and menstrual irregularities have metabolic and neuroendocrine mechanisms. Due to lower levels of sex hormone-binding globulin (SHBG) and higher levels of testosterone, fasting insulin, and free androgen index, women with higher BMI are more prone to menstrual irregularities (Shim et al., 2024),

The results of this study found that the BMI of the majority of workers was normal BMI of 108 people (80.6%) and those who experienced menstrual cycle disorders were 69 people (63.9%), while those who had overweight BMI were 12 people (9%) and those who experienced menstrual cycle disorders were only 7 people (58.3%). This suggests that BMI may not be the only factor affecting cycle disorders, but it can also be influenced by the use of hormonal contraceptive methods.

PT X is a garment factory with 5 divisions, namely administration, cutting, finishing, quality control and sewing. The results showed that the majority of workers who experience menstrual cycle disorders occur in the sewing division, which has a fairly heavy load compared to other divisions. Workers in the sewing division are more in a sitting position for a long time. However, the results of the analysis stated that there was no influence between work division and menstrual cycle disorders (p 0.075). This could be due to the absence of shift work schedules, which can disrupt the normal functioning of circadian rhythms. Disruption of this function is considered as one of the factors contributing to menstrual cycle changes. The risk of menstrual irregularities was higher among women with a shift work schedule compared to those with a fixed work schedule. An American study on women aged 28-45 years and found that the likelihood of having an irregular menstrual cycle was 1.23 times higher among those who worked in rotating shifts for more than 20 months than those who did not. (Lawson et al., 2011). A cohort study among nurses in China found that irregular menstrual cycles were significantly higher in the shift work group. (Y. Wang et al., 2016),

CONCLUSION

The menstrual cycle is one of the indicators of workers' reproductive health, so knowing the prevalence and identifying the factors that cause menstrual cycle disorders is very important. The prevalence of menstrual cycle disorders in garment workers of PT X Tasikmalaya City is majority in the age of 30-39 years, multiparous parity, normal BMI, sewing division, moderate work stress, and contraceptive methods used 3-month injections, while the majority of menstrual cycle disorders are amenorrhea. Factors affecting menstrual cycle disorders are worker age, parity, work stress and contraceptive methods used. It is necessary to conduct health education to prevent and overcome menstrual cycle disorders to improve health and work productivity, and it is necessary to conduct further studies on factors that influence menstrual cycle disorders in workers both in terms of physiology, psychology, social and environment.

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CORRELATION OF NEUTROPHIL LYMPHOCYTE RATIO (NLR) AND HIGH SENSITIVITY C-REACTIVE PROTEIN (HS-CRP) LEVELS IN PATIENTS CORONARY HEART DISEASE (CHD) AT DR. BRATANATA HOSPITAL JAMBI CITY

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ABSTRACT

Background: *Coronary Heart Disease (CHD) is a disorder of heart function caused by reduced blood supply to the heart muscle, resulting in blockage of the coronary arteries due to plaque formation that known as atherosclerosis, this condition is caused by hypercholesterolemia which can induce Granulocyte-Colony Stimulating Factor (G-CSF) so that neutrophil extravasation occurs, a condition of increased neutrophil levels in the body. Increased atherosclerosis leads to apoptosis, resulting in elevated neutrophil levels and reduced lymphocyte levels in the blood, thereby affecting the Neutrophil Lymphocyte Ratio (NLR), which reflects an individual's immune status. Blood cells adhere to form atherosclerotic cell aggregates, stimulating active inflammatory cells. Inflammation can be detected by the biomarker High Sensitivity C-Reactive Protein (Hs-CRP).*
Methods: *This descriptive-analytic study used a cross-sectional design and population comprised 30 CHD patients at Dr. Bratanata Hospital Jambi. The sample were selected by using purposive sampling, based on inclusion and exclusion criteria. Hs-CRP levels were measured using a Wondfo Meter and NLR was measured using the Mindray Hematology Analyzer. Statistical tests were conducted to determine the relationship between the variables.*
Results: *The average NLR was 7.82 and also the average Hs-CRP level was 4.94 mg/L. But there was no significant correlation between NLR and Hs-CRP levels in CHD patients. Although the regression plot suggested a possible positive trend but still not statistically significant.*
Conclusion: *There is no significant correlation between NLR and Hs-CRP levels in CHD patients at Dr. Bratanata Hospital Jambi.*

Keywords: *Coronary Heart Disease, Hs-CRP, NLR, Inflammation*

INTRODUCTION

Coronary Heart Disease (CHD) is classified under the global burden of disease and is a cardiovascular disorder where the heart and blood vessels fail to function properly (Linda & Rahayu, 2021; Saesarwati & Satyabakti, 2017). It is caused by a lack of blood supply to the heart muscle, leading to blockage or narrowing of the coronary arteries due to plaque buildup that is called atherosclerosis, resulting in reduced blood flow and oxygen insufficiency (Kemenkes RI, 2021).

In CHD patients, endothelial dysfunction combined with risk factors leads to a prolonged increase in lipids in the arteries, induced by *hypercholesterolemia*, which stimulates *Granulocyte-Colony Stimulating Factor* (G-CSF), chromatin in granulopoiesis and elevates *Chemokine CXC Ligand* (CXCL) 1 levels, affecting neutrophil migration via *Chemokine CXC Receptor* (CXCR) 2. Increased TNF and IL-17 levels result in neutrophil extravasation, a condition where neutrophil levels rise. Atherosclerosis progression also causes *apoptosis*, leading to reduced lymphocyte levels (Drechsler et al., 2010). The *Neutrophil*

Lymphocyte Ratio (NLR) combines the roles of two leukocyte subtypes into one predictive factor that significantly contributes to the inflammatory process underlying atherosclerosis (Aufa et al., 2021).

Blood cells adhere to form atherosclerotic aggregates, stimulating active inflammatory cells. *C-Reactive Protein* (CRP) is an acute-phase protein synthesized by hepatocytes and circulated in the blood, making it a highly sensitive marker for inflammatory stimuli (Nugraha & Badrawi, 2018). High Sensitivity C-Reactive Protein (Hs-CRP) testing is a sensitive assay for detecting cardiovascular disease risk and serves as a biomarker for systemic inflammation (Aipassa et al., 2023).

Previous studies by Aufa et al. (2021) and Aipassa et al. (2023) demonstrated a positive correlation between NLR and coronary artery stenosis severity. However, Sharma et al. (2017) reported that NLR values were significantly higher and more reliable than Hs-CRP as a marker for coronary artery disease.

Based on previous studies on CHD cases, the author is interested in further investigating the correlation between NLR values and Hs-CRP levels in CHD patients at Dr. Bratanata Hospital Jambi.

METHODS

This study used a descriptive-analytic design with a cross-sectional approach to examine the relationship between Neutrophil Lymphocyte Ratio (NLR) and High Sensitivity C-Reactive Protein (Hs-CRP) levels in CHD patients. The study population comprised 30 CHD patients receiving inpatient and outpatient care who met the inclusion and exclusion criteria at Dr. Bratanata Hospital, Jambi. The research was start from December 10, 2024, until January 20, 2025. Hs-CRP levels were measured using a Wondfo meter (mg/L) and NLR was measured using the Mindray Hematology Analyzer. Primary data were collected through purposive sampling.

Inclusion criteria:

- Diagnosed CHD patients (IMA (Acute Myocardial Infarction) STEMI (ST Elevation Myocardial Infarctio), UAP (Unstable Angina Pectoris)) based on medical records and had an signed an informed consent
- Aged over 18 years

Exclusion criteria:

- CHD patients with a history of hematological malignancies (leukemia) or carcinoma/cancer, and still chemotherapy
- CHD patients who had known complications such as TB, HIV/AIDS, Hepatitis, or Rheumatoid infections

This research obtained ethical approval from the Ethics Committee of the Jambi Ministry of Health Polytechnic.

RESULTS AND DISCUSSION

3.1 Respondent Characteristics

In this study, the author's research findings about respondent characteristics including demographic attributes. The demographic distribution is presented graphically below.

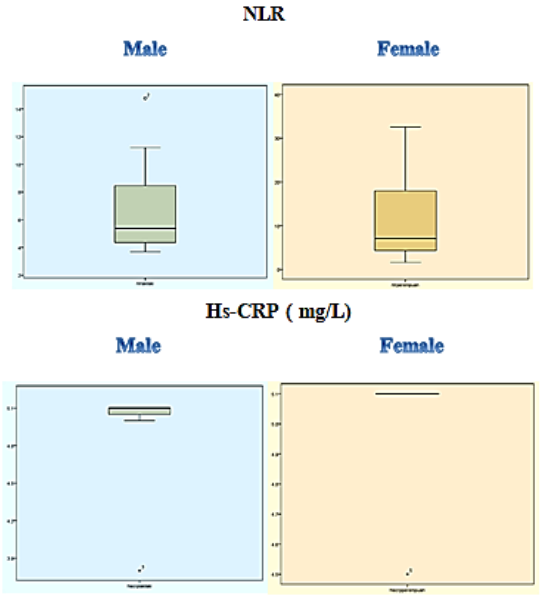


Figure 1. Distribution Based on Gender

Tab1e 1. Result of Examination based on gender

NLR	N	Mean	Min	Max	SD	P-Value
Male	23	7.07	3.69	14.78	4.23	
Female	7	12.26	1.64	32.59	12.73	0.052
Total	30	9.66	1.64	32.59	8.48	
Hs-CRP						
Male	23	4.92	3.8	5.1	0.35	0.582
Female	7	5.01	4.5	5.1	0.22	
Total	30	4.96	3.8	5.1	0.28	

Distribution of NLR values with Hs-CRP levels by gender. In the NLR box plot, women have slightly higher medians and means compared to men. The mean NLR for men is 7.07 and the mean NLR for women is 12.26 (p = 0.052) and shows no significant difference. The box plot for Hs-CRP shows a relatively similar distribution between men and women, with a mean of 4.92 mg/L for men and 5.01 mg/L for women (p = 0.582) which also indicating no statistically significant difference.

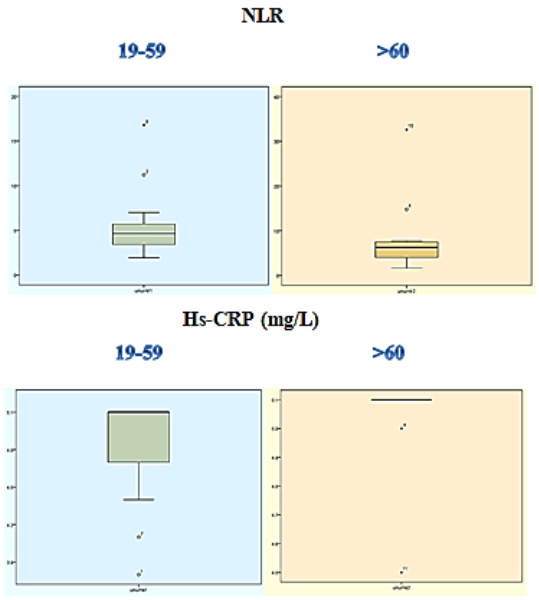


Figure 2. Distribution Based on Age

Table 2. Result of Examination Based on Age

NLR	N	Mean	Min	Max	SD	P-Value
19-59	13	5.64	1.93	16.79	4.13	
>60	17	7.90	1.64	32.59	8.15	0.426
Total	30	6.77	1.64	32.59	6.14	
Hs-CRP						
19-59	13	4.79	3.8	5.1	0.438	
>60	17	5.04	4.5	5.1	0.166	0.734
Total	30	4.91	3.8	5.1	0.302	

Distribution between NLR values and Hs-CRP levels based on age groups. The NLR box plot shows that the median and mean are higher in the age group above 60 years. The mean NLR value in the 19-59 age group is 5.64 while in the age group above 60 years is 7.90 (p = 0.426) but the difference is also not statistically significant. The hs-CRP box plot shows a nearly similar distribution between the two groups, with a mean of 4.97 mg/L for individuals aged 19-59 years and 5.04 mg/L for individuals aged above 60 years (p = 0.734) indicating no statistically significant difference.

3.2 Correlation between NLR values and Hs-CRP levels in coronary heart disease patients at Dr. Bratanata Hospital, Jambi

Correlation analysis is presented in the table below. Before processing, the data was assessed with a normality test using the Shapiro Wilk test. NLR showed a p-value ≤ 0.05 and Hs-CRP showed a p-value ≤ 0.05 which indicated that the data had an abnormal distribution. Therefore, the non-parametric Spearman correlation test was applied in this data processing.

Table 3. Spearman correlation test results

	N	Mean	Median	Min - Max	SD	Coeffisien Correlation	P-Value
NLR	30	7.82	5.29	1.64-32.59	1.34	0.258	0.168
Hs-CRP	30	4.94	5.1	3.8-5.1	0.06		

Table 4 presents the results of the Spearman correlation between Hs-CRP and NLR values in 30 Coronary Heart Disease patients at Bratanata Hospital, Jambi. The average Hs-CRP level was 4.94 mg/L while the average NLR value was 7.82. Spearman correlation analysis revealed a correlation (Rho = 0.258) between NLR and Hs-CRP which was statistically insignificant (p = 0.168)

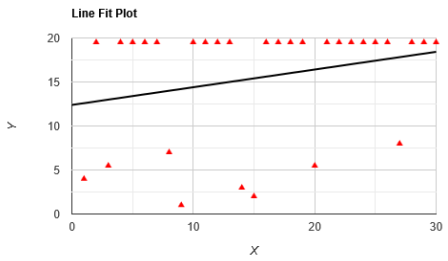


Figure 3. Result of Correlation Spearman

Correlation of NLR (X) and Hs-CRP (Y) levels, with a linear regression line shown in black. Overall, the regression line has a positive slope, indicating a potential positive relationship between variable X and variable Y, in other words, if the X value increases, it is followed by an increase in the Y value. However, the diverse distribution of data points suggests that this relationship may be weak or highly variable. Therefore, there is insufficient evidence to confirm a linear relationship between these two variables based on this study.

Research that published by Aufa et al. (2021) and Aipassa et al. (2023) reported research results showing a significant positive relationship between NLR values and Hs-CRP levels in coronary heart disease patients. In this study, the average patient who had Hs-CRP levels above 3 mg/L tended to have higher NLR values and showed that increased systemic inflammation could be accompanied by increased Neutrophils and lymphocytes in the body.

The results in this study differed, possibly due to many factors, starting from variations in subject characteristics such as the classification of coronary heart disease patients, the length of time the patient has suffered from coronary heart disease, the treatment or therapy that has been undergone, complications experienced by the patient, statistical analysis methods, parameter measurement techniques in the laboratory, sample size, and the inclusion and exclusion criteria applied.

CONCLUSION

1. The average NLR in CHD patients at Dr. Bratanata Hospital Jambi is 7.82.
2. The average Hs-CRP level in CHD patients at Dr. Bratanata Hospital Jambi is 4.94 mg/L.
3. There was no significant correlation between NLR and Hs-CRP levels among CHD patients at Dr. Bratanata Hospital, Jambi.

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CONFLICT OF INTEREST

The author declares there is no any conflict of interest during this study.

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VITAMIN D IS RICH IN BENEFITS THAT ARE A PRIORITY IN THE DISEASE: LITERATURE REVIEW

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ABSTRACT

***Background**: Research on literature studies that explain the importance of vitamin D as an important factor supporting prevention, control, and even maintenance to survive the Disease attack.*
***Methods**: In this study, the authors conducted a literature review to gather various valid results regarding the importance of vitamin D in our lives, especially to prevent the major threats that occur with infection with the disease virus. In this study, the authors reviewed articles published from 2008 to 2021 through the electronic databases used to identify relevant research, namely Science Direct, PubMed, and Google Scholar, which were restricted to publications from 2008 to 2021. The electronic search database found 60 articles. while only 17 studies were used as articles for the research objectives.*
***Results**: From this study, the authors collected research data regarding the benefits of vitamin D as a major supporting factor in the healing of diseaseinfection including avoid the occurrence of cytokine storms and not only that, the authors also revealed threat events that occur if the body is deficient in vitamin D which causes the threat to the cardiovascular system, lungs, kidneys, even heart, rheumatoid arthritis, and even excess Vitamin D causes effects including hypercalcemia.*
***Conclusion**: The use of vitamin D as the main therapy to support prevention, healing, and health maintenance to protect against Disease infection is very feasible so that quality of life during and after the Disease can be maintained.*

***Keywords**: Vitamin D, disease, therapy, literature*

INTRODUCTION

Vitamin D, also known as calciferol, is a group of fat-soluble pro-hormone vitamins. To make it easier to understand, the author explains lightly that in the body, this vitamin have the ability to act as a formative of good bone and tooth structure. However, current attention is far from discussing the benefits of vitamin D for bones also teeth, because now it is also known that vitamin D is a fat-soluble vitamin, which means that vitamin D can last for a long time in our body. There are two main types of vitamin D, namely vitamin D2 and vitamin D3. Vitamin D2 (ergocalciferol) comes from plants and can be found in several types of mushrooms. Meanwhile, vitamin D3 (cholecalciferol) is found in fish, fish oil, egg yolks, and sunlight. Vitamin D itself can be formed naturally when the skin is exposed to direct sunlight. Vitamin D3 is produced non-enzymatically when the cholesterol precursor 7-dehydrocholesterol is exposed to UV-B from sunlight; that is, all cholesterol-synthesizing species, including humans, can make vitamin D3 (Carlberg & Velleuer, 2021). The discussion of vitamin D in this study is not only about the benefits but also includes things that can happen if the body has a deficiency or even an excess of vitamin D. Vitamin D3 is produced non-enzymatically, when cholesterol precursor 7-dehydrocholesterol is exposed to UV-B from sunlight, that is, all species that synthesize cholesterol, including humans, can make vitamin D3.

METHOD

A reference review is carried out to explore relevant research.

2.1. Study Identification

Three electronic data media, namely PUBMED, Science Direct, and Google Scholar, were first searched in October 2021. The search terms used are summarized in Table 1. The Additional articles were identified through reference tracking.

Table 1. Summarize Database Search

No	Database	Search Term
1	PUBMED	Vitamin D, Vitamin D and immune
2	Science Direct	Vitamin D, Disease
3	Google Scholar	Vitamin D, Vitamin D, and Disease

2.2. Data Extraction

Data were extracted independently by a study using a form of data extraction including research details to obtain relevant studies regarding the ability of vitamin D in the treatment against the disease virus.

RESULTS AND DISCUSSION

A review of the literature review to obtain a discussion of research that is relevant to the needs of the importance of vitamin D as an important factor supporting prevention, overcoming, and even maintenance to survive the Disease attack is very feasible to do. It is known that infection and transmission of the Disease can pose a major threat to the quality of human life, aggravated by the increasing number of variant mutations of the virus, forcing us to always fortify ourselves with good immunity, even though vaccines remain a priority.

3.1 Characteristic studies

Several articles show that research on vitamin D is not only related to the benefits of this vitamin as a protective factor for the body but also discusses the events that will arise if the body experiences a deficiency or even excess vitamin D. In this article, the author tries to narrow the discussion by tracing the results. Research can be the basis for considering the importance of vitamin D for our bodies. The studies reviewed were from Australia, Bahrain, Cairo, California, China, Finland, India, Iran, Israel, London, Iowa, San Diego, Texas, and Turkey. Some of these studies conducted several experiments and assessed data validity. However, not all have described their research in detail. For this reason, the researcher extracted the articles by first determining the inclusion criteria through the title, extraction, and full text as described in Table 2.

Table 2. Characteristics of Studies

No	Author/Year	City/Country	Research Design	Results
1	Aibana, O., dkk/2019	Texas, United Kingdom	Cohort Study	Functions of vitamin D to reduce the risk of TB disease.
2	Ali Rm, et al /2018	Cairo University, Egypt	Original Study	Reduction of renal disease or ischemia severity as a cause of reperfusion in mice treated with Vitamin D and pioglitazone
3	Amirkhiz, et al./2021	Zabol University of Medical Sciences, Zabol, Iran	Cross-sectional Study	Hypertensive obese patients who have low vitamin D levels may be at risk of high hs-CRP
4	Hatice Aygun/2020	Tokat, Turkey	Letter Communication	Vitamin D is an immunomodulatory hormone that can reduce the threat of inflammation and infection and has a fairly good safety profile; besides that, it also protects and saves from damage caused by exposure to the coronavirus

No	Author/Year	City/Country	Research Design	Results
5	Booeshaghi A & Pachter L./2020	California, United States	Original Study	Vitamin D decreases ACE expression in rat lung
6	Butler, et al /2021	Royal College of Surgeons in Ireland, Bahrain, Adliya, Bahrain	Cross-sectional Study	Vitamin D deficiency increases cardiovascular risk and susceptibility to infectious agents, such as disease
7	Carlberg, C., & Velleuer, E./2021	Finland	Literatur review	Effects of vitamin D on the epigenome and transcriptome of stromal and tumor cells, interindividual variation in vitamin D response and its relationship to cancer prevention and possible therapy.
8	Fraser/2021	Australia	Theoretical article	The sun's UV rays induce vitamin D formation in the skin, and surveys have shown that vitamin D status is determined primarily by this method. The amount of vitamin D produced in the skin is far more than that which can be obtained from natural foods
9	Hansdottir S, et all (2008).	Lowa City	Original article	Inactive vitamin D becomes active, altering immune function in the lungs
10	Jiang JS, et all (2020)	California, United States of America	Original research	Neonatal hyperoxia increases pulmonary expression of 8-hydroxy-2'-deoxyguanosine (8-OHG). Neonatal hyperoxia reduces lung expression of superoxide dismutase (SOD1. Cathelicidin reverses hyperoxia-induced changes in 8-OHdG and SOD1 expression. Cathelicidin evades the threat of hyperoxia-induced impaired alveolar and vascular development. Cathelicidin reduces hyperoxia-induced lung injury by inhibiting oxidative stress.
11	Lin, M., et al (2016)	Hubei China	Original research	Calcitriol reduces proteinuria in diabetic rats without affecting calcium-phosphorus metabolism. The levels of ACE and ACE2 were significantly increased in diabetic rats compared to control rats.
12	Mohareb, et al (2020)	San, Diego	Original article	Inhibition of RAS may reduce the effects of the toxic over-accumulation of angiotensin II that induces acute respiratory distress syndrome and fulminant myocarditis.
13	Peterson CA &Heffernan ME. (2008).	London	Original article	Serum 25(OH)D status was inversely related to TNF- concentrations in healthy women, which may partly explain this role of vitamin K in the prevention and healing of inflammatory diseases.
14	Sinaci, S., et al (2021).	Ankara, Turkey	Original article	Low vitamin D levels in pregnant women with disease. There is a significant difference in terms of the severity of the disease. Maintenance of adequate vitamin D levels could be

No	Author/Year	City/Country	Research Design	Results
				useful as an approach to the prevention of aggressive inflammation caused by this novel coronavirus in pregnant women.
15	Talmor Y, et al (2008)	Israel	Original article	Inhibitory effect of calcitriol on pro-inflammatory parameters: adhesion molecule, RAGE, and IL-6.
16	Ul Afshan, F., et al (2021)	India	Original article	Vitamin D is a mainstay in avoiding various threats caused by the coronavirus
17	Yanrong L, et al (2006).	China	Original article	Higher ACE2 in young adults compared to older age groups may contribute to the predominance of SARS

Furthermore, the data were independently extracted by researchers using a form of data extraction, including research details showing that research on vitamin D is not only related to this vitamin as a protective barrier factor for the body, but also discusses events that will occur if the body experiences a deficiency or even excess vitamin D.

3.2 Vitamin D deficiency and excess

Currently, vitamin D is a topic of discussion and priority for use and research regarding its ability to protect the body, including against disease-causing viruses. This vitamin, which is rich in benefits can be based on many studies. However, vitamin D deficiency also causes many risks that will arise (Amirkhizi et al., 2021) revealed that Vitamin D has a good role in cardiovascular disease in adults, where the threat of cardiovascular disease complications will occur if the body is deficient in vitamin D.

In addition, low vitamin D status is a precipitating risk, especially for colon, prostate, breast, and leukocyte cancers (Carlberg & Velleuer, 2021). Vitamin D deficiency is a negative endocrine modulator of the renin-angiotensin system (RAS), and PCOS women are often vitamin D deficient, leading to RAS overactivation in PCOS. Decreased plasma ACE2 levels were seen in vitamin D deficiency in non-PCOS controls, which may predispose these vitamin D-deficient subjects to increased cardiovascular risk and susceptibility to infectious agents, such as disease, where this is a risk factor (Butler et al., 2021).

In kidney disease and diabetes, the role of vitamin D is also great because it has been revealed that vitamin D has been shown to inhibit the expression of ACE2 in the kidneys. diabetes and protect the kidneys (Ali RM et al., 2018; Aygun, 2020; Lin M et al., 2016).

However, continuous intake of large amounts of vitamin D can cause hypercalcemia toxicity (Aibana et al., 2019; Fraser, 2021) explained through their research that vitamin D can be used as a threat predictor factor for TB disease by showing that the threat of TB disease is highest among HIV-positive people with severe vitamin D deficiency.

3.3 Benefits of vitamin D

The rich benefits that vitamin D has for the human body are something that deserves to be discussed. Besides being interesting in research, its current use is a breakthrough that was not previously thought to be a supporting solution in the prevention and control of the disease virus.

In cancer therapy, rapidly growing immune system cells, as well as malignant tumor cells, depend on comparable genes and pathways, some of which are modulated by vitamin D. Therefore, vitamin D has anti-cancer effects either directly through controlling the differentiation, proliferation, and apoptosis of neoplastic cells and indirectly through the regulation of immune cells that are

included in the malignant tumor microenvironment. This paper describes the effectiveness of vitamin D on the epigenome and transcriptome of stromal cells and tumors, inter-individual variation in vitamin D responsiveness, and its relationship to cancer prevention and possible therapy (Carlberg & Velleuer, 2021).

In the role of vitamin D during the disease endemic, several studies have shown that it is clear that new findings from vitamin D suggest that together with the regulation of cell growth, the neuroprotective effect of vitamin D can regulate immune responses and modulate the cytokine Interleukin-6 (IL-6). which works to induce inhibitory factors carried out by progesterone (PIBF), considering that IL-6 levels are very high in disease patients which can lead to an increase in excess complications in patients. Vitamin D can be an inhibitor of the angiotensin-converting enzyme (ACEII), which is the way the Disease enters cells. Most of the research results explain the ability of Vitamin D in preventing the occurrence of disease complications, including in patients with comorbid conditions, neurological manifestations, and immunological aspects, making vitamin D the best choice as supportive therapy for the healing of Disease infection. Incorporating Vitamin D as an adjunct therapy in the management of disease can help stop the infection and reduce the threat of infectious disease (Ul Afshan et al., 2021). In a study conducted by Yanrong et al. (2006), the presence of vitamin D is very important for patients with cardiovascular disease, especially in the elderly and men. The increase in ASCII expression is very thin in the elderly and men; this is, of course, likely to lead to the possibility of severe complications in disease infection in male patients and the elderly (Booeshaghi A & Pachter L, 2020; Jiang JS et al., n.d.; Yanrong L et al., 2006). Even so, vitamin D supplementation has been shown to reduce the threat of ARDS, myocarditis, or heart injury in patients infected with the Disease(Mohareb AM et al., 2020).

Research on the ability to complete vitamin D as a supporting effort in fighting the Disease has also found that sufficient amounts of vitamin D in pregnant women are very useful in helping with active vitamin D in preventing bad inflammation for pregnant women who experience the Disease attack (Sinaci et al., 2021). Supplying an amount of vitamin D to pregnant women can help protect pregnant women in defending against the disease virus. For this reason, it is recommended to consume vitamin D or to activate vitamin D in the body of pregnant women.

In the threat of complications leading to the lungs, vitamin D was promoted as a factor that can reduce the threat after infection with the disease virus, infection with the ability of vitamin D to induce the production of cathelicidin and defensins, which can reduce the survival and replication of viruses, including the Disease(Aygun, 2020; Hansdottir S et al., 2008; Jiang JS et al., 2008.).

In severe complications, the presence of vitamin D cannot be taken lightly; the ability of vitamin D to prevent cytokine storms when infected with the Disease has been widely demonstrated (Aygun, 2020; Peterson CA & Heffernan ME, 2008; Talmor Y et al., 2008).

CONCLUSION

Thus, in addition to excess vitamin D, which is at risk of hypercalcemia, Vitamin D deficiency can increase the threat of diseases, including cardiovascular disease, lung, kidney, and even cancer. Vitamin D deficiency also poses a threat of expanding the area infected with the disease virus. In other words, decreasing serum vitamin D levels can improve clinical outcomes in patients with Disease infection, and increasing serum vitamin D levels can improve clinical outcomes in patients. For that reason, in healing using vitamin D as the main therapy, supporting

treatment can increase the success of the treatment to fight the Disease infection.

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CONFLICT OF INTEREST

The authors declare that there are no competing or potential conflicts of interest.

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MORE THAN JUST FOOD: EXPLORING CULTURAL, EMOTIONAL, AND PRACTICAL REALITIES OF COMPLEMENTARY FEEDING IN WASTED CHILDREN

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ABSTRACT

Background: *The prevalence of stunting in Indonesia has decreased, but there is an increase in wasting cases. Children who experience wasting have a 3 times higher risk of becoming stunted compared to children with normal nutritional status. Wasting is not only caused by a lack of food intake, but also influenced by various factors. This study aims to explore the practice of complementary feeding from various aspects from the perspective of mothers who have wasting children.*
Method: *In-depth interviews (IDI) were conducted with 16 parents of children aged 6-24 months with wasting nutritional status in 4 areas in Sleman Regency. The triangulation method was conducted by interviewing the family, including husband and grandmother, and health cadres.*
Result: *There were four main themes influencing complementary feeding practices, namely: 1) Cultural aspects including traditions, perceptions of food, and family roles; 2) Emotional and psychological aspects such as maternal rejection or acceptance of wasting; 3) Practical realities, including access to food ingredients and mother's time; and 4) Maternal nutrition understanding and experience with educational programs. Mothers who accepted their child's wasting condition were more open to education and tended to make changes to their complementary feeding practices.*
Conclusion*: Addressing wasting cannot be done solely with nutritional interventions, but requires an approach that considers the cultural, emotional, and practical context faced by mothers. Empathetic and contextualized nutrition education is key to saving children from wasting that progresses to stunting.*

Keywords: *Complementary Feeding; Cultural; Emosional; Wasting*

INTRODUCTION

Malnutrition in children under five is still a global problem, including Indonesia (Kementrian Kesehatan RI, 2020). Globally, stunting cases have decreased in the last 10 years. In 2022 there were 22.3% of Children under five years of age experienced stunting (UNICEF et al., 2023). Based on the Indonesian Nutrition Status Survey (SSGI) in 2022, there were 21.6%, which represents a decrease compared to 2021, which was 24.4% (Kemenkes RI, 2022). It should be noted that there is an increase in wasting cases in 2022 to 7.7% when compared to 2021, of 7.1% (Kemenkes RI, 2022).

Children who experience wasting have three times the risk of becoming stunted compared to children with normal nutritional status (Choudhary et al., 2024) So this condition, if not handled properly, will add new cases of stunting. Wasting harms child growth and development, because wasting reduces endurance and increases the risk of infectious diseases and even death (Noori et al., 2022).

One of the efforts to deal with wasting cases is to provide appropriate complementary food according to the age and nutritional needs of the child (Ayuningrum, 2018; Chhabra et al., 2021). However, the practice of providing complementary foods is not as simple as increasing food intake. Research findings show that complementary feeding practices in

various communities are influenced by cultural values, socioeconomic status, and maternal knowledge (Shahbaz et al., 2024) gender roles in childcare, and maternal emotional factors such as guilt, lack of confidence, fatigue, and other psychological factors (Sousa & Virella, 2024). In addition, there are also challenges in providing complementary foods to mothers who have limited time, limited access to nutritious food ingredients, and a lack of information and support from family, health cadres, and health workers, so that they cannot provide complementary foods optimally (Tully, 2019).

Stunting and wasting are distinct but interrelated conditions that sometimes occur simultaneously in child populations, yet stunting and wasting are sometimes treated separately by programs, policies, and financing (Sadler et al., 2022). Many interventions focus on children who are already stunted, while children who are wasted also require treatment (Wells et al., 2019).

A policy study in Lombok Timur showed that the government's primary focus on reducing stunting rates did have an impact on the success of the stunting program, but the problem of wasting remained high, indicating an imbalance of priorities in the implementation of nutrition programs (Taofik et al., 2024). In addition, government programs focus more on stunting, through food assistance and care for children at risk of stunting. However, there is no specific emphasis on wasting, indicating that wasting is still not a major concern in intervention policies (Rokhmah et al., 2024)

Research on appropriate complementary feeding practices according to World Health Organization recommendations (WHO, 2023). Specifically, minimum dietary diversity (MDD) (Anato et al., 2022), Minimum Acceptable Diet (Abebe et al., 2021), Animal protein consumption (Traoré, 2024), barriers to complementary feeding practices have been conducted, but data on the cultural, emotional, and practical realities of complementary Feeding in wasting children are limited. Understanding these conditions can provide useful information to determine empowerment methods according to the needs of mothers and can prevent children from progressing to stunting.

METHODS

Research design

This study used a cross-sectional survey design that utilized in-depth interview (IDI) methods to collect information in the form of opinions or experiences in complementary feeding practices, and explore socio-cultural beliefs among mothers, husbands, grandmothers, and health cadres in sub-urban areas. This study has obtained ethical approval from the ethics committee of health research, Universitas Respati Yogyakarta.

Participant Selection

Data were collected in four villages in the Sleman district. This area has a large number of wasting cases and has low dietary diversity and animal protein consumption. This study involved 16 main informants, namely parents who have children aged 6-24 months with wasting nutritional status. In addition to interviewing mothers, it was also necessary to explore the perspectives of husbands, grandmothers, and health cadres to enrich the data and for triangulation. The selection of informants was done purposively, namely mothers who have children with wasting nutritional status, but do not have a history of congenital abnormalities or a history of chronic infectious diseases such as tuberculosis, HIV, Helminthiasis, and are willing to be interviewed in depth regarding socio-cultural and complementary feeding practices.

Instrumen pengumpulan data

In-depth interviews lasted 40-60 minutes and were conducted directly by researchers and assisted by enumerators to conduct

documentation. Open-ended questions were asked, which consisted of 3 themes, namely: 1). Cultural aspects, 2). Emotions and psychology in complementary feeding, 3). Practical realities, 4). Health and nutrition. In-depth interviews were conducted with 16 main informants and 8 triangulation informants until no new themes emerged, which means that data saturation can be concluded. Interviews were conducted after informants gave informed consent and without coercion.

Data analysis

Transcripts of the in-depth interviews were prepared verbatim by the research assistants. Subsequently, the research team validated the transcripts by comparing them with the voice recordings and field notes. Qualitative data analysis was conducted using the approach developed by Helvi Kyngäs (Kyngäs, 2020), which includes three main stages: identification of initial codes from the data, grouping of codes into categories, and development of key themes to explore the deep meaning of the phenomenon under study. The validity of the research findings was strengthened by using criteria from Lincoln and Guba (1985), which include: credibility through data triangulation and verification by participants, transferability through presenting the research context in detail, dependability through analysis by independent researchers who were not involved in data collection, and confirmability through complete documentation of the analysis process (Lincoln & Guba, 1985). To maintain data objectivity, researchers also used voice recordings and field notes as sources of verification. The analysis process was conducted by analysts who are competent in qualitative research and not directly involved in the data collection process.

RESULTS AND DISCUSSION

The practice of complementary feeding in wasting children does not only focus on the process of feeding, but more than that many things affect the practice of complementary feeding, such as cultural aspects, emotion and psychology, practical reality, health, and nutrition.

Table 1. Themes and sub-themes of complementary feeding practices in wasting children

Theme	Sub Theme
Cultural Aspects	1. Local Traditions and Customs 2. Cultural influences on food choices for children 3. The role of family and community
Emotional and psychological	Parents' feelings about Complementary feeding for wasting children
Practical Reality	1. Challenges faced by parents in providing complementary food 2. Accessibility and availability of food ingredients in the neighborhood
Health and Nutrition	1. Parents' understanding of the nutritional needs of wasting children. 2. Parents' experience with nutrition programs or support from policymakers

3.1. Cultural Aspects

This theme examines the cultural aspects that influence complementary feeding, where local traditions and customs, cultural influences on food choices, and the role of family and community in complementary feeding practices.

3.1.1. Local traditions and customs

The tradition of early complementary feeding is still an issue in the community, hence the need for continuous education to provide age- age-appropriate complementary feeding.

"...I was given information to give complementary food when my child was 6 months old, but my mother-in-law told me to give complementary food sooner, because my child looked thin, so I gave complementary food at 5 months..."
(IDI, mother 21 years)

Early complementary feeding may increase the risk of obesity, diabetes, and allergic diseases later in life (Wang, 2016). Feeding complementary foods that do not meet nutritional needs can lead to malnutrition (Ashraf et al., 2024). Early introduction of solids may affect children's taste preferences and future eating habits, which may impact long-term health (D'auria, 2020). Early complementary feeding is also influenced by several factors, including family and environmental influences. Education is not only given to mothers who have children, but also to all family members involved in childcare.

"...my baby only drank breast milk from birth until 4 months old, but he was underweight, so I took the initiative to feed him before 6 months old..." (IDI, Mother, 36 years old)

There needs to be more in-depth education on the correct way to breastfeed, not only the position and attachment, but it is necessary to recommend breastfeeding until the breast feels empty so that the child gets both foremilk and hindmilk. When the baby only gets foremilk, the baby's nutritional needs will not be fulfilled, and this has an impact on the child's weight. Foremilk is breast milk that comes out in the early breastfeeding sessions and is thinner because it contains more lactose and water. This foremilk serves to relieve the baby's thirst. While hindmilk is breast milk that is released at the end of the breastfeeding session, and is thicker because it contains a lot of fat (Takumi et al., 2022). Hindmilk provides energy and satiety, therefore, it is important to breastfeed until the breasts feel empty so that the baby gets both foremilk and hindmilk (Nurita, 2021).

3.1.2. Cultural influences on food choices for children

Some traditions indirectly limit the provision of animal protein when giving complementary foods because of the perception that meat is difficult to digest, so it is not recommended to be given at the beginning of complementary foods (Saleh et al., 2023). In addition, there is also a perception that animal protein sourced from marine products, namely fish and shrimp, is at risk of causing allergies, as quoted in the following interview:

"...I still hesitate to give meat before my child is 1 year old, for fear of choking..." (IDI, mother, 23 years old).

"...I haven't tried giving fish or shrimp for complementary food for fear of allergies, because I have a history of allergies too..." (IDI, mother, 30 years old).

In addition to cultural factors, complementary feeding practices are also influenced by exposure to information from various media. The massive promotion of instant complementary food products in various media also influences mothers in their complementary feeding practices. Some mothers prefer to give instant complementary foods compared to homemade ones for several reasons.

"...at the first feeding I gave instant baby porridge that I bought at the supermarket..." (IDI, mother 34 years old).

WHO recommends feeding complementary foods derived from local food ingredients, which aims to introduce the original taste of various food ingredients (WHO, 2023).

3.1.3. The role of family and community

Family and community support play an important role in complementary feeding practices (Fadilah et al., 2023). Support is not only financial but also plays a role in the provision and feeding of complementary foods. Most informants reported that their husbands provided financial support, but few were willing to be involved in the process of cooking and providing complementary foods. This is

consistent with the following interview except:

"...Husband provides financial support to buy complementary food ingredients, but is never involved in the cooking process..." (IDI, mother, 27 years old).

...I support my wife to give homemade complementary food and entrust the cooking of complementary food to my wife because I feel that I cannot do it..." (IDI, Husband 35 years old)

Husbands are expected to be involved in complementary feeding practices, not only providing financial support, but also expected to be involved in the process of complementary feeding (Harris et al., 2020). A study shows that increasing fathers' knowledge about child nutrition will increase support both materially and psychologically (Umugwaneza, 2021). Support from health cadres plays an important role in complementary feeding practices and wasting management. Global evidence shows that more than 85% of malnutrition in 6-59-month-olds is successfully treated at home with outpatient care. This can be successful with the role of health cadres (Blandina Rosalina Bait, 2023).

...I got information about complementary food from a health cadre, she suggested that I make complementary food using the guidance on maternal and child health books..." (IDI, mother, 25 years old)

Cadres have an important role in providing education on complementary feeding practices, but the findings in the field are that not all cadres have attended the infant and young child feeding counselor training (IYCF), so they use guidance from maternal and child health books (Widaryanti & Rahmuniyati, 2019).

3.2. Emotional and psychological

3.2.1. Parents' feelings about complementary feeding for wasting children

Various responses were given by parents when they found out that their children were wasting. Some mothers refuse if their children experience wasting, but there are also responses from mothers who accept it despite experiencing sadness. This is according to the following interview excerpt:

"...my third child is thin just like my first and second child, but still active, so I am not worried, indeed my child is difficult to feed, but I have given formula milk to meet his nutritional needs..." (IDI, Mother 36 years old)

"...I am sad that my child is said to be thin by the health worker, but I admit that my child does like to choose food..." (IDI, mother, 33 years old)

Mothers who deny that their children are wasting will find it more difficult to improve complementary feeding practices, because they feel that their children's condition is hereditary, so there is no effort to improve their diet. A study in Vietnam showed that only 34.5% of parents were able to identify a healthy body shape often; parents do not realize that their child is malnourished (Le Thi Tuyet & Nguyet, 2023). Whereas mothers who have accepted their child's condition will find it easier to evaluate whether their complementary feeding practices have been appropriate or not. Mothers will be more open to getting information on how to give the right complementary food so that their children no longer experience wasting (Nafista et al., 2023).

3.3. Practical Reality

3.3.1. Challenges faced by parents in providing complementary foods.

One of the challenges faced by mothers is the limited time to make complementary foods, in addition to the mother's overly high expectations of the child when consuming food also has an impact on the practice of providing complementary foods, as quoted in the

following interview:

"...I sometimes feel sad when I have taken the time and effort to cook complementary foods, but my child does not eat them..."
(IDI, mother, 23 years old).

Often parents have the expectation that their children will eat voraciously when mothers cook complementary foods, so that mothers are willing to take the time even though busy working, but sometimes mothers become disappointed when children only eat a little (Hässig-Wegmann et al., 2024).

3.3.2. Accessibility and availability of food ingredients in the neighborhood.

Ease of access and availability of foodstuffs are one of the factors that affect the nutritional status of children. In some areas, it is found that children are malnourished due to the inability to access foodstuffs, but in Sleman Regency, the fact is that most children who are malnourished do not come from poor families, but from families with good economic status.

"...I have no difficulty in accessing food ingredients *for complementary feeding, but I have difficulty in ensuring that my child will consume the food with gusto..."*
(IDI, mother 35, years old).

"...Our family income in one month is equivalent to the regional minimum wage, but because we still have a mortgage and my husband also smokes, I cannot often buy meat for complementary food, so I replace it with eggs..." (IDI, mother, 23 years old).

Family economic capacity has an impact on the ability to access diverse foods (Wolfson et al., 2019). In addition, there needs to be awareness to manage money wisely to prioritize meeting the needs of complementary foods rather than buying cigarettes (Muchlis et al., 2023). The adverse effects of cigarettes not only directly affect children's health due to the content of harmful substances, but also have an indirect impact, namely reducing the allocation of family finances to buy healthy food(Astuti et al., 2020).

3.4. Health and Nutrition

3.4.1. Parents' understanding of the nutritional needs of wasting children

Parents' understanding of their children's nutritional needs plays an important role in children's nutritional status. A study in Indonesia found that the mother's education level was a significant factor influencing the practice of providing complementary feeding to children, indicating the importance of education in improving complementary feeding practices (Nurrizka et al., 2021). In this interview, mothers were found to be concerned about the nutritional Adequacy.

"...I am sometimes not sure whether the complementary food I give is sufficient for my child's needs..."
(IDI, mother, 21 years old)

"...To overcome the problem of my child who is difficult to eat, so I give food according to the child's request, even though I know the food is not healthy..."
(IDI, mother, 30 years old)

"...my child is a poor eater and a picky eater, so I give him formula milk to fulfill his nutritional needs, a day my child can consume 8 bottles of formula milk..."
(IDI, Mother, 36 years old)

Maternal concerns about children's nutritional adequacy can be minimized through comprehensive education on recommended complementary feeding practices (Forh et al., 2022). Formula feeding without a medical indication may interfere with the child's food intake as it provides satiety before the child receives solid food (Haschke et al., 2013).

3.4.2. Parents' experience with nutrition programs or support from policymakers

"...I have participated in educational activities

conducted by nutritionists and volunteers, and he information provided is very useful, and this helps me in dealing with children who like to eat picky food. It was hard to implement at first, but I will keep trying..."
(IDI, mother 24 years old)

Nutrition education has been provided through posyandu activities by health cadres, but due to the limited knowledge and skills of cadres, it is necessary to collaborate with nutritionists from the health center and volunteers. Malnutrition prevention programs are still focused on children who have already experienced stunting, such as providing food assistance, education on how to fulfill nutrition and parenting practices. Many interventions focus on children who are already stunted, even though children who are wasting also need treatment (Wells et al., 2019).

The strength of this study lies in the use of a qualitative design that allows in-depth exploration of complex phenomena related to complementary feeding practices, including cultural, emotional, and practical realities. However, this study has limitations as it has not thoroughly explored the eating patterns or habits of children with wasting.

CONCLUSION

Addressing wasting cannot be done solely with nutritional interventions, but requires an approach that takes into account the cultural, emotional, and practical context faced by mothers. Empathic and contextualized nutrition education is key to saving children from wasting that progresses to stunting.

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CONFLICT OF INTEREST

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AUTHOR'S CONTRIBUTION

All authors contributed their thoughts to the preparation of the article. RW: conceptualization, writing–original draft, methodology, coding, transcript verbatim. MIK: Methodology, writing, review and editing, and supervision. MZR: Data curation, validation, writing, review, and editing supervision. SAN: conceptualization, formal analysis, writing, review, and editing.

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PERSONAL TWINS DAUGHTER'S EXPERIENCE WHEN MY FATHER LEFT ME TO CONTINUE NURSING STUDY IN ANOTHER CITY: A CASE STUDY

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Abstract

Background: *Father absence due to higher education can significantly impact child development, especially in a cultural context that values family values , such as Indonesia. This study explores our personal experiences as twin daughters of a father who studied for his undergraduate, master's, and doctoral degrees in another city, which resulted in his absence for seven years of our growing up.*
Method: *This study used a qualitative case study approach with an open-ended interview technique. Interviews were conducted between participants with a jointly developed question guide. Data were analyzed using thematic analysis to identify patterns and key themes from the published narratives.*
Results*: Three main themes were found: (1) Emotional turmoil and abandonment, reflecting emotional instability due to the father's absence; (2) Challenges to self-esteem, indicating the need for a father figure in building children's self-confidence; and (3) Coping mechanisms and resilience, in the form of support from the mother, extended family, and positive activities that help foster coping.*
Conclusion: *The results show that the absence of the verse impacts the emotional, psychological, and social aspects of children, in line with previous literature findings. This study highlights the importance of supportive interventions and the active role of families in mitigating the impact of a father's absence.*

Keywords: *child-relationships, father absence, twins-experiences*

INTRODUCTION

We are twin daughters of a father who is a nursing lecturer. My father continued his undergraduate studies in nursing at the largest university in Indonesia when we were 3 days old until we were 3 years old. Then, my father started his master's studies at the same university when we were 7 to 10 years old and in elementary school. My father continued his doctoral studies at the same university when we were in the 3rd grade of high school.

With the absence of a father for 7 years at our age, we get a lot of things. We realize. In several scientific articles, the absence of a father has been widely studied because of its profound impact on child development, including emotional, psychological, and social dimensions. (East et al., 2014). In the Indonesian context, where family ties are deeply rooted in cultural and societal norms, a father's departure to pursue education, such as at a nursing school in another city, presents unique challenges. (Chang, 2024). In another article, the absence of a father creates psychological problems for girls. (Boothroyd & Perrett, 2008). This article will tell the story of our experience of our father's absence, the challenges we faced, and the coping mechanisms we used. We will present this as a case study.

METHOD

We use a qualitative case study to explore our experiences of the father's absence. To reveal the experience, we are guided by

questions that have been prepared together (Za, La, Ky, Fi); Ky will act as an interviewer, and questions are asked openly with question guides:

1. Can you tell us when your father left to attend nursing school in another city?
2. How did you feel when your father first left? What were the most difficult moments for you during his absence?
3. What helped you cope with your father's absence? Were there certain people, activities, or habits that made you feel better?
4. Have you ever tried to communicate with him during that time? How was that experience?

Thematic analysis was conducted to identify recurring patterns and themes in the narrative.

RESULTS AND DISCUSSION

RESULTS

Emotional Turmoil and Abandonment

Za and La frequently expressed feelings of abandonment and emotional distress following their father's passing. The sudden absence disrupted their sense of security and stability, leading to anxiety and sadness. La shared, "I felt like a part of me was missing. His absence left a void that nothing could fill."

Self-Esteem Challenges

The absence of a father figure during a critical developmental stage impacted self-esteem. Fathers were instrumental in influencing self-esteem. La shared, "I try to communicate with my father if I have problems at school, for example, doing schoolwork or being asked to perform at school."

Coping Mechanisms and Resilience

Despite the challenges, participants developed a variety of coping strategies to cope with their father's absence. Some found solace in their mother or extended family members who provided emotional support. Others engaged in extracurricular activities or hobbies as outlets for their emotions. These mechanisms fostered resilience and personal growth over time. Za shared, "My mother is amazing, always helping us, and my grandparents also helped."

DISCUSSION

The findings underscore the multifaceted impact of paternal absence due to educational pursuits. Children's emotional, psychological, and social challenges in such scenarios highlight the need for supportive interventions. Fathers, in addition to mothers, play a critical role in the development and well-being of their children (Geddes, 2008). Research findings suggest that a father's active involvement and participation in a child's life are associated with improved academic achievement (Flouri & Buchanan, 2004), psychological well-being, and social outcomes, and offer protection from the development of disruptive behaviors, especially among boys (Sarkadi, Kristiansson, Oberklaid, & Bremberg, 2007). However, when a father lives outside the home, the time spent with the child is reduced, meaning that the protective factors that fathers offer the child may be lost (Carlson, 2006).

Furthermore, the literature suggests that children who grow up in fatherless homes are at greater risk for exposure to life adversity (East, Jackson, & O'Brien, 2006). Research exploring the amount of contact between children and their nonresident fathers suggests that decreased paternal involvement may increase the likelihood of delinquent behavior in adolescence (Coley & Medeiros, 2007). Similarly, Flouri and Buchanan (2002a) found that lack of paternal involvement was a risk factor for delinquency in boys, and Harper and McLanahan (2004) found that adolescent boys growing up in fatherless homes were at increased risk of incarceration. Other research has also found that children growing up in fatherless homes experience feelings of abandonment and may feel unloved by their fathers (East, Jackson, & O'Brien, 2007).

CONCLUSIONS

Father's absence for educational reasons, such as attending nursing school in another city, significantly impacts children's emotional and psychological well-being. Understanding this experience through a qualitative narrative study provides valuable insights into the challenges faced and the coping mechanisms developed. This highlights the importance of support systems in enhancing resilience and facilitating healing.

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PROPORTION OF FRUIT AND VEGETABLE CONSUMPTION AND THE PREVALENCE OF HYPERTENSION AND DIABETES MELLITUS IN INDONESIA (SURVEI KESEHATAN INDONESIA ANALYSIS 2023)

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ABSTRACT

Background: *Hypertension and diabetes mellitus (DM) are major global health issues due to their high prevalence and impact on morbidity and mortality. A key risk factor for both diseases is an unhealthy diet, particularly low intake of fruits and vegetables. These foods provide essential nutrients that help reduce the risk of cardiovascular and metabolic diseases. This study aimed to examine the relationship between fruit and vegetable consumption and the incidence of hypertension and DM in Indonesia, using data from the 2023 Indonesian Health Survey (IHS).*
Method: *The study used a cross-sectional design from aggregate data from 38 provinces as a result of the 2023 Indonesian Health Survey. Bivariate analysis uses Pearson and Spearman correlation.*
Result: *The prevalence of hypertension based on blood pressure measurements was 26.5%. This study showed that infrequent consumption of vegetables and fruits (1-2 servings per day in a week) was significantly positively associated with the prevalence of hypertension (r=0.443) and DM (r=0.405), and the proportion of consumption of vegetables and fruits of more than 4 servings per day in a week was negatively related to the prevalence of hypertension (r=-0.205) and DM (r=-0.256). These results suggest that more frequent consumption of vegetables and fruits can reduce the prevalence of DM.*
Conclusion: *The study concludes that the overall consumption of fruits and vegetables in Indonesia is low, especially in urban areas, contributing to higher rates of hypertension and DM. Policies promoting better nutrition education and healthier food access are essential to reducing the risk of these non-communicable diseases.*

Keywords: *Fruits and vegetables Consumption, Hypertension, Diabetes Mellitus*

INTRODUCTION

Diabetes mellitus (DM), also known as diabetes, is a metabolic disease caused by an increase in blood glucose levels above normal values (Sulistyorini et al., 2023). The global prevalence of diabetes among adults increased from 6.8% in 1990 to 14.3% in 2022 for men, and from 6.9% to 13.9% for women. In 2022, approximately 445 million adults aged 30 and above with diabetes did not receive treatment, which is equivalent to 59% of that population (Zhou et al., 2024).

Hypertension is an important preventable risk factor for cardiovascular disease (CVD), including heart failure, stroke, and myocardial infarction (Nouri et al., 2023). The report shows that only 54% of adults with hypertension have been diagnosed, 42% receive treatment, and only 21% can control their condition. Viewed from a regional perspective, the percentage of adults suffering from hypertension in 2019 decreased in the WHO Europe region compared to 1990. This is especially true in the WHO's Southeast Asia region (from 29% to 32%; including countries such as India, New Zealand, China, the Republic of Korea, the Philippines, Malaysia, Vietnam, and Japan) and the WHO's Western Pacific Region (from 24% to 28%; including countries such as Australia, New Zealand, China, Republic of Korea, the Philippines

(Kario et al., 2024). In Indonesia alone, 34.11% of the population has hypertension (Kemenkes, 2018)

The results of Basic Health Research in 2018 show that the majority of Indonesian people still do not consume fruits and vegetables according to nutritional recommendations. Data shows that 66.5% of the population aged 5 years and above only consume 1-2 servings of fruits and vegetables per day in a week. As many as 18.3% of respondents ate 3-4 servings per day, and only 4.6% consumed at least 5 servings according to WHO standards. In fact, there are 10.7% of respondents who do not consume fruits and vegetables at all. This problem of low consumption, with figures showing that 95.4% of the population still does not meet the daily consumption recommendations of fruits and vegetables (Kemenkes, 2018)

Lifestyle and diet can greatly influence the prevalence of hypertension. Fruits and vegetables are important components of the diet because they contain vitamins, minerals, and folic acid that help with endothelial function. Endothelial function amenities are considered a risk factor for hypertension. According to some studies, there is an inverse correlation between vegetable and fruit consumption and hypertension. In contrast, additional research found no association between vegetable and fruit consumption and a reduced risk of hypertension (Nouri et al., 2023)

In the DM Puskesmas II West Denpasar Association, it was found that there was a significant relationship between fruit and vegetable consumption and diabetic blood pressure. This research was conducted (Septiyanti & Jafar, 2020). The relationship is negative (reversed), meaning that the consumption of fruits and vegetables is higher and lowers blood pressure, and vice versa with moderate relationship strength. Another study found that fruit and vegetable consumption was linked to DM; individuals who eat fruits and vegetables regularly have a 3.9 times greater chance of avoiding DM compared to individuals who consume less (Sulistyorini et al., 2023). Meanwhile, research in Iran shows that increasing fruit consumption is linked to reducing the chances of hypertension. Regarding vegetable consumption, no significant association was found with the possibility of hypertension (Nouri et al., 2023). Therefore, this study aims to analyze the picture of fruit and vegetable consumption, analyze the prevalence of Hypertension and Diabetes Mellitus based on Indonesian regions, and analyze the relationship between fruit and vegetable consumption and the incidence of Hypertension and Diabetes Mellitus in Indonesia based on data from the 2023 Indonesian Health Survey (IHS).

METHODS

This study uses a cross-sectional design of data from the 2023 Indonesian Health Survey (IHS), this study investigates the relationship between the consumption of fresh fruits and vegetables and the proportion of hypertension and diabetes mellitus in individuals aged at least fifteen years. This study involved all ART patients who have hypertension or diabetes mellitus who have been diagnosed by doctors in 38 Indonesian provinces, which were then divided into 7 regions: Sumatra, Java-Bali, Nusa Tenggara, Kalimantan, Sulawesi, Maluku, and Papua. The population is made up of samples. For this study, the population as a whole was taken as a sampling. The study involved 586,000 households in 38 provinces/514 districts/cities across Indonesia from August to the first week of October 2023.

The behavior of the population in consuming fruits and vegetables is seen from IHS data which is measured based on the frequency and portion of fruit and vegetable consumption in ART aged 5 years and above, by calculating the number of days of consumption in a week and the average number of servings in a day. The proportion of fresh

fruit and/or vegetable consumption per day in a week is calculated by dividing the total number of ART aged ≥15 years who consume fruit/vegetables per day in province x with the total number of ART aged ≥5 years in province x. The instrument used to collect data on vegetable and fruit consumption is the STEP-wise instrument from the World Health Organization (WHO). Residents are categorized as "adequate" in the consumption of vegetables and fruits if they consume vegetables and/or fruits (a combination of vegetables and fruits) at least 5 servings per day for 7 days a week. Categorized as "less" if the consumption of vegetables and fruits is less than the above provisions(Kementerian, 2023).

The prevalence of hypertension based on a doctor's diagnosis is the mean prevalence of systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg in the population aged ≥ 15 years with hypertension based on doctor's diagnosis (percent). It was calculated using the formula for dividing ART ≥15 years who had been diagnosed with hypertension by a doctor and ART ≥15 years who were interviewed. Blood pressure measurement using a digital sphygmomanometer

The prevalence of Diabetes Mellitus incidence was taken from DM prevalence data based on diagnosis in the population aged ≥ 15 years calculated by dividing the number of ART ≥15 years old who had been diagnosed with DM with ART aged ≥15 years interviewed. Blood glucose measurements were carried out in the laboratory with fasting blood glucose (>126 mg/dL) and 2 hours (>199 mg/dL) after loading, using the Accu check rapid detection tool.

This study uses tertiary data from the 2023 Indonesian Health Survey (IHS) to maintain the confidentiality of respondents. Data is collected through direct examination by health workers at least D3. The analysis was conducted with SPSS 22, using univariate, bivariate analysis (Pearson and Spearman correlation test), as well as linear regression to evaluate the relationship between fruit and vegetable consumption with hypertension and diabetes mellitus.

The Indonesian Health Survey has received ethical approval from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023. This approval ensures that research is conducted by applicable ethical standards, thereby ensuring the protection of respondents' rights and privacy.

RESULTS AND DISCUSSION

Table 1 shows that the proportion of fruits and vegetables with consumption of 1-2 servings is lowest in the Maluku region (55.4%) and the highest is found in the Sumatra regional region (70.7%). The lowest proportion of fruits and vegetables with consumption of 3-4 servings is found in the Sumatra region (12.3%) and the highest is found in the Nusa Tenggara region (28.6%). The lowest proportion of fruits and vegetables with consumption ≥5 portions are found in the Sumatra regional area (3.1%) and the highest is found in the Papua regional area, namely in the province of Central Papua (6.5%). The proportion of not consuming fruits and vegetables is lowest in the Java and Bali regional areas (9.7%) and the highest in the Maluku region (24.5%). Nationally, the average proportion of fruit and vegetable consumption with portions (1-2 servings (63.0%), 3-4 servings (17.6%), ≥5 servings (4.2%), and not consuming fruits and vegetables (15.2%).

These results show that people in Nusa Tenggara have a higher tendency to consume more fruits and vegetables than in Sumatra. This can be influenced by cultural, economic, and the availability of fruits and vegetables in each region. One of the studies carried out by the Rokan Hulu shows that this consumption pattern may be related to economic factors and

public education about the importance of adequate fruit and vegetable intake (Hadi & Sembiring, 2023).

Table 1. The proportion of Consumption of fresh fruit and/or vegetables per day in a week by region in 2023

Regions	Proportion of Fresh Fruit and/or Vegetable											
	(1-2 portion)			(3-4 portion)			(≥5 portion)			(not consuming)		
	Min	Max	χ ± SD	Min	Max	χ ± SD	Min	Max	χ ± SD	Min	Max	χ ± SD
Sumatera	58.1	78.7	70.7 ± 6.1	5.3	30.6	12.3 ± 7.5	1.1	6.3	3.1 ± 1.5	5	21.6	14.1 ± 5.1
Jawa and Bali	62	73.8	67.6 ± 5.2	9.2	27.1	19.5 ± 8.6	1.2	4.7	3.2 ± 1.4	5.1	15.8	9.7 ± 4.4
Kalimantan	66.5	78.1	70.3 ± 4.6	5.7	18.6	12.6 ± 6.1	1.4	7.1	3.5 ± 2.3	9.2	23	13.6 ± 5.6
Sulawesi	56.3	73.2	64.0 ± 7.3	9.2	18.8	12.8 ± 3.9	1.8	5.4	3.7 ± 1.3	14.2	30.7	19.6 ± 6.2
Maluku	54.6	56.2	55.4 ± 1.1	12.1	17.8	15.0 ± 4.0	5.1	5.3	5.2 ± 0.1	22.5	26.4	24.5 ± 2.8
Nusa Tenggara	47	66.5	56.8 ± 13.8	20.3	36.9	28.6 ± 11.7	2.4	5.8	4.1 ± 2.4	10.3	10.7	10.5 ± 0.4
Papua	48	66.2	56.3 ± 6.4	12.3	29.4	22.8 ± 6.1	2	11.8	6.5 ± 3.6	7.6	25.5	14.4 ± 6.4
Indonesia	**47**	**78.7**	**63.0 ± 3.8**	**5.3**	**36.9**	**17.6 ± 2.8**	**1.1**	**11.8**	**4.2 ± 1.1**	**5**	**30.7**	**15.2 ± 2.2**

These results show that people in Nusa Tenggara have a higher tendency to consume more fruits and vegetables than in Sumatra. This can be influenced by cultural, economic, and the availability of fruits and vegetables in each region. One of the studies carried out by the Rokan Hulu shows that this consumption pattern may be related to economic factors and public education about the importance of adequate fruit and vegetable intake (Hadi & Sembiring, 2023). Most of Indonesia's population still does not consume fruits and vegetables at all, with a national average of 15.2%. Maluku is the region with the highest proportion (24.5%), while the lowest is Java and Bali (8.7%). These results show that fruit and vegetable consumption patterns in Indonesia are different, which may be influenced by the availability of local food, people's purchasing power, and awareness of the importance of fruit and vegetable consumption for health.

Research in the UK found that food insecurity in urban communities leads to an imbalance in food consumption, leading to an increase in obesity and the prevalence of diabetes mellitus in Indonesia (Turnbull et al., 2021). Wiboworini's research supports this finding, stating that patients and families tend to consume vegetables and fruits that are easily available at nearby stalls (Wiboworini et al., 2021a). Although fruits and vegetables can be purchased in small quantities and consumed by a single family in one household, the intake of fruits and vegetables remains low. People in the community rarely eat fruits and vegetables every day. Some people only eat fruit after religious ceremonies (Ayu Hari Krisna Dewi & Nym Widyanthini, 2022; Samsiati et al., 2023).

Table 2. Prevalence of Hypertension Incidence by Doctor's Diagnosis and Measurement by Regional in 2023

Regions	Prevalence of Hypertension					
	Doctor's Diagnosis			Blood Pressure Measurement		
	Min	Max	χ ± SD	Min	Max	χ ± SD
Sumatera	4.3	8.8	6.9±1.3	21.4	28.3	24.3±2.0
Jawa and Bali	6.8	12.6	9.6±2.2	21.7	32.8	29.3 ± 3.9
Kalimantan	7.2	11.1	8.4±1.6	28.0	38.7	31.8 ± 4.5
Sulawesi	5.3	12.1	7.9 ±0.4	26.5	29.5	27.8 ± 1.2
Maluku	4.3	4.4	4.4±0.1	20.8	25.6	23.2 ± 3.4
Nusa Tenggara	6.3	6.8	6.6±0.4	24.5	26.4	25.5 ± 1.3
Papua	2.2	7	5.0±20	19.4	27.5	23.8 ± 3.0
Indonesia	**2.2**	**12.6**	**6.9±0.9**	**19.4**	**38.7**	26.5 ±**0.1**

Table 2 shows that the prevalence of hypertension incidence based on doctor's diagnosis and measurement is lowest in the Maluku region (4.4%) and (23.2%), while the highest prevalence of hypertension based on doctor's diagnosis is found in the Java and Bali regional areas (9.6%) and hypertension based on measurement is located in the Kalimantan region (31.8%). Nationally, the average prevalence of hypertension incidence (6.9%) and (26.5%).

The results in Table 2 show a disparity in the prevalence of hypertension, which may have different risk factors between regions in Indonesia. Previous research has shown that lifestyle factors, diet, and access to health services play a significant role in the prevalence of hypertension and diabetes. Studies conducted in Banjarmasin show that attitudes, the quality of food consumed, and the consumption pattern of foods that contain a lot of energy, sugar, and fat are the main risk factors for increased hypertension in urban areas (Aziza & Farhat, 2021). In the context of geographic distribution, regions with better access to health services tend to have a higher prevalence of hypertension and diabetes mellitus due to better early detection factors. In contrast, areas with limited access to health services, such as Maluku and Papua, may have lower numbers due to a lack of case detection and reporting.

Table 3. Prevalence of Diabetes Mellitus Incidence by Regional Doctor Diagnosis in 2023

Regions	Doctor's Diagnosis		
	Min	Max	$\chi \pm SD$
Sumatera	1.3	2.8	1.9±0.5
Jawa and Bali	2.1	3.9	2.8±0.7
Kalimantan	1.7	3.1	2.1±0.6
Sulawesi	1.4	2.7	2.0±0.5
Maluku	0.9	1.2	1.1±0.2
Nusa Tenggara	1.0	1.8	1.4±0.6
Papua	0.2	1.8	1.2±0.6
Indonesia	**0.2**	**3.9**	**1.8±0.1**

Table 3 shows that the lowest prevalence of Diabetes Mellitus is found in the Maluku region (1.1%), while the highest prevalence is found in the Java and Bali regions (2.8%). Nationally, the average prevalence of Diabetes Mellitus (1.8%).

Table 4. The Relationship between the Proportion of Fruit and Vegetable Consumption with the Prevalence of Hypertension and Diabetes Mellitus in Indonesia in 2023

Proportion of Fruit and Vegetable Consumption Portion per Day in a Week	Statistics	Prevalence of Hypertension Based on Doctor's Diagnosis	Prevalence of Hypertension Based on Blood Pressure Reduction	Prevalence of Diabetes Mellitus by Doctor's Diagnosis
1-2 servings per day a week	Correlation Coefficient (r)	0.443	0.154	0.405
	p-value	0.005	0.355	0.012
3-4 servings per day a week	Correlation Coefficient (r)	-0.224	0.014	-.0122
	p-value	0.175	0.934	0.465
>4 per day of the week	Correlation Coefficient (r)	-0.315	-0.122	-0.299
	p-value	0.05	0.464	0.05

The results of data analysis in Table 4 show that the proportion of fruit and vegetable consumption of 1-2 servings per day in a week is related to the prevalence of hypertension (p-value 0.005) and diabetes mellitus (p-value 0.012) based on the doctor's diagnosis, based on the correlation coefficient value shows that there is a positive relationship between the

infrequent consumption of vegetables and fruits with the prevalence of hypertension (r=0.443) and diabetes mellitus (r=0.405) based on doctor's diagnosis. The higher the proportion of rarely consuming vegetables and fruits, the higher the prevalence of hypertension and diabetes mellitus based on a doctor's diagnosis. Low consumption of vegetables and fruits (1-2 servings) has a moderate relationship with the high prevalence of hypertension and diabetes mellitus in Indonesia.

Table 4 also shows that the proportion of fruit and vegetable consumption > 4 servings per day in a week is related to the prevalence of hypertension (p-value 0.05) and diabetes mellitus doctor's diagnosis (p-value 0.05), based on the correlation coefficient value shows that there is a negative relationship between frequent consumption of vegetables and fruits with the prevalence of hypertension (r=-0.315) and diabetes mellitus (r= 0.299). The lower the proportion of frequent consumption of vegetables and fruits, the higher the prevalence of hypertension and diabetes mellitus. Frequent consumption of vegetables and fruits (>4 servings per day in a week) has a weak association with the high prevalence of hypertension and diabetes mellitus. The results showed that the more often vegetables and fruits were consumed, the lower the prevalence of diabetes mellitus.

These findings are supported by additional research that found that daily consumption of fruits and vegetables is linked to hypertension; Greater consumption is associated with a lower risk of hypertension (Faishal Ramadhan et al., 2022; Samsiati et al., 2023) and found there was a significant association between following a healthy diet and blood pressure (Nasya, 2024). Daily consumption of vegetables can lower blood pressure values in people with hypertension through the formation of nitric oxide from blood vessels which acts as a vasodilator and potassium levels play a role in inhibiting the renin-angiotensin system, blood vessel relaxation, and baroreflex activation so that it can have the effect of lowering blood pressure (Faishal Ramadhan et al., 2022).

Fruit and vegetable consumption did not show a significant association with hypertension prevalence based on measurements as shown in Table 4. This indicates that increased consumption of fruits and vegetables may have some effect on a reduced risk of hypertension, but not linearly or significantly across all consumption groups. These differences in results may be due to variations in the study design, the population studied, as well as the methods of measuring blood consumption and pressure (Manik et al., 2020). This is in line with previous findings that show that 1-2 servings of fruit are associated with a reduced risk of diabetes mellitus (Fatimah & Siregar, 2021). The positive correlation found (r = 0.405) indicates that the lower the consumption of fruits and vegetables, the higher the prevalence of Diabetes Mellitus. These results support previous findings that healthy food consumption patterns, including fruits and vegetables, have a role in reducing the risk of metabolic disease. Adequate consumption of vegetables and fruits can help prevent non-communicable diseases (Kurniati et al., 2022). Consumption of fruits and vegetables can reduce the risk of type 2 Diabetes Mellitus by up to 20% compared to consumption of less than 2 servings per day (Wu et al., 2015). Consuming as much as 200 grams of fruit per day such as apples and their derivatives can reduce the risk of diseases such as being able to control the glycemic index, and reduce the risk of complications, and mortality in people with Type-2 Diabetes Mellitus. Fruit intake of up to 530-600 g/day can be protective against the incidence of hypertension. However, consumption of >4 servings per day of even 100% fruit juice can increase the risk of hypertension (Park, 2021; Zhang et al., 2023). The role of fruits and vegetables in maintaining blood sugar levels through their effects as antioxidants, fiber content, and magnesium

content. Antioxidants can counteract the harmful effects of reactive oxygen species involved in DM pathogenesis. The fiber contained in fruits and vegetables will be fermented so that it causes an increase in the diversity of the gut microbiota where this diversity is useful for producing insulin. Meanwhile, magnesium content acts as a cofactor in regulating blood sugar levels (Wiboworini et al., 2021b).

Consumption of higher amounts of fruits and vegetables (≥5 servings) or not consuming at all had no significant association with the prevalence of Diabetes Mellitus, as indicated by (p-value > 0.05). The quality and type of vegetables and fruits consumed also affect their benefits on glucose metabolism (Li et al., 2014).

This low consumption pattern can be caused by a lack of knowledge about diet in people with diabetes mellitus (Maysaroh et al., 2022). Further research on the consumption of fruit as a medical nutrition to prevent non-communicable diseases is essential (Wijayanti et al., 2025) Increasing public understanding of food is also needed to increase the risk of developing DM so that they can avoid the disease (Nurjana & Veridiana, 2019). The selection of subtypes of vegetables and fruits to be consumed must also be considered. Intake of certain fruits such as apples/pears consumed more inversely proportional to the risk of Type II Diabetes Mellitus (T2DM), while higher intake of bananas, cabbage, and tomatoes was positively associated with T2DM (Barouti et al., 2022).

CONCLUSION

This study found that fruit and vegetable consumption in Indonesia still varies between regions, most people consume in less amounts than the WHO recommendation. The Sumatra and Java-Bali regions have the lowest proportion of fruit and vegetable consumption, while Papua and Nusa Tenggara tend to be higher. This low consumption contributes to the high prevalence of hypertension and diabetes mellitus, especially in urban areas such as Jakarta.

The analysis also showed that low consumption of fruits and vegetables (1-2 servings per week) had a significant association with an increased risk of hypertension and diabetes mellitus. However, higher amounts of consumption did not always show a significant relationship. Based on the results of the study, it is recommended that the government increase educational campaigns on the importance of vegetable and fruit consumption, especially in areas with low consumption such as Maluku and Sumatra. Health workers need to be more active in educating the public about the relationship between a healthy diet and disease prevention, as well as conducting early detection of hypertension and diabetes mellitus. The public is expected to increase awareness to consume more vegetables and fruits and regularly check their health. Researchers are further advised to explore other factors, such as socio-economic and cultural, that may influence the relationship between vegetable and fruit consumption and the prevalence of hypertension and diabetes mellitus.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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THE PROPORTION OF SEASONING CONSUMPTION HABITS AND THE PREVALENCE OF HYPERTENSION AND DIABETES MELLITUS (INDONESIAN HEALTH SURVEY 2023)

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ABSTRACT

Background: *Non-communicable diseases such as hypertension and diabetes mellitus are increasing globally, including in Indonesia. One of the risk factors that is thought to contribute is the habit of consuming seasonings containing sodium and monosodium glutamate (MSG). This study aims to analyze the relationship between the proportion of seasoning consumption and the prevalence of hypertension and diabetes mellitus based on data from the 2023 Indonesian Health Survey (IHS).*
Method: *The research method used was a cross-sectional design with samples from households spread across 38 provinces in Indonesia. Data were collected through interviews, blood pressure measurements, and blood glucose level checks.*
Result: *The results of the analysis showed a significant relationship between daily seasoning consumption and an increase in the prevalence of hypertension based on a doctor's diagnosis (r = 0.470), while based on measurement results it was (r = 0.511), and for the prevalence of diabetes mellitus was (r = 0.364). Conversely, less frequent consumption tends to reduce the prevalence of both diseases.*
Conclusion: *The conclusion of this study confirms that high consumption of seasonings contributes to an increased risk of hypertension and diabetes mellitus, so education on balanced sodium consumption and control of seasoning use needs to be improved to prevent negative impacts on public health. These findings are expected to be the basis for consideration by policymakers in designing more effective nutrition interventions and health promotion programs.*

Keywords: *"Seasonings, Hypertension, Diabetes Mellitus, Public Health*

INTRODUCTION

Currently, the development of diseases in the world, including Indonesia, has shifted from infectious diseases to non-communicable diseases (NCDs) such as hypertension and diabetes mellitus, which continue to increase from year to year (Pakpahan et al., 2022). Non-communicable diseases (NCDs) are one of the global health problems and contribute to increased morbidity and mortality (Arifin et al., 2022). Non-communicable diseases are not diseases that can be transmitted between individuals but are chronic conditions that continue to increase throughout the world, especially in developing and poor countries (Soeroso et al., 2024) .

Hypertension also known as high blood pressure is an asymptomatic condition in which there is an increase in blood pressure in the arteries. A person is said to have high blood pressure if when sitting their systolic pressure is ≥140 mmHg or their diastolic pressure is ≥90 mmHg or both. Diabetes mellitus (DM) is a metabolic disease with symptoms of hyperglycemia caused by abnormalities in the insulin working mechanism, a diagnosis of DM can be made if there are classic complaints of DM with random plasma glucose test results ≥200 mg/dL or fasting plasma glucose test results ≥126 mg/dl (Damayanti et al., 2023) .

Consuming preserved foods too often, consuming excess salt, and using seasonings such as monosodium glutamate (MSG) in high

amounts can cause increased blood pressure due to the high sodium content in these foods (Nugroho et al., 2019) . Consumption of risky foods or drinks is divided into sweet foods, sweet drinks, fatty foods, cholesterol, fried foods, foods using seasonings, and fast food. Based on data analysis, it is known that consuming risky foods and drinks is one of the risk factors for the occurrence of diabetes mellitus (Aniska, 2022) .

Globally according to the World Health Organization (WHO) In 2021, diabetes was the direct cause of 1.6 million deaths and 47% of all deaths from diabetes occurred before the age of 70. Another 530,000 deaths from kidney disease were caused by diabetes, and high blood glucose caused about 11% of cardiovascular deaths (WHO, 2024) . The World Health Organization (WHO) estimates that the prevalence of hypertension will reach 33% in 2023 and two-thirds of these are in poor and developing countries (WHO, 2023) . The 2018 Basic Health Research data showed that the prevalence of hypertension was 34.1% in the population aged ≥18 years, increasing from 25.8% in 2013. Meanwhile, the prevalence of diabetes mellitus based on blood sugar examinations also increased from 6.9% to 8.5% in the same period (Riskesdas, 2018) . There is a relationship between Mono Sodium Glutamate (MSG) consumption and the incidence of hypertension. This study is in line with research conducted by Zainuddin and Yunawati (2018), MSG consumption has a significant relationship with the incidence of hypertension, where consuming large amounts of sodium will increase extracellular so that intracellular fluid is released which results in increased extracellular volume, this causes an increase in blood volume which has an impact on hypertension (Aristi et al., 2020) .

The study (MS et al., 2023) showed a relationship between excessive salt consumption and the incidence of DM. Respondents who consume excess salt are also at high risk of suffering from DM. The results of the questionnaire showed that people prefer foods that taste salty. Previous research on the effect of diet on the potential risk of DM stated that consuming salty foods has a risk of 2.62 times experiencing DM. 65% of all respondents who consume salty foods experience DM. High salt intake in hypertension occurs through increased plasma volume and blood pressure. The high salt content in the body can also cause fluid accumulation in the body because it draws fluid outside the cells so that it is not excreted, which can cause increased blood volume and pressure.

Although there have been several studies examining the relationship between dietary patterns and the incidence of hypertension and diabetes mellitus in Indonesia, studies that specifically examine the effect of seasoning consumption habits on the prevalence of both diseases are still very limited. This study aims to determine the relationship between the proportion of seasoning consumption habits and the proportion of hypertension and diabetes mellitus cases based on doctors' diagnoses through analysis of the 2023 Indonesian Health Survey (IHS) data. With the results of this study, it is hoped that it can provide deeper insights to formulate more effective policies in dealing with health problems related to seasoning consumption, as well as reducing its negative impacts on the health of the Indonesian people.

METHODS

This study used a cross-sectional design to evaluate the relationship between the habit of consuming seasonings with the proportion of hypertension and diabetes mellitus based on the doctor's diagnosis and measurement results. This design allows for the simultaneous measurement of variables at one time to see the relationship between the habit of consuming seasonings with the incidence of hypertension and diabetes mellitus in Indonesia. The population in this study were residents aged

≥15 years recorded in the 2023 IHS data who experienced Hypertension and Diabetes Mellitus. The research sample came from the 2023 Indonesian Health Survey (IHS) data, which involved 586 thousand households in 38 provinces and 514 districts/cities. The sampling method was carried out randomly with stratification to ensure a representative distribution in each region. The inclusion criteria in this study were individuals who had complete data on their consumption habits of seasonings and a diagnosis of hypertension and diabetes mellitus by a doctor. Meanwhile, individuals with incomplete data or no medical diagnosis information were excluded from the analysis.

The data in this study came from IHS 2023, collected in the period from August to October 2023. The independent variable in this study was the proportion of seasoning consumption habits obtained through a questionnaire. The dependent variable was the proportion of hypertension and diabetes mellitus based on the results of the doctor's diagnosis and the results of the measurements. Data were generated through blood pressure and blood sugar measurements. Blood pressure measurements were carried out using a Tensimeter, while blood glucose levels were measured using the Point of Care Testing (POCT) method. The results of the doctor's diagnosis were then compared with the interview data.

The prevalence of hypertension was calculated using the comparison formula between household members aged ≥15 years who had been diagnosed with hypertension with household members aged ≥15 years who were interviewed. Hypertension was categorized if systolic blood pressure was ≥140 mmHg and/or diastolic blood pressure was ≥90 mmHg in residents aged ≥15 years. The prevalence of diabetes mellitus was calculated using the comparison formula between household members aged ≥15 years who had been diagnosed with diabetes mellitus with household members aged ≥15 years who were interviewed. Diabetes mellitus was categorized if fasting blood glucose levels were ≥126 mg/dL or blood glucose levels 2 hours after loading were ≥200 mg/dL.

Data analysis was performed using SPSS software version 22. Descriptive analysis was used to describe the characteristics of respondents, including the distribution of seasoning consumption and the proportion of hypertension and diabetes mellitus. Univariate analysis was performed to describe the characteristics of each variable using the middle and variance measures (mean, standard deviation, minimum value, and maximum value). To analyze the relationship between seasoning consumption habits and the prevalence of Hypertension and Diabetes Mellitus, bivariate analysis was performed using the Pearson correlation test, after the assumption of data normality was met. If the data was not normally distributed, the Spearman correlation test was performed. This research has been approved and has a code of ethics with the number HK.01.07/MENKES/156/2023.

RESULTS AND DISCUSSION

Based on Table 1, the highest proportion of seasoning consumption ≥1 time per day is in the Java and Bali regions with a maximum value of 86.5%. Meanwhile, the lowest proportion of daily seasoning consumption is in the Papua region with a minimum value of 37.7%. Nationally, the proportion of daily seasoning consumption in Indonesia is an average of 67.5%. For seasoning consumption 1-6 times per week, the highest proportion is in the Papua region with a maximum value of 39.1%, while the lowest proportion is in the Java and Bali regions with a minimum value of 10.0%. Nationally, the average consumption of seasoning per week in Indonesia is 20.8%. Meanwhile, for seasoning consumption ≤3 Times per month, the highest proportion is in

the Papua region with a maximum value of 35.3%, while the lowest proportion is in the Java and Bali regions with a minimum value of 3.3%. Nationally, the average consumption of seasoning per month in Indonesia is 11.5%.

Table 1. Distribution of Proportion of Seasoning Consumption by Region of Indonesia in 2023

Region	Consumption Habit of Seasoning ≥1 time per day			Consumption Habits of Seasonings 1 – 6 times per week			Consumption habits of seasonings ≤3 times per month		
	Min	Max	$\underline{X}$ ±SD	Min	Max	$\underline{X}$ ±SD	Min	Max	$\underline{X}$ ±SD
Sumatra	30.1	79.0	62.1 ± 16.8	15.7	34.7	23.3 ± 6.6	5.4	35.3	14.5 ± 10.9
Java And Bali	67.8	86.5	78.5 ± 6.2	10.0	26.1	15.1 ± 5.4	3.3	10.3	6.3 ± 2.5
Nusa Tenggara	71.2	78.6	74.9 ± 5.2	15.0	15.4	15.2 ± 0.2	6.0	13.8	9.9 ± 5.5
Kalimantan	62.1	76.4	69.5 ± 5.9	17.3	30.9	23.5 ± 5.2	6.1	9.0	6.9 ± 1.1
Sulawesi	61.8	73.4	69.1 ± 4.6	17.4	26.1	20.2 ± 3.7	8.6	12.4	10.6 ± 1.4
Maluku	63.8	71.4	67.6 ± 5.3	19.0	27.1	23.0 ± 5.7	9.1	9.7	9.4 ± 0.4
Papua	37.7	70.1	57.1 ± 11.6	14.9	39.1	23.5 ± 8.6	13.3	30.4	19.2 ± 6.4
Indonesia	**30.1**	**86.5**	**67.5 ± 12.2**	**10.0**	**39.1**	**20.8 ± 6.5**	**3.3**	**35.3**	**11.5 ± 7.4**

The results of this study indicate that there are differences in the proportion of seasoning consumption in various regions in Indonesia. In general, the national average of seasoning consumption ≥1 time per day is 66.2%, with the highest proportion in Java and Bali (78.5%) and the lowest in Papua (51.7%). Meanwhile, the habit of consuming 1–6 times per week has a national average of 20.8%, and consumption ≤3 times per month has a national average of 11.6%. The high consumption of seasonings, especially those containing Monosodium Glutamate (MSG), can have an impact on health (Rizkaprilisa et al., 2024) . The results of the study indicate that there are variations in the proportion of seasoning consumption in Indonesia, which can affect public health. Seasonings, especially Monosodium Glutamate (MSG), are often used to enhance the taste of food. However, excessive consumption of MSG can have negative impacts on health, such as increasing the risk of hypertension (Arapa et al., 2023)..

Other studies have shown that the use of natural flavor enhancers, such as those based on oyster mushrooms, can be a healthier alternative. Oyster mushroom-based flavor enhancer formulations have been evaluated and have shown positive results in enhancing flavor without adverse side effects. (Kadaryati et al., 2022). Thus, although synthetic flavorings such as MSG are widely used, it is important to consider natural alternatives that are safer for health. Education regarding the consumption of flavorings and their impact on health needs to be improved to encourage healthier eating patterns in the community (Rizkaprilisa et al., 2024).

Table 2. Distribution of prevalence of hypertension and diabetes mellitus by Indonesian Region in 2023

Region	Prevalence of Hypertension based on doctor's diagnosis			Prevalence of hypertension based on measurement results			Prevalence of Diabetes Mellitus based on doctor's diagnosis		
	Min	Max	$\underline{X}$ ±SD	Min	Max	$\underline{X}$ ±SD	Min	Max	$\underline{X}$ ±SD
Sumatra	4.3	8.8	6.9 ± 1.2	21.4	28.3	24.2 ± 2.0	1.3	2.8	1.8 ± 0.4
Java And Bali	6.9	12.6	9.5 ± 2.2	21.7	32.8	29.2 ±3.8	2.1	3.9	2.7 ± 0.7
Nusa Tenggara	6.3	6.8	6.5 ± 0.3	24.5	26.4	25.4 ±1.3	1.0	1.8	1.4 ± 0.5
Kalimantan	7.2	11.1	8.4 ± 1.5	28.0	38.7	31.8 ±4.5	1.7	3.1	2.1 ± 0.5
Sulawesi	5.3	12.1	7.8 ± 2.3	26.5	29.5	27.7 ±1.1	1.4	2.7	2.0 ± 0.4
Maluku	4.3	4.4	4.3 ± 0.0	20.8	25.6	23.2 ±3.3	0.9	1.2	1.0 ± 0.2
Papua	2.2	7.0	5.0 ± 1.9	19.4	27.5	23.7 ±2.9	0.2	1.8	1.2 ± 0.6
Indonesia	**2.2**	**12.6**	**7.3 ± 2.2**	**19.4**	**38.7**	**26.7 ± 3.9**	**0.2**	**3.9**	**1.9 ± 0.7**

Based on Table 2, the prevalence of hypertension based on the highest doctor's diagnosis occurred in the Java and Bali region, with an average value of 9.5%, while the lowest prevalence of hypertension occurred in the Maluku region, with an average value of 4.3%. Nationally, the prevalence of hypertension in Indonesia is an average of 7.3%. For the prevalence of hypertension based on measurement results, the region with the highest number is Kalimantan with an average value of 31.8%, while the region with the lowest prevalence of hypertension is Nusa Tenggara with an average value of 25.4%. Nationally, the prevalence of hypertension based on measurement results in Indonesia has an average of 26.7%. Meanwhile, for the prevalence of diabetes mellitus based on doctors' diagnosis, the region with the highest number is Java and Bali, with an average value of 2.7%, while the region with the lowest prevalence of diabetes mellitus is Papua, with an average value of 1.2%. Nationally, the prevalence of diabetes mellitus in Indonesia has an average of 1.9%.

This study revealed that the prevalence of hypertension and diabetes mellitus in Indonesia showed significant variations between regions. Nationally, the prevalence of hypertension based on a doctor's diagnosis was recorded at 7.3%, with Java and Bali recording the highest prevalence at 9.5%, while Papua had the lowest prevalence at 5.0%. Meanwhile, the prevalence of hypertension based on measurement results showed a national figure of 26.7%, with Kalimantan recording the highest prevalence at 31.8% and Papua having the lowest prevalence at 23.7%. In addition to hypertension, the prevalence of diabetes mellitus based on a doctor's diagnosis also showed variations between regions, with a national figure of 1.9%. The region with the highest prevalence was Java and Bali at 2.7%, while the lowest prevalence was recorded in Papua at 1.0%. These data show a striking difference in the distribution of non-communicable diseases in various regions of Indonesia.

Table 3. Relationship between the proportion of seasoning consumption with the prevalence of hypertension and diabetes mellitus in Indonesian Region 2023

Proportion seasoning Consumption	Prevalence of Hypertension based on doctor's diagnosis	Prevalence of hypertension based on measurement results	Prevalence of Diabetes Mellitus based on doctor's diagnosis
Consumption ≥1 time per day			
Beta	2.534	1.582	6.220
Constant	49.083	25.309	55.607
Correlation Coefficient (**r**)	0.470	0.511	0.364
p-value	0.003	0.001	0.023
Consumption 1 – 6 times per week			
Beta	-0.977	-0.574	-2.531
Constant	27.980	36.168	25.717
Correlation Coefficient (**r**)	-0.340	-0.347	-0.278
p-value	0.034	0.030	0.087
Consumption ≤3 times per month			
Beta	-1.552	-1.008	-3.674
Costan	22.919	38.524	18.660
Correlation Coefficient (**r**)	-0.472	-0.535	-0.353
p-value	0.002	0.000	0.027

Previous studies have shown that Indonesia faces significant challenges in reducing the prevalence of hypertension and diabetes mellitus. Data from the 2018 Basic Health Research (Riskesdas) showed that the prevalence of diabetes mellitus in Indonesia

was 10.9%. In addition, the prevalence of hypertension also showed a significant increase. In 2019, there were 15,971 cases of diabetes mellitus recorded in Indonesia, placing this disease in the top ten diseases with the highest number of cases (Nurhalizah k et al., 2022) . The findings of this study illustrate the imbalance in the prevalence of hypertension and diabetes mellitus between regions in Indonesia. The short-term impact of this problem is enormous, where individuals with hypertension and diabetes mellitus are at high risk of health problems, decreased organ function, and other serious complications. In the long term, this problem can affect individual productivity, increase vulnerability to other non-communicable diseases, and add to the burden on the country's health system and economy (Ednur et al., 2023).

The results in Table 3 show varying relationships between seasoning consumption and the prevalence of hypertension in Indonesia. In one analysis, a positive relationship was found, with correlation coefficients of r = 0.470 (based on the doctor's diagnosis) and r = 0.511 (based on measurements), indicating moderate to strong correlations, respectively. The p-values were 0.003 and 0.001, both below 0.05, suggesting statistically significant associations. These results imply that higher seasoning consumption is associated with a higher prevalence of hypertension. Conversely, other analyses revealed a negative relationship. For seasoning consumption 1–6 times per week, correlation coefficients were r = -0.340 (doctor's diagnosis) and r = -0.347 (measurement results), both indicating moderate negative relationships, with statistically significant p-values of 0.034 and 0.030, respectively. A separate analysis of seasoning consumption every month showed stronger negative correlations: r = -0.472 (doctor's diagnosis) and r = -0.535 (measurement), with p-values 0.002 and 0.000, respectively. These results suggest that less frequent seasoning consumption is associated with lower hypertension prevalence.

The results of the study showed a significant relationship between the consumption of seasonings and the prevalence of hypertension based on the doctor's diagnosis and measurement results. Consumption of seasonings ≥1 time per day has a positive correlation with the prevalence of hypertension based on the doctor's diagnosis. Based on the interpretation of the strength of the relationship, the R value shows a moderate to strong relationship, which means that the higher the frequency of seasoning consumption, the higher the prevalence of hypertension. This can happen because the use of seasonings such as monosodium glutamate (MSG) in high amounts can cause increased blood pressure due to the large amount of sodium contained in food. Excessive sodium consumption can retain water (retention), so there is an increase in blood volume. Because of the increase in blood volume, the heart has to work harder to pump it, and blood pressure increases.

In contrast, moderate consumption of seasonings (1–6 times per week) showed a negative correlation with the prevalence of hypertension. This suggests that moderate consumption may play a role in reducing the prevalence of hypertension. However, very low consumption of seasonings (≤3 times per month) showed a stronger negative relationship with the prevalence of hypertension based on measurement results ($r = -0.535$; $p < 0.001$). This suggests that the less frequent the consumption of seasonings, the lower the risk of hypertension. This study is in line with Mantuges et al. (2021), which states that the results of interviews with subjects showed that the use of seasonings in the food processing process also contributed to the incidence of hypertension. According to research from Hendriyani et al. (2024) explains the Consumption of high-sodium foods once or more than once a day or once in three days and more than five types of food is significantly

related to blood pressure status. Consumption of foods that contain high sodium can cause the diameter of the arteries to shrink, thus triggering the heart to work harder to pump blood, which causes increased blood pressure. In addition, excessive sodium consumption will increase extracellular fluid, which triggers an increase in blood volume, which causes hypertension.

This study is research by Novitasari et al. (2024), which states that there is a significant relationship between sodium consumption and the incidence of hypertension in the Batu Health Center work area. Respondents who often consume foods containing sodium are more likely to suffer from hypertension than respondents who rarely consume sodium. This study found that the sources of sodium most often consumed by the people of Batu City are fried foods, meatballs, and seasonings such as soy sauce. People have a habit of adding seasonings to every dish, and soy sauce and salted fish are often eaten as side dishes. This can certainly cause blood pressure to increase and cause hypertension.

The results in Table 3 show there was a positive correlation between seasoning consumption and the prevalence of diabetes mellitus, with a correlation coefficient of r = 0.364 and a statistically significant p-value of 0.023. This suggests that higher daily seasoning consumption may be associated with a higher prevalence of diabetes. However, subsequent analyses revealed negative relationships. For seasoning consumption, 1–6 times per week, the correlation with diabetes mellitus, which indicates a low negative relationship, but the p-value of 0.087 shows this association was not statistically significant. In contrast, a more substantial negative relationship was observed when seasoning consumption was assessed monthly, with a correlation coefficient of r = -0.353 and a significant p-value of 0.027. These findings suggest that lower seasoning consumption may be linked to lower diabetes prevalence, although the strength of this relationship remains weak to moderate.

Consumption of seasonings also has a significant relationship with the prevalence of diabetes mellitus based on a doctor's diagnosis. Consumption of seasonings ≥1 time per day has a positive correlation with the prevalence of diabetes mellitus (r = 0.364; p = 0.023). This shows that the higher the frequency of consumption of seasonings, the higher the prevalence of diabetes mellitus. Excessive sodium consumption, including that from seasonings, can cause fluid retention in the body, which increases blood volume and blood pressure. In addition, high sodium intake can affect glucose metabolism and insulin sensitivity, which contributes to the development of diabetes mellitus (Hendriyani et al., 2024). According to research from Dewanti et al., (2022) Seasonings such as monosodium glutamate (MSG) added to food to add delicious taste in the long term can damage neurons in the nucleus and interfere with the delivery of leptin signals. This will cause leptin resistance which will exacerbate the risk of obesity and diabetes mellitus. research by Gultom and Ginting (2023) showed a relationship between blood glucose levels and hypertension in patients with type 2 diabetes mellitus, indicating that these two conditions are interrelated (Ginting et al., 2024) . Therefore, it is important to pay attention to the consumption pattern of seasonings, especially those containing MSG and sodium, to reduce the risk of hypertension and diabetes mellitus.

However, moderate consumption of seasonings (1–6 times per week) did not show a significant association with the prevalence of diabetes mellitus. This indicates that moderate consumption may not have a direct impact on the risk of diabetes mellitus. In contrast, very low consumption of seasonings (≤3 times per month) had a negative association with the prevalence of diabetes mellitus (r = -0.353; p = 0.027), meaning that the less frequent the

consumption of seasonings, the lower the risk of diabetes mellitus.

CONCLUSION

The results of this study can conclude that there is a significant relationship between the consumption of seasonings and the prevalence of hypertension and diabetes mellitus in Indonesia. High consumption of seasonings, especially those containing sodium and monosodium glutamate (MSG), contributes to increased blood pressure through the mechanism of fluid retention and increased blood volume. In addition, the habit of consuming seasonings more often is also associated with an increased risk of diabetes mellitus, which can be influenced by leptin resistance and metabolic disorders due to excessive MSG intake.

This study emphasizes the importance of nutritional education for the community to control the consumption of seasonings to reduce the risk of hypertension and diabetes mellitus. Regulation of sodium content in food products and promotion of the use of natural seasonings as a healthy alternative also needs to be improved. Thus, effective intervention policies in controlling the consumption of seasonings can contribute to improving overall public health.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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INTEGRATION OF DIGITAL HEALTH EDUCATION MODELS INTO PRIMARY HEALTHCARE SERVICES TO IMPROVE EARLY DETECTION AND TREATMENT ADHERENCE FOR TUBERCULOSIS: A SYSTEMATIC REVIEW

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ABSTRACT

Background: *Tuberculosis (TB) remains a major public health concern globally. In Indonesia, TB control is challenged by delayed case detection and poor treatment adherence. This review evaluates the effectiveness of digital health education interventions such as the KECAPI model in improving early detection and treatment adherence, and explores their integration into primary healthcare.*
Methods: *A systematic literature search was conducted across PubMed, Scopus, and Google Scholar for studies published between 2013-2023. A total of 27 studies were included.*
Results: *Digital interventions including SMS, mobile apps, video DOT, and web-based tools demonstrated significant improvements in TB knowledge, early detection, and adherence.*
Conclusion: *Digital education models can enhance TB control. Integrating such models into primary health services holds strong potential.*

Keywords: *Tuberculosis, digital health, adherence, detection, primary care*

INTRODUCTION

Tuberculosis (TB) remains the leading cause of death from infectious diseases globally. In 2023, TB surpassed COVID-19 with approximately 1.25 million deaths and 10.8 million new cases reported worldwide (WHO, 2023). Indonesia ranks among the top five countries with the highest TB burden, alongside India, China, the Philippines, and Pakistan. The World Health Organization (WHO) identifies these countries as contributing to over 50% of the global TB incidence (WHO, 2023).

Despite the availability of free and effective treatment through national programs, Indonesia continues to face persistent challenges in TB control. Delayed diagnosis and poor treatment adherence remain central issues. Several factors contribute to this problem, including geographic and economic barriers to healthcare access, social stigma surrounding TB, and a general lack of TB-related health literacy among the population (Chaniago et al., 2021; Aditama et al., 2022).

Digital health interventions (DHIs)—including mobile health (mHealth) applications, SMS-based reminders, and video-observed therapy (vDOT)—have emerged as promising solutions to address these challenges. These interventions enable real-time monitoring, improve patient engagement, and provide accessible health education, even in remote areas (Thomas et al., 2020; Liu et al., 2015). Evidence from various studies demonstrates the effectiveness of DHIs in

increasing treatment adherence and reducing default rates.

In Indonesia, one innovative initiative is the KECAPI model (Keluarga Cegah dan Peduli Tuberkulosis), a culturally contextualized DHI that integrates TB education, self-screening, and treatment support into primary healthcare services. Developed with the intent to empower families and communities, KECAPI emphasizes accessible and user-friendly digital tools to enhance early detection and sustained adherence (Abbasiah et al., 2022). The model aligns with the country's health system structure and supports TB control strategies at the grassroots level.

METHODS

This review followed PRISMA guidelines. Articles were searched using terms including "tuberculosis," "digital intervention," "treatment adherence," and "primary health care." Inclusion criteria were interventional studies, published in English or Bahasa Indonesia, between 2013–2023, assessing digital tools in TB management. From 312 records, 27 studies met inclusion.

Search Strategy

A systematic search was conducted in PubMed, Scopus, and Google Scholar databases using keywords: "tuberculosis," "digital health," "treatment adherence," "self-screening," "mobile health," and "primary care." Boolean operators and filters were applied to refine the search. The search strategy was guided by PRISMA guidelines to ensure comprehensive coverage.

Eligibility Criteria

This review included peer-reviewed interventional studies published between 2013 and 2023 in English or Bahasa Indonesia. Eligible studies evaluated digital tools aimed at improving TB management, such as mobile applications, SMS reminders, or web-based platforms. Studies focusing solely on qualitative outcomes or lacking full-text availability were excluded.

PRISMA Diagram

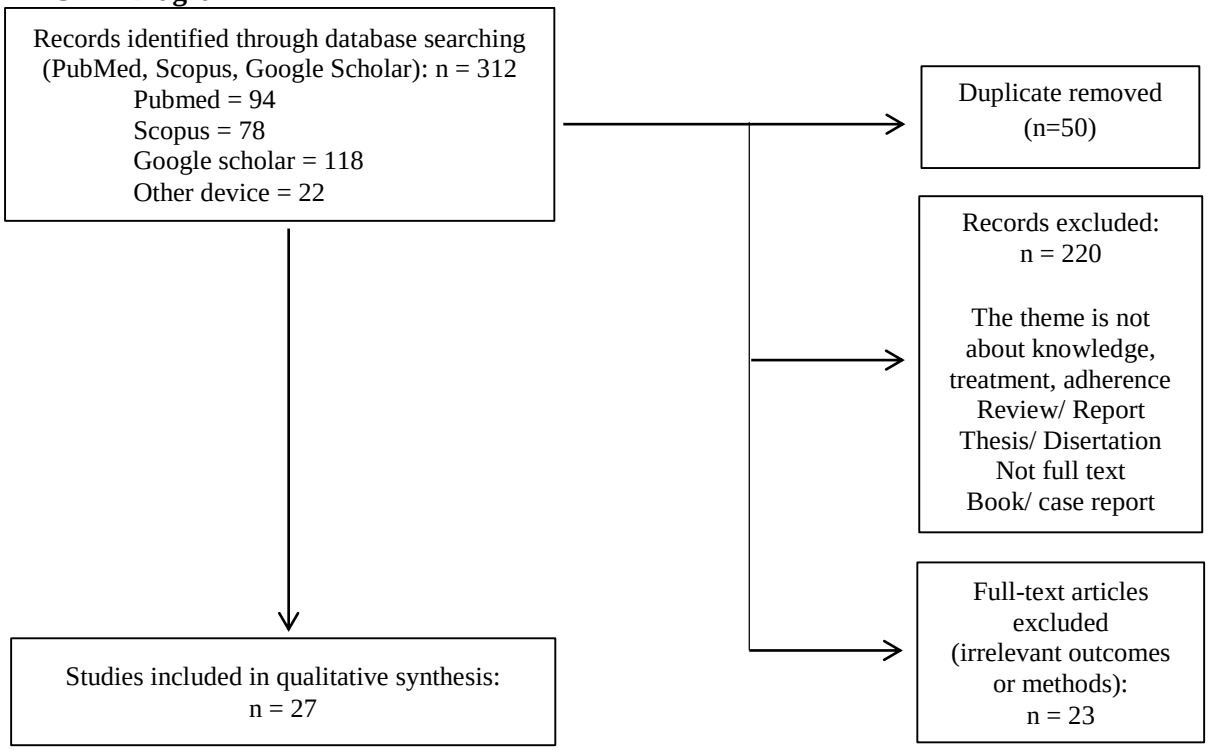


Figure 1. PRISMA flow diagram of the systematic review

Study Quality

Study quality was assessed using the Mixed Methods Appraisal Tool (MMAT) and Cochrane Risk of Bias criteria for RCTs. Studies ranged from moderate to high quality.

Extraction and Analysis

Data were extracted using a standardized form: author, year, location, study design, type of digital intervention, outcomes, and key findings. Thematic synthesis was used for qualitative integration.

RESULTS AND DISCUSSION

RESULTS

Among the 27 studies included in this systematic review, digital health interventions demonstrated significant contributions to improving both early detection and treatment adherence in tuberculosis (TB) care. The most frequently employed interventions were SMS reminders, mobile applications for education and symptom tracking, and video Directly Observed Therapy (vDOT) for remote treatment monitoring.

Out of these, 15 studies specifically reported improved treatment adherence following digital health implementations. For instance, Patel et al. (2023) documented a treatment adherence rate of 90.87% using a gamified mobile application tailored to enhance engagement and motivation among TB patients. Similarly, Liu et al. (2015) and Bediang et al. (2018) reported significant increases in medication adherence and treatment completion rates among patients receiving SMS reminders compared to control groups.

Six studies focused on improvements in TB-related knowledge, particularly through the use of digital e-booklets, mobile-based educational tools, and online modules. Irawati et al. (2023) found that participants who used e-booklets exhibited a statistically significant increase in knowledge regarding TB symptoms, transmission, and prevention. In addition, Hasan et al. (2021) reported that an Android-based TB education application led to substantial improvements in both knowledge and adherence behavior among patients.

Early detection was another key outcome identified in four studies. These studies examined the use of digital self-screening tools and symptom-based algorithms that facilitated timely identification of suspected TB cases, especially in community settings. Notably, Abbasiah et al. (2022) introduced the KECAPI model, a culturally adapted digital intervention from Indonesia, which enabled family-based screening through a mobile platform, thereby supporting prompt referral and diagnosis within primary care networks.

The included studies were conducted in high-burden TB countries, namely India, China, Indonesia, Vietnam, and Cameroon. The study designs encompassed randomized controlled trials (RCTs), quasi-experimental designs, and pre-post intervention studies, contributing to the overall methodological robustness and enhancing the generalizability of the findings across different healthcare settings.

Screening Strategies

Initial screening involved titles and abstracts (n=312). Duplicates were removed (n=42), followed by full-text assessment of 50 studies. Final inclusion was 27 studies based on relevance and methodological rigor.

Screening Results

From an initial pool of 312 records, 270 unique articles were identified after removing duplicates. Title and abstract screening excluded 220 articles due to irrelevance or lack of digital intervention focus. Full-text review of 50 articles led to the inclusion of 27 studies that met all eligibility criteria.

The included studies varied in design, intervention type, and outcomes measured. Common interventions included SMS reminders, mobile applications, and video-observed therapy. These studies provided

insights into the effectiveness of DHIs in improving TB treatment adherence and early detection .

DISCUSSION

The integration of digital health interventions (DHIs) into tuberculosis (TB) management has yielded promising outcomes, particularly in enhancing treatment adherence and enabling earlier detection. Multiple studies have reported the effectiveness of SMS reminders in improving medication adherence, which has translated into higher treatment completion rates. For instance, Liu et al. (2015) demonstrated that electronic reminder systems significantly improved adherence among TB patients, reinforcing the feasibility of simple, low-cost technologies in resource-limited settings.

Mobile health applications further support TB control by offering interactive platforms for patient education, symptom reporting, and self-monitoring. These applications promote active engagement from patients and increase accountability in their treatment journey. Thomas et al. (2020) emphasized the role of mobile health tools in providing real-time feedback and remote management, thereby improving patient-provider communication and reducing default rates [2] Additionally, video-observed therapy (vDOT) has been effective in ensuring compliance by allowing remote supervision of daily medication intake, thus minimizing the need for direct physical observation by health workers.

Despite these advancements, several challenges persist in the implementation of DHIs. Technological barriers, such as limited internet connectivity, lack of smartphone ownership, and digital illiteracy, often impede widespread adoption, particularly in rural or marginalized communities. Furthermore, patient data privacy and confidentiality remain pressing ethical issues, especially when dealing with stigmatized diseases like TB. Healthcare workers also require adequate training to effectively utilize digital tools, which necessitates institutional investment and policy support.

The KECAPI model, developed in Indonesia, presents a contextually grounded approach to integrating DHIs with primary healthcare services. Designed with cultural sensitivity, it leverages community-based self-screening and education modules to address local barriers, such as stigma and misinformation. Abbasiah et al. (2022) found that KECAPI effectively increases TB case detection and awareness through household-level interventions and digital content tailored to the Indonesian population. Such models demonstrate the importance of localized innovation in global TB control strategies.

Looking forward, future research should prioritize large-scale implementation studies that explore the scalability, cost-effectiveness, and long-term impact of DHIs across diverse settings. In addition, collaborative frameworks involving policymakers, public health institutions, healthcare providers, and digital technology developers are essential to optimize the design, integration, and sustainability of digital tools. This multi-sectoral approach will ensure that DHIs are not only effective but also accessible, acceptable, and equitable in their deployment (WHO, 2023).

CONCLUSION

Digital health education significantly improves TB program outcomes. Integration of models like KECAPI into primary healthcare services offers a strategic opportunity for scalable and sustainable TB control.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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THE RELATIONSHIP BETWEEN THE SEVERITY OF *CHRONIC MYELOCYTIC LEUKEMIA* (CML) PATIENTS AND *THE MYELOID: ERYTHROID RATIO* AT MOHAMMAD HOESIN HOSPITAL, PALEMBANG

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ABSTRACT

Background: *Chronic Myelocytic Leukemia (CML) is a type of blood cancer caused by abnormalities in hematopoietic stem cells, often linked to the Philadelphia chromosome. It progresses through three phases: chronic, accelerated, and blastic. Diagnosis involves bone marrow puncture (BMP), which also measures the Myeloid: Erythroid (M: E) ratio to assess blood cell production. CML accounts for about 15% of adult leukemia cases, mostly in individuals aged 40–60. Mohammad Hoesin Hospital (RSMH) in Palembang serves as a cancer referral center with integrated oncology services.*
Objective: This study investigates the relationship between CML severity and M: E ratio in patients at RSMH in 2024.
Method: *The research method uses Descriptive Analytical with a Cross Sectional approach. The number of samples that will be used in this research is 40 Chronic Myelocytic Leukemia patients in the Internal Medicine Hematology Oncology Division of Mohammad Hoesin Hospital (RSMH). Bone marrow samples analyzed via BMP and stained with Wright stain. The Myeloid:Erythroid (M:E) ratio, measured from bone marrow examinations. This ratio indicates the balance of blood cell production and is essential for evaluating disease impact.*
Result: *The mean severity was in the chronic phase for 32 patients (76.2%). The average myeloid-to-erythroid (M: E) ratio was 22.69, with 40 patients (95.2%) showing a high ratio (>6:1). There was no statistically significant correlation between disease severity and the M: E ratio (p>0,05).*
Conclusion: *These findings suggest that most patients were in the chronic phase, indicating a lower severity. The chronic phase is characterized by a relatively stable condition with fewer blast cells in the blood and bone marrow, in contrast to the more aggressive accelerated and blastic phases. Implement a comprehensive early-detection program for leukemia across all age groups—from students to the general population to facilitate timely diagnosis and treatment.*

Keywords: *Bone marrow, Chronic Myelocytic Leukemia, Myeloid: Erythroid Ratio*

INTRODUCTION

Leukemia is a hematological malignancy caused by immunological, genetic, viral and chemical factors (Zelly, 2012). Chronic Myelocytic Leukemia (CML) is a type of cancer caused by disorders of the hematopoietic stem cell. CML is a form of leukemia characterized by an increase and uncontrolled growth of myeloid cells in the bone marrow (Sawyers, 2004). Bone marrow is an organ that produces blood cells in the body. Bone marrow examination, is often called Bone marrow puncture (BMP), is a procedure to take a bone marrow sample to check for signs of certain diseases, one of which is Chronic Myelocytic Leukemia (CML). Through BMP can be seen disorders and blood cancers, and other conditions that affect the bone marrow. (Bakta, 2016). Myeloid erythroid ratio (M: E ratio) can be used to see if there is a problem with blood cell production in the bone marrow. Myeloid-erythroid ratio is a procedure for taking a bone marrow sample to check for signs of certain diseases (Siloam Hospital, 2024). The cause of CML is unclear, with an important role of genetic and environmental factors, such as exposure to radiation (Jonathan and Rahmasari, 2017). The aims of this study is to investigate the relationship between CML

severity and M: E ratio in patients at RSMH in 2024.

METHODS

The research method uses Descriptive Analytical with a Cross Sectional approach. The number of samples that will be used in this research is 40 *Chronic Myelocytic Leukemia* patients in the Internal Medicine Hematology Oncology Division of Mohammad Hoesin Hospital (RSMH). Bone marrow samples analyzed via BMP and stained with Wright stain. The *Myeloid: Erythroid* (M:E) ratio, measured from bone marrow examinations. This ratio indicates the balance of blood cell production and is essential for evaluating disease impact.

RESULTS AND DISCUSSION

The research was conducted in January-June 2024 at Mohammad Hoesin Hospital (RSMH) Palembang City with 40 *Chronic Myelocytic Leukemia* patients in the Internal Medicine Hematology Oncology Division of Mohammad Hoesin Hospital (RSMH).

3.1 Characteristics of Respondents Based on Gender

Total respondents in this research were 42 patients with Chronic Myelocytic Leukemia (CML) at RSMH Palembang with male patients 23 (54.8%) in higher proportion. This result indicates a slight male predominance in CML cases at the study site (Figure 1).

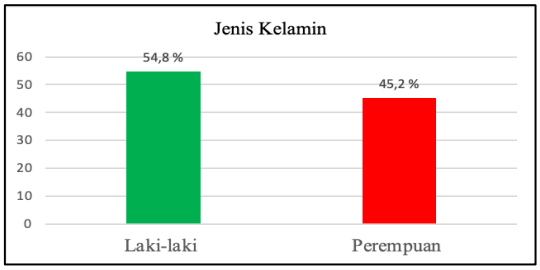


Figure 1. Characteristic of respondents based on gender

This aligns with a study by Adhika and Joko (2020) at the Regional General Hospital of West Nusa Tenggara Province, which also reported a higher number of male patients (61.5%). The study found that among 42 CML patients at Mohammad Hoesin Hospital, Palembang, the majority were male (54.8%). This may be due to genetic differences, including a higher number of target cells and cancer-prone genes in males, as suggested by Radivoyevitch (2020) and research from the Broad Institute of Harvard and MIT (Todd Gersten, 2022). Similarly, data from the United States show that males are about 38% more likely to be diagnosed with leukemia than females.

3.2 Characteristic Respondents Based on Age

Most patients were in the early elderly group (46–55 years): 13 patients (31.0%). Most CML patients fall within the middle-aged to early elderly range, with fewer cases in very young or older populations (Figure 2).

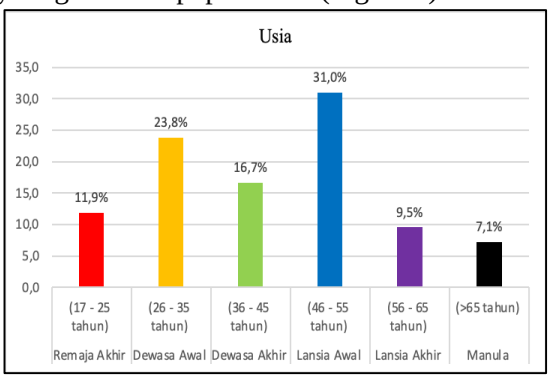


Figure 2. Characteristic of respondents based on age

This Study is consistent with a 2020 study by Adhika and Joko. CML is more common in adults aged 65-74, with a median diagnosis age of 65. Bintoro (2019) identifies age, gender, radiation exposure, and low immunity as risk factors for CML. Genetic mutations in bone marrow cells, which are more common in older adults, contribute to the development of the disease.

3.3 Average Severity of Chronic Myelocytic Leukemia (CML) Patients

The average severity of Chronic Myelocytic Leukemia (CML) based on 42 patients was chronic phase (<10% blast cells): 32 patients (76.2%). Accelerated phase (10–19% blast cells): 5 patients (11.9%). Blastic phase (≥20% blast cells): 5 patients (11.9%). The majority of patients are in the chronic phase, indicating early detection and potentially better prognosis (Figure 3).

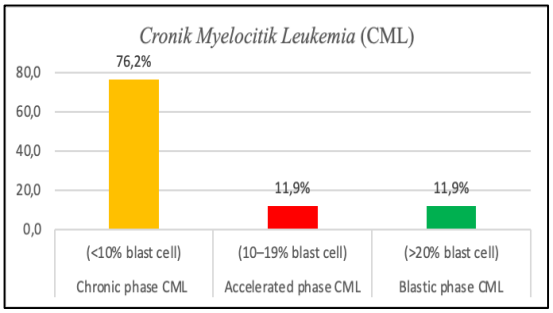


Figure 3. Average Severity of Chronic Myelocytic Leukemia (CML) Patients

These findings suggest that most patients were in the chronic phase, indicating a lower severity. The chronic phase is characterized by a relatively stable condition with fewer blast cells in the blood and bone marrow, in contrast to the more aggressive accelerated and blastic phases.

3.4 Average Myeloid Erythroid Ratio In Chronic Myelocytic Leukemia (CML) Patients

The average Myeloid Erythroid Ratio in Chronic Myelocytic Leukemia (CML) Patients was a High Ratio (≥6:1): 40 patients (95.2%), a Normal Ratio (1.2:1 – 5:1): 2 patients (4.8%), Low Ratio (<1.2:1): 0 patients (0%). Almost all patients exhibit elevated M: E ratios, indicating an overproduction of myeloid cells in bone marrow, a hallmark of CML (Figure 4).

In 42 CML patients at Mohammad Hoesin Hospital in Palembang (2024). Subsequent correlation analysis revealed no significant relationship between disease severity and the myeloid-to-erythroid (M: E) ratio (p <0,05).

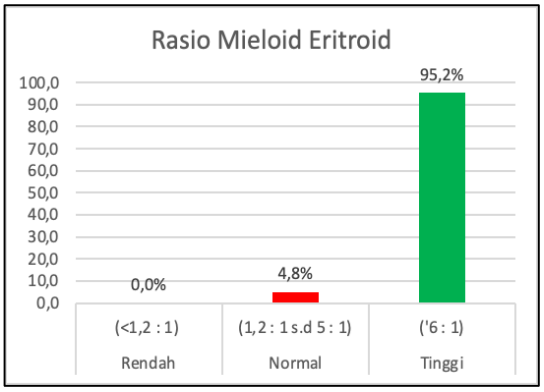


Figure 4. Average Myeloid Erythroid Ratio in Chronic Myelocytic Leukemia (CML) Patients

Myeloblasts, immature white-blood cells in the bone marrow, may rise during CML progression, but did not show a direct link to the M:E ratio. This finding aligns with Ashkan (2023), who noted that elevated granulocyte counts (up to ≤50 × 10⁹/L in asymptomatic and 200–1,000 × 10⁹/L in symptomatic patients), along with neutrophilia, basophilia, and eosinophilia, characterize CML, while hemoglobin and platelet levels often remain near normal.

CONCLUSION

There was no statistically significant correlation between disease severity and the M: E ratio (p>0,05). These findings suggest that most patients were in the chronic phase, indicating a lower severity. The chronic phase is characterized by a relatively stable condition with fewer blast cells in the blood and bone marrow, in contrast to the more aggressive accelerated and blastic phases. Implement a comprehensive early-detection program for leukemia across all age groups—from students to the general population to facilitate timely diagnosis and treatment.

CONFLICT OF INTEREST

There was no conflict of interest in the manuscript.

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SUPPLEMENTARY FOOD AND CONSUMPTION OF IRON TABLETS WITH THE PREVALENCE OF CHRONIC ENERGY DEFICIENCY

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ABSTRACT

Background: *The prevalence of pregnant and non-pregnant women experiencing chronic nutritional deficiency (CED) has become a societal issue. Chronic Energy Deficiency is characterized by chronic energy intake occurring in women of reproductive age. The provision of Supplementary Food based on local food with regional menus adjusted to local conditions, as well as the consumption of iron tablets (CIT), aims to meet nutritional needs, especially for those experiencing Chronic Energy Deficiency. The study aims to determine the relationship between the prevalence of the proportion of supplementary feeding and iron tablet distribution with the prevalence of chronic energy deficiency in Indonesia.*

Method: *This research uses aggregated data from the 2023 Indonesian Health Survey (IHS). The sample consists of 38 provinces in Indonesia divided into seven regions. The dependent variable is the prevalence of Chronic Energy Deficiency in pregnant and non-pregnant women. The independent variables are the proportion of women (pregnant and non-pregnant) who do not receive Supplementary Food and the proportion of mothers (pregnant and non-pregnant) who do not receive consumption of iron tablets. Data analysis used the Spearman test.*

Result: *The research findings indicate that there is no significant relationship between the proportion of non-receipt of Supplementary Food and the proportion of non-receipt of (CIT) with the prevalence of pregnant and non-pregnant women with chronic nutritional deficiency (CED) (p-value >0.05)*

Conclusion: *Further evaluation is needed on the effectiveness of the Supplementary Feeding and Iron Tablet programs, as well as a more comprehensive approach to reducing the prevalence of anemia in Indonesia*

Keywords: *Consumption of iron tablets, supplementary food, chronic energy deficiency*

INTRODUCTION

In Indonesia, nutritional deficiencies are associated with low nutritional status, indicating the occurrence of deficiencies (Pastuty et al., 2018). Chronic nutritional deficiency (CED) remains a major issue affecting women of reproductive age, as those experiencing CED have a high risk of giving birth to children who will later experience CED (Fitriana et al., 2024). In addition, malnutrition causes health problems such as morbidity, mortality, and disability, as well as reducing the quality of human resources (Irnawati, 2024). Chronic Energy Deficiency (CED) in Women of Reproductive Age (WRA) and pregnant women also poses a risk of giving birth to Low Birth Weight (LBW) (Andini, 2020). This is caused by a low intake of macro and micronutrients. The measurement of Upper Arm Circumference (UAC) on the arm that is less actively moving is one of the indices used to identify the risk of Chronic Energy Deficiency (CED) in anthropometric measurements. In Indonesia, the threshold value used is an average UAC < 23.5 cm, which indicates a risk of chronic energy deficiency among women of reproductive age (Pujiastuti et al., 2023). The condition of pregnant women with Chronic Energy Deficiency (CED) are at risk of reduced muscle strength that aids the delivery process (Utami et al., 2018). Other impacts of Chronic Energy Deficiency (CED) can also occur, such as increasing the risk of anemia, bleeding, and contracting infectious diseases (Andini, 2020).

Data from the United Nations International Children's Emergency Fund (UNICEF) in 2011 showed that the prevalence of chronic energy deficiency (CED) among pregnant women was 41%, in India it was around 19%, in Bangladesh it was 34%, and in Dhaka it was 34**%** (Novianti et al., 2022)**.** In developing countries, the prevalence of CED ranges from 15–47%, with Indonesia ranking fourth after India with a prevalence of 35.5% (Bakri, 2021). The increase in the number of CED cases in Indonesia from 2019 (11,487) to 2020 (11,357) shows an insignificant change or a very slight decrease in the number of cases. In 2021, the number of CED cases surged to 23,096, indicating a significant increase compared to the previous year (Harmawati Rustan et al., 2024).

Efforts to provide supplementary food and the consumption of iron tablets to improve nutrition in addressing nutritional problems (Adfar et al., 2023). This strategy, especially for vulnerable groups, in addressing nutritional problems (Puspitasari et al., 2021)**.** Supplementary feeding (SF) is carried out by providing safe and high-quality food (Nurhayati, 2021). Providing a high intake of energy and protein (Bakri, 2021). The supplementary feeding program is aimed at pregnant women whose examination results show an upper arm circumference (UAC) of less than 23.5 cm (Wariyaka & Kristin, 2024). Provision of supplementary food to vulnerable groups (Rohmah, 2020)**.** Efforts to provide supplementary food for pregnant women with CED to improve the nutritional status of pregnant women (Erna et al., 2023).

The administration of consumption of iron tablets with proper dosage can prevent anemia and increase iron reserves in the body (Fathony et al., 2022). One tablet (60 mg of elemental iron and 400 mcg of folic acid) is given as a blood tablet supplement (Rizkiana, 2022). Anemia can occur due to a decrease in hemoglobin levels in the blood (Ningtyas et al., 2021). In addition, iron deficiency can cause disturbances in the growth of body cells (Nurahmawati & Wulaningtya, 2024). Anemia does not occur in mothers who properly consume iron supplements (Sunarti Ayu, 2024). The impact of anemia on pregnant women results in bleeding, hinders fetal growth, increases the risk of miscarriage, and leads to premature birth and low birth weight (Luh Putu Sri Yuliastuti et al., 2023). This study aims to determine the relationship between the prevalence of the proportion of Supplementary Food (SF) and the Consumption of Iron Tablets (CIT) provision and the prevalence of chronic energy deficiency (CED) in Indonesia.

METHODS

This study uses aggregated data from 2023 Indonesian Health Survey (IHS) (SKI, 2023). The research uses a cross-sectional approach that allows the researchers to compare the proportion of Chronic Energy Deficiency among pregnant and non-pregnant women. HIS 2023 was conducted from August to October 2023 across all provinces in Indonesia, selected through stratified random sampling involving 586 thousand households in 38 provinces. The population of IHS 2023 consists of all women aged 10-54 years, while the sample includes women aged 10-54 years who are pregnant and not pregnant at the time of the survey. The population and sample of this study are 38 provinces in Indonesia, which are divided into 7 regions.

Independent variables are the proportion of currently pregnant women who do not receive Supplementary Food and the proportion of women aged 10-54 who have never received Consumption Iron Tablets (CIT). To calculate the proportion of pregnant women who do not receive Supplementary Food (SF). The number of pregnant women aged 10-54 years who do not receive Supplementary Food (SF)/the number of pregnant women aged 10-54 years. To calculate the proportion of women aged 10-54 who did

not receive CIT. The number of women aged 10-54 who did not receive CIT during the last child's pregnancy (who gave birth between January 1, 2018, and the interview date) according to the source of data. The number of women aged 10-54 who did not receive CIT during their last child's pregnancy (who gave birth in the period from January 1, 2018, to the interview). The dependent variable used is the prevalence of Chronic Energy Deficiency (CED) in pregnant and non-pregnant women. There is a formula to calculate the prevalence of CED in pregnant and non-pregnant women. The number of pregnant and non-pregnant women with mid-upper arm circumference (MUAC) <23.5 cm / The number of pregnant and non-pregnant women. Measurement of Upper Arm Circumference (UAC) using a UAC measuring tool with an accuracy level of 1 mm, conducted by trained enumerators with a minimum educational background of a Diploma 3 in Health.

Data analysis uses univariate analysis based on variance measures (minimum, maximum, mean, and standard deviation). Bivariate analysis uses the Spearman Test with the SPSS version 22 program (Statistical Package for the Social Sciences). This research is limited to the data available in IHS 2023 and cannot control other factors that may influence CED.

RESULTS AND DISCUSSION

Table 1 shows the prevalence of Chronic Energy Deficiency (CED) in the Indonesian region in 2023 among pregnant women, with the highest prevalence in the Papua region at 23.5% and the lowest in the Kalimantan region at 12.8%. Whereas in non-pregnant women, the highest prevalence of CED is found in the Southeast region at 29.0% and the lowest in the Java-Balinese region at 18.8%. The national figures show the prevalence of pregnant women with CED (17.1%) and non-pregnant women with CED (21.2%).

Table 1. Distribution of Chronic Energy Deficiency (CED) Prevalence by Indonesian Region in 2023

Regional		Min	Max	x̄±SD
Sumatera	Pregnant womens	10.1	19.2	14.8±3.4
	Non-pregnant women	17.2	22.8	18.8±1.6
Java-Balinese	Pregnant women	5.4	24.6	14.7±7.1
	Non-pregnant women	12.5	22.5	19.2±3.3
Southeast	Pregnant women	15.7	28.0	21.8±8.6
	Non-pregnant women	22.4	35.7	29.0±9.4
Kalimantan	Pregnant women	5.2	20.0	12.8±5.5
	Non-pregnant women	18.4	23.0	20.8±1.7
Sulawesi	Pregnant women	10.5	21.5	18.7±4.1
	Non-pregnant women	17.6	23.9	21.5±2.3
Maluku	Pregnant women	18.1	21.2	19.6±2.1
	Non-pregnant women	19.5	25.5	22.5±4.2
Papua	Pregnant women	7.6	44.7	23.5±13.5
	Non-pregnant women	21.0	30.9	24.8±3.5
Indonesia	**Pregnant women**	**5.2**	**44.7**	**17.1±7.4**
	Non-pregnant women	**12.5**	**35.7**	**21.2±3.9**

The results of this study show the prevalence of Chronic Energy Deficiency (CED) by region in Indonesia in 2023. Among pregnant women, the highest prevalence of CED is found in the Papua region at 23.5% and the lowest in the Kalimantan region at 12.8%. Among non-pregnant women, the highest prevalence of CED is found in the Southeast region at 29.0% and the lowest in the Java-Balinese regions at 18.8%. The national figures indicate the prevalence of CED among pregnant women, 17.1,% and non-pregnant

women 21.2%. The incidence of CED in pregnant women globally is reported to reach 35-75%, significantly higher in the third trimester compared to the first and second trimesters of pregnancy (Hasyim et al., 2023). Indonesia ranks fourth with the highest prevalence of CED among pregnant women, which is 35.5% (Sri Lestari et al., 2023).

Chronic Energy Deficiency (CED) in pregnant women can be described as a persistent malnutrition condition that can negatively impact the health of the mother and the growth of the fetus. Pregnant women with CED are characterized by an upper arm circumference (UAC) of less than 23.5 cm. The purpose of measuring the UAC is to determine the risk of CED in pregnant and non-pregnant women. Factors affecting the nutritional status of pregnant women with CED are direct and indirect factors. Direct factors include food consumption and diseases, while indirect factors include socio-economic factors (family income, mother's education level, other related factors), related to consumption patterns, behavioral factors), biological factors (mother's age during pregnancy, interval between pregnancies), number of births, weight during pregnancy) and activities, facilities, socio-cultural factors, environmental health, and treatment (Pujiastuti et al., 2023).

Table 2. Distribution of the Proportion of Pregnant Women Not Receiving Supplementary Food by Indonesian Region in 2023

Region	Min	Max	$\bar{x}$±SD
Sumatera	64.2	98.1	79.9±9.4
Java-Balinese	68.7	96.9	81.8±11.1
Southeast	69.8	76.8	73.3±4.9
Kalimantan	71.6	81.9	76.7±5.1
Sulawesi	70.0	83.7	76.3±4.4
Maluku	77.2	77.6	77.4±0.2
Papua	72.7	92.4	78.8±8.1
Indonesia	**64.2**	**98.1**	**78.9±7.8**

Table 2 shows the Proportion of Pregnant Women Currently Not Receiving Supplementary Food by the Indonesian Region in 2023, with the highest proportion in the Java-Balinese region (81.8%) and the lowest in the Southeast region (73.3%). Nationally, the proportion of currently pregnant women who do not receive Supplementary Food in Indonesia averages 78.9%.

The results of this study show that the proportion of pregnant women currently not receiving Supplementary Food by region in Indonesia in 2023 is highest in the Java-Balinese region at 81.8% and lowest in the Southeast region at 73.3%. Nationally, the proportion of pregnant women currently not receiving Supplementary Food in Indonesia averages 78.9%. The level of family income is one of the socio-economic indicators that plays a role in the provision of food and family eating patterns; income also affects the level of food expenditure incurred by a family. Low income can be one of the factors causing malnutrition status in toddlers, because if the income level is low, the food expenditure level is also low, which can lead to reduced purchasing power and food availability, affecting the optimal nutritional consumption level of toddlers.

Table 3 shows the Proportion of Women aged 10-54 years who received CIT by Indonesian Region in 2023, with the highest proportion of mothers not receiving CIT in the Papua region (27.4%) and the lowest in the Southeast region (3.2%). Nationally, the current proportion of mothers in Indonesia who do not receive CIT is an average of 11.4%.

The results of this study show the proportion of women aged 10-54 who received Consumption of Iron Tablets (CIT) by the Indonesian region in 2023, with the highest proportion of mothers not receiving CIT in the Papua region (27.4%) and the lowest in the Southeast region (3.2%). Nationally, the current proportion of mothers in Indonesia who do not receive iron tablets CIT is an average of 11.4%. The administration of CIT with proper dosage can prevent anemia and increase iron reserves in the body (Fathony et al., 2022). Chronic energy deficiency can lead to inadequate nutrient intake, thereby reducing the production of red blood cells and hemoglobin, which play a crucial role in preventing anemia.

Anemia can occur due to a decrease in hemoglobin (HB) levels in the blood (Ningtyas et al., 2021). There are several factors that influence the occurrence of iron deficiency anemia, namely the role of health workers and the availability of iron tablets. Health workers play an active role in providing health education and are involved in the treatment and healing process of diseases (Nisa et al., 2023).

Table 3. Distribution of the Proportion of Women aged 10-54 who do not receive Consumption of Iron Tablets

Region	Min	Max	$\bar{x}$±SD
Sumatera	5.9	17.8	10.5±3.7
Java-Balinese	2.9	9.3	5.6±2.1
Southeast	2.2	4.3	3.2±1.4
Kalimantan	5.2	14.1	9.2±3.5
Sulawesi	5.4	12.2	8.1±3.0
Maluku	12.5	15.1	13.8±1.8
Papua	12.4	54.8	27.4±18.7
Indonesia	**2.2**	**54.8**	**11.4±10.2**

Table 4 of the data analysis results shows that in pregnant women, the proportion not receiving Supplementary Food (p-value 0.12) and the proportion not receiving Consumption of Iron Tablets (p-value 0.10) are not related to the prevalence of pregnant women with CED. In non-pregnant women, the proportion not receiving Supplementary Food (p-value 0.84) and the proportion not receiving Consumption of Iron Tablets (p-value 0.45) are not related to the prevalence of non-CED pregnant women.

The results of this study used analysis with the Spearman test, obtaining a p-value >0.05, thus concluding that there is no significant relationship between the proportion of not receiving Supplementary Food and the proportion of not receiving Consumption Iron Tablets with the prevalence of pregnant and non-pregnant women with CED. This study is not in line with the research conducted by (Silawati and Nurpadilah, 2018) which states that the provision of supplementary food and milk to pregnant women affects weight gain in pregnant women with CED. The limitation of this study is that it only uses data from IHS 2023 without direct observation or in-depth interviews, so other factors influencing CED may not be detected.

Table 4. The relationship between the proportion of not receiving Supplementary Food and Consumption Iron Tablets (CIT) with the prevalence of Chronic Energy Deficiency (CED)

Prevalence of CED in Pregnant Women	Proportion Not receiving Supplementary Food	Proportion Not Receiving Consumption Iron Tablets
Beta	-0.22	0.19
Constant	34.74	14.95
Correlation coefficient (r)	0.25	0.26
p-value	0.12	0.10
Prevalence of CED in Non-Pregnant Women		
Beta	0.01	0.04
Constant	22.4	20.7
Correlation coefficient (r)	0.03	0.12
p-value	0.84	0.45

This results in information related to social, cultural, and individual behavior aspects in food consumption and nutritional intake patterns being less deeply detected. The advantage of this research on the relevant topic is that it addresses nutritional issues that remain a major problem in Indonesia, namely Chronic

Energy Deficiency (CED) in women of reproductive age. CED has long-term impacts on maternal and child health, including an increased risk of low birth weight, growth disorders, and increased morbidity and mortality for mothers and babies.

CONCLUSION

This study shows that there is no significant relationship between the proportion of not receiving Supplementary Food and the proportion of not receiving Consumption Iron Tablets with the prevalence of pregnant and non-pregnant mothers with CED. There are other factors such as diet, socioeconomic status, and community awareness of nutrition that also play a role in the occurrence of CED. Although no significant relationship was found, efforts to

provide supplementary food and iron tablets remain part of the strategy to improve nutritional status, especially for vulnerable groups. Further evaluation of the effectiveness of this program and a more comprehensive approach are needed to reduce the prevalence of CED in Indonesia. The issue of CED requires solutions that not only involve the health sector but also the education, social, and economic sectors. Collaboration between the government, academics, community organizations, and the private sector is essential to create a more comprehensive strategy to reduce the CED rate in Indonesia. Further research is needed to identify other factors contributing to CED, such as dietary patterns, access to healthcare services, and economic factors.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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THE RELATIONSHIP BETWEEN KNOWLEDGE AND TOOTH BRUSHING BEHAVIOR IN CHILDREN WITH MILD IMPAIRMENT IN SLBN SUNGAI PENUH CITY YEAR 2024

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ABSTRACT

Background: *Mental retardation is a child who has below average intellectual abilities and tends to be intellectually, physically, emotionally and socially retarded. The causes of dental and oral disease are influenced by various factors, including knowledge, behavior, and dental and oral health services. Dental and oral diseases that many Indonesian people suffer from are generally related to dental and oral hygiene. One way to maintain oral hygiene is by brushing your teeth properly and correctly. The aim of this research was to determine the relationship between knowledge and tooth brushing behavior in mentally retarded children at SLB N Sungai Penuh City.*
Method: *This research design used a cross sectional method, the sample used was purposive sampling, a total of 32 students. The data collection method is by distributing questionnaires to be filled in by students and using the data analysis technique uses Chi-Square.*
Result: *The results of research on the level of knowledge of SLB N students in Sungai Penuh City had high criteria of 31.3%, medium 43.8%, and low 25.0%. Based on tooth brushing behavior, the criteria are 34.4% good, 37.5% moderate, and 28.1%.*
Conclusion: *The results of statistical tests showed that there was a significant relationship between knowledge and toothbrushing behavior in children with intellectual disabilities at SLB N Sungai Penuh City.*

Keywords: *mental retarded, knowledge, behavior, brushing teeth*

INTRODUCTION

Oral health is part of physical health as the gateway to overall body health. In the oral cavity, there are teeth that function in chewing food, speaking, and maintaining beauty (Kemenkes RI, 2018). Oral health is important for general health and quality of life. Oral health means freedom from throat cancer, infections and sores in the mouth, gum disease, tooth decay, tooth loss, and other diseases, resulting in limited impairments in biting, chewing, smiling, and speaking, World Health Organization (WHO, 2012).

Health Research Data (Riskesdas) Jambi Province 2018, states that the population of Jambi Province in 2018 had oral health problems of 45.01%, for the age group 5-9 years of 52.08%, and the age group 10-14 years of 42.79%. Children who brush their teeth every day are 96.44%, the correct time to brush their teeth is 0.98%, while in Sungai Penuh City shows the percentage of children brushing their teeth every day is 97.51%, and the data on the percentage of children brushing their teeth at the correct time is 0.87%. This data shows that there is still a low level of how to maintain oral health (Kemenkes RI, 2018).

Oral health maintenance is one of the efforts to improve health. One of the causes of a person ignoring oral health problems is the factor of lack of knowledge and behavior about dental and oral hygiene (Gede et al., 2013). Knowledge is the result of human sensing, or

the result of someone knowing objects through their senses (eyes, nose, ears, and so on).

A person gains knowledge through sensing certain objects. Knowledge can be obtained naturally or in a planned manner, namely through the education process. Dental health education program (counseling) is one of the dental health programs with the aim of tackling dental health problems in Indonesia (Budihartono, 2013).

Oral hygiene maintenance behavior is the effort to improve health. The mouth is not just for the entrance of food and drink, but the function of the mouth is more than that, and not many realize the magnitude of the role of the mouth for one's health and well-being. Therefore, oral health plays a very important role in supporting one's health. One of the factors causing oral health problems in a person is the level of knowledge.

Knowledge is influenced by internal factors and external factors. Internal factors consist of age and gender, and external factors consist of occupation, information sources, experience, socio-culture, and environment. These factors affect a person's knowledge (Ratih, 2019).

Data from the World Bank shows that the population of students with special needs reaches 10%. It is estimated that 85% of students with special needs worldwide under the age of 15 are found in developing countries (Fasalwati, 2016). A special needs child is a child whose intelligence is far below average and is characterized by limited intelligence and inability to communicate socially. Children with special needs are also often known as mentally retarded because of their limited intelligence. As a result, children with special needs with tuna grahita have difficulty following education in ordinary schools (Atmaja, 2018).

Mild Tunagrahita, their intelligence level IQ ranges from 50 - 70,has the ability to develop in the field of academic subjects, social adjustment, and work skills, is able to adapt to a wider environment, can be independent in society, can do semi-skilled work, and simple work. Tunagrahita is another form of mental retardation. Tunagrahita is characterized by its main feature is weakness in thinking or reasoning, has learning abilities, and social adaptation is below average (Juwono, 2018).

The results of Simaremare and Wulandari (2021) on the relationship between the level of knowledge of oral health and dental care behavior in children aged 10-14 years show that there is a significant relationship between the level of knowledge and children's behavior towards oral hygiene. Meanwhile, the results of research by Zia et al (2023) on the relationship between children's level of knowledge about oral health and tooth brushing behavior in grades 1-3 at SDN 28 East Rawang, with a sample size of 103 respondents taken by purposive sampling.

Data collection was carried out by giving questionnaire sheets to 1-3 grade elementary school students at SDN 28 East Rawang. the results of statistical tests showed that there was a significant relationship between knowledge and tooth brushing behavior. Previous research examining the relationship between education levels and the behavior of maintaining oral health of children with disabilities in Sidoarjo City SLD by Julia et al, the number of research samples was 115 children with disabilities from SDLB, SMPLB, and SMALB education levels, it was found that the level of knowledge about how to maintain oral health of children with disabilities was 32% at a good level, 46% at a moderate level, and 22% at a bad level. In terms of behavior, 39% of children with dementia maintain their oral health at a good level, 59% at a moderate level, and 2% at a poor level.

The knowledge and behavior of mentally retarded children in maintaining oral health is mostly in the moderate category, the results of statistical tests show that the knowledge behavior of mentally retarded children in maintaining oral health has no relationship (Julia, et al., 2018).

METHODS

The tool to measure the level of knowledge and behavior is a questionnaire. This questionnaire uses a Guttman scale, which is a measurement with this scale that will get firm answers, such as "Yes" and 5 "No", "True" and "False" (Sugiyono, 2013). This type of research is quantitative research with a cross-sectional study method, in studying the dynamics of the correlation between risk factors and the effects of "knowledge and behavior" (Praktinya, 2010).

The population of all mildly retarded children at SLBN Sungai Penuh totaling 47 people, sampling by purposive sampling amounted to 32 people who met the instrinsic criteria. Research place at SLBN Kota Sungai Penuh, in March 2024.

Univariate analysis in this study is to see a description of the frequency distribution of each variable studied between knowledge and tooth brushing behavior in children with disabilities at SLBN Kota Sungai Penuh. Bivariate analysis is a data analysis conducted on two variables that are suspected to be related or correlated (Sibagariang, 2010).

The suspected variable is knowledge with tooth brushing behavior. The statistical test used is chi square because the data of the Independent and Dependent variables use a categorical scale.

RESULTS AND DISCUSSION

RESULTS

3.1 Knowledge

Table 1. Frequency Distribution of Respondents Based on Knowledge of Tunagrahita Children of SLB N Kota Sungai Penuh Year 2024

Knowledge	N	%
High	10	31,3
Medium	14	43,8
Low	8	25,0
Total	**32**	**100,0**

The results of the analysis of knowledge of children with disabilities in SLB N Kota Sungai Penuh, knowledge in high criteria 10 children (31.3%), moderate criteria 14 children (43.8%), and low criteria 8 children (25.0%). This shows that the level of knowledge of children with moderate criteria is more dominant than knowledge with high or low criteria.

3.2 Behavior

Table 2. Frequency Distribution of Respondents Based on the Behavior of Tunagrahita Children of SLB N Kota Sungai Penuh, Year 2024

Tooth Brushing Behavior	N	%
Good	11	34,4
Medium	12	37,5
Bad	9	28,1
Total	**32**	**100,0**

The results of the analysis of the level of behavior of children with disabilities in SLB N Kota Sungai Penuh, behavior with good criteria as many as 11 children (34.4%), moderate criteria as many as 12 children (37.5%), and bad criteria as many as 9 children (28.1%). This shows that the level of behavior with moderate criteria is more dominant than the behavior with good and bad criteria.

3.3 Bivariate Analysis Results

The relationship between the independent variable and the dependent variable was seen by conducting bivariate analysis using the ChiSquare test.

From the results of the analysis of the relationship between knowledge and tooth behavior, it was found that 2 children (6.3%) had good tooth brushing behavior and had low knowledge, as many as 3 children (9.4%) had good tooth brushing behavior and had moderate knowledge, while for good tooth brushing behavior and high knowledge there were 6 children (18.8%).

From the overall data results of the relationship between knowledge and tooth brushing behavior in children with disabilities in SLB N Kota Sungai Penuh, the most

dominant is knowledge with moderate criteria and moderate brushing behavior with a total of 25.0% higher than knowledge and tooth brushing behavior with high or good or low or bad criteria.

Table 3. Frequency Distribution of Respondents Based on the Relationship Knowledge with Tooth Brushing Behavior in Tunagrahita Children, SLB N Kota Sungai Penuh, Year 2024

Knowledge Level	Level of tooth brushing behavior								p-value
	Bad		Medium		Good		Total		
	N	%	N	%	N	%	N	%	
Low	5	15.6	1	3.1	2	6.3	8	25.0	0.033
Medium	3	9.4	8	25.0	3	9.4	14	43.8	
High	1	3.1	3	9.4	6	18.8	10	31.3	
Total	**9**	28.1	**12**	**37.5**	**11**	**34.4**	**32**	**100.0**	

The results of statistical tests using the Chi Square test obtained a p-value = 0.033. These results indicate that Ha is accepted and Ho is rejected, thus, it can be concluded that in this study, there is a relationship between knowledge and tooth brushing behavior in children with disabilities in SLB N Kota Sungai Penuh.

The results of the study of tooth brushing knowledge in SLB N Kota Sungai Penuh showed that the majority of children had moderate knowledge. This can be seen in Table 1, as many as 10 children (31.3%) have high-criteria knowledge, as many as 14 children (43.8%) have moderate criteria, and as many as 8 children (25.0%) have low criteria. The results of this study are also confirmed in research conducted by Julia et al (2018), regarding the relationship between the level of education and the level of education. the behavior of maintaining oral health of children with disabilities in Sidoarjo City SLB in 2018, the results of which showed that the knowledge 7 of children with disabilities had a moderate level of knowledge with a percentage of 0.43% higher than the good criteria with a percentage of 0.32% and bad criteria of 0.22%. From the results of the knowledge questionnaire that has been answered by 32 children with disabilities of SLB N Kota Sungai Penuh as many as 12 questions regarding tooth brushing knowledge and there are 3 questions (questionnaire numbers 10, 11 and 12) which only some children can answer correctly, while the contents of the questionnaire ask about the requirements for using toothpaste, brushing teeth and the right time to do oral health checks.

DISCUSSION

According to the Indonesian Ministry of Health (2012), the most important thing in choosing the time to brush your teeth is in the morning after eating and at night before going to bed. Toothpaste that is recommended for brushing teeth is toothpaste containing fluoride because fluoride is effective in preventing dental caries or cavities (Andlaw and Rock, 2012). Toothpaste can be used to brush teeth, which is about the size of a corn kernel (Susanto et al, 2017).

According to Notoatmodjo (2010), knowledge is the result of knowing that occurs after someone senses a certain object. Despite having a fairly high knowledge about oral health maintenance, there are still many children who do not know how to maintain oral health. do not know how to improve their knowledge of oral health. According to Fauziah (2015), family environmental factors play a major role in children's knowledge, because basically the family environment is the largest educational vehicle.

This knowledge is also closely related to a person's attitude about disease and prevention efforts; for this reason, it is necessary to carry out school dental health program activities routinely at least 4 times a year. Ghofur (2016) explains that the higher the

knowledge about oral health maintenance, the better the level of dental hygiene, on the contrary, the lower the level of knowledge about dental health maintenance, the worse the oral hygiene.

The results of research on tooth brushing behavior in children with disabilities in SLB N Kota Sungai Penuh show that the majority of children have moderate behavior. This can be seen in table 2. that children who behave with good criteria are 11 children (34.4%), children with moderate criteria are 12 children (37.5%), and children who behave with bad criteria are 9 children (28.1%). The results of this study are the same as the results of research conducted by Julia, et al (2018) entitled the relationship between the level of education and the behavior of maintaining oral health of children with disabilities in Sidoarjo City Special School in 2018, where the results showed that the behavior of brushing teeth with moderate criteria was 0.56% higher than those with good criteria 0.43% and bad 0.02%.

According to Notoatmodjo (2012), the oral health status of a person or community is influenced by four important factors, namely heredity, environment, behavior and health services. Of the four factors, behavior plays an important role in influencing oral health status directly, behavior can also influence environmental factors and health services. Oral health maintenance behavior is an effort made to improve oral health. This research is in line with the theory (Notoatmodjo, 2012) that 8 knowledge is a cognitive domain that is very important for the formation of action (overt behavior) and it turns out that behavior based on knowledge will be more lasting than that without knowledge.

The statistical test results show that the p value = 0.033, meaning that there is a significant relationship between knowledge and tooth brushing behavior in children with disabilities in SLB N Kota Sungai Penuh. This research is supported by Zia, et al (2023) on the relationship between children's knowledge level about oral health and tooth brushing behavior in grades 1-3 at SDN 28 Rawang Timur, showing that there is a significant relationship between knowledge and tooth brushing behavior.

Research conducted on children with disabilities in SLB N Kota Sungai Penuh to determine the relationship between knowledge and tooth brushing behavior, showed that the highest number of respondents had a moderate level of knowledge criteria with moderate tooth brushing behavior criteria. Children's knowledge about oral health is directly proportional to their brushing behavior, this is because children who have poor knowledge will affect their behavior in everyday life. Educational institutions have a role in improving oral health maintenance in children (Zia, et al, 2023).

The results of data analysis for knowledge variables with tooth brushing behavior show that the two variables have a relationship. higher knowledge will cause the actions of children with disabilities in maintaining oral health to also increase. There are also self-help lessons for children with disabilities at school, so that in their daily lives they are taught how to brush their teeth. This habit that is repeated every day allows it to be the cause of the relationship between knowledge and tooth brushing behavior. This is supported by Notoatmodjo opinion that one of the psychological factors in shaping one's behavior is habit. Habit is the result of a long period of habituation or as a typical reaction that is repeated many times (Zia, et al, 2023).

CONCLUSION

1. Knowledge of children with disabilities SLBN Kota Sungai Penuh with high criteria 10 children (31.3%), moderate criteria 14 children (43.8%), and low criteria 8 children (25.0%).
2. Tooth brushing behavior in children with disabilities SLBN Kota Sungai Penuh, with

tooth brushing behavior with good criteria 11 children (34.4%), moderate criteria 12 children (37.5%), and bad criteria as many as 9 children (28.1%).

3. There is a significant relationship between knowledge and tooth brushing behavior in children with disabilities, SLBN Kota Sungai Penuh, with a p value = 0.033 α < (0.05).

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ANALYSIS OF KNOWLEDGE AND BEHAVIOR OF DENTAL AND ORAL HEALTH MAINTENANCE IN STUDENTS OF SDN 050/XI KUMUN HILIR KOTA SUNGAI PENUH IN 2024

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ABSTRACT

Background: *Oral health is important for general health and quality of life. Oral health means being free from throat cancer, oral infections and sores, gum disease, tooth loss and other diseases, resulting in disorders that limit biting, chewing, smiling and speaking. This study aims to analyze the relationship between the level of knowledge and the behavior of maintaining oral health of students at SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024.*
Method: *This cross-sectional study, conducted on March 18, 2024, at SDN 050/XI Kumun Hilir, analyzed 30 second-grade students. Total sampling was used. Data on oral health knowledge and behavior were collected via valid and reliable questionnaires. Analysis involved univariate and bivariate methods, utilizing the Chi-Square test.*
Result: *Most second-grade students at SDN 050/IX Kumun Hilir demonstrated high oral health knowledge (63.3%) and good oral hygiene practices (66.7%). Notably, 50.0% of students with high knowledge also showed good oral health behavior, significantly more than those with moderate (13.3%) or low (3.3%) knowledge. Statistical analysis confirmed a relationship between knowledge level and oral health maintenance behavior in these students.*
Conclusion: *Students are advised to improve their tooth brushing habits in the morning after breakfast and at night before going to bed and maintain a diet that includes watery and high-fiber foods such as fruits and vegetables and reduce sweet and sticky foods.*

Keywords: *knowledge, behavior, dental health, students*

INTRODUCTION

Oral health is important for overall health and quality of life. Oral health means being free from throat cancer, mouth infections and sores, gum disease, tooth loss and other diseases. So that there are disorders that limit the form of biting, chewing, smiling and speaking (World Health Organization, 2023).

One of the causes of dental and oral health problems in society is ignoring dental and oral hygiene. This is based on a lack of knowledge about the importance of maintaining dental and oral health. Children are still very dependent on adults in terms of maintaining dental hygiene because of the lack of knowledge of children about dental health compared to adults (Budiharto, 2013).

The causes of dental and oral diseases are influenced by various factors, namely the environment, behavior and dental and oral health services. Dental and oral health has experienced various improvements in recent years, but the prevalence of dental caries or the emergence of cavities in children's teeth remains a significant clinical problem. Dental and oral diseases that are widely suffered by people in Indonesia are generally related to dental and oral hygiene (Herijulianti et al., 2001).

Common problems that occur in the teeth and mouth are dental caries. Caries is the most common disease and most experienced by people in the world. Caries is caused by excessive sugar consumption, lack of dental health care, and difficulty in accessing standard

dental health services. Dental and oral health problems, especially dental caries, are diseases experienced by almost half of the world's population (5.58 billion people) (CDC, 2024).

Dental and oral health problems of 93% were found in the 6-12-year age group, because at the age of 6-12 years most of them still have the wrong habit of brushing their teeth, namely when taking a morning shower and an evening shower. This is proven by the fact that the habit of brushing teeth properly in school-age children is only 2%. In addition, it was found that 91.1% of Indonesians brush their teeth every day. However, only 7.3% brush their teeth properly. The fact is that 72.1% of the Indonesian population has problems with cavities and 46.5% of them do not treat cavities (Kemenkes RI, 2018).

At the age of 6-12 years, children are expected to receive more intensive care because at that age, teeth change and new teeth grow. At the age of 12, all primary teeth have fallen out and the majority of permanent teeth have grown. One of the causes of caries in children is food residue that sticks to the surface of the teeth and the habit of consuming sweet and sticky snacks. The extent of the influence of risk factors on the occurrence of caries in school children is influenced by knowledge, awareness, and habits in caring for dental health, habits that children need to have include cleaning their teeth and choosing the type of food (Rusmiati et al., 2023).

School age is one of the stages of life that is still experiencing growth. Bad eating habits in elementary school children (SD) often occur, such as the habit of consuming excessive snack foods. Snack foods that are often consumed by elementary school children are mostly cariogenic, such as sweet, sticky foods, and foods that are attractively shaped. One of the negative effects of frequently consuming sweet or cariogenic foods is on dental health. Cariogenic foods tend to stick to the surface of the teeth. If this happens often, it can cause tooth decay. Cariogenic foods are foods that contain fermentable carbohydrates, such as sugar and starch, which can be converted by bacteria in the mouth into acid. This acid then lowers the pH of dental plaque, causes enamel demineralization, and ultimately triggers tooth decay. A study by Asmara found that high consumption of cariogenic foods was significantly associated with an increase in the incidence of tooth decay in children (Asmara, 2018).

Based on the initial survey, it was found that SDN 050/XI Kumun Hilir Kota Sungai Penuh has implemented the School Dental Health Effort (UKGS) program and has also received dental and oral health counseling, dental and oral health examinations, and mass toothbrushing by dental health workers from the Kumun Health Center Kota Sungai Penuh. For UKGS activities, it consists of dental and oral health checks every 6 months, dental health counseling and mass toothbrushing are carried out once a year at the beginning of each odd semester. Based on this, it is necessary to conduct research on the relationship between the level of knowledge and the behavior of maintaining dental and oral health in students of SDN 050/XI Kumun Hilir Kota Sungai Penuh.

METHODS

This study is a cross-sectional study. This study was conducted at SDN 050/XI Kumun Hilir, Sungai Penuh City on March 18, 2024. The population was 30 students of grade II of SDN 050/XI Kumun Hilir, Sungai Penuh City, with a sample size of 30 students taken using total sampling. Data were collected by distributing questionnaires about knowledge and behavior of maintaining dental and oral health. This questionnaire has been tested for validity and reliability. Data were analyzed univariately and bivariately using the Chi Square test.

RESULTS AND DISCUSSION

Research on the relationship between the level of knowledge and behavior in maintaining dental and oral health in students of SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024, which was conducted on March 18, 2022, with a sample of 30 students.

1. Level of Knowledge of Students of SDN 050/XI Kumun Hilir, Sungai Penuh City

Table 1 Frequency Distribution of Respondents Based on Knowledge of Class II Students of SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024

Level of Knowledge	n	%
High	19	63,3
Medium	6	20
Low	5	16,7
Total	**30**	**100**

In table 1, the results of the study found that most (63.3%) of the samples had a high level of knowledge about maintaining dental and oral health. The majority of respondents had a good understanding of the concept of healthy teeth, namely teeth that are clean, free from cavities, and free from other dental diseases. Data from questions 9 and 11 showed that more respondents knew how to properly care for their teeth, including the importance of brushing their teeth gently and thoroughly on all parts of the teeth, including the front, back, and between the teeth. The basic principle of brushing your teeth properly is being able to clean all food debris, especially in the interdental space, without damaging the tooth and gum tissue.

Too much pressure when brushing can damage the inner dentin and cementum layer of the teeth, and cause trauma to sensitive gums that can potentially irritate them. Incorrect brushing movements can also damage gum tissue and abrade the tooth enamel. Therefore, education about proper brushing techniques is essential to prevent tooth and gum damage, as well as maintain overall dental health. (Fitriana, 2006).

Based on the tabulation data from question number 7, the majority of respondents have understood that the requirements for a good toothbrush are with soft bristles and a flat surface. However, the tabulation of question number 20 shows that only 9 respondents answered correctly, while 21 respondents answered incorrectly regarding the importance of brushing the tongue when brushing their teeth. This shows a lack of knowledge among respondents about tongue hygiene which is also crucial for oral health. In addition, the majority of respondents know that the right time to have a dental check-up is every 6 months, the importance of education about this cannot be ignored. This routine check-up is highly recommended especially for school-age children who are changing from baby teeth to permanent teeth. Regular dental check-ups, even without any complaints, are very important to prevent tooth decay and other oral health problems. Thus, increasing education and awareness about the importance of complete dental and oral hygiene, including the tongue, as well as routine dental check-ups should be encouraged to maintain dental and oral health from an early age.

Family environmental factors play an important role in developing children's knowledge, because the family is the main educational vehicle. Knowledge instilled in the family influences children's behavior, including in terms of dental health and disease prevention efforts. Therefore, it is important to support dental health programs in schools that are carried out routinely at least four times a year. This program not only strengthens the education provided at home, but also ensures that children receive consistent and comprehensive information about proper dental care. Through this activity, children can learn and practice dental health habits from an early age, which will have a positive impact on their dental health in the future. Routine implementation of dental health programs in schools also allows for early detection of dental problems, so that intervention can be carried out before conditions worsen, reducing the

prevalence of dental disease among children (Kurniastuti, 2015).

2. Dental and Oral Health Maintenance Behavior of Students of SDN 050/XI Kumun Hilir, Sungai Penuh City

Table 2 Frequency Distribution of Respondents Based on Dental and Oral Health Maintenance Behavior of Class II Students of SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024

Dental and Oral Health Maintenance Behavior	n	%
Good	20	66,7
Enough	8	26,7
Bad	2	6,7
Total	**30**	**100**

Based on table 1, it shows that the majority (67.7%) of samples have good dental and oral health maintenance behavior. This study is in line with the study by Silfia, A (2019) which found that samples with good dental and oral health maintenance behavior were 67.8% (Silfia et al., 2019).

According to Notoatmodjo (2012), the level of knowledge is an important domain for shaping a person's behavior. Behavior that is adopted through a process that is conscious of knowledge, awareness, and positive attitudes tends to be lasting, while behavior that is not conscious of knowledge and awareness will not last long. The four main factors that influence health are heredity, environment (physical and socio-cultural), behavior, and health services. Among these factors, behavior plays an important role in influencing the status of dental and oral health directly and influencing environmental factors and health services (Notoatmodjo, 2012).

Oral and dental health maintenance behavior includes individual, group, and community efforts to improve oral and dental health. The role of parents is very crucial in guiding, providing understanding, and providing facilities that support children in maintaining their oral and dental health. With high knowledge and awareness, good hygienic behavior can be instilled early on, so that children can develop habits that will have a positive impact on their oral and dental health in the future.

3. The Relationship between Knowledge Level and Dental and Oral Health Maintenance Behavior of Students at SDN 050/XI Kumun Hilir, Sungai Penuh City

Table 3 Frequency Distribution of Respondents Based on the Relationship between Knowledge Level and Dental and Oral Health Maintenance Behavior in Students of SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024

Level of Knowledge	Dental and Oral Health Maintenance Behavior						Total		P value
	Good		Enough		Bad				
	n	%	n	%	n	%	n	%	
High	15	50,0	4	13,3	0	0	19	63,3	0,013
Medium	4	13,3	2	6,7	0	0	6	20,0	
Low	1	3,3	2	6,7	2	6,7	5	16,7	
Amount	20	66,7	8	26,7	2	6,7	30	100	

Table 3 shows that the behavior of maintaining dental and oral health with a good category is more often found in samples with high knowledge (50.0%) compared to moderate knowledge (13.3%) and low knowledge (3.3%). The results of the statistical analysis test show that Ha is accepted, thus it can be concluded that in this study there is a relationship between the level of knowledge and the behavior of maintaining dental and oral health in students of SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024.

This study is in line with Gree's theory (2000) in Arianto (2018), which states that a person's behavior can be influenced by the knowledge they have. Knowledge is an important domain in forming a person's actions, behavior based on knowledge tends to be more lasting than behavior that is not based on knowledge. Good knowledge of dental and oral

health allows individuals to understand the importance of proper maintenance practices, such as brushing their teeth with the right technique and regularly. This supports the formation of consistent and sustainable hygienic habits, which ultimately improve the status of dental and oral health. Therefore, effective and sustainable health education programs are very important to improve knowledge and, directly, dental and oral health maintenance behavior in the community.

This study is in line with that conducted by Gopdianto, Rattu and Mariati, (2015) who concluded that there is a relationship between the level of knowledge and the behavior of maintaining dental and oral health of students at SDN 1 Malalayang. Artawa showed that good and correct dental and oral health behavior includes the habit of brushing teeth at least twice a day. The right time to brush your teeth is every after breakfast and at night before going to bed. This habit is important to remove food residue and plaque that can cause tooth decay and gum disease. Adequate knowledge about the importance of time and frequency of brushing teeth can increase awareness and implementation of effective dental hygiene practices. Therefore, educational efforts that emphasize this basic knowledge must be intensified among students to form lasting hygienic behavior and have a positive impact on their dental and oral health.

However, the results of this study are not supported by research conducted by Silfia, A (2019) on students of SDN 36/IV Jambi City, which showed that there was no strong relationship between the level of knowledge and oral health maintenance behavior. Silfia, A found that although children had high knowledge and understood good oral health maintenance behavior, this knowledge was not always applied in real actions. This shows that knowledge alone is not enough to encourage behavioral change; other factors such as motivation, environment, and support from parents also play an important role in applying knowledge to daily practice. Knowledge that is not applied in real behavior indicates a gap between knowing and doing, which may be caused by a lack of awareness, limited facilities, or a lack of support and encouragement from the surrounding environment. Therefore, in addition to increasing knowledge, efforts to strengthen motivation and environmental support also need to be increased to ensure that oral health knowledge can be applied effectively (Silfia et al., 2019). This happens because the child's knowledge is quite high, and the child's good behavior only reaches the level of knowing and understanding, besides that, a person's knowledge can be influenced by several factors so that this knowledge is not applied in a behavioral action.

Knowledge, awareness and behavior regarding dental and oral health maintenance are influenced by population factors, environment, education level, economy and the presence of health facilities as well as the extent of the risk of developing dental and oral diseases (Suwelo, 1992).

From the UKGS activity data at SDN 050/XI Kumun Hilir Kota Sungai Penuh, the school has implemented the School Dental Health Effort (UKGS) program and has also received dental and oral health counseling, dental and oral health checks, and mass toothbrushing by dental health workers from the Kumun Health Center, Sungai Penuh City. For UKGS activities, it consists of dental and oral health checks every 6 months, dental health counseling and mass toothbrushing are carried out once a year at the beginning of each odd semester. In this regard, it is necessary to conduct research on the relationship between the level of knowledge and the behavior of maintaining dental and oral health in grade II students of SDN 050/XI Kumun Hilir Kota Sungai Penuh.

CONCLUSION

The results of the research that has been conducted regarding the level of knowledge and behavior of maintaining dental and oral health in students of SDN 050/XI Kumun Hilir, Sungai Penuh City, can be concluded that:

1. Most (63.3%) of the samples have a high level of knowledge about maintaining dental and oral health.
2. Based on table 1, it shows that most (67.7%) of the samples have good dental and oral health maintenance behavior.
3. There is a relationship between the level of knowledge and dental and oral health maintenance behavior in students of SDN 050/XI Kumun Hilir, Sungai Penuh City in 2024..

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CONFLICT OF INTEREST

In this research there is no conflict of interest in writing the manuscript.

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VITAMIN A COVERAGE AND PREVALENCE OF STUNTING, UNDERWEIGHT, AND WASTING IN CHILDREN 6-59 MONTHS OF AGE (ANALYSIS OF IHS 2023 DATA)

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ABSTRACT

Background: *Nutritional problems, such as stunting, wasting, and being underweight, are significant contributors to the global burden of disease in children, including in Indonesia. Indonesia has been identified as having low levels of Vitamin A sufficiency among under-fives. Vitamin A deficiency can inhibit protein synthesis, which is critical for cell development. As a result, Vitamin A-deficient children are at high risk of growth impairment. This study aims to analyze the association between Vitamin A supplementation and the prevalence of stunting, wasting, and underweight among children under five years of age in Indonesia using the 2023 IHS (Indonesia Health Survey) data.*
Method: *This study used a cross-sectional design using secondary aggregate data from the 2023 IHS covering 38 provinces in seven regions in Indonesia. The independent variable in this study is the proportion of Vitamin A supplementation, while the dependent variable is the prevalence rate of stunting, wasting, and underweight. The analysis will be conducted using the Pearson correlation test, after previously testing the normality of the data.*
Result: *The results showed that vitamin A coverage was significantly associated with the prevalence of stunting, underweight, and wasting. The higher the vitamin A coverage, the lower the prevalence of stunting, underweight, and wasting.*
Conclusion: *The conclusion of this study is that vitamin A supplementation plays an important role in reducing the prevalence of stunting and wasting. This study provides a basis for more effective policies and interventions aimed at addressing child malnutrition in Indonesia.*

Keywords: *Vitamin A, Stunting, Underweight, Wasting, IHS 2023*

INTRODUCTION

Stunting refers to a condition where a child's height is below the expected standard deviation for their age group, indicating that they are shorter than their peers. These children are vulnerable to degenerative diseases as adults. The impact is not only physical, but also general health, including affecting IQ or intelligence levels. According to the World Health Organization (WHO, 2022), stunting occurs in children who are short, measured using anthropometric tools with results below -2 SD. This condition indicates that significant nutrition is a chronic problem with multiple underlying causes, including inadequate nutrient intake during infancy, insufficient maternal nutrition during pregnancy and lactation, socioeconomic factors, and maternal knowledge. As a result, affected children may face challenges in achieving optimal physical and cognitive development in the future (Amelia Yuniarti and Asih Setiarini, 2024).

Nutrition is a major contributor to the global burden of disease among children. According to the World Health Organization (WHO, 2022), by 2022 22.3% of all children under 5 years old, or equal to 148.1 million children are too short for their age, while 45.0 million children are considered underweight, or too underweight for their height 45.0 million are too thin for their height (wasting). According to the 2018 Global Nutrition Report, 22.2% of the world's children under five (aged

0-59 months) are stunted, 7.5% are wasted, and 5.6% are overweight. In Indonesia, according to the 2018 Basic Health Research in Indonesia, the prevalence of undernourished children was 17.7%, the prevalence of stunting (very short and short) was 30.8%, and the prevalence of underweight children (very thin and thin) was 10.2% (Kemenkes RI, 2018). The three main indicators used to assess child malnutrition are stunting, wasting, and underweight, which are measured using height-for-age (H/A), weight-for-age (W/A), and weight-for-height (W/H) indices, respectively. Indonesia is one of the countries with relatively low levels of Vitamin A intake in children under five. In 2020, Vitamin A supplementation coverage for children in Indonesia was reported to be 86.3% (Wijaya, Azizah and Rohman, 2024) The 2018 Basic Health Research in Indonesia data shows that 28.8% of Vitamin A capsule distribution did not meet standards, and 17.6% of children never received Vitamin A capsules.

The results of previous research in the city of Surabaya showed an association between vitamin A administration and the incidence of stunting (Putri, Irawan and Mukono, 2021) Research results elsewhere also prove that vitamin A provision has an impact on the incidence of stunting (Fatimah and Wirjatmadi, 2018; Ramadhani, 2023) However, there are also research results that find no relationship between vitamin A coverage and the incidence of stunting (Bahmat, Bahar and Jus'at, 2019; Sugianti, 2021; Kundarwati *et al.*, 2022). Research by (Muliah, Wardoyo and Mahmudiono, 2018; Yuziani and Sofia, 2022) shows that vitamin A coverage is associated with the incidence of underweight. Based on the results of the research (Amelia Yuniarti and Asih Setiarini, 2024), subjects classified as wasted showed inadequate vitamin A levels. Vitamin A supplementation can synergistically affect health improvement in children.

However, while many studies have been conducted on vitamin A coverage and child nutritional status, no studies have used national data to analyze the relationship between vitamin A coverage and the prevalence of height deficiency, undernutrition, and underweight among children under five in Indonesia. Therefore, this study aims to describe and analyze these relationships using the 2023 IHS data. The novelty of this study lies in the use of national IHS 2023 data to compare vitamin A coverage with the prevalence of stunting, underweight, and wasting across Indonesia, as well as the differences between Indonesia's 7 regions. The objectives of the study were to describe the description of vitamin A coverage in 7 Indonesian regions, the description of the prevalence of height deficiency, undernutrition, and wasting in children under five in 7 Indonesian regions, and the relationship between vitamin A coverage and the prevalence of stunting, underweight, and wasting in children under five in Indonesia.

METHODS

The study was conducted using a cross-sectional method with aggregate data from the 2023 IHS. The population in this study was children aged 6-59 months throughout Indonesia who were stunted, underweight and wasted in 38 Indonesian provinces, which were grouped into seven regions, namely Sumatra, Java-Bali, Nusa Tenggara, Kalimantan, Sulawesi, Maluku, and Papua. The study sample consisted of the total population in all provinces covered by the 2023 IHS. This study uses data from all provinces in Indonesia totaling 79,625 people. The data used in this study come from the IHS 2023, which was conducted in the period August to October 2023.

The independent variable in this study is vitamin A coverage. According to the Minimum Service Standards for Health, it is stated that every toddler should receive vitamin A capsules twice a year. Vitamin A coverage was calculated using the formula: number of

children aged 6-59 months who received vitamin capsules divided by the total number of children under five, multiplied by 100%. The research instrument used was an individual questionnaire developed by the IHS team in 2023. The dependent variables analyzed included the prevalence of stunting, wasting, and underweight in children under five. The prevalence rates of stunting, wasting, and underweight were determined by dividing the number of children experiencing each condition by the total number of children under five, then multiplying by 100%.

Stunting is based on the anthropometric ratio of body length according to age (length-for-age) <-2 SD, to obtain height data, anthropometric measurements are taken using a height/length measuring instrument with an accuracy level of 1 mm. Underweight was determined from body weight-for-age <-2 SD and wasting based on body weight-for-length <-2 SD. Body weight data was obtained using a digital weight scale with an accuracy of 0.1 kg. The anthropometric process was carried out by trained enumerators with a minimum educational background of D3 health to ensure the accuracy of the data obtained. Height measurements were carried out by following the standard procedures set out in the IHS 2023 enumerator training. The data collection process was carried out by means of direct interviews and anthropometric measurements in each household selected as a sample.

Descriptive analysis was used to describe vitamin A coverage and the prevalence of stunting, underweight, and wasting across provinces in Indonesia. Univariate analysis or description of the characteristics of each variable, using measures of center and variance (mean, standard deviation, minimum value, and maximum value). Bivariate analysis aimed to analyze the relationship between the variable proportion of diverse food consumption and the prevalence of stunting, underweight, and wasting using the Pearson correlation test. The implementation of IHS 2023 has obtained ethical approval from the National Health Research and Development Ethics Commission (KEPPKN) with number HK.01.07/MENKES/1562023 to ensure that all research procedures meet the applicable ethical standards in health research.

RESULTS AND DISCUSSION

Vitamin A coverage never in one year is highest in the Papua region, namely the province of Papua Mountains (37.5%), and the lowest in the Java and Bali region, namely DI Yogyakarta Province (13.9%).

Table 1. Distribution of One-Year Vitamin A Coverage by Region in Indonesia by 2023

	Never			1 time		
Region	**Minimum**	**Maximum**	**$\bar{X}$± SD**	**Minimum**	**Maximum**	**$\bar{X}$± SD**
Sumatera	11.0	27.7	20.8± 5.6	44.2	54.0	48.9±3.4
Jawa dan Bali	10.2	22.1	13.9± 3.9	49.9	60.2	53.1±3.3
Nusa Tenggara	13.8	14.0	13.9± 0.1	47.4	47.9	47.6±0.3
Kalimantan	12.7	21.3	17.6± 3.7	45.7	56.7	49.8±4.1
Sulawesi	22.3	30.4	25.7± 2.9	43.9	47.9	46.4±1.4
Maluku	30.6	31.5	31.0± 0.6	39.6	42.1	40.8±1.7
Papua	22.3	54.8	37.5± 14.0	25.3	49.6	39.1±9.7
Indonesia	**10.2**	**54.8**	**22.7±10.1**	**25.3**	**60.2**	**47.4±6.4**
	2 time			**< 2 time**		
Region	**Minimum**	**Maximum**	**$\bar{X}$± SD**	**Minimum**	**Maximum**	**$\bar{X}$± SD**
Sumatera	18.4	44.7	30.1±6.7	55.3	81.7	69.8±6.7
Jawa dan Bali	24.8	37.4	32.8±4.8	62.6	75.1	67.1±4.8
Nusa Tenggara	38.4	38.6	38.5±0.1	61.4	61.7	61.5±0.2
Kalimantan	30.6	34.7	32.5±1.7	65.3	69.4	67.5±1.7
Sulawesi	23.5	30.7	27.8±2.6	69.3	76.5	72.2±2.6
Maluku	27.4	28.9	28.1±1.0	71.1	72.7	71.9±1.1
Papua	16.3	32.9	23.2±6.1	67.1	83.7	76.7±6.0
Indonesia	**16.3**	**44.7**	**29.8±5.9**	**55.3**	**83.7**	**70.1±5.9**

Meanwhile, the highest coverage of vitamin A once a year was found in the Java and Bali regions, namely DKI Jakarta province (53.1%), and the lowest was found in the Papua region, namely Papua mountainous province (39.1%).

Vitamin A coverage twice a year is highest in the Sumatra region, namely Jambi province (30.1%), and the lowest in the Papua region, namely Central Papua province (23.2%). Whereas vitamin A coverage of less than 2 times a year is highest in the Papua region, namely Central Papua province (76.7%), and the lowest in the Sumatra region, namely Jambi province (69.8%). The results show that there are significant differences in the proportion of vitamin A administration and prevalence of nutritional problems (underweight, wasting, underweight) between regions in Indonesia. In general, the proportion of vitamin A administration in Indonesia is still low, with a national average of 47.4%.

This figure illustrates the low provision of vitamin A, which has an impact on the nutritional status of children. The highest proportion of vitamin A administration is found in Java and Bali, while the lowest is found in Papua. This suggests inequalities in vitamin A provision between regions. Social factors such as maternal education level, maternal knowledge level, and occupation may influence low vitamin A intake. The distance from home to the posyandu, and the number of visits to the posyandu in certain areas may exacerbate this problem (Samosir, Sinaga and Batubara, 2023; Haikal, Yuziani and Mardiati, 2024).

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 21 of 2015 concerning the provision of vitamin A to toddlers, infants, and postpartum mothers, infants aged 6 to 11 months receive 100,000 international units (IU) of vitamin A in the form of blue capsules. Meanwhile, toddlers aged 12 to 59 months and postpartum women receive 200,000 IU of vitamin A in the form of red capsules. Vitamin A administration is carried out twice a year, in February and August, and is carried out simultaneously for all children aged 6 to 59 months. Vitamin A administration can be done at the posyandu (Kemenkes RI, 2015). Table 1 shows that the proportion of vitamin A administration by province in Indonesia is lowest in Papua and highest in Java and Bali. Vitamin A deficiency can inhibit protein synthesis which is essential for cell growth. As a result, children who are vitamin A deficient have a higher risk of developing growth disorders. In addition, vitamin A is also very important in maintaining the body's immune system. Therefore, vitamin A deficiency can weaken the body's defenses, increasing the likelihood of disease seeds, such as diarrhea when it attacks the intestinal lining (Ramadhani, 2023).

Table 2. Distribution of Stunting Prevalence by Region in Indonesia in 2023

Region	Stunting			Severely Stunting			Stunting + Severely Stunting		
	Min	**Max**	$\bar{X}$**±SD**	**Min**	**Max**	$\bar{X}$**±SD**	**Min**	**Max**	$\bar{X}$**±SD**
Sumatera	9.5	20.3	13.8±3.2	3.3	9.1	5.3±1.7	13.5	29.4	19.2±4.9
Jawa dan Bali	5.5	16.9	13.7±3.9	1.7	7.0	4.3±1.6	7.2	23.9	18.1±5.3
Nusa Tenggara	19.3	26.2	22.7±4.8	5.2	11.7	8.4±4.5	24.5	37.9	31.2±9.4
Kalimantan	12.8	17.3	16.0±1.8	4.6	7.8	6.5±1.3	17.4	24.7	22.5±2.9
Sulawesi	14.8	22.8	19.4±2.7	6.5	9.4	7.7±1.0	21.3	30.4	27.1±3.2
Maluku	16.0	18.3	17.1±1.6	7.6	10.1	8.8±1.7	23.6	28.4	26.0±3.3
Papua	15.8	20.3	17.8±1.5	8.0	20.7	13.2±5.6	24.8	39.3	31.0±6.1
Indonesia	**5.5**	**26.2**	**16.2±3.8**	**1.7**	**20.7**	**7.2±3.9**	**7.2**	**39.3**	**23.5±6.8**

Vitamin A sufficiency is mainly obtained through dietary intake, such as fruits and vegetables that are rich in this vitamin. Generally, orange and red fruits and vegetables have high vitamin A content. In addition, vitamin A can also be obtained from animal protein sources such as fish, eggs, and shrimp. Apart from food, vitamin A supplementation is also routinely conducted in February and August as a preventive measure against vitamin A deficiency. This program aims to reduce the risk of diseases such as measles and diarrhea.

With regular vitamin A supplementation, children are expected to stay strong and healthy, have a better immune system, and achieve optimal growth and development (Kemenkes RI, 2016).

Table 2 shows that the prevalence of stunting was highest in the Nusa Tenggara region, namely East Nusa Tenggara province (22.7%) and the prevalence of stunting was lowest in the Java and Bali regions, namely Bali province (13.7%). Meanwhile, the prevalence of severe stunting was highest in the Papua region, namely Central Papua province (13.2%), and the prevalence of severe stunting was lowest in the Java and Bali regions, namely Bali province (4.3%). The total incidence of stunting was highest in the Papua region in Central Papua Province (31.0%) and lowest in the Java and Bali regions in Bali Province (18.1%).

Table 3. Distribution of Underweight Prevalence by Region Indonesia in 2023

Region	Underweight			Severely Underweight			Underweight + Severely Underweight		
	Min	Max	$\bar{X}$±SD	Min	Max	$\bar{X}$±SD	Min	Max	$\bar{X}$±SD
Sumatera	7.4	17.7	11.3±2.9	1.5	4.9	2.6±0.9	8.9	22.6	13.9±3.8
Jawa dan Bali	4.9	14.2	11.1±2.9	0.7	3.5	2.2±0.9	5.6	17.7	13.3±3.7
Nusa Tenggara	17.2	22.9	20.0±4.0	3.6	6.8	5.2±2.2	20.8	29.7	25.1±6.2
Kalimantan	12.7	16.2	14.7±1.4	2.6	5.4	4.0±1.2	15.3	21.6	18.7±2.6
Sulawesi	11.4	18.6	16.6±2.7	2.9	5.9	4.6±1.0	14.3	24.4	21.2±3.7
Maluku	16.0	18.4	17.2±1.6	4.9	6.7	5.8±1.2	20.9	25.1	23.0±2.9
Papua	11.7	17.2	14.6±1.8	3.7	8.5	5.7±1.6	15.4	23.9	20.3±2.8
Indonesia	**4.9**	**22.9**	**13.8±3.6**	**0.7**	**8.5**	**3.8±1.7**	**5.6**	**29.7**	**17.7±5.1**

Table 3 shows that the prevalence of underweight was highest in the Nusa Tenggara region, namely East Nusa Tenggara province (20.0%) and the prevalence of underweight was lowest in the Java and Bali regions, namely Bali province (11.1%). Meanwhile, the prevalence of severely underweight was highest in Papua, Central Papua province (5.7%) and lowest in Java and Bali, Bali province (2.2%). The total incidence of underweight was highest in the Nusa Tenggara region in East Nusa Tenggara province (25.1%) and lowest in the Java and Bali region in Bali province (13.3%).

Table 4. Distribution of Wasting Prevalence by Region Indonesia in 2023

Region	Wasting			Severely Wasting			Wasting + Severely Wasting		
	Min	Max	$\bar{X}$±SD	Min	Max	$\bar{X}$±SD	Min	Max	$\bar{X}$±SD
Sumatera	4.9	9.8	6.1±1.5	1.4	3.8	2.2±0.7	6.3	13.6	8.4±2.1
Jawa dan Bali	3.1	7.2	5.5±1.3	0.5	3.2	1.7±0.9	3.6	10.2	7.3±2.2
Nusa Tenggara	7.2	9.4	8.3±1.5	1.4	4.2	2.8±1.9	8.6	13.6	11.1±3.5
Kalimantan	6.5	9.2	7.7±1.3	2.2	4.1	2.9±0.7	8.7	13.3	10.7±2.0
Sulawesi	6.4	9.7	8.0±1.2	1.7	3.8	2.8±0.8	9.1	12.9	10.9±1.8
Maluku	10.5	11.0	10.7±0.3	4.4	5.3	4.8±0.6	15.4	15.8	15.6±0.2
Papua	6.4	9.6	8.6±1.1	3.2	9.2	4.8±2.1	10.9	18.2	13.4±2.5
Indonesia	**3.1**	**11.0**	**7.3±1.8**	**0.5**	**9.2**	**2.9±1.5**	**3.6**	**18.2**	**10.2±3.1**

Table 4 shows that the prevalence of wasting is highest in the Maluku region, namely Maluku province (10.7%) and the prevalence of wasting is lowest in the Java and Bali regions, namely Bali province (5.5%). Meanwhile, the prevalence of severe wasting was highest in the Papua region, namely Central Papua province (4.8%), and the prevalence of severe wasting was lowest in the Java and Bali regions, namely Bali province (1.7%). The total incidence of wasting was highest in the Papua region in Central Papua Province (13.4%) and lowest in the Java and Bali regions in Bali Province (7.3%).

Table 5. Relationship between One-Year Vitamin A Coverage and Prevalence of Stunting in Children Aged 6-59 Months in Indonesia in 2023

Vitamin A coverage	Stunting	Severely Stunting	Severy Stunting + Stunting
Vitamin A coverage never/year			
Beta	0.28	0.80	0.62
Constant	13.84	0.31	14.15
Correlation Coefficient (r)	0.10	0.30	0.41
p-value	0.08	0.00	0.00
Vitamin A coverage 1 times/year			
Beta	-0.17	-0.48	-0.65
Constant	24.36	30.41	54.78
Correlation Coefficient (r)	0.28	0.80	0.62
p-value	0.08	0.00	0.00
Vitamin A coverage <2 times/year			
Beta	0.11	0.33	0.44
Constant	8.19	16.01	7.82
Correlation Coefficient (r)	0.18	0.50	0.39
p-value	0.27	0.00	0.01
Vitamin A coverage 2 times/year			
Beta	-0.11	-0.33	-0.44
Constant	19.66	17.15	36.81
Correlation Coefficient (r)	0.17	0.50	0.39
p-value	0.28	0.00	0.01

The results of the data analysis in Table 5 showed that vitamin A coverage was never associated with the prevalence of severe stunting (p-value 0.00) and the prevalence of total stunting (p-value 0.00), but not with the prevalence of stunting (p-value 0.08). Vitamin A coverage of 1 time was associated with the prevalence of severely stunted (p-value 0.00) and the prevalence of total stunting (p-value 0.00) but was not associated with the prevalence of stunting (p-value 0.08). Vitamin A coverage <2 times was associated with the prevalence of severely stunted (p-value 0.00) and the prevalence of total stunting (p-value 0.01), but was not associated with the prevalence of stunting (p-value 0.27). 2 times vitamin A coverage was associated with the prevalence of severe stunting (p-value 0.00) and the prevalence of total stunting (p-value 0.01), but not with the prevalence of stunting (p-value 0.28). Based on the beta coefficient value, the higher the proportion of vitamin A administration, the lower the prevalence of stunting.

The prevalence of stunting in Java and Bali is relatively lower (16.2%), which may be related to better maternal attitudes and accessibility of health facilities in these regions. Stunting in Indonesia is influenced by various factors, including maternal knowledge and socioeconomic (Wello *et al.*, 2022; Nirmalasari, 2025). The findings of this study suggest a correlation between vitamin A coverage and stunting prevalence in Region Indonesia. Research by Bahmat, Bahar, and Jus'at, (2019) and Kundarwati *et al.*, (2022) did not find a direct relationship between vitamin A supplementation and the incidence of stunting but identified other influencing factors, such as iron and protein intake. In contrast, Putri, Irawan, and Mukono, (2021) stated that vitamin A coverage is associated with stunting in children aged 24-59 months. This study is also in line with the research Fatimah and Wirjatmadi (2018) which shows that stunted toddlers experience a deficit in vitamin A sufficiency levels.

Vitamin A deficiency affects protein synthesis, which in turn affects cell growth. As a result, children who are deficient in vitamin A may develop growth disorders. In addition, vitamin A plays an important role in the

functioning of the human immune system. As a result, vitamin A deficiency can lead to a weak immune response, making individuals more susceptible to infections, such as diarrhea if it occurs in the intestinal wall (Sugianti, 2021). Food sources rich in vitamin A include various fruits and vegetables, especially orange-colored ones, which tend to have higher vitamin content. However, stunted toddlers often do not eat fruits and prefer soupy foods. Protein sources consumed by stunted toddlers, which provide vitamin A, include eggs, mackerel, and pindang fish (Fatimah and Wirjatmadi, 2018).

Factors that cause stunting can be both individual and family factors. A history of exclusive breastfeeding and a history of maternal LBW are causes of stunting. The main factor that indirectly contributes to the problem of stunting is the socioeconomic status of the family, which is influenced by the parent's education level. When parents have a higher level of education, the likelihood of earning an adequate income increases, allowing the family to live in a healthy and supportive environment (Wello *et al.*, 2022).

When analyzed regionly, the highest prevalence of stunting in 2020 occurred in Africa, with 31.7% according to WHO data. This is followed by Southeast Asia with 30.1% and the Eastern Mediterranean with 26.2%. In Southeast Asia, Indonesia is ranked second highest for stunting, after Timor-Leste which has a rate of 31.8% in 2020. Timor-Leste tops the list with a stunting prevalence of 48.8% in children. Laos ranked third after Indonesia with 30.2%, followed by Cambodia with 29.9%, Philippines with 28.7%, Myanmar with 25.2%, and Vietnam with 22.3%. In addition, Malaysia reported a prevalence of 20.9%, Brunei Darussalam 12.7%, and Thailand 12.3%. Singapore has the lowest prevalence of stunting among children in Southeast Asia at 2.8%. Data collected in 2022 showed that the prevalence of stunting in Indonesia was 21.6%, while Malaysia reported 20.9%, Thailand 12.3%, Japan 5.5%, and Singapore maintained a low rate of 2.8%.

Table 6. Relationship between One-Year Vitamin A Coverage and the Prevalence of Underweight Children Aged 6-59 Months in Indonesia in 2023

Vitamin A coverage	Underweight	Severely Underweight	Severy Underweight + Underweight
Vitamin A coverage never/year			
Beta	0.07	0.09	0.16
Constant	12.2	1.64	13.86
Correlation Coefficient (r)	0.28	0.55	0.33
p-value	0.21	0.00	0.03
Vitamin A coverage 1 times/year			
Beta	-0.11	-0.13	-0.25
Constant	19.23	10.31	29.55
Correlation Coefficient (r)	0.20	0.49	0.31
p-value	0.22	0.00	0.05
Vitamin A coverage <2 times/year			
Beta	0.08	0.12	0.20
Constant	8.22	4.90	3.31
Correlation Coefficient (r)	0.13	0.42	0.23
p-value	0.42	0.00	0.14
Vitamin A coverage 2 times/year			
Beta	-0.07	-0.12	-0.20
Constant	16.22	7.54	23.77
Correlation Coefficient (r)	0.13	0.41	0.23
p-value	0.43	0.00	0.15

Table 6 shows that never vitamin A coverage is associated with the prevalence of severely underweight (p-value 0.00) and the prevalence of total underweight incidence (p-value 0.03), but not with the prevalence of underweight (p-value 0.21). Vitamin A coverage of 1 time was associated with the prevalence of severely underweight (p-value 0.00) but was not associated with the prevalence of total underweight (p-value 0.05) and the prevalence of underweight (p-value 0.22). Vitamin A coverage <2 times was associated with the prevalence of severely underweight (p-value 0.00), but not with the prevalence of total underweight (p-value 0.14) and underweight prevalence (p-value 0.42). 2 times vitamin A coverage was associated with the prevalence of severely underweight (p-value 0.00), but was not associated with the prevalence of total underweight (p-value 0.15) and underweight prevalence (p-value 0.43). Based on the beta coefficient value, the higher the proportion of vitamin A administration, the lower the prevalence of underweight.

Regarding the prevalence of underweight, data shows that the Nusa Tenggara region has the highest rate at 20.0%, indicating a more severe malnutrition problem. Inadequate energy and carbohydrate intake can lead to weight loss in children. The link between inadequate nutrient intake and the risk of being underweight can be understood through the role of carbohydrates as a source of energy. When carbohydrate consumption is low, the body will metabolize protein and fat to meet its energy needs (Aprilya Roza Werdani and Syah, 2023).

Based on the research conducted, there is an association between vitamin A coverage and underweight prevalence between regions in Indonesia. A research finding (Yuziani and Sofia, (2022) that there is an association between vitamin A coverage and the incidence of underweight. The results showed that toddlers who received blue vitamin A at 6 months of age had a 37% chance of avoiding the risk of being underweight.

Toddlers who do not consume enough blue-colored vitamin A, especially from 6 months of age, have a high risk of being underweight. Children who do not get enough vitamin A tend to have higher rates of underweight and wasting compared to their peers who get adequate amounts of vitamin A intake. Vitamin A deficiency can increase the risk of mortality, morbidity, and greater incidence of infectious diseases in children. Vitamin A status in children is influenced by various factors, not only by vitamin A intake (Muliah, Wardoyo and Mahmudiono, 2018).

The prevalence of underweight in Indonesia is not only due to the lack of vitamin A supplementation but also to various other factors. The prevalence of underweight in Indonesia is influenced by various interrelated factors, including insufficient intake of energy and carbohydrates, which can lead to nutritional deficiencies and impaired growth. In addition, high rates of infectious diseases worsen health conditions, especially in vulnerable groups such as infants and children. The lack of exclusive breastfeeding is also an important factor, as breast milk contains essential nutrients needed for optimal development in the early years of life. Maternal parenting in providing food also plays a role in determining the quality of children's nutritional intake, which is often influenced by increased maternal knowledge about nutrition and health. Increased family income also affects access to nutritious food and adequate health services, and together these factors contribute to the high rates of nutrition and health problems in Indonesia (Aprilya Roza Werdani and Syah, 2023; Esti, 2024).

Table 7. Relationship between One-Year Vitamin A Coverage and Prevalence of Wasting in Children Aged 6-59 Months in Indonesia in 2023

Vitamin A coverage	Wasting	Severely Wasting	Severy Wasting + Wasting
Vitamin A coverage never/year			
Beta	0.17	0.10	0.17
Constant	6.15	0.45	6.15
Correlation Coefficient (r)	0.38	0.70	0.57
p-value	0.01	0.00	0.00
Vitamin A coverage 1 time/year			
Beta	-0.10	-0.15	-0.25
Constant	12.20	10.28	22.48
Correlation Coefficient (r)	0.35	0.64	0.52
p-value	0.03	0.00	0.00
Vitamin A coverage <2 times/year			
Beta	0.08	0.13	0.22
Constant	1.11	6.57	5.46
Correlation Coefficient (r)	0.28	0.52	0.42
p-value	0.08	0.00	0.00
Vitamin A coverage 2 times/year			
Beta	-0.08	-0.13	-0.22
Constant	9.93	6.93	16.86
Correlation Coefficient (r)	0.28	0.52	0.42
p-value	0.08	0.00	0.00

The results of data analysis in Table 7 show that never vitamin A coverage is associated with the prevalence of stunting (p-value 0.01), associated with the prevalence of severe wasting (p-value 0.00), and associated with the prevalence of total wasting (p-value 0.00). Vitamin A coverage of 1 time was associated with the prevalence of wasting (p-value 0.03), associated with severely wasted (p-value 0.00), and associated with the total prevalence of wasting (p-value 0.00). Vitamin A coverage <2 times was associated with the prevalence of severely wasted (p-value 0.00) and the prevalence of total wasting (p-value 0.01), but not with the prevalence of wasting (p-value 0.08). 2 times vitamin A coverage was associated with the prevalence of severe wasting (p-value 0.00) and the prevalence of total wasting (p-value 0.01), but not the prevalence of wasting (p-value 0.08). The beta coefficient showed that the higher the proportion of vitamin A supplementation, the lower the prevalence of wasting.

The highest prevalence of wasting was found in the Maluku region at 10.7%. Meanwhile, the prevalence of wasting in Java and Bali was the lowest at 5.5%. Wasting puts toddlers at risk of long-term developmental delays, decreased immune system function, increased severity and susceptibility to infectious diseases, and increased risk of death, especially toddlers who experience severe wasting (Soedarsono and Sumarmi, 2021).

The findings of this study indicate an association between vitamin A intake and the incidence of wasting. Research conducted by (Maulida and Pramono, 2015) revealed that subjects classified as wasting had inadequate vitamin A consumption. Vitamin A deficiency is often found in children with poor nutritional status. Synergistic vitamin A supplementation can improve children's health (Maulida and Pramono, 2015). Research (Lestari, 2020) supports these findings, showing a link between vitamin A consumption and nutritional problems. Food intake, especially vitamin A, fundamentally impacts the health of children under five. Research (Yuziani and Sofia, 2022) Suggests that toddlers who receive blue vitamin A supplements from the age of six months are 37% less likely to be underweight compared to toddlers who do not receive such supplements.

This is in line with research conducted in India, which indicated that children with adequate vitamin A intake were less likely to be wasted, underweight, and underweight compared to those without adequate vitamin A intake. In addition, vitamin A-deficient children are highly susceptible to malnutrition and disease due to a weakened immune system (Ghanynafi *et al.*, 2024). In theory, micronutrients play important roles in influencing nutritional status, including their involvement in the metabolism of macronutrients into energy, child development and growth, and the body's defense against infection.

CONCLUSION

This study shows a significant association between the proportion of vitamin A coverage and the prevalence of stunting, underweight, and wasting among children under five in Indonesia. Regions with a higher proportion of vitamin A provision, such as Java-Bali, tend to show lower rates of stunting, underweight, and wasting. Conversely, regions with low vitamin A coverage, such as Nusa Tenggara and Maluku, show higher prevalence. Nationally, the prevalence of stunting, underweight, and wasting remains very high, highlighting the importance of vitamin A supplementation for children to address under-five nutrition. Based on these findings, health policies should focus on increasing vitamin A coverage, especially in areas with a high prevalence of underweight and wasting, such as Maluku, Papua, and Nusa Tenggara.

Nutrition education programs and vitamin A distribution should be strengthened, as well as ensuring accessibility of health facilities in remote areas. Future researchers are advised to investigate other factors that influence children's nutritional status, such as eating habits, parenting, and environmental factors. In addition, conducting longitudinal studies is also recommended to determine the causal relationship between vitamin A supplementation and children's nutritional status.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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STUNTING IN CHILDREN UNDER TWO YEARS OLD IN RURAL AREAS WONOSOBO REGENCY, CENTRAL JAVA, INDONESIA: DOES ANEMIA MATTER?

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ABSTRACT

Background: *Stunting is a serious problem if it is not treated better. Several factors are known to influence stunting, what about anemia in children under two old? This study aims to know the factors that influence stunting, especially anemia in children under two old in rural regions.* ***Method:*** *Cross sectional research in rural regions in Wonosobo Regency involving 285 respondents. This study analyzed five independent variables (gender, age, Hb status, maternal education, and maternal occupation). Meanwhile, the dependent variable is stunting. The author uses a logistic regression test at the final stage.*
Results: *This research shows that there is no relationship between gender, age, maternal education, maternal employment, and stunting p =>0.05. Meanwhile, what had a significant relationship was the anemia status of children under two old with p-value of < 0.05. Logistic regression analysis proves that anemia in children under two years old has a risk of 2,105 times stunting compared to those who are not anemic (95% CI: 1.168 – 3.795).*
Conclusion: *This research shows that anemia in children under two old influences the incidence of stunting in rural regions in Wonosobo Regency Central Java Indonesia.*

Keywords: *stunting, anemia, children, rural*

INTRODUCTION

In several countries, the incidence of stunting among the children has experienced a remarkable decline, even though it is not as expected. Each country has its speed and strategy to achieve this. The strategies implemented in several countries scope the health sector and non-health sector. In Indonesia, the composition of the contribution from the health and nutrition sector is 40% and the non-health sector is 50%. These are often called nutrition-specific and sensitive interventions (Bhutta et al., 2020), and it is estimated that the health sector is 30% and non-health 70% (TNP2K, 2018).

In Rwanda, stunting remains a major public health challenge. The majority of fatalities associated with stunting can be attributed to nutritional practices observed during the initial five years of an individual's life (Habimana & Biracyaza, 2019). In Indonesia, stunting is a key nutritional concern. Stunting represents a significant consequence of persistent malnutrition in pediatric populations and exerts enduring effects on growth and developmental trajectories across successive generations(Julianti & Elni, 2020). The rate of stunting in Indonesia varies from year to year, increasing in the 2010 - 2013 period, then decreasing in the 2014 - 2018 period, and then in 2021 show decreasing to 24.4%, and in 2022 it decreased to 21.6% (SSGI, 2023).

Several research results show that there is a wide gap in the incidence of stunting between rural and urban regions. Stunting in rural regions is a problem that needs specialy. Problems in rural regions occur almost all over the world. Factors related to rural regions

include: low education and knowledge about health, poverty, and access to health service facilities. Multiple studies show that stunting rates are considerably higher among children in rural regions than those in urban settings(Ashar et al., 2024), (Laksono, Sukoco, et al., 2022), (Suratri et al., 2023), (Sserwanja et al., 2021), (Wulandari & Laksono, 2023). Low education is also associated with less knowledge (Yunitasari et al., 2021). These factors often become a circle of problems that are difficult to overcome. Breaking the chain of problems is a challenge that requires more attention. With conditions of insufficient knowledge, poverty, and poor access to health services, this creates problems with children's nutritional status which has the potential to cause anemia.

The government has made efforts to treat child anemia. Treatment of anemia starts from the upstream, namely giving iron tablets to young women, pregnant women, and the postpartum period. With this provision, it is hoped that the baby born will not experience anemia. Handling anemia in children under five is not easy, various programs have been carried out but have not met the expected targets. Anemia in children under five in Indonesia is still very high, in Aceh, the results of the Word Vision Indonesia Survey (2010) amounted to 67.8% of children under five suffering from anemia, while 2019 Riskesdas data found that anemia in children old 12-59 months was 30.3% in the city and 25.8% in rural regions. Anemia is more common in children under five with iron deficiency status, namely 73.1% compared to non-deficient children, 31.7%. The results of research in rural regions in Wonososbo Regency show that 72.4% of stunted children under two old also experience anemia (Ashar et al., 2020).

METHODS

Research with a crosssectional survey design was conducted in 2020 with 285 respondents in rural Wonosobo District Central of Java Indonesia. Samples from 20 existing villages were selected randomly. To maintain data quality, the team's perception equation was carried out on questionnaires, editing, coding and tabulation, data cleaning, and data analysis. Stunting is the dependent variable, while the variables gender, age, Hb status, mother education, and mother employment are the independent variables.

In the initial stage of sampling, this study used Chi Square to analyze bivariate comparisons. We used logistic regression in the last stage. We used previous tests to analyze the multivariate relationship between all independent factors and shopping behavior and stunting. Next, we used SPSS application during the statistical stage analysis. This research was conducted in accordance with research principles and obtained approval from the research ethics commission with number: LB.02.01/2/KE/.045/2019 and received approval from respondents in the form of signing an informed consent.

RESULTS AND DISCUSSION

RESULTS

Table 1. Descriptive statistics on the nutritional status of children under two old in rural Wonosobo District, Central of Java Indonesia (n=285)

Variable	Nutritional Status		*p*-value
	Stunted (n= 67)	**Normal (n =218)**	
Children's gender			
Girls	20.49%	79.51%	0.056
Boys	25.77%	74.23%	
Children"s age (month)			
0 - <12	23.18%	76.82%	0.721
12 – 24	79.6%	20.4%	
Hemoglobin Status			
Not Anemia	19.81%	80.19%	0.013
Anemia	33.33%	66.67%	
Mother’s education			
Primary	27.91%	72.09%	0.286
Secondary	21.98%	78.02%	
Higher	17.63%	82.35%	
Mother’s employment			
Employed	24.81%	75.19%	0.732
Unemployed	22.44%	77.56%	

Table 1 shows that stunting affects around 25% of children under 2 yo who live in rural regions. Male children under the age of two have a higher prevalence than females, and the majority of them are older than 12 months. Besides that, more than a third of children under two in rural regions suffer from anemia. In terms of education, almost 30 percent of mothers have elementary school education and almost a quarter do not work.

Table 2. Logistic regression of nutritional status of children under two old in rural Wonosobo District, Central of Java Indonesia (n=285)

Predictor	*p*-value	Stunted		
		AOR	95%CI Lower	95%CI Upper
Children's gender				
Girls	-	-	-	-
Boys	0.259	0.718	0.404	1.276
Children"s age (month)				
0 - <12	-	-	-	-
12 – 24	0.814	0.935	0.533	1.629
Hemoglobin Status				
Not Anemia	-	-	-	-
Anemia	0.013	2.105	1.168	3.795
Mother's education				
Primary	-	-	-	-
Secondary	0.254	0.449	0.114	1.775
Higher	0.439	0.587	0.152	2.263
Mother's employment				
Employed	-	-	-	-
Unemployed	0.513	0.826	0.467	1.463

AOR; Adjusted Odds Ratio. *p<0.050, CI; Confidence Interval

Table 2 displays the findings of the logistic regression analysis, in which gender, age, mother education, and maternal employment are not associated with stunting, but the anemic status of children under two old is strongly related to stunting, with 2.1 times the probability of experiencing stunting.

DISCUSSION

Table 1 demonstrates that nearly 25% of children under 2 years in rural regions experience stunting. Stunting in rural regions is a problem that requires specially. Problems in rural regions occur almost all over the world. Factors related to rural regions include: low education and knowledge about health, poverty, and access to health service facilities related to demographics. According to various studies, stunting is more prevalent among children in rural regions than to urban regions (Ashar et al., 2024), (Laksono, Sukoco, et al., 2022), (Suratri et al., 2023), (Sserwanja et al., 2021), (Wulandari & Laksono, 2023). The results of research in Congo show that there's a considerable discrepancy between rural and urban regions, with rural regions having a higher proportion of children suffering from stunting than urban regions (Christian et al., 2020). The same thing is also common in rural regions of eastern and western Rwanda (Habimana & Biracyaza, 2019). Children in rural regions face a 1.10 times higher risk of stunting than children in urban regions (Kismul et al., 2017).

Table 1 shows that boys experience stunting at a slightly higher rate than girls. The results of this research show the same thing as the results of further analysis of Indonesian nutritional status survey (SSGI) data in eastern Indonesia, that boys are more prone than girls to endure stunting (Ashar et al., 2024), (Kismul et al., 2017). In the Central African Republic, almoust one-third of all children under the age of five were stunted, with boys having a higher prevalence (Kusumawardani et al., 2023), as were the results of research in the Congo in 2017(Christian et al., 2020). In both rural and urban regions, the sole relevant determinant was the child's gender (Laksono, Wulandari, et al., 2022). Other studies reveal that boys are 1,320 times more likely than girls to experience stunting (Vonaesch et al., 2017). Boys to be more active during toddlerhood. This mobility requires more energy. If this is not balanced with adequate nutritional intake, energy imbalance can occur and will disrupt growth.

This research also showed that the majority of stunting occurs in children aged 12 to 24 months. This is in conformity with the results of the 2024 Ashar study, which indicated that stunting occurs more greater in children age 12 to 23 months compared to

children under 12 months (Ashar et al., 2024). Other studies reveal that children aged 24 to under 36 months and 36 to under 48 months have a higher risk of stunting than those younger than 6 months (Laksono et al., 2024). This means that when children grow older, they have a greater change of stunting (Wulandari & Laksono, 2023). A study conducted in the eastern section of Indonesia, Maluku province, show that children aged 12 to 23 months are 4.09 times more likely to acquire stunting than those under 12 month (Kismul et al., 2017). Further examination of 2018 Basic health research data in the NTT province of Eastern Indonesia show that the highest proportion of stunting is in children aged 12 to 23 months 45.2% (Suratri et al., 2023). Other studies reveal that children age 12 to 23 months had a 3.033 times higher probability of developing stunting than those under 12 months (Vonaesch et al., 2017).

This study also shows that almost 30% of mothers' education is only elementary school. Several other studies show that better maternal education will protect their child under two years old from experiencing stunting (Laksono, Sukoco, et al., 2022), (Suratri et al., 2023). In rural regions of Eastern and Western Rwanda, maternal education is significantly linked to stunting (Habimana & Biracyaza, 2019). This implies that when a mother's education level of grows, the likehood of her child experience stunting diminishes (Laksono et al., 2024). Other research also indicate that a higher level of mother's education reduces the likehood of a toddler experiencing stunting (Wulandari & Laksono, 2023). Mothers with elementary education are 1,587 times more likely to produce a stunted child than mothers with higher education (Chowdhury et al., 2022). In Papua, Eastern Indonesia, Mothers with elementary school education are 1,263 times more likely to produce stunted children than Mothers with higher education (Laksono, Wulandari, et al., 2022)

This research also shows that almost a quarter of the mothers who experience stunting are working, slightly higher than non-working mothers. Statistical investigation revealed that the mother's employment position is not connected to stunting. Nonetheless, the researchers discovered that the prevalence of stunting was greather among the children of worked moms. This is aligns with the results of research in Peru based on the results of further analysis of DHS data with 4,637 respondents in children aged 6 – 36 months (Wulandari et al., 2022). The same thing was also conveyed from the results of the 2022 Laksono research showing that: Mothers employment within rural environments is associated with an elevated likehood of offspring under the age of two experiencing growth stunting (Habimana & Biracyaza, 2019), (Laksono, Sukoco, et al., 2022). This means that work factors influence the occurrence of stunting (Chavez-Zarate et al., 2019). Other research based on further analysis of SSGI data showed that working women are 1.116 times higher risk of stunting and children aged 12 to 23 months whose mothers work are 2.831 times more likely to be stunted than children under the age of 12 months (Danso & Appiah, 2023). Based of this research and several similar earlier studies, reveals that working mothers influence stunting. This finding can be a guideline that as long as the mother is working, parenting patterns while the mother is working can be a problem that requires further study. The questions that need answers are, what parenting style is provided, and who replaces the mother's role while the biological mother is working.

Table 2 illustrates the outcames derived from the logistic regression analysis, revealing that variables such as child gender, child age, mother's education, and occupation do not significant relationships with stunting. However, this research shows that more than 30% of children under two old in rural regions experience anemia. Logistic regression analysis shows that anemia is significantly to stunting.

Children under two old with anemia are 2,105 times more likely to have stunting. Muhammed also said something similar in 1918 that anemia and stunting often occur together in young children (Supadmi et al., 2024). Other research suggests that anemia in children aged 6-23 months has major impact on their growth and development (Mohammed et al., 2019). In Haiti, anemia is a serious problem for the growth, development, and survival of children (Castro-Bedriñana et al., 2020). Anemia in under-five children is related to conditions at birth, which meant that the mother's condition during pregnancy will influence the anemia status of the newborn. Anemia prevention is aimed at mothers during pregnancy, with the hope that the child's condition at birth will not be anemic. In several countries, when treating anemia in toddlers, the strategy used is to provide iron supplements to women of childbearing age , maternal pregnant, maternal postpartum, and children under two old (Castro-Bedriñana et al., 2020).

CONCLUSION

This research reveals that anemia in children under two old influences the oourrence of stunting in rural regions in Wonosobo Regency, Central Java, Indonesia.

STRENGTHS AND LIMITATIONS

This study aims to see how the characteristics of childrend under two years old in rural areas are related to stunting, does anemia have an effect? On the other hand, this study has limitations, namely the sample setting in rural areas, cannot describe urban areas. Research with samples in different areas, with larger samples may provide better results.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest

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RELATIONSHIP OF PROPORTIONS MINIMUM ACCEPTABLE DIET (MAD) WITH THE PREVALENCE OF STUNTING, WASTING, AND UNDERWEIGHT IN CHILDREN 0-23 MONTHS

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ABSTRACT

Background: *Stunting, wasting, and underweight in children under two years of age are serious health problems in many countries, including Indonesia. Adequate nutrition in the first two years of life is essential to prevent growth and development disorders. A minimum acceptable diet (MAD) can reduce the prevalence of nutritional problems in children, but the provision of MAD in Indonesia is often not in accordance with recommendations. This study aims to analyze the relationship between the proportion of MAD with the prevalence of stunting, wasting, and underweight in children aged 0-23 months in Indonesia.*
Method: *The study used a cross-sectional design with aggregate data from 38 provinces from the 2023 Indonesian Health Survey (IHS).*
Results: *The independent variables analyzed included five MAD indicators, namely food diversity, meal frequency, milk provision, minimal diet accepted, and animal protein consumption. The dependent variables were the prevalence of stunting, wasting, and underweight, which were measured using anthropometric indicators (BAZ, HAZ, and WAZ).*
Conclusion: *The results of this study can be the basis for formulating health policies to improve child feeding patterns and reduce the prevalence of stunting, wasting, and underweight in Indonesia.*

Keywords: *Minimum Acceptable Diet (MAD), Nutritional Status*

INTRODUCTION

Nutritional problems in Indonesia are still a major challenge, especially in terms of stunting, wasting, and underweight in toddlers. Wasting, or a condition of low body weight compared to height, is an indicator of acute malnutrition that increases the risk of child death by 11.6 times compared to children with normal nutritional status. Based on Riskesdas 2018 data, the prevalence of wasting in Indonesia reached 10.2%, although it has decreased slightly compared to previous years. Stunting, as one of the main indicators, has been identified by WHO as a significant obstacle to human development, with a global prevalence of around 162 million toddlers. This problem is not only centered on inadequate nutritional intake but is also influenced by inappropriate feeding practices, such as low food diversity and minimal meal frequency in children aged 6-23 months (Febriati et al., 2024) .

Underweight, which is low weight compared to age, shows the combined impact of wasting and stunting. In 2018, the prevalence of underweight reached 17.7% among Indonesian toddlers. These two conditions not only pose a risk to children's health and development, but also impact future productivity, worsen the cycle of poverty, and reduce the quality of human resources.

One of the causes of nutritional problems is inadequate intake of nutrients obtained from food. Feeding practices for children are very important to pay attention to. This is because feeding practices will directly affect health, development, and nutritional status and also

have an impact on the survival of children (Ministry of Health of the Republic of Indonesia, 2018; Trisnawati et al., 2016). Feeding practices for children can be seen from the quality of food provided by parents, especially mothers and/or caregivers, which are reflected in several indicators, namely minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum frequency of milk feeding for children who are not breastfed or Minimum Milk Feeding Frequency for non-breastfed children (MMFF), and minimum acceptable diet (MAD) (WHO & UNICEF, 2010) (Yudianti et al., 2024) .

The low achievement rate of MAD in Indonesia is related to a number of factors including family socio-economic factors, family welfare level, number of children, mother's knowledge level, exposure to media, parent's occupation, and others. One of the factors that influences MAD in children that needs to be highlighted is the mother's nutritional factor (Putra et al., 2022) . Based on Marshall's research (2022), it is known that the amount and diversity of food consumed by mothers before and during pregnancy and breastfeeding affect the health of mothers and children. The low achievement of the MAD indicator and socio-economic factors worsen it, making it a top priority in the national health development plan. Research related to feeding patterns and the factors that influence them is needed to develop strategies to reduce nutritional problems effectively (Sirajuddin et al., 2023).

This study aimed to analyze the relationship between the proportion of MAD and the prevalence of stunting, wasting, and underweight in children aged 0-23 months.

METHOD

This study used a cross-sectional design to determine the relationship between Minimum Acceptable Diet (MAD) and the Prevalence of Stunting, Wasting, and Underweight in Children Aged 0-23 Months using data from the 2023 Indonesian Health Survey (IHS). The unit of analysis in this study was aggregate data in 38 provinces in Indonesia with the population in this study covering all children aged 0-23 months in Indonesia recorded in the 2023 IHS. Data collection was carried out from June to August 2023. The population in this study were all children aged 0-23 months recorded at the IHS Regency Posyandu in 2023. The samples taken were children who met the inclusion and exclusion criteria of the study. (Thobias & Djokosujono, 2021)

The independent variable in this study is the Minimum Acceptable Diet (MAD). The description of the Minimum Acceptable Diet (MAD) in children aged 6-23 months is seen through five indicators, namely: minimum dietary diversity *(MDD*), minimum meal frequency (*MMF*), *Minimum Milk Feeding Frequency for Non-Breastfed Children (MMFF*), minimum acceptable diet (*MAD*) and consumption of animal protein, namely meat/fish/eggs (*Egg And/Or Flesh Food/EFF*) (UNICEF, 2021) .

Dietary diversity is an approach to assessing the adequacy of dietary diversity in foods consumed within 24 hours before data collection. A child aged 6-23 months meets the minimum dietary diversity requirement if they consume ≥5 food groups (UNICEF, 2021) (WHO2023). The five food groups must come from the following 8 food groups: Breast milk (ASI),Cereal, tuber and processed product groups, Group of legumes, nuts and processed products, Group of processed animal milk products, Meat, poultry, fish, seafood and processed products groups, Egg group and processed products, Groups of vegetables (fruit, sweet potatoes which are rich in vitamin A and their processed products), and Groups of other vegetables and fruit and their processed products.

The Minimum Food Diversity (MFD) Proportion for children aged 6-23 months is

calculated by dividing the number of children aged 6-23 months who consumed 5 or more food groups from 8 food groups in the previous 24 hours by the number of children aged 6-23 months x 100%. Minimum meal frequency (MMF) in children aged 6-23 months is a description of the number of main meals and snacks given to toddlers who consume solid, semi-solid, or soft foods (including milk for children who are not breastfed) within 24 hours before data collection. The minimum meal frequency in children who are breastfed, aged 6-8 months is ≥ 2 times/day while those aged 9-23 months are ≥ 3 times/day. While the minimum meal frequency in children who are not breastfed at the age of 6-23 months is ≥ 4 times/day. The proportion of Minimum Meal Frequency (MMF) is calculated by dividing the number of children aged 6-23 months who consume food according to the frequency according to age by the number of children aged 6-23 months x 100%.

Minimum Milk Feeding Frequency for non-breastfed children (MMFF) is a description of the frequency of milk feeding in toddlers who are not breastfed within 24 hours before data collection. The minimum frequency of milk feeding in children aged 6-23 months who are not breastfed is ≥ 2 times/day. The proportion of MMFF is calculated by dividing the number of children aged 6-23 months who are not breastfed and receive milk according to recommendations (≥ 2 times) by the number of children aged 6-23 months who are not breastfed x 100%.

Minimum Acceptable Diet (MAD) is a minimally acceptable diet that is a description of the provision of food (amount and type) to children aged 6-23 months which is a composite index of the MDD, MMF, and MMFF indicators (in children who are not breastfed) in the amount according to recommendations. The proportion of MAD in breastfed children is calculated by dividing the number of children aged 6-23 months who achieve MDD and MMF according to recommendations by the number of children aged 6-23 months. The proportion of MAD in children who are not breastfed is calculated by dividing the number of children aged 6-23 months who achieve MDD, MMF, and MMFF according to recommendations by the number of children aged 6-23 months x 100%.

Consumption of Animal Protein *Egg And/Or Flesh Food* (EFF) in children aged 6-23 months is a description of the consumption of eggs and/or meat food in children aged 6–23 months within 24 hours prior to data collection. The EFF proportion is calculated using the formula of dividing the number of children aged 6–23 months who consumed eggs and/or meat and/or fish in the previous 24 hours by the number of children aged 6–23 months x 100%.

The dependent variables are the prevalence of stunting, wasting, and underweight. The nutritional status of toddlers (under two years old) is measured based on age, body weight (BW), and body length (PB). The weight of toddlers is weighed using a digital scale with a precision of 0.05 kg, while body length is measured using a body length measuring instrument with a precision of 0.1 cm. The variables of BW and BW of toddlers are presented in the form of three anthropometric indices, namely WAZ, HAZ, and WHZ. To assess the nutritional status of toddlers, the weight and length figures of each toddler are converted into standardized values (*Z-score*) using the WHO 2005 toddler anthropometric standards. Furthermore, based on the *Z-score value* of each indicator, the nutritional status of toddlers is determined.

Classification of nutritional status based on WAZ index, *Severely Underweight if Z-score* < -3.0, and underweight if *Z-score* ≥-3.0 to Z- *score* < -2.0. The total prevalence of *underweight* is the sum of the prevalence of *underweight* and *severely underweight.* The prevalence of Underweight Toddlers is the division of the Number of Severely Underweight Toddlers + underweight by the Number of Toddlers Weighed Weight x 100%.

Classification of nutritional status based on HAZ indicators, *Severely Stunting if Z-score* < -3.0 and stunting if *Z-score* ≥ -3.0 to *Z-score* < -2.0. The total prevalence of stunting is the sum of the prevalence of stunting and *severely stunting*. The prevalence of stunting in toddlers is the division of the Number of Toddlers *Severely Stunting* + stunting by the Number of Toddlers measured by Body length x 100%. Classification of nutritional status based on WHZ indicators, *Severely Wasting if Z-score* < -3.0 and wasting if *Z-score* ≥ -3.0 to *Z-score* < -2.0. The total prevalence of wasting is the sum of the prevalence of wasting and *severely wasting*. The prevalence of stunting in toddlers is the division of the Number of Toddlers *with severe wasting* + *Wasting* by the Number of Toddlers Measured by Weight and length x 100%.

Data were collected through face-to-face interview techniques using a validated structured questionnaire. This questionnaire includes information on child feeding (eating frequency and food diversity). Nutritional status data were collected by measuring body length (for children aged 0-23 months) using a legboard. Data collection was carried out by trained enumerators with the criteria of D3/Bachelor of Applied Nutrition graduates and having a competency certificate in anthropometric measurements. Enumerators were intensively trained in interview techniques, anthropometric measurements, and ethical research procedures. The supervision process was carried out by researchers to ensure that data collection went well.

The data processing process includes checking the 2023 IHS report, coding, and compiling data. Univariate analysis was conducted to describe the size of the distribution of data on the proportion of weighing and the prevalence of wasting and severe wasting (minimum, maximum, mean, and standard deviation). Bivariate analysis was conducted to identify the relationship between the proportion of weighing and the prevalence of *severe wasting* and *wasting* in children aged 0-23 months in Indonesia, using the Pearson correlation test. The study participants were given an explanation of the purpose and procedures of the study and their right to participate voluntarily, and they gave written consent before the data were collected. The Indonesian Health Survey (IHS) has obtained an ethics clearance letter from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023.

RESULT AND DISCUSSION

Based on Table 1 shows the highest distribution of the proportion of the minimum diet (MAD) in the Java and Bali Region (47.5%) and the lowest in the Papua Region (21.5%). The highest non-conforming MAD in the Papua Region (78.4%) and the lowest in the Java and Bali Region (52.4%). The proportion of the appropriate MAD in Indonesia is between 9.4%-64.1% with an average of 34.9%. The proportion of the inappropriate MAD in Indonesia is between 35.9%-90.6% with an average of 65%.

Child nutrition problems, especially stunting, wasting, and underweight, are serious challenges faced by many countries, including Indonesia. In this study, the relationship between the proportion of MAD and the prevalence of stunting, wasting, and underweight in children aged 0-23 months in Indonesia was analyzed based on data from the 2023 Indonesian Health Survey (IHS).

Table 2 shows that the highest prevalence of Stunting is in the Papua Region (28.1%) and the lowest in the Java and Bali Region (16.3%). The highest prevalence of Wasting is in the Maluku Region (17.8%) and the lowest in the Java and Bali Region (7.9%). The highest prevalence of Underweight is in the Maluku Region (21.3%) and the lowest in the Java and Bali Region (11.3%).

Table 1. Distribution of Minimum Diet Proportion (MAD) in Indonesian Toddlers in 2023

Regional	MAD Compliant			Not compliant with MAD Standards		
	Min	Max	$\bar{X}$ ±SD	Min	Max	$\bar{X}$ ±SD
Sumatra	30.0	46.3	37.1 ±4.8	53.7	70.0	62.8 ±4.8
Java - Bali	39.0	64.1	47.5 ±8.9	35.9	61.0	52.4 ±8.9
Southeast	26.0	39.9	32.9 ±9.8	60.1	74.0	67.0 ±9.8
Kalimantan	30.2	40.8	37.0 ±4.0	59.2	69.8	62.9 ±4.0
Sulawesi	27.2	41.2	30.6 ±5.2	58.8	72.8	69.4 ±5.2
Maluku	26.6	29.7	28.1 ±2.1	70.3	73.4	71.8 ±2.1
Papua	9.4	36.1	21.5 ±10.1	63.9	90.6	78.4 ±10.1
Indonesia	**9.4**	**64.1**	**34.9 ±10.2**	**35.9**	**90.6**	**65.0 ±10.2**

The prevalence of Stunting in Indonesia is between 7.0%-36.6% with an average of 20.8%. The prevalence of Wasting in Indonesia is between 3.7%-20.4% with an average of 11.3%. The prevalence of Underweight in Indonesia is between 4.6%-24.8% with an average of 15.5%. The results of the study found that there were variations in the prevalence of stunting, wasting, and underweight of children aged 6-23 months in various regions of Indonesia.

Table 2. Distribution of Prevalence of Stunting, Wasting, and Underweight in Indonesian Toddlers in 2023

Regional	Prevalence of Stunting			Prevalence of Wasting			Prevalence of Underweight		
	Min	Max	$\bar{X}$ ±SD	Min	Max	$\bar{X}$ ±SD	Min	Max	$\bar{X}$ ±SD
Sumatra	12.4	24.8	17.1 ±3.8	6.5	14.8	9.4 ±2.5	7.9	19.0	12.1 ±3.4
Java - Bali	7.0	21.1	16.3 ±4.4	3.7	12.8	7.9 ±2.9	4.6	15.4	11.3 ±3.6
Southeast	19.9	31.0	25.4 ±7.8	7.4	14.8	11.1 ±5.2	15.5	24.8	20.1 ±6.5
Kalimantan	14.7	23.5	20.1 ±3.2	9.6	13.9	11.7 ±2.0	13.0	19.2	16.6 ±2.5
Sulawesi	21.6	25.2	23.3 ±1.4	9.4	14.2	11.9 ±1.6	14.7	20.7	18.0 ±2.2
Maluku	21.4	22.8	22.1 ±0.9	17.7	17.9	17.8 ±0.1	20.3	22.3	21.3 ±1.4
Papua	21.8	36.6	28.1 ±6.2	12.3	20.4	15.3 ±2.8	9.5	24.2	19.3 ±5.2
Indonesia	7.0	36.6	20.8 ±5.8	3.7	20.4	11.3 ±3.6	4.6	24.8	15.5 ±4.9

The results of the data analysis in Table 3 show the higher the MAD correlation coefficient, the lower the prevalence of stunting, wasting, and underweight prevalence, and vice versa, the lower the MAD coefficient, the higher the prevalence of stunting, wasting, and underweight prevalence.

Table 3. Proportion of Minimal Diet (MAD) with Prevalence of Stunting, Wasting, and Underweight in Children Aged 0-23 Months

Minimum Acceptable Diet (MAD)	Prevalence of Stunting	Prevalence of Wasting	Prevalence of Underweight
MAD Compliant			
Beta	-0.342	-0.186	-0.198
Constant	32.715	17.792	22.459
Correlation coefficient (r)	0.610	0.524	0.417
p-value	0.001	0.001	0.001

The results of this study demonstrate a significant relationship between the proportion of the Minimum Acceptable Diet (MAD) and the prevalence of stunting, wasting, and underweight among children aged 0-23 months. The p-values obtained for the associations between MAD and these three indicators of malnutrition were all below 0.05, indicating statistical significance ($p < 0.05$). This suggests that a higher proportion of MAD compliance is

inversely related to the prevalence of stunting, wasting, and underweight. Specifically, as the proportion of children receiving an adequate diet increases, the rates of malnutrition indicators such as stunting, wasting, and underweight decrease.

The negative relationship between MAD compliance and the prevalence of these malnutrition indicators may be explained by the fact that meeting the MAD standards ensures that children receive the required nutrients to support healthy growth and development. MAD is a measure that reflects the adequacy of both the quantity and diversity of food provided to young children, as well as the frequency of feeding. As such, children who receive an adequate diet are less likely to experience growth stunting, underweight, and wasting, which are often direct consequences of inadequate nutrition during early childhood (Black et al., 2013).

In light of these findings, it is evident that improving the nutritional status of young children should be a priority for public health programs aimed at reducing malnutrition. Increased adherence to MAD standards can significantly contribute to reducing the prevalence of stunting, wasting, and underweight in Indonesia, and potentially other countries facing similar challenges. By prioritizing better nutritional practices, we can ensure that children have the opportunity to grow, develop, and thrive, ultimately fostering a healthier, more prosperous future for both individuals and the nation. (Black et al., 2013).

This study has several limitations that need to be considered. First, the use of a cross-sectional design limits the study's ability to identify a causal relationship between the MAD and the prevalence of stunting, wasting, and underweight in children. Because the data were collected at only one point in time, this study can only show an association, not a causal relationship. Second, although using data from the 2023 Indonesian Health Survey (IHS), which includes data on 38 provinces, this study cannot fully control for variability or differences in social, economic, and health access conditions between regions, which can affect the MAD and children's nutritional status. In addition, although the use of MAD indicators, such as food diversity, meal frequency, and milk consumption provides a clear picture, the possibility of measurement bias or reporting by mothers regarding the provision of the Minimum Acceptable Diet (MAD), can also affect the results of the study.

This study has significant advantages. One of them is the use of data sourced from the 2023 Indonesian Health Survey (IHS), which includes a large sample with national representation, allowing for the generalization of research results throughout Indonesia. In addition, data collection was carried out by trained enumerators who have competency certification in anthropometric measurements, thereby increasing the accuracy and reliability of the data obtained. This study also uses standardized indicators from WHO to assess the MAD, which provides a strong basis for analysis and allows comparisons between similar studies. With a comprehensive approach and systematic data processing procedures, this study can provide important insights into the relationship between MAD, and the prevalence of nutritional problems in children aged 0-23 months in Indonesia.

CONCLUSION

This study found that the proportion of the Minimum Acceptable Diet (MAD) has a significant relationship with the prevalence of stunting, wasting, and underweight in children aged 0-23 months in Indonesia. Children who receive a diet that meets MAD standards tend to have better nutritional status and a lower risk of malnutrition. However, there are still many children who do not meet MAD standards, especially in areas with limited access to nutritious food. Therefore, more targeted efforts are needed to improve the fulfillment of

children's nutrition to reduce stunting, wasting, and underweight rates in Indonesia.

The government needs to strengthen the availability and affordability of nutritious food in all regions, especially in areas with high levels of malnutrition. Increased socialization and education to parents, especially mothers, regarding the importance of a diet in accordance with the MAD to prevent stunting, wasting, and underweight. It is necessary to optimize the Supplementary Feeding (SF) program which is more targeted for children aged 0-23 months to increase access to better nutrition. Providing training for health workers, Posyandu cadres, and parents in providing nutritious food following MAD guidelines. The government needs to strengthen the monitoring and evaluation system for children's nutritional status periodically to assess the effectiveness of the interventions that have been carried out. Cross-sector collaboration is needed, including government, private sector, and community, to improve policies that support the provision of nutritious food and improve the nutritional status of early childhood. Implementation of these recommendations is expected to help reduce the prevalence of stunting, wasting, and underweight, as well as improve the nutritional quality of children aged 0-23 months in Indonesia.

CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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RELATIONSHIP BETWEEN STATUS AND FREQUENCY OF WEIGHING WITH PREVALENCE OF SEVERELY WASTING AND WASTING IN TODDLERS IN INDONESIA

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ABSTRACT

Background: *Wasting is a health problem that affects children's growth and development. This study aims to analyze the relationship between weighing frequency and the prevalence of nutritional status (severely wasting and wasting) in children aged 0-23 months in Indonesia.*
Methods: *This study used a descriptive correlation method with a cross-sectional approach. The study sample consisted of toddlers aged 12-18 months who met the inclusion criteria. Data were collected through the Healthy Menu Card (KMS) and analyzed using a correlation statistical test.*
Result: *The results showed that the Papua region had the highest proportion of toddlers who were not weighed (67.6%), while Java and Bali had the highest proportion of toddlers who were weighed more than 8 times (73.8%). The highest wasting prevalence was found in Papua (14.2%) and the lowest in Java and Bali (3.2%). The results of the analysis showed a significant relationship between weighing frequency and the prevalence of wasting (p = 0.011) and severe wasting (p = 0.001).*
Conclusion: *Therefore, increasing the frequency of weighing and nutritional interventions are needed to address the problem of wasting in toddlers.*

Keywords: *weight measurement, nutritional status, toddler*

INTRODUCTION

Nutritional problems in the community are often measured based on the prevalence of nutritional issues in toddlers, who are a vulnerable group to such problems (Muliyati et al., 2021). The prevalence of nutritional problems in toddlers is often used to illustrate the nutritional conditions of the community (Syarfaini et al., 2022). One of the nutritional problems in toddlers that need attention is wasting (underweight) and severe wasting (very underweight) (Alfadhila Khairil Sinatrya, 2020). The prevalence of wasting and severe wasting in toddlers is a health problem that is still a major challenge in Indonesia. Wasting and severe wasting are acute nutritional problems that occur in a short time and are at risk of causing death if not treated immediately (Mareta et al., 2024). According to data from the World Health Organization (WHO), the prevalence of severe wasting in children aged 0-23 months in Indonesia is quite high and still far from the reduction target set by the government (Tri Ariani et al., 2024). This condition, if not addressed immediately, can have long-term impacts on children's physical and cognitive development, as well as increase their vulnerability to infectious diseases (Muliyati et al., 2021) In toddlers, underweight nutrition can reduce intelligence, productivity, and creativity. This problem also has a major impact on the quality of human resources (HR) in the future (Mantur et al., 2023). Toddlers who experience wasting and severe stunting not only threaten their physical health but also hinder their future development potential.

WHO states that wasting is a public health problem, a public health problem is categorized as serious if it has a percentage between 10.0% to 14.0%, and is considered critical if it exceeds 15%(Mantur et al., 2023). The incidence of wasting in Indonesia has shown a decline in recent years, namely 12.1% in 2013 increasing to 13.3% in 2010 (Ministry of Health of the Republic of Indonesia 2013) and 10.2% in 2018 (Rosyida et al., 2024). Although the waste rate in Indonesia fluctuates, the percentage is still above 10%, which makes the waste problem a serious issue to be addressed (Rosyida et al., 2024). Problem-wasting children aged 0-23 months in Indonesia also have a high prevalence and wide disparities between provinces and regions. According to the 2022 Indonesian Nutritional Status Survey (SSGI), the prevalent age group still shows quite worrying figures. These figures reflect poor eating patterns and general health conditions at the family and community level, which are closely related to low access to health services and good food security(Mareta et al., 2024).

The high prevalence of malnutrition and poor nutrition in toddlers is influenced by three main factors. The first factor is the low quality and quantity of food consumption due to weak family food security. The second factor is poor parenting. The third factor is limited access to health facilities (Yanti et al., 2019). In response to this problem, one important step that needs to be considered is the frequency of weighing children to monitor children's nutritional status in a more structured manner. Routine weighing is one of the essential interventions in efforts to monitor the nutritional status of toddlers. Routine weighing will help detect significant weight loss, which is an important indicator for identifying nutritional problems, including severe wasting and wasting. Research conducted by (Putriastuti et al., 2024). Shows that a higher frequency of weighing can accelerate the detection and treatment of nutritional problems in children, reducing the risk of wasting, and increasing the success of nutritional interventions carried out.

The Indonesian government has carried out various interventions and government programs to reduce the number of waste and severe wasting. Study of the relationship between the frequency of weighing and the prevalence of nutritional problems in children aged 0-23 months in Indonesia has not been widely studied. Existing research is still limited to other nutritional factors, such as food consumption and access to health services(Mareta et al., 2024). Therefore, it is important to identify the role of routine weighing in reducing the prevalence of wasting and severe wasting in this age group. The results of this study are expected to provide scientific evidence that can be used to design more effective policies and programs in reducing the prevalence of nutritional problems in children. The purpose of this study was to describe the proportion of weight and the prevalence of growth disorders by region and to analyze the relationship between the proportion of weight and the prevalence of severe wasting and wasting in children aged 0-23 months in Indonesia. The results of this study are expected to provide evidence-based recommendations regarding the importance of increasing the frequency of weighing in efforts to prevent and overcome nutritional problems in children (Andini et al., 2020).

METHODS

This study used a cross-sectional design method, where data on the proportion of body weight with prevalence of severe wasting and wasting collected at one time simultaneously on the same subject. This study uses a unit of analysis from aggregate data in 38 provinces from the 2023 Indonesian Health Survey (IHS) report with the population in this study covering all children aged 0-59 months in Indonesia recorded in the IHS 2023.

Independent variables are the proportion of weighing status and the proportion of weighing frequency in the last 12 months, while the dependent variable is the prevalence of children aged 0-23 months who experience wasting and severely wasting. Both variables are measured using a ratio scale. The proportion of weighing is calculated using the formula Proportion of growth monitoring in children aged 0-59 months = Number of children aged 0-59 months who weigh or measure their length/ height divided by the total number of toddlers x 100%. Growth monitoring through weighing (WEIGHT) or measuring body length/height (PB/TB) in the last 12 months. The intended weighing and measuring of body length/height is calculated a maximum of only 1 time in 1 month, so if there are 2 or more weighing/measurements, it is considered only 1 time, weighing and measuring PB/TB does not include weighing and measuring height carried out during this survey or when the child is sick. The categories of data collection results on weighing are not weighed, weighed 8 times in 12 months, and weighed less than 8 times in 12 months. In children who have never been weighed or measured for height in the past year, the main reason for never being weighed or measured for height was asked. The prevalence of toddlers who experience wasting and severely wasting in toddlers aged 0-23 months is calculated using the formula for dividing the Number of Toddlers Severely Wasting or wasting divided by the number of toddlers measured weight and PB x 100. The weight of toddlers is weighed using a digital scale with a precision of 0.05 kg, while the length body was measured using a body length measuring tool with a precision of 0.1 cm. To assess the nutritional status of toddlers, the weight and length figures for each toddler were converted into standardized values (Z-score) using the WHO 2005 anthropometric standards for toddlers. Classification of nutritional status based on the Body Weight according to Body Length (WHZ) indicator is categorized as wasting if Z-score≥ -3.0 to Z-score< -2.0 and is categorized as severely wasting if Z-score< -3.0

The data processing process includes checking the 2023 IHS report, coding, and compiling data. Univariate analysis was conducted to describe the size of the distribution of the proportion of weighing and the prevalence of wasting and severe wasting data (minimum, maximum, average, and standard deviation). Bivariate analysis was conducted to identify the relationship between the proportion of weighing and the prevalence of severe wasting and wasting in children aged 0-23 months in Indonesia, using the Pearson correlation test. The implementation of the Indonesian Health Survey (IHS) has received approval and an ethical clearance letter from the National Health Research and Development Ethics Commission (KEPPKN) with the number HK.01.07/MENKES/156/2023. During the implementation of the IHS, all procedures were carried out by observing ethical principles, including data confidentiality and informed consent. The study participants were given an explanation of the purpose and procedures of the study and their right to participate voluntarily, and they gave written consent before the data were collected.

RESULTS AND DISCUSSION

Table 1 shows that the highest distribution of unweighed weight occurs in the Papua region (67.6%) and the lowest in the Java and Bali regions (3.8%). The highest distribution of weighted weight occurs in the Java and Bali regions (96.2%) and the lowest in the Papua region (32.4%). Table 2 shows that the distribution of Weighing more than 8 times is highest in Java and Bali (73.8%) and the lowest in Papua (13.5%). The distribution of Weighing less than 8 times is highest in Papua (58.8%) and the lowest in Nusa Tenggara (13.5%). This study revealed a gap in the distribution of weighing services in various

regions in Indonesia. Papua is the region with the highest percentage of unweighed toddlers (67.6%) and has the lowest number of weighing more than 8 times (13.5%). In contrast, Java and Bali recorded the highest number of toddlers weighing (96.2%) and the largest proportion weighing more than 8 times (73.8%). This difference shows that access to health services is still a problem, and challenges in several regions, especially Papua and Maluku. Geographical constraints, limited health infrastructure, and low public awareness are thought to be the main factors in the low frequency of weighing in these areas. Meanwhile, areas with high weighing coverage, such as Java and Bali, generally have more adequate health facilities and more active education programs in raising awareness of the importance of monitoring nutritional status.

Table 1. Distribution of Proportion of Weight Weighing Status by Region of Indonesia in 2023

Region	Unweighed			Weighed		
	Minimum	**Maximum**	***X* ± *SD***	**Minimum**	**Maximum**	***X* ± *SD***
Sumatera	14.4	32.4	25.3±6.6	67.6	85.6	74.6±6.6
Jawa dan Bali	3.8	22.1	9.8± 6.1	77.9	96.2	90.1± 6.1
Nusa Tenggara	9.3	12.4	10.8±2.2	87.6	90.7	89.1±2.1
Kalimantan	20.3	28.9	23.6±3.8	71.1	79.7	76.4±3.8
Sulawesi	17.4	31.8	24.4±4.6	68.2	82.6	75.5±4.6
Maluku	30.2	32.2	31.2±1.4	67.8	69.8	68.8±1.4
Papua	28.3	67.6	43.4±15.7	32.4	71.7	56.6±15.7
Indonesia	**3.8**	**67.6**	**24.52±12.9**	**32.4**	**96.2**	**75.47±12.9**

Table 2. Distribution of Proportion of Body Weight Weighing by Region of Indonesia in 2023

Region	Unweighed			Weighed		
	Minimum	**Maximum**	***X* ± *SD***	**Minimum**	**Maximum**	***X* ± *SD***
Sumatera	30.9	50.9	40.5± 6.9	34.7	56.6	48.3±7.3
Jawa dan Bali	41.3	73.8	62.7±11.5	24.4	50.4	32.84±9.4
Nusa Tenggara	68.5	69.8	69.1±0.9	23.7	25.4	24.55±1.2
Kalimantan	35.1	51.8	44.9±6.2	39.7	58.3	45.28±7.5
Sulawesi	36.4	56.7	44.2±7.1	34.5	47.4	42.98±4.6
Maluku	49.3	51.3	50.3±1.4	33.6	38.0	35.80±3.1
Papua	13.5	45.3	30.3±10.5	38.2	58.8	48.11±7.8
Indonesia	**13.5**	**73.8**	**46.17±13.8**	**23.7**	**58.8**	**42.2±9.9**

Table 3. Prevalence of Wasting and Severely Wasting in Toddlers by Region of Indonesia in 2023

Region	Unweighed			Weighed		
	Minimum	**Maximum**	***X* ± *SD***	**Minimum**	**Maximum**	***X* ± *SD***
Sumatera	30.9	50.9	40.5± 6.9	34.7	56.6	48.3±7.3
Jawa dan Bali	41.3	73.8	62.7±11.5	24.4	50.4	32.84±9.4
Nusa Tenggara	68.5	69.8	69.1±0.9	23.7	25.4	24.55±1.2
Kalimantan	35.1	51.8	44.9±6.2	39.7	58.3	45.28±7.5
Sulawesi	36.4	56.7	44.2±7.1	34.5	47.4	42.98±4.6
Maluku	49.3	51.3	50.3±1.4	33.6	38.0	35.80±3.1
Papua	13.5	45.3	30.3±10.5	38.2	58.8	48.11±7.8
Indonesia	**13.5**	**73.8**	**46.17±13.8**	**23.7**	**58.8**	**42.2±9.9**

Table 1 shows that the highest distribution of Unweighed Weight occurs in the Papua region (67.6%) and the lowest in the Java and Bali region (3.8%). The highest distribution

of Weighed Weight occurs in the Java and Bali region (96.2%) and the lowest in the Papua region (32.4%). Table 2 shows that the distribution of Weighing more than 8 times is highest in Java and Bali (73.8%) and the lowest in Papua (13.5%). The distribution of Weighing less than 8 times is highest in Papua (58.8%) and the lowest in Nusa Tenggara (13.5%).

Prevalence of Nutritional Status The prevalence rates of wasting and severely wasting vary across regions in Indonesia. Papua recorded the highest wasting rate, at 14.2%, while Java and Bali had the lowest, at 3.2%. For the severely wasting category, Maluku had the highest prevalence (6.9%), while Java and Bali had the lowest (0.5%). When these two categories are combined, Papua is the region with the highest prevalence, reaching 20.4%.

These data indicate that areas with better access to health services and infrastructure tend to have lower wasting rates. Conversely, areas with limited access to health services and less than-optimal parenting patterns tend to experience higher wasting rates. The high prevalence of wasting and severely wasting in Papua and Maluku reflects the problems of food security, limited health services, and a lack of understanding of appropriate parenting patterns in meeting children's nutritional needs. On the other hand, areas with low prevalence such as Java and Bali show better effectiveness of nutrition interventions.

Based on data from the 2023 Indonesian Health Survey (IHS), the prevalence of wasting at the national level was recorded at 6.6%, while the prevalence of severely wasting reached 2.6%. According to WHO standards, this figure is still in the serious category, where a wasting prevalence of between 10-14% is classified as a serious problem, while a figure above 15% is considered a critical condition.

Table 4. Relationship between weight status and frequency with the prevalence of saverely wasting and wasting among toddlers in Indonesia

Weighing Status and Frequency	Prevalence Severely Wasting	Prevalence Wasting	Prevalence of Saverely wasting + wasting
The Proportions are Unweighed			
Beta	0.07	0.06	0.13
Constant	1.68	6.28	7.96
Correlation Coefficient (r)	0.58	0.35	0.47
p-value	0.00	0.02	0.00
The proportion of Body Weight Weighing < 8 times			
Beta	0.02	0.02	0.04
Constant	2.39	6.85	9.25
Correlation Coefficient (r)	0.16	0.09	1.13
p-value	0.33	0.55	0.43
Proportion of Body Weight Weighing ≥ 8 times			
Beta	-0.05	-0.04	-0.09
Constant	5.86	9.72	15.5
Correlation Coefficient (r)	0.43	0.26	0.34
p-value	0.00	0.11	0.03

The results of data analysis in Table 4 show that never being weighed is related to the prevalence of saverly wasting (p-value 0.00), the prevalence of wasting (p-value 0.02) and the prevalence of saverly wasting + wasting (p-value 0.00). Weighing < 8 times was not related to the prevalence of severe wasting (p-value 0.33), the prevalence of wasting (p-value 0.55) and the prevalence of severe wasting + wasting (p-value 0.43). Weighing > 8 times is associated with the prevalence of severe wasting (p-value 0.00), weighing > 8 times is

not associated with the prevalence of wasting (p-value 0.11) and weighing > 8 times is associated with the prevalence of extremely wasting + wasting (p-value 0.03).

Weight Distribution

This study revealed a gap in the distribution of weighing services in various regions in Indonesia. Papua is the region with the highest percentage of unweighed toddlers (67.6%) and has the lowest number of weighing more than 8 times (13.5%). In contrast, Java and Bali recorded the highest number of toddlers weighing (96.2%) and the largest proportion of weighing more than 8 times (73.8%).

This difference shows that access to health services is still a problem. challenges in several regions, especially Papua and Maluku. Geographical constraints, limited health infrastructure, and low public awareness are thought to be the main factors in the low frequency of weighing in these areas. Meanwhile, areas with high weighing coverage, such as Java and Bali, generally have more adequate health facilities and more active education programs in raising awareness of the importance of monitoring nutritional status.

Prevalence of Nutritional Status

The prevalence rates of wasting and severely wasting vary across regions in Indonesia. Papua recorded the highest wasting rate, at 14.2%, while Java and Bali had the lowest, at 3.2%. For the severely wasting category, Maluku had the highest prevalence (6.9%), while Java and Bali had the lowest (0.5%). When these two categories are combined, Papua is the region with the highest prevalence, reaching 20.4%.

These data indicate that areas with better access to health services and infrastructure tend to have lower wasting rates. Conversely, areas with limited access to health services and less than optimal parenting patterns tend to experience higher wasting rates. The high prevalence of wasting and severely wasting in Papua and Maluku reflects the problems of food security, limited health services, and a lack of understanding of appropriate parenting patterns in meeting children's nutritional needs. On the other hand, areas with low prevalence such as Java and Bali show better effectiveness of nutrition interventions (Russiska et al., 2020).

Based on data from the 2023 Indonesian Health Survey (IHS), the prevalence of wasting at the national level was recorded at 6.6%, while the prevalence of severely wasting reached 2.6%. According to WHO standards, this figure is still in the serious category, where a wasting prevalence of between 10-14% is classified as a serious problem, while a figure above 15% is considered a critical condition.

Relationship between Body Weight and Nutritional Status

The results of statistical analysis revealed a significant relationship between the frequency of weighing and the prevalence of wasting (p=0.011) and severely wasting (p=0.001). Toddlers who were never weighed tended to have a higher risk of wasting and severely wasting. Conversely, toddlers who were weighed more than 8 times a year tended to have a lower prevalence of wasting.

The frequency of weighing plays a role in the early detection of nutritional problems. However, this study also highlighted the importance of additional interventions such as supplementary feeding and nutrition education. The findings show that some areas with high weighing coverage still have significant wasting rates.

Regularly weighing children under five is an effective preventative measure to reduce the incidence of severe wasting or severe malnutrition. Through regular weighing activities, ideally every month the child's growth can be monitored continuously and more precisely. This monitoring makes it easier to identify growth disorders early, such as weight loss or weight that does not increase according to the growth curve. (Asri & Nooraeni, 2021)

Early detection allows for quicker nutritional intervention, so that the child's condition does not progress to severe malnutrition. These intervention measures can include counseling parents about balanced eating patterns, monitoring children's nutritional intake, as well as providing supplements or referrals to health facilities if needed. (Ardiansyah & Simbolon, 2018)

Apart from that, regular weighing also increases parents' understanding of the importance of monitoring children's growth. Parents' active involvement in this process makes them more sensitive to early symptoms of nutritional disorders, which can ultimately encourage improvements in the child's overall nutritional status (Ariesta et al., 2023)

Social and Economic Influences on Wasting in Toddlers in Indonesia

Social and Economic Influences on Wasting in Toddlers in Indonesia Social and economic factors play an important role in determining the prevalence of wasting and severe wasting in toddlers in Indonesia. Aspects such as family economic conditions, maternal education level, and access to health services are the main factors that influence children's nutritional status. Families with low economic levels often face difficulties in meeting nutritious food needs, which contributes to an increased risk of malnutrition. Previous studies have shown that toddlers from low-income families are more vulnerable to wasting due to limited access to nutritious food and adequate health facilities (Sari, 2022).

In addition, the mother's education level also greatly influences the parenting pattern and fulfillment of children's nutrition. Mothers with higher education tend to have a better understanding of children's nutritional needs and the importance of monitoring growth. Conversely, mothers with lower education levels tend to be less aware of the importance of regular weighing and providing a balanced diet, which contributes to high wasting rates in toddlers (Saptarini et al., 2021).

Access to health services is also a major challenge, especially for people in remote and isolated areas such as Papua and Maluku. Limited infrastructure, lack of health workers, and long distances to healthcare facilities are major obstacles to routine monitoring of toddler growth. As a result, the coverage of weighing in these areas is still low, making it difficult to detect wasting early. Therefore, a more effective strategy is needed to expand the reach of health services in areas with a high prevalence of wasting(Hanifah et al., 2019).

Nutrition Intervention and Wasting Prevention Program

To reduce wasting rates in toddlers, the Indonesian government has implemented various efforts, including specific and sensitive nutrition intervention programs. Specific nutrition interventions include providing additional food for toddlers at risk of wasting, education about balanced nutrition, and providing nutritional supplements such as vitamin A and iron. This program has been implemented through Posyandu, Puskesmas, and other health institutions, but its coverage still needs to be expanded, especially in areas with high wasting rates (Agiwahyuanto & Ernawati, 2021).

Nutrition-sensitive interventions that include improving sanitation and access to clean water also play a role in reducing wasting rates. Poor sanitation conditions and limited access to clean water increase the risk of gastrointestinal infections, which can lead to weight loss and increase the likelihood of wasting. Therefore, improving sanitation infrastructure and the availability of clean water are key factors in efforts to prevent wasting in Indonesia (Dewi & Rozi, 2021).

In addition, increasing public awareness of the importance of routinely monitoring toddler weight also needs to be strengthened. Health campaigns through mass media, training of health cadres at the village level, and socialization in the community can help increase public participation in monitoring

toddler growth. With increased public awareness, it is hoped that the number of toddlers weighing can increase so that wasting can be detected earlier and handled more effectively (Assyfa et al., 2023).

Challenges in Handling Wasting

Although various programs have been implemented, there are still a number of challenges in addressing wasting in Indonesia. One of the main challenges is the limited budget for public health programs, especially in supporting national monitoring of toddler growth. Limited funds often lead to a lack of health workers and inadequate healthcare facilities in remote areas. Therefore, a larger allocation of funds is needed to strengthen nutritional monitoring and wasting intervention programs.

Another challenge is the low level of community participation in nutrition monitoring programs. Factors such as lack of awareness, low levels of education, and cultural influences that consider weighing as something less important contribute to this problem. To overcome this, a more intensive community-based approach and the involvement of community leaders in socializing the importance of nutrition monitoring are needed.

In addition, changes in people's consumption patterns are also a challenge in preventing wasting. The increasing consumption of instant foods that are low in nutrition and the lack of access to healthy foods in some areas have led to an unbalanced diet. Therefore, education about healthy eating patterns needs to be further encouraged, both through school and community programs.

Implications and Recommendations

This study emphasizes the importance of expanding the scope of weighing to detect nutritional problems early. Therefore, access to health services needs to be improved so that they are more easily accessible to the community. This effort is very important, especially in areas with high wasting rates such as Papua and Maluku (Nurhayani et al., 2023).

Some steps that can be taken include increasing access to health services, nutrition education for the community, and specific nutrition interventions. In addition, improving data quality and monitoring is also needed to ensure the effectiveness of nutrition programs. With these efforts, it is hoped that the wasting and severely wasting rates in toddlers in Indonesia can be reduced, thus supporting improvements in children's nutritional status nationally.

CONCLUSION

Conclusion This study shows that there is a significant relationship between the frequency of weighing and the prevalence of wasting and severe wasting in toddlers in Indonesia. Areas with low weighing coverage, such as Papua and Maluku, tend to have higher wasting rates compared to areas with better-weighing coverage, such as Java and Bali. In addition, although the frequency of weighing plays a role in the early detection of nutritional problems, additional interventions, such as providing additional food and nutrition education, are still needed to significantly reduce the prevalence of wasting.

To reduce wasting and severely wasting rates, efforts are needed to improve access to health services, especially in areas with low-weight coverage. Nutrition education programs for the community must be strengthened to raise awareness of the importance of monitoring the nutritional status of toddlers. In addition, policies are needed that support specific nutritional interventions and improvements in the monitoring and recording system for nutritional data to ensure the effectiveness of the programs implemented.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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ASSOCIATION THE PROPORTION OF CARBONATED BEVERAGE CONSUMPTION AND THE PREVALENCE OF HYPERTENSION AND DIABETES IN INDONESIA (INDONESIA HEALTH SURVEY ANALYSIS 2023)

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ABSTRACT

Background: *Hypertension and diabetes mellitus are non-communicable diseases with increasing prevalence in Indonesia. High consumption of carbonated beverages is suspected to be a major risk factor due to their high sugar and sodium content, which can affect blood pressure and glucose levels.*
Method: *This cross-sectional study used aggregate data from IHS 2023. The sample consisted of regional data from 38 provinces in Indonesia. Data analysis was conducted using Pearson and Spearman correlation tests to assess the relationship between carbonated beverage consumption and the prevalence of hypertension and diabetes.*
Result: *Summarize the key findings of the study. The results showed that consuming carbonated beverages ≥1 time/day had a significant relationship with the prevalence of hypertension (r=0.612; p=0.001) and diabetes (r=0.629; p=0.001). Consumption of 1-6 times/week was also associated with hypertension (r=0.343; p=0.035) and diabetes (r=0.362; p=0.026). However, consumption ≤3 Times/month showed only a weak relationship with the prevalence of hypertension and diabetes.*
Conclusion: *High consumption of carbonated beverages is significantly associated with increased prevalence of hypertension and diabetes among individuals aged ≥15 years in Indonesia. Health policies are needed to reduce carbonated beverage consumption, such as health education and the implementation of taxes on sugary drinks.*

Keywords: *Carbonated drinks, hypertension, diabetes, consumption patterns*

INTRODUCTION

Hypertension is a condition in which a person's blood pressure exceeds the normal limit, with systolic pressure ≥140 mmHg and diastolic pressure ≥90 mmHg. This condition is often referred to as 'the silent disease' because many individuals are unaware that they have hypertension until they undergo a blood pressure check at a healthcare facility (Casmuti & Fibriana, 2023). According to the World Health Organization (WHO), around 71% of global deaths are caused by non-communicable diseases, including hypertension, which contributes to approximately 17.9 million deaths annually. It is also known as the 'silent killer' because many people are unaware they have hypertension until serious complications such as stroke or heart failure occur (Listyana et al., 2022).

According to the World Health Organization (WHO), the global prevalence of hypertension reached 26.4% or approximately 972 million people affected by the disease. This figure increased to 29.2% in 2021. WHO also estimates that each year, 9.4 million people die due to complications related to hypertension. In developed countries, 333 million cases were recorded out of the total 972 million, while the remaining 639 million cases were found in developing countries, including Indonesia. In Indonesia, hypertension ranks as the third leading cause of death after stroke and tuberculosis, contributing to 6.8% of the total mortality (Casmuti & Fibriana, 2023).

Diabetes mellitus is a metabolic disease characterized by elevated blood sugar levels

due to impaired insulin function. This hormone plays a vital role in maintaining the body's homeostasis by lowering blood glucose levels. Diabetes mellitus is closely related to lifestyle, making it important to maintain balance in daily activities such as eating, sleeping, and working. The quantity and type of food, as well as physical activity, must be properly managed and should not be neglected (Astutisari et al., 2022).

The Southeast Asia region, where Indonesia is located, ranks third in terms of diabetes mellitus (DM) prevalence, with a rate of 11.3%. Indonesia itself ranks seventh among the ten countries with the highest number of DM cases worldwide. As the only Southeast Asian country on the list, Indonesia's contribution to the regional DM prevalence is considered significant. According to the World Health Organization (WHO), the number of people with DM in Indonesia is projected to increase significantly, from 8.4 million in 2000 to around 21.3 million by 2030. Similarly, the World Diabetes Association predicts a rise in DM prevalence in Indonesia, from 9.1 million in 2014 to 14.1 million by 2035. This indicates that diabetes mellitus poses a serious public health challenge for Indonesia in the coming years (Resti & Cahyati, 2022).

In Indonesia, diabetes mellitus (DM) ranks as the third leading cause of death, accounting for 6.7%, following stroke (21.1%) and heart disease (12.9%). According to Basic Health Research in 2013, the prevalence of DM in Indonesia was 1.5%, which increased to 2.0% in the 2018 Riskesdas. This reflects a 0.5% increase in DM prevalence over five years. In addition, the prevalence of DM based on blood tests among individuals aged over 15 years also rose, from 6.9% to 8.5% in 2018. This indicates the emergence of approximately 25% of new cases, underscoring that diabetes mellitus is becoming an increasingly serious health issue in Indonesia (Resti & Cahyati, 2022).

Various factors can contribute to increased blood pressure, one of which is dietary patterns, including food and beverage consumption. The intake of carbonated beverages—both calorie-containing and calorie-free—has drawn attention in numerous studies due to its potential impact on blood pressure. Soft drinks often contain sodium, artificial sweeteners, and other additives that may contribute to elevated blood pressure through various mechanisms, including increased fluid retention and alterations in glucose metabolism (Wirawan et al., 2015).

The consumption of carbonated beverages has become a part of modern lifestyle. These drinks are widely consumed due to their sweet and refreshing taste; however, various studies have shown that excessive consumption of carbonated beverages can increase the risk of non-communicable diseases, including hypertension and diabetes mellitus. Carbonated drinks contain high levels of sugar, which can lead to insulin resistance and elevated blood pressure (BKPK, 2018).

Recent data show that the prevalence of prediabetes and diabetes mellitus among younger age groups continues to rise, driven by changes in consumption patterns and decreased physical activity. Considering the serious health impacts of soft drink consumption habits, research on the relationship between the proportion of carbonated beverage consumption and the prevalence of hypertension and diabetes mellitus in Indonesia is essential (Agung & Hansen, 2022), however, there are no research results that explain the relationship between the proportion of carbonated beverage consumption and the prevalence of hypertension and diabetes mellitus using aggregate data in Indonesia.

This study aims to analyze the overview of carbonated beverage consumption, examine the prevalence of hypertension and diabetes mellitus across the seven regions of Indonesia, and assess the relationship between

the proportion of carbonated beverage consumption and the prevalence of hypertension and diabetes among Indonesian residents aged ≥15 years based on the 2023 IHS data. The results of this study are expected to serve as a foundation for formulating health policies and more effective interventions to prevent metabolic diseases.

METHODS

This study uses a cross-sectional design with aggregate data from the 2023 IHS. The data analyzed include the proportion of carbonated beverage consumption, as well as the prevalence of diabetes mellitus and hypertension in 38 provinces across Indonesia. This design allows researchers to measure the prevalence of diabetes mellitus and hypertension at a single point in time across provinces, which are grouped into seven regions of Indonesia.

The population in this study includes all Indonesian residents covered in the 2023 Indonesian Health Survey (IHS). The research sample consists of regional data taken from 38 provinces in Indonesia, as presented in the relevant tables, namely Table 11.61 (Proportion of Soft Drink or Carbonated Beverage Consumption Habits among the Population Aged >3 Years by Province), Table 7.10 (Prevalence of Diabetes Mellitus Diagnosed by a Doctor among the Population Aged ≥15 Years by Province), and Table 7.34 (Prevalence of Hypertension Based on Doctor Diagnosis and Measurement among the Population Aged ≥15 Years by Province). The data used in this study were obtained from the 2023 Indonesian Health Survey (IHS), conducted from August to October 2023.

The independent variable in this study is the proportion of soft drink or carbonated beverage consumption habits, obtained from Table 11.61. The dependent variables consist of two aspects: the prevalence of Diabetes Mellitus (DM) based on doctor diagnosis (sourced from Table 7.10) and the prevalence of hypertension based on both doctor diagnosis and measurement results (sourced from Table 7.34). This study uses provinces as the unit of analysis to serve as a control variable, ensuring that the analysis is conducted specifically based on regional distribution. The status of DM and the prevalence of hypertension are calculated using the following formulas: the prevalence of DM based on doctor diagnosis among individuals aged ≥15 years is defined as the number of individuals aged ≥15 years who have ever been diagnosed with DM divided by the number of individuals aged ≥15 years who were interviewed, while the prevalence of hypertension based on doctor diagnosis is defined as the number of individuals aged ≥15 years who have ever been diagnosed with hypertension by a doctor divided by the number of individuals aged ≥15 years who were interviewed.

The research instrument used was a questionnaire that included information regarding household members aged ≥15 years who had been diagnosed with diabetes mellitus and those who had been diagnosed with hypertension. All data collection processes were conducted by trained personnel with a minimum educational background of a three-year diploma in health sciences to ensure data accuracy. Data were collected through direct interviews using a structured questionnaire instrument.

Descriptive analysis in this study will present the distribution of the proportion of carbonated beverage consumption, as well as the prevalence of Diabetes Mellitus (DM) and hypertension in each province. Furthermore, correlation analysis will be conducted using Pearson or Spearman correlation tests to examine the relationship between carbonated beverage consumption and the prevalence of DM and hypertension. The data will be processed and statistically analyzed using SPSS version 27. This survey gathered health-related information. The implementation of the 2023

IHS received ethical approval from the Health Research Ethics Committee under Approval Number HK.01.07/MENKES/156/2023, ensuring that all research procedures adhered to established health research ethics standards.

RESULTS AND DISCUSSION

Table 1 shows that the highest proportion of carbonated beverage consumption ≥1 time/day was found in the Maluku region (8.0%), while the lowest was in the Java and Bali regions (1.7%). The highest proportion of carbonated beverage consumption 1-6 times/week was also observed in the Maluku region (23.5%), and the lowest in the Java and Bali regions (10.2%). Conversely, the highest proportion of carbonated beverage consumption ≤3 Times/month was found in the Java and Bali regions (88.0%), while the lowest was in the Maluku region (68.4%). Nationally, the average proportion of carbonated beverage consumption ≥1 time/day was 3.6%, 1–6 times/week was 16.2%, and ≤3 Times/month was 80.2

Table 1. Distribution of Carbonated Beverage Consumption Proportion by Region, IHS 2023

Province	Carbonated Beverage Consumption Habits (%)								
	≥1 time/day			1-6 times/week			≤3 times/month		
	Max	Min	$\bar{X}$ ±SD	Max	Min	$\bar{X}$ ±SD	Max	Min	$\bar{X}$ ±SD
Sumatera	3.3	2.0	2.6±0.4	17.5	11.6	14.4±2.0	85.8	80.0	83.0±1.9
Jawa dan Bali	2.6	1.3	1.7±0.5	17.2	5.4	10.2±4.1	93.3	81.1	88.0±4.4
Nusa Tenggara	3.4	2.7	3.0±0.4	14.7	10.8	12.7±2.7	85.8	82.7	84.2±2.1
Kalimantan	3.0	2.4	2.6±0.2	25.4	11.6	17.4±5.5	85.5	71.7	79.9±5.5
Sulawesi	5.2	3.5	4.2±0.7	23.2	13.9	17.9±4.0	82.7	72.3	77.8±4.2
Maluku	10.0	6.1	8.0±2.7	27.5	19.5	23.5±5.6	74.4	62.5	68.4±8.4
Papua	8.9	4.9	6.3±1.4	28.7	13.9	22.2±6.7	80.4	64.5	71.4±6.3
Indonesia	10	1.3	3.6±2.0	28.7	5.4	16.2±5.8	93.3	62.5	80.2±7.2

Table 2 shows that the highest prevalence of hypertension diagnosed by doctors was found in the Java and Bali regions (9.5%), while the lowest was in the Maluku region (4.3%). The highest prevalence of diabetes mellitus diagnosed by doctors also occurred in the Java and Bali regions (2.7%), whereas the lowest was in the Papua region, specifically in Maluku Province (1.0%). The highest prevalence of hypertension based on measurements was observed in the Kalimantan region (31.8%), while the lowest was in the Maluku region (23.2%). Nationally, the average prevalence of hypertension diagnosed by doctors was 7.2%, the average prevalence of diabetes mellitus diagnosed by doctors was 1.9%, and the average prevalence of hypertension based on measurements was 26.6%.

Table 2. Distribution of Hypertension and Diabetes Mellitus by Region, IHS 2023

Region	Diagnosed Hypertension (%)			Diagnosed DM (%)			Measured Hypertension (%)		
	Max	Min	$\bar{X}$ ±SD	Max	Min	$\bar{X}$ ±SD	Max	Min	$\bar{X}$ ±SD
Sumatera	8.8	4.3	6.9±1.2	2.8	1.3	1.8±0.4	28.3	21.4	24.2±2.0
Jawa dan Bali	12.6	6.9	9.5±2.2	3.9	2.1	2.7±0.7	32.8	21.7	29.3±3.9
Nusa Tenggara	6.8	6.3	6.5±0.3	1.8	1.0	1.4±0.5	26.4	24.5	25.4±1.3
Kalimantan	11.1	7.2	8.4±1.5	3.1	1.7	2.1±0.5	38.7	28.0	31.8±4.5
Sulawesi	12.1	5.3	7.8±2.3	2.7	1.4	2.0±0.4	29.5	26.5	27.7±1.1
Maluku	4.4	4.3	4.3±0.0	1.2	0.9	1.0±0.2	25.6	20.8	23.2±3.3
Papua	7.0	2.2	5.0±1.9	1.8	0.2	1.2±0.6	27.5	19.4	23.7±2.9
Indonesia	12.6	2.2	7.2±2.3	3.9	0.2	1.9±0.7	38.7	19.4	26.6±4.0

Table 3. The Relationship Between the Proportion of Carbonated Beverage Consumption and the Prevalence of Hypertension and Diabetes Mellitus in Individuals Aged ≥15 Years in Indonesia (IHS 2023)

Proportion of Carbonated Beverage Consumption	Hypertension Prevalence (Diagnosis)	Diabetes Mellitus Prevalence (Diagnosis)	Hypertension Prevalence (Measurement)
Consumption ≥1 Time/Day			
Beta	0.703	0.228	0.854
Constant	9.823	2.742	29.752
Correlation Coefficient (R)	0.612	0.629	0.426
p-value	0.001	0.001	0.008
Consumption 1–6 times/week			
Beta	0.135	0.045	0.159
Constant	9.474	2.648	29.254
Correlation Coefficient (R)	0.343	0.362	0.232
p-value	0.035	0.026	0.161
Consumption ≤3 times/month			
Beta	0.141	0.047	0.170
Constant	4.042	1.816	13.033
Correlation Coefficient (R)	0.444	0.464	0.307
p-value	0.005	0.003	0.061

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia resulting from abnormalities in insulin action, insulin secretion, or both. Classic symptoms of DM include polyuria, polydipsia, polyphagia, and unexplained weight loss (Damayanti et al., 2023). One of the factors that influence fluctuations in blood pressure is blood glucose levels. Hyperglycemia is one of the risk factors for the development of hypertension (Ira Maulidah Dwi Julianti, 2024).

Based on the analysis results in Table 3, there is a relationship between carbonated drink consumption and the prevalence of hypertension and diabetes mellitus, both medically diagnosed and measured directly. In the group consuming carbonated drinks ≥1 time per day, there is a significant association with the prevalence of hypertension based on medical diagnosis, indicating that high consumption of carbonated beverages is closely related to an increased risk of hypertension. A significant association is also observed with the prevalence of diabetes mellitus based on diagnosis, suggesting that daily consumption of carbonated drinks may increase the risk of diabetes mellitus. Meanwhile, regarding the prevalence of hypertension based on blood pressure measurements, a negative but still statistically significant relationship was found.

In the group consuming carbonated drinks 1–6 times per week, the relationship with hypertension based on diagnosis remains significant, although weaker compared to the group that consumes them daily. For diabetes mellitus, the association is still significant, albeit smaller than in the more frequent consumption group. However, for hypertension based on measurement, the relationship found is not significant, indicating that carbonated drink consumption at this frequency is not directly associated with measured blood pressure during the study.

In the group that consumed carbonated drinks ≤3 Times per month, the relationship with hypertension based on diagnosis showed a significant association, although weaker compared to groups with more frequent consumption. For diabetes mellitus, the results indicate that a significant association still exists, though not as strong as in the daily consumption group. However, for hypertension based on measurement, the relationship found was not statistically significant (p-value > 0.05), meaning that low-frequency consumption of carbonated drinks did not show

a clear impact on measured blood pressure during the study.

Based on the research findings, there is a significant relationship between the consumption of carbonated beverages and the prevalence of hypertension and diabetes mellitus among individuals aged ≥15 years in Indonesia. The data indicate that individuals who consume carbonated drinks more than once a day have an increased risk for both conditions compared to those who consume them less frequently or not at all. This is evident from the higher regression coefficient (Beta) values in the group with more frequent consumption, as well as the significance (p-value < 0.05), which suggests that the relationship is not due to chance. Daily consumption of carbonated beverages is strongly associated with high blood pressure, based on both blood pressure measurements and medical diagnoses of hypertension. Moreover, this group also shows a significant correlation with the prevalence of diabetes mellitus based on medical diagnosis.

In addition to metabolic factors, the consumption of carbonated beverages also affects the body's electrolyte balance. The phosphoric acid content in these drinks can disrupt the balance of calcium and magnesium, which are involved in the regulation of blood pressure (Liwanto & Santoso, 2021). Several studies have also indicated that high consumption of carbonated beverages is associated with an increased risk of metabolic syndrome, which includes hypertension, insulin resistance, and central obesity (Susanti et al., 2024). Therefore, understanding the relationship between carbonated beverage consumption and the prevalence of hypertension and diabetes mellitus is essential as a foundation for public health interventions (Muna & Rukminiati, 2023).

The link between carbonated beverage consumption and hypertension has also been widely discussed in research. The high sugar content in these drinks can lead to increased blood pressure due to alterations in glucose metabolism in the body (Ramadhani & Mahmudiono, 2019). In addition, excessive fructose intake from these beverages may trigger endothelial dysfunction, which contributes to the development of hypertension (Liwanto & Santoso, 2021).

Several studies have shown a positive association between soda consumption and increased blood pressure. For example, research indicates that consuming a single serving of soda can significantly raise both systolic and diastolic blood pressure. This effect may be more pronounced in individuals with a history of hypertension or other risk factors such as obesity and diabetes (Wirawan et al., 2015). However, some studies have found no significant association between soda consumption and the incidence of hypertension. A study conducted in Blang Bintang Subdistrict, Aceh Besar Regency, found that the consumption of soft drinks, coffee, salt, junk food, and physical activity had no significant relationship with the incidence of hypertension among the working-age population (Listyana et al., 2022).

Changes in lifestyle and consumption patterns have led to an increase in the intake of high-calorie foods and beverages, including carbonated drinks or soft drinks. Previous studies have shown that soft drink consumption can contribute to various health problems, including obesity, insulin resistance, and an increased risk of metabolic diseases such as type 2 diabetes mellitus (Yulinar et al., 2022). In Indonesia, the habit of consuming carbonated beverages is on the rise, particularly among younger age groups, with a significant frequency of consumption observed among adolescents (Yulinar et al., 2022).

Data from the 2018 Basic Health Research (Riskesdas) show that the prevalence of diabetes mellitus among individuals aged ≥15 years in Indonesia increased from 1.5% in 2013 to 2% in 2018 (BKPK, 2018). In addition, regular consumption of sugar-sweetened

beverages is significantly associated with increased blood glucose levels and a higher risk of insulin resistance (Astuti, 2021).

Type 2 diabetes mellitus is one of the major health problems with a continuously increasing prevalence worldwide, including in Indonesia (Agung & Hansen, 2022). High blood glucose levels, the primary indicator of diabetes, are often associated with excessive sugar consumption, including from carbonated beverages (Anjangsari & Isnawati, 2020). A study found that high soft drink consumption can lead to insulin resistance, which in turn increases the risk of diabetes (Aringaneng et al., 2020). Moreover, obesity—a major risk factor for diabetes—is often rooted in the habit of consuming high-sugar foods and beverages (Asriati, 2023).The results of this study have important implications for public health policy in Indonesia. There is a need for more intensive education and health campaigns to raise public awareness about the dangers of excessive consumption of carbonated beverages. The government and health institutions can play a role in limiting the promotion and distribution of carbonated drinks, especially among younger age groups who are more susceptible to advertising influences. In addition, fiscal policies such as the implementation of a tax on sweetened beverages could be an effective strategy to reduce consumption. Studies in various countries have shown that taxing sugary drinks can decrease consumption and ultimately reduce the incidence of obesity and metabolic diseases. Beyond restrictive policies, efforts are also needed to encourage the public to adopt healthier consumption patterns, such as increasing the intake of plain water and natural beverages without added sugar.

However, this study also has several limitations that should be considered when interpreting the results. One of the main limitations is the observational nature of the study, which means that the relationships found cannot be directly interpreted as causal. Although statistical analysis showed a significant correlation between carbonated beverage consumption and hypertension and diabetes mellitus, other factors such as overall dietary patterns, physical activity, and genetic predispositions may also have influenced the outcomes. Furthermore, since the data were obtained through surveys and blood pressure measurements as well as medical diagnoses, there is a possibility of reporting bias in respondents' food and beverage consumption, which could affect the validity of the study's findings. Therefore, further research with a stronger design, such as longitudinal studies or clinical trials, is needed to confirm a causal relationship between carbonated beverage consumption and the risk of hypertension and diabetes mellitus.

Overall, this study provides strong evidence that excessive consumption of carbonated beverages can increase the risk of hypertension and diabetes mellitus among individuals aged ≥15 years in Indonesia. These findings highlight the importance of public health interventions to reduce the consumption of such beverages and promote healthier lifestyles. With proper education, regulation, and health policies, it is expected that a more health-conscious society can be formed, leading to a reduction in the incidence of non-communicable diseases related to excessive sugar intake.

This differs from longitudinal studies such as the one conducted by Agung & Hansen (2022) which used a cohort approach to observe the long-term effects of junk food and sugary drink consumption on type 2 diabetes mellitus. In addition, this study did not examine the relationship between carbonated beverage consumption and the prevalence of stunting. Previous research has shown that consuming carbonated beverages can negatively impact children's growth, as the high sugar content may displace essential nutrient intake. A study by (Asriati, 2023) found that the consumption of high-sugar foods and beverages is associated with an increased risk of prediabetes among

adolescents, which may also affect their growth and development.

Previous studies have shown that individuals who consume carbonated beverages more frequently tend to have a more active lifestyle or a more controlled diet compared to those who consume them less frequently (Yulinar et al., 2022). A more active lifestyle may offset the negative effects of high sugar intake found in carbonated beverages, thus not directly increasing the risk of hypertension and diabetes mellitus (Agung & Hansen, 2022).

Carbonated beverages come in various types, ranging from high-sugar versions to low-calorie options (diet soda). Several studies have found that the consumption of low-calorie carbonated beverages is not directly associated with an increased risk of diabetes but rather influenced by other factors such as total daily caloric intake (Anjangsari & Isnawati, 2020). If respondents who frequently consume carbonated drinks tend to choose low-calorie or unsweetened variants, the negative impact on blood pressure and blood glucose levels may be smaller compared to those who consume sweetened beverages in smaller amounts but more sporadically.

Previous studies have shown that individuals who consume large amounts of carbonated beverages tend to be more health-conscious and may adopt a more balanced diet to compensate for their higher sugar intake (Resti & Cahyati, 2022). In other words, they may pay more attention to fiber, protein, and healthy fat intake, which can help regulate blood sugar and blood pressure levels. Individuals who rarely consume carbonated beverages may come from lower socioeconomic groups, who also have limited access to healthy foods, physical activity, and adequate healthcare services (Casmuti & Fibriana, 2023). Therefore, the higher prevalence of hypertension and diabetes in this group may be more related to other factors beyond carbonated beverage consumption itself.

Low consumption of carbonated beverages, if not accompanied by a healthy diet and active lifestyle, can still increase the risk of metabolic diseases. Several studies have shown that factors such as consumption of ultra-processed foods, high salt intake, and sedentary behavior have a greater impact on hypertension and diabetes than sugary drink consumption alone (Aringaneng et al., 2020). For policymakers in the health sector, this study can serve as a consideration in formulating evidence-based policies. For instance, although carbonated beverages are often linked to health risks, these findings suggest that the relationship is not always linear and may be influenced by other factors such as diet and physical activity. Therefore, policies that focus solely on restricting carbonated beverages may be less effective without a more holistic approach, such as promoting balanced diets and active lifestyles.

However, this study also has several limitations that should be considered. The cross-sectional research design does not allow for causal inferences, meaning that the relationship between carbonated beverage consumption and the prevalence of hypertension and diabetes cannot be confirmed as causal. Confounding factors such as overall dietary patterns, levels of physical activity, and genetic predispositions that may influence the results were not fully controlled. In addition, this study relied solely on secondary data from IHS 2023, which presents limitations in terms of the variables that could be analyzed. There was no information regarding the specific types of carbonated beverages consumed (e.g., low-sugar or calorie-free drinks), making it difficult to determine whether the observed effects were due to added sugars or other components within the beverages. The study did not specifically differentiate the types of carbonated beverages consumed, such as those with high sugar content, artificial sweeteners, or low-calorie versions (diet soda). Further research is recommended to include these variables to

evaluate whether the effects differ depending on the type of beverage. This is important, as previous studies have shown that artificial sweeteners in diet soda may affect glucose metabolism and increase the risk of diabetes.

CONCLUSION

This study found a surprising inverse relationship between daily carbonated beverage consumption (≥1 time/day) and the prevalence of hypertension and diabetes in Indonesia, while infrequent consumption (≤3 times/month) showed a positive correlation. These findings differ from prior research linking sugary drinks to higher metabolic disease risk, suggesting that the relationship may be influenced by confounding factors such as lifestyle, diet, or beverage type. However, due to the cross-sectional design and limitations in the secondary data, including a lack of detail on beverage types and lifestyle variables, the results should be interpreted cautiously. Future research should adopt longitudinal or experimental designs to establish causality and better control for confounders like physical activity, dietary habits, and socioeconomic status. Objective health measurements, such as blood pressure and glucose levels, are also recommended to improve data reliability. From a public health perspective, interventions should focus on comprehensive nutrition and lifestyle education rather than solely restricting carbonated drink intake. Policies like sugar-sweetened beverage taxes may be effective if paired with impact assessments and public awareness campaigns, particularly targeting youth to prevent early adoption of unhealthy dietary habits.

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CONFLICT OF INTEREST

All authors declare that there is no conflict of interest influencing the research process, data analysis, or the preparation of this manuscript.

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THE RELATIONSHIP BETWEEN THE AGE OF INTRODUCING COMPLEMENTARY FOODS AND THE PREVALENCE OF STUNTING, WASTING, UNDERWEIGHT IN TODDLERS IN INDONESIA

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ABSTRACT

Background: *The toddler stage is a crucial phase in a child's growth that requires optimal nutritional intake. Nutritional issues such as stunting, wasting, and underweight continue to be health concerns in Indonesia. The provision of complementary foods at the right time is important to meet the nutritional needs of children.*
Method: *This study uses a cross-sectional design with secondary data from the 2023 Indonesian Health Survey covering all provinces, grouped by region areas. The independent variable is the age of introduction to complementary feeding, categorized into less than six months, six months, and more than six months. Meanwhile, the dependent variables are the prevalence of stunting, wasting, and underweight. The analysis was conducted using the Pearson correlation test after the normality test was fulfilled.*
Result: *Research results show that the introduction of complementary feeding at the age of six months is associated with a decrease in the prevalence of stunting and wasting. On the other hand, the introduction of complementary feeding after six months is associated with an increase in nutritional problems, and the introduction before six months does not show a significant relationship.*
Conclusion: *Six months of age is the ideal time for introducing complementary feeding to reduce the risk of stunting and wasting, as well as to support nutritional intervention efforts and health policies to reduce malnutrition among toddlers in Indonesia.*

Keywords: *complementary feeding, stunting, wasting, underweight, toddlers*

INTRODUCTION

Malnutrition and poor nutrition in toddlers are still major problems in the field of nutrition that require special attention (Zona, Mulyani, and Raudhoh, 2021). The high level of malnutrition in Indonesia, including the problem of malnutrition, is one of the major challenges in the health sector. One type of malnutrition that has a serious impact on the nutritional status of children is stunting, which is a condition of chronic malnutrition. Stunting is often associated with malnutrition that occurred in the past and affects the development of children in the first 1000 days of life (HPK). This condition can inhibit optimal child growth and development, which includes physical, mental, intellectual, and cognitive development. The impact of stunting is long-term and can affect the quality of life of children into adulthood (Graceana M.A. Kuyap, 2022).

Wasting is a condition of significant weight loss compared to the child's height, which indicates acute malnutrition. Acute malnutrition in children can have varying degrees of severity, ranging from moderate to severe. Acute malnutrition is defined as a severe wasting condition, namely extreme weight loss, and/or a decrease in the size of the mid-upper arm circumference (MUAC), which is an important indicator for assessing a child's nutritional status more accurately (Maulani and Julianawati, 2022).

The problem of malnutrition has a very complex impact, ranging from increased risk of death and disease in children to impaired physical growth, and decreased learning and cognitive abilities. In addition, malnutrition also causes increased costs of prevention and

treatment, reduced work productivity, and ultimately economic losses (Wiyono *et al.*, 2023)

The causes of stunting, wasting, and underweight vary widely and involve many interrelated factors, but in general, these factors can be grouped into three main categories: basic factors, indirect factors, and direct factors. Basic factors include economic, social, and political aspects that affect quality of life and access to health services. Indirect factors include the influence of the family environment and access to adequate health services. Meanwhile, direct factors are related to the child's diet and health conditions. In addition, insufficient breastfeeding, previous exposure to infectious diseases, and elements from the social and community environment also play an important role in this malnutrition problem (Rahmaniah *et al.*, 2023).

The nutrients contained in food play a major role in the child's growth process, so the type and quality of food consumed by the mother, as a direct influence on the family's diet, greatly impacts the physical development and health of toddlers (Graceana M.A. Kuyap, 2022). Food intake is one of the factors that influences the nutritional status of toddlers. In addition, the level of maternal knowledge regarding complementary feeding and the quality of health services also play a role in determining the nutritional status of toddlers (Rhamadani, Noviasty and Adrianto, 2020).

According to data reported by UNICEF in 2017, around 92 million toddlers worldwide or around 13.5% are underweight, 151 million toddlers, or 22% are stunted, and 51 million toddlers, or 7.5% are wasted. The majority of toddlers who experience these three malnutrition conditions come from the African and Asian continents. Meanwhile, based on the 2018 Basic Health Research (Riskesdas), the nutritional status of toddlers in Indonesia showed significant improvement compared to 2013. The prevalence of underweight decreased from 19.6% to 17.7%, the prevalence of stunting decreased from 37.2% to 30.8%, and the prevalence of wasting decreased from 12.1% to 10.2%. Despite the encouraging decline, the prevalence rate is still considered high according to the standards set by the World Health Organization (WHO) to determine malnutrition as a public health issue (Hanifah, Djais and Fatimah, 2019).

The toddler period is a crucial stage for physical growth and development of body structure and function, emotions, intellect, and behavior (Batubara and Maisyura, 2024). Providing appropriate and quality complementary foods is very important to ensure that the nutritional needs of infants and children can be met properly, thus supporting their growth and development process optimally (Virginia, Maryanto and Anugrah, 2020).

A study conducted by Chionardes in 2016 revealed that the late or even early introduction of complementary foods, as well as inconsistent provision of complementary foods, can be major risk factors for the occurrence of growth faltering in children. This growth faltering has the potential to adversely affect a child's physical and cognitive development, including impacting their intelligence levels between the ages of 7 to 24 months. This research emphasizes the importance of timely and high-quality complementary feeding to support children's health and intelligence during their growth period (Rahmaniah *et al.*, 2023).

The objective of this research is to determine the relationship between the age of introduction of Complementary Feeding and the prevalence of stunting, wasting, and underweight among toddlers in Indonesia using data from the 2023 Indonesian Health Survey. The results of this study are expected to serve as a basis for planning more effective nutrition intervention programs and health policies to reduce the prevalence of malnutrition among toddlers in Indonesia.

METHODS

This study uses secondary data obtained from the 2023 Indonesian Health Survey (IHS) report with a Cross-sectional Study research design. The 2023 Indonesian Health Survey (IHS) was conducted from January to December 2023 and covered all provinces in Indonesia. The population in this study consists of all children under five years old in Indonesia recorded in IHS 2023. The research sample consists of the total population

of toddlers recorded in the survey, grouped by region areas in Indonesia.

The inclusion criteria in this study are toddlers who have complete data regarding the age of introduction to complementary feeding, nutritional status (stunting, wasting, and underweight) measured using WHO anthropometric standards, as well as demographic characteristics such as age, gender, and place of residence. Toddlers who have data on the age of introduction to complementary feeding and have identified nutritional status based on measurements of weight, height, weight-for-age, height-for-age, and weight-for-height are also included in the sample. The exclusion criteria are toddlers with a history of chronic diseases or genetic disorders that can affect growth and nutritional status, such as metabolic disorders, congenital heart disease, or significant genetic abnormalities.

In addition, toddlers with incomplete or invalid data on weight and height measurements or the age of introduction to complementary feeding were also excluded from the analysis. The variables analyzed in this study consist of independent and dependent variables. The independent variable is the age of introduction to complementary feeding, which is measured based on questions in the 2023 IHS related to the first time the child was given complementary feeding. The dependent variables in this study include the prevalence of stunting, wasting, and underweight in toddlers. Stunting is determined based on the height-for-age anthropometric index < -2 SD. Wasting is determined based on the weight-for-height index < -2 SD. Underweight is determined based on the weight-for-age index < -2 SD.

The formula for calculating stunting, wasting, and underweight:

a. The prevalence of stunting is calculated using the formula of dividing the number of severely stunted and stunted children by the number of children measured for height, multiplied by 100%. Toddlers are categorized as severely stunted if the Z-score < -3,0, and stunted if the Z-score ≥ -3,0 to Z-score < -2,0.
b. The prevalence of wasting is calculated using the formula of the number of severely wasted and wasted children divided by the number of children measured by weight and height, multiplied by 100%. Toddlers are categorized as severely wasting if the Z-score < -3,0, and as wasting if the Z-score ≥ - 3,0 To Z-score<-2,0.
c. The prevalence of underweight is calculated using the formula of dividing the number of severely underweight and underweight toddlers by the number of toddlers weighed by body weight, multiplied by 100%. Toddlers are categorized as severely underweight if the Z-score < -3,0 and underweight if the Z-score ≥ -3,0 to Z-score < -2,0.

The nutritional status of toddlers (under two years old) is measured based on age, weight, and height. The weight of toddlers is measured using a digital scale with a precision of 0.05 kg, while height is measured using a height-measuring device with a precision of 0.1 cm. The variables of weight and height of toddlers are presented in the form of three anthropometric indices, namely weight-for-age, height-for-age, and weight-for-height. To assess the nutritional status of toddlers, the weight and height of each toddler are converted into standardized values (Z-scores) using the WHO 2005 child anthropometric standards.

Definition the age at which solid foods and complementary foods are first introduced is the age at which the baby is first introduced to foods/drinks other than breast milk or complementary foods within the first month of introduction. The proportion of children aged 0 – 23 months is based on the age they were first introduced to food other than breast milk. Calculated using the formula of dividing the number of children in the age group first introduced to food other than breast milk and complementary food by the number of children aged 0-23 months.

The proportion of children aged 0 – 23 months is based on the type of food other than breast milk and the first complementary food introduced. Calculated using the formula of dividing the number of children who were first given types of food other than breast milk and complementary foods at the age of 0-23 months by type, divided by the total number of children aged 0-23 months who were first introduced to food other than breast milk and complementary foods. Age Proportion Regularly Given Food

Other Than Breast Milk and Complementary Foods.

The definition of "Age when complementary foods and other foods besides breast milk are routinely given" is the age when foods/drinks other than breast milk and complementary foods start to be routinely/continuously given during the first month of provision. Food other than breast milk is the provision of food and other liquids given to infants aged 0–5 months. Complementary Foods to Breast Milk are the provision of food and other liquids given to infants starting at 6 months of age.

The proportion of children aged 0 - 23 months is based on the age of regular provision of food other than breast milk and complementary foods. Calculated using the formula: the number of age groups of children who are routinely given food other than breast milk and complementary foods divided by the number of children aged 0-23 months who were first introduced to food other than breast milk and complementary foods.

The proportion of children aged 0 - 23 months is based on the type of food other than breast milk and complementary foods that are regularly given. Calculated using the formula: the number of children aged 0-23 months who regularly consume food other than breast milk and complementary food based on type, divided by the number of children aged 0-23 months based on the age of regular provision of food other than breast milk and complementary food (Kemenkes, 2023).

Data collection was conducted using information recorded in the 2023 IHS, which includes the age of introduction to complementary feeding, toddler anthropometric data, and socio-demographic characteristics such as age, gender, and residential area. Data were analyzed using SPSS software version 26. Descriptive analysis was conducted to describe the distribution of the prevalence of stunting, wasting, and underweight, as well as the characteristics of the sample. Pearson correlation test was conducted to determine the relationship between the age of introduction of complementary feeding with breastfeeding and the nutritional status of toddlers, after ensuring the data normality was met. This study uses secondary data from IHS 2023 with permission from the Ministry of Health of the Republic of Indonesia.

RESULTS AND DISCUSSION

Table 1 shows that the distribution of the age of introduction to complementary feeding under six months is highest in the Sulawesi region (30.3%) and lowest in the Nusa Tenggara region (18.5%). The age of introduction to complementary feeding at six months is highest in the Nusa Tenggara region (52.3%) and lowest in the Papua region (35.5%). Meanwhile, the age of introduction to complementary feeding over six months is highest in the Papua region (10.1%) and lowest in the Java and Bali regions (13.5%). In Indonesia, (25.8%) are indicated to have received complementary feeding under six months, (47.9%) are indicated to have received complementary feeding at six months, and (5.8%) are indicated to have received complementary feeding over six months.

Table 1. Distribution of Age for Introducing Complementary Foods According to Indonesian

Region	Less than six months			Six months			More than six months		
	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$
Sumatra	13,5	30,8	24,0 ± 5,9	44,3	58,8	52,0 ± 4,5	2,1	7,1	5,5 ± 1,4
Java-Balinese	22,9	33,1	28,2 ± 4,4	44,2	57,0	50,9 ± 4,6	1,8	5,6	3,5 ± 1,4
Southeast	17,7	19,4	18,5 ± 1,2	51,6	53,1	52,3 ± 1,0	7,3	8,0	7,6 ± 0,4
Kalimantan	18,9	25,7	22,2 ± 3,0	50,4	53,7	52,0± 1,3	4,1	7,0	5,5 ± 1,0
Sulawesi	17,1	37,8	30,3 ± 7,3	39,1	57,8	45,5 ± 6,5	3,2	5,9	4,3 ± 6,4
Maluku	22,6	25,3	23,9 ± 1,9	45,5	49,7	47,6 ± 2,9	5,3	7,6	6,4 ± 1,6
Papua	13,3	41,2	27,5 ± 8,8	25,4	47,9	35,5 ± 7,5	6,2	17,2	10,1 ± 4,5
Indonesia	13,3	41,2	25,8 ± 6,4	25,4	58,8	47,9 ± 7,6	1,8	17,2	5,8 ± 2,9

Table 2 shows that the highest prevalence of stunting occurs in the Nusa Tenggara Region area (31.2%), and the lowest prevalence of stunting occurs in the Java and Bali Region areas (18.1%). The prevalence of underweight occurrence is highest in the Nusa Tenggara region (25.5%), and the lowest prevalence of underweight occurrence is in the Java and Bali regions (13.3%). Meanwhile, the highest prevalence of wasting occurrence is in the Maluku region (15.6%), and the lowest prevalence of wasting occurrence is in the Java and Bali regions (7.3%). In Indonesia, the stunting indicator is 23.5%, the underweight indicator is 17.7%, and the wasting indicator is 10.2%.

The results of this study indicate that there is a significant relationship between the proportion of age at which complementary feeding is introduced and the prevalence of nutritional problems (stunting, wasting, underweight) across regions in Indonesia. In general, the relationship between the age of introduction to complementary feeding under six months in Indonesia is still low, averaging 25.8%, the age of introduction to complementary feeding at six months with an average of 47.9%, and over six months in Indonesia with an average of 5.8%. These figures illustrate that many toddlers are given complementary feeding at different ages, which impacts the child's nutritional status. WHO recommends that infants receive exclusive breastfeeding for the first six months of life to support optimal growth, development, and health. After that period, infants need to receive adequate and safe complementary foods to meet their nutritional needs, while continuing to be breastfed until the age of two years or beyond. The provision of complementary foods is a process that begins when breast milk alone is no longer sufficient to meet the baby's nutritional needs, thus requiring additional food and fluids as a supplement to breast milk (Hardiningsih *et al.*, 2020).

Complementary foods for infants are given as food and drink before the baby is less than 6 months old. Complementary foods are given to infants because at that time, breast milk production decreases, so the supply of nutrients from breast milk no longer meets the increasing nutritional needs of the child, making the provision of complementary foods highly recommended (Simamora, Afrinis and Lestari, 2024). Difficulty in transitioning from breast milk to complementary foods can hinder a child's growth, resulting in suboptimal development as they age (Purnama Sari *et al.*, 2024). Complementary foods serve as a supplement to breast milk, so breastfeeding should continue to ensure the child's nutritional needs are met. The purpose of providing complementary foods is to meet the energy and nutrient needs that support optimal growth and development. In addition, complementary foods help children get used to consuming healthy foods and recognizing, choosing, and liking foods according to their body's needs (Lestari and Syamsussabri, 2025).

The provision of complementary feeding before the child reaches the age of 6 months still occurs frequently. Other research also shows that complementary foods given before the age of six months generally have inadequate quality and quantity. The research findings reveal that the practice of introducing complementary foods to breastfeeding is still a problem due to its suboptimal nature. The introduction of complementary foods before the age of 6 months is associated with an increased risk of stunting, wasting, and underweight. Additionally, children aged 6–24 months with minimal meal frequency tend to have a higher risk of experiencing stunting (Wahyuni *et al.*, 2024).

According to the Global Nutrition Report of 2018, every country in the world faces challenges in nutrition issues. The report revealed that around 22.2% of children aged 0–59 months experience stunting, which is a condition of impaired growth due to long-term

malnutrition. In addition, about 7.5% of children experience wasting, which means they have a weight far below the standard for their height, often caused by acute malnutrition (Rhamadani, Noviasty, and Adrianto, 2020). Based on 2020 data, Asia is the region with the highest proportion of stunted children in the world, reaching 53%. The second position is occupied by Africa with a rate of 41%. Within the Asian region, South Asia has the highest stunting rate with a prevalence of 30.7%, followed by Southeast Asia at 27.4%. On the other hand, East Asia has the lowest stunting rate compared to other regions in Asia, at only 4.9%. More specifically in Southeast Asia, the countries with the highest stunting rates are Timor Leste and Indonesia. Data from the period 2005–2007 show that the prevalence of stunting in Timor Leste reached 48.8%, while in Indonesia the figure was 31.8%. The high stunting rates in these countries indicate significant challenges in meeting children's nutritional needs, likely influenced by factors such as food security and access to healthcare services (Budiono, Mardiana, and Handayani, 2024).

The causes of stunting, wasting, and underweight rates in Indonesia are still higher than in other countries due to many interrelated factors, but generally, these factors can be grouped into three main categories: basic factors, indirect factors, and direct factors. Basic factors include economic, social, and political aspects that affect the quality of life and access to healthcare services. Indirect factors include the influence of the family environment and access to adequate healthcare services. Meanwhile, direct factors are related to the child's diet and health condition. In addition, insufficient breastfeeding, exposure to previous infectious diseases, and elements originating from the social and community environment also play an important role in this malnutrition issue (Rahmaniah *et al.*, 2023).

This study reveals that the prevalence of stunting among toddlers in Indonesia shows significant figures with notable variations between regions. Nationally, the prevalence of stunting is recorded at 23.5%, with the Nusa Tenggara region recording the highest prevalence at 31.2%, while Java and Bali have the lowest prevalence at 18.1%. In addition to stunting, the prevalence of underweight also shows significant differences between regions, with Nusa Tenggara recording the highest prevalence at 25.5%, while the highest prevalence of wasting was recorded in Maluku (15.6%), with the lowest prevalence found in Java and Bali (7.3%). National data shows an underweight prevalence of 17.7% and a wasting prevalence of 10.2%.

Table 2. Distribution of Toddler Nutritional Status by Region in Indonesia 2023

Region	Prevalence of Stunting			Prevalence of Underweight			Prevalence of Wasting		
	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$
Sumatra	13.5	29.4	19.2 ± 4.9	8.9	22.6	13.9 ± 3.8	6.3	13.6	8.4 ± 2.1
Java-Balinese	7.2	23.9	18.1± 5.3	5.6	17.7	13.3 ± 3.7	3.6	10.2	7.3 ± 2.2
Southeast	24.5	37.9	31.2 ±9.4	20.8	29.7	25.2 ± 6.2	8.6	13.6	11.1 ± 3.5
Kalimantan	17.4	24.7	22.5 ± 3.0	15.3	21.6	18.7 ± 2.6	8.7	13.3	10.7 ± 2.0
Sulawesi	21.3	30.4	27.1 ± 3.2	14.3	24.4	21.2 ± 3.7	9.1	12.9	10.9 ± 1.8
Maluku	23.6	28.4	26.0 ±3.3	20.9	25.1	23.0 ±2.9	15.4	15.8	15.6 ±0.2
Papua	24.8	39.3	31.0 ± 6.1	15.4	23.9	20.38 ±2.8	10.9	18.2	13.4 ±2.5
Indonesia	7.2	39.3	23.5 ± 6.8	5.6	29.7	17.7 ± 5.1	3.6	18.2	10.2 ±3.1

The results of this study indicate significant region disparities in the prevalence of nutritional problems among toddlers in Indonesia. Nusa Tenggara and Maluku recorded higher prevalence rates of stunting, wasting, and underweight compared to other regions. This indicates the need for more specific and focused nutritional interventions in regions with high prevalence of malnutrition. Meanwhile, Java and Bali have lower

prevalence compared to other regions, which is likely influenced by better access to healthcare services and nutritious food.

Table 3. The Relationship Between the Age of Introduction to Complementary Foods and the Prevalence of Stunting, Underweight, and Wasting in Toddlers in Indonesia in 2023

Age of introduction of complementary foods	Prevalence Stunting	Prevalence Wasting	Prevalence Underweight
Age less than six months			
Beta	0.079	0.092	0.170
Constant	21.406	7.852	13.323
Correlation Coefficients (r)	0.083	0.187	0.213
p-value	0.638	0.261	0.199
Age six months			
Beta	-0.542	-0.236	-0.249
Constant	49.580	21.547	29.641
Correlation Coefficients (r)	0.607	0.568	0.369
p-value	0.000	0.000	0.023
Age More than six months			
Beta	1.073	0.419	0.355
Constant	17.264	7.768	15.631
Correlation Coefficients (r)	0.464	0.389	0.203
p-value	0.003	0.016	0.221

Table 3 shows that the introduction of complementary feeding before six months of age is not significantly associated with the prevalence of stunting, wasting, or underweight, as indicated by p-values of 0.638, 0.261, and 0.199, respectively. The beta coefficient values also suggest no significant relationship. The correlations are very weak to weak, with r = 0.083 for stunting, r = 0.213 for wasting, and r = 0.187 for underweight. In contrast, introducing complementary feeding at exactly six months of age is significantly associated with the prevalence of stunting (p-value 0.000) and wasting (p-value 0.000), but not with underweight (p-value 0.23). The beta coefficient values indicate a significant relationship with stunting and wasting. The strength of the association is also greater in this group, with a strong correlation for stunting (r = 0.607), moderate for wasting (r = 0.568), and weak for underweight (r = 0.369).

Introducing complementary feeding after six months is significantly associated with stunting (p-value 0.003) and wasting (p-value 0.016), but not with underweight (p-value 0.221). According to the beta coefficient values, a significant relationship exists with stunting and wasting. The correlation strength is moderate for wasting (r = 0.464), weak for underweight (r = 0.389), and very weak for stunting (r = 0.203).

Age of Introduction to Complementary Feeding and the Prevalence of Stunting

The provision of complementary foods to breast milk at the right time, specifically when the baby is six months old, has been proven to have a significant relationship with the reduction of stunting prevalence. This shows that providing complementary foods according to recommendations can help meet the child's nutritional needs optimally, thereby supporting their growth and development. On the other hand, delays in introducing complementary foods, specifically beyond six months, are associated with an increased risk of stunting. This is caused by the possibility of chronic malnutrition due to insufficient nutrient intake during the critical growth period of the child. If nutritional needs are not met during this period, the child's linear growth can be disrupted, ultimately increasing the risk of stunting.

Therefore, timely provision of complementary foods is very important in efforts to prevent stunting and ensure optimal child growth and development. These results

indicate that a delay in introducing complementary foods to breastfeeding can increase the risk of stunting, although the relationship found is weak. Delays in the introduction of complementary foods can lead to chronic malnutrition, which affects the linear growth of children. Research conducted by Lestari, Lubis, and Pertiwi (2014) shows that children who start receiving complementary foods at the age of ≥ 6 months have better nutritional status compared to children who are given complementary foods earlier (Simamora, Afrinis and Lestari, 2024).

Four significant studies have discussed the impact of the timing of the first introduction of complementary feeding on the incidence of stunting in children based on the height-for-age parameter. Three of them concluded that the early introduction of complementary feeding increases the risk of stunting in children (Masuke *et al.*, 2021; Briaux J, et al., 2019; Makori N, et al., 2018), while the study by Appiah CA, et al, (2020) showed different results. The average introduction of complementary feeding was at 3 months of age, with 91.2% of 3,355 children receiving complementary feeding before reaching 6 months of age. In addition, the introduction of complementary feeding at the age of 2-3 months increases the risk of stunting by up to 1.88 times compared to children who receive complementary feeding at the age of 6-8 months (Masuke *et al.*, 2021).

The provision of complementary feeding before the appropriate time can increase the risk of diarrhea and upper respiratory tract infections (URTI). These disorders contribute to growth delays, which can lead to stunting in children. In addition, the provision of pre-lacteal foods or drinks before breast milk production begins can make infants more susceptible to gastrointestinal infections, diarrhea, and malnutrition (Sariy, Simanjuntak, and Suryani, 2018).

The provision of complementary foods at six months of age plays a role in preventing stunting and reducing the prevalence of stunting by meeting nutritional needs that support height growth. If complementary foods are given too early, the immature digestive system of the baby can be disrupted, resulting in suboptimal nutrient absorption. On the other hand, if complementary foods are introduced too late, the baby may suffer from deficiencies in essential nutrients such as protein, iron, calcium, and vitamins needed for bone growth and overall body development. By providing complementary foods in a timely manner, babies receive adequate nutrition to support their linear growth, thereby minimizing the risk of stunting.

The provision of complementary foods after six months of age is also associated with an increased risk of stunting due to the lack of essential nutrients needed for linear growth. After six months, breast milk alone is no longer sufficient to meet the needs for protein, iron, zinc, and other micronutrients required for bone growth and height development. If complementary foods are introduced later than the recommended time, the baby is at risk of chronic nutrient deficiencies that hinder their height growth. Nutritional deficiencies during this golden growth period can lead to long-term growth disturbances, which are difficult to correct later on. Therefore, delays in providing complementary foods become one of the significant factors contributing to the occurrence of stunting.

Age of Introduction to Complementary Feeding and the Prevalence of Wasting

The research results show that the age of introducing complementary foods to breast milk under six months is not significantly related to the prevalence of wasting. This indicates that other factors such as acute infectious diseases and the mother's health status during pregnancy may contribute to the incidence of wasting in toddlers. However, it is said that children who receive complementary feeding before the age of 6 months are at a

higher risk of experiencing wasting (Triveni and Hasnita, 2021).

The provision of complementary feeding at the right time, specifically when the baby is six months old, has been proven to have a significant relationship with the reduction in the prevalence of wasting. This indicates that providing complementary foods according to recommendations can help meet the child's nutritional needs optimally, thereby supporting their growth and health. On the other hand, a delay in introducing complementary foods, specifically beyond six months, is associated with an increased risk of wasting. This condition can occur due to a lack of energy and nutrients needed for a child's growth, causing the child's weight to fall below the standard it should be. If this condition continues, the child is at risk of experiencing acute malnutrition, which can affect their immune system and overall development. Therefore, the timely introduction of complementary foods is crucial in the effort to prevent wasting and ensure that the child receives adequate nutrition to grow healthily. Delayed introduction of complementary foods can lead to energy and nutrient deficiencies during critical periods, resulting in wasting.

The provision of complementary foods has a significant impact on the incidence of wasting in toddlers. This is due to the introduction of good and varied complementary foods early on, which helps children get used to consuming different types of food, thereby reducing the risk of becoming picky eaters. On the other hand, a lack of variety in complementary feeding can increase the likelihood of children having difficulty accepting food (Syawalia and Kariani, 2020). Previous research by Suryana, et al., (2022), showed that 84.0% of infants who received complementary feeding at the right time experienced normal development. On the contrary, the majority of infants who received inappropriate complementary feeding, approximately 75.8%, showed questionable or deviating development (Afifah, Anna, and Afifah, 2025).

The provision of complementary foods Breast milk at six months helps prevent wasting by ensuring that the baby receives adequate energy and protein intake. At this age, the baby's caloric needs increase, and breast milk alone is no longer sufficient. If complementary foods are not given on time, the baby is at risk of experiencing energy deficiency, which can cause drastic weight loss in a short period. The lack of nutritional intake also makes the baby more vulnerable to infections, which further exacerbates the condition of wasting. With the provision of sufficient and nutritious complementary foods at six months of age, the baby's weight growth can be well maintained, thereby reducing the risk of wasting. The provision of complementary feeding after six months of age is significantly associated with an increased risk of wasting. This happens because babies who receive complementary foods late do not get enough additional energy and protein at the needed time. As a result, the baby's body starts using existing energy reserves, causing a drastic weight loss in a short period of time. Additionally, babies who experience delays in consuming complementary foods often have difficulty adapting to solid foods, which can lead to insufficient calorie and nutrient intake. This condition increases the risk of wasting, especially if the baby also experiences infections or diseases that further reduce their nutritional status.

Age of Introduction to Complementary Feeding and the Prevalence of Underweight

The research results indicate that the age of introducing complementary feeding before six months does not show a significant relationship with the prevalence of underweight. Although there is a weak correlation, these results indicate that other factors are likely to have a greater influence on the occurrence of underweight in children. These factors may include the child's health

condition, history of infectious diseases, and the mother's nutritional status during pregnancy. Therefore, although the provision of complementary foods before six months is not directly related to underweight, it is still important to ensure that the food provided meets the child's nutritional needs to support optimal growth and development. This indicates that other factors such as infections and chronic diseases may also play a role in the occurrence of underweight in toddlers. The provision of complementary feeding too early is associated with an increased risk of diarrhea, which has the potential to cause weight loss. In addition to affecting nutritional status based on the Weight-for-Age indicator, early introduction of complementary feeding is also associated with an increased risk of stunting (Height-for-Age) and wasting (Weight-for-Height) (Tampi, Kawengian and Bolang, 2024).

Research results show that the introduction of complementary foods to breast milk at six months of age has a significant relationship with the reduction in the prevalence of underweight. This indicates that the timely introduction of complementary feeding plays an important role in ensuring that children receive adequate nutrition to support growth and maintain weight within the normal range. On the other hand, a delay in the introduction of complementary feeding, specifically beyond six months, does not show a significant relationship with the prevalence of underweight. However, children who receive complementary feeding late are at risk of experiencing acute malnutrition, which can affect their immune system and overall development. This shows that the delay in providing complementary feeding does not directly affect the prevalence of underweight, but it can impact long-term growth. In addition to the timing of the first introduction of complementary feeding, there are other factors related to the occurrence of underweight, such as socio-cultural practices in childcare, cultural constraints, the distance between home and market, and limited information (Safirah and Hananingtyas, 2021).

Two studies, namely by Appiah CA, et al., (2020) and (Masuke *et al.*, 2021), found that the timing of the first introduction of complementary feeding significantly affects the incidence of underweight (Masuke R, Msuya SE, Mahande JM, Diarz EJ, Stray-Pedersen B, 2021), reported that infants who received complementary feeding earlier, at the age of 4-5 months, had a 2.14 times higher risk of being underweight. One of the causes is the limited access to clean and safe water in lower-middle-income countries, which increases the risk of microorganism contamination in complementary foods. The introduction of complementary foods before 6 months or exactly at 6 months of age has a lower risk of underweight occurrence (Masuke *et al.*, 2021).

CONCLUSION

This study highlights a significant relationship between the timing of complementary feeding and the prevalence of stunting and wasting among toddlers in Indonesia. Introducing complementary foods at six months is linked to reduced stunting and wasting, while delayed introduction is associated with increased prevalence. Early introduction (before six months) shows no significant impact. Stunting and wasting are most prevalent in Nusa Tenggara, Maluku, and Papua, while Java and Bali have the lowest rates. Nationally, malnutrition remains high, underscoring the need for improved dietary practices and nutrition policies.

To address this, the government and healthcare workers are advised to enhance education for mothers and pregnant women on timely and nutritious complementary feeding, especially in high-risk regions. Expanding access to nutrient-rich foods—particularly local ingredients—is crucial. Strengthening child growth monitoring programs through *posyandu*

and *puskesmas* is also essential for early detection and intervention. Further research is needed to examine other factors affecting toddler nutrition, such as parenting practices, infections, socioeconomic status, maternal education, and healthcare access. Longitudinal studies are recommended to better understand the long-term effects of complementary feeding timing, as well as the quality and variety of foods in supporting optimal child growth and development.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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TREND OF OVERWEIGHT AND OBESITY PREVALENCE IN ADULT MALES IN INDONESIA 2010-2023

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ABSTRACT

Background: *Overweight and obesity are growing nutritional issues among adult Indonesian males, significantly increasing their risk of chronic diseases. This rise is primarily attributed to an imbalance in nutritional intake and lifestyle changes. This study will analyze the prevalence and distribution of overweight and obesity in adult Indonesian males, utilizing data from the 2010 and 2018 Basic Health Research, and the 2023 Indonesian Health Survey (IHS).*
Methods: *This study is an analytical survey with a cross-sectional approach and quantitative descriptive methods. The study population was adult males >18 years in 38 provinces in Indonesia, grouped into 7 regional areas. Data were obtained from Basic Health Research 2010, 2018, and IHS 2023. Overweight status was determined based on BMI ≥ 25.0 kg/m² to < 27.0 kg/m² and obesity ≥ 27.0 kg/m². Data analysis was performed using SPSS version 22.*
Results: *The prevalence of overweight nationally increased from 8.9% (2010) to 13.5% (2023), while obesity increased from 8.5% (2010) to 15.6% (2023). The Papua region showed the highest prevalence for both categories, increasing from 10.6% (2010) to 15.2% (2023), while the Nusa Tenggara region had the lowest prevalence for both categories, increasing from 6.2% (2010) to 9.8% (2023).*
Conclusion: *Overweight and obesity in adult Indonesian males significantly rose from 2010-2023. Public health efforts are crucial, promoting healthy eating, physical activity, and weight management education to reduce chronic disease risks.*

Keywords: *Prevalence, Overweight, Obesity, Adult Males*

INTRODUCTION

Overweight and obesity have become a growing global health problem in recent decades. The World Health Organization (WHO) reports that since 1975, the global prevalence of obesity has nearly tripled, with more than 1.9 billion adults overweight and 650 million obese in 2016 (WHO. 2021). Each individual requires different nutritional intake depending on age, gender, daily physical activity, body weight, and others (Nur *et al.*. 2023).

Health problems related to nutritional status in Indonesia are currently entering a double burden of nutrition, meaning a combination of two nutritional issues that occur at the same time (Astuti, Huriyati and Susetyowati, 2022), the coexistence of undernutrition and overnutrition in a population caused by the phenomenon of undernutrition at an early age that contributes to or is related to the occurrence of overnutrition in adulthood (Ahriyasna, Laila and Ilham, 2020). The problem of undernutrition has not been fully resolved, while overnutrition is increasing. A person's nutritional status can be seen from their nutritional intake and needs, this problem arises due to incorrect dietary behavior, such as choosing the wrong food ingredients, an imbalance between nutritional consumption and the recommended nutritional adequacy, and adopting an unhealthy lifestyle (Ambar Wati *et al.*, 2022).

Adults with nutritional problems tend to be overweight. Overweight and Obesity are one of the leading health problems in both developed and developing countries such as Indonesia. A study recently published in The Lancet states that currently, two-thirds of people who suffer from overweight and obesity are in developing countries than in developed countries, this is because in developed countries the factors that influence obesity are mostly lifestyle or diet, while in developing countries overweight and obesity are influenced by the transition and adaptation of western lifestyles by the population, rapid changes in diet, demographic changes, geographic patterns, social and economic factors (Pus *et al.*, 2016). Obesity occurs due to excess fat accumulation in adipose tissue (Dahlia *et al.*, 2022).

According to the results of the 2010 Basic Health Research data, nationally the percentage of adults > 18 years old who are overweight (10.0%) and obese (11.7%), which means that the total percentage of the population who are overweight and obese is (21.7%) higher than the population who are malnourished (12.6%) (Health Research and Development Agency, 2010). The results of the 2018 Basic Health Research data, nationally the percentage of adults > 18 years old who are overweight (13.6%) and obese (21.8%), which means that the total percentage of the population who are overweight and obese is (35.4%) higher than the population who are malnourished (9.3%) (Basic Health Research, 2018).

Meanwhile, according to the results of the 2023 IHS data, nationally the percentage of adults > 18 years old who are overweight (14.4%) and obese is (23.4%), which means that the total percentage of the population who are overweight and obese is (37.8%) higher than the population who are malnourished (7.8%). This indicates that there is an increase in the population experiencing overweight and obesity and that overweight and obesity are the most common nutritional problems that occur in adults > 18 years old (BKPK, 2023).

Overweight and obesity are influenced by several factors, namely environmental factors, the selection of types of food that are not nutritionally balanced, the wrong diet, portion sizes per meal, and the level of activity in each individual that is lacking, the WHO report states that more than 30% of adults in developing countries have low levels of physical activity, which contributes to uncontrolled weight gain (WHO, 2019). Epidemiological studies show that the effects of obesity are not only from these factors but can also be influenced by socio-economic and genetic factors which can affect the formation of body fat, someone with this genetic factor tends to build more body fat than other individuals (Syifa and Djuwita, 2023).

Overweight and obesity can also interfere with sexual activity in men, in this case, erectile dysfunction (Situmorang *et al.*, 2022). Research that has been conducted in Europe discusses physical damage and sexual function in men who are overweight and obese, from the results of the study it was found that men with a BMI> 23 kg / m 2 are more likely to show two or more symptoms that lead to physical damage and impaired sexual function (Husain, Tendean and Queljoe, 2015). In addition, being overweight and obese can also have an impact on accelerating the aging process, impaired intelligence, insulin resistance which will manifest as hypertension, dyslipidemia, hyperuremia, endothelial dysfunction and lipotoxicity to beta cells, then also have an impact on cancer, osteoarthritis, cholelithiasis, chronic degenerative diseases such as coronary heart disease, stroke, cancer and type 2 diabetes, and death at a young age (Budyono *et al.*, 2022). This is in line with other studies that say overweight and obesity are associated with an increased risk of various non-communicable diseases (NCDs), including cardiovascular disease, type 2 diabetes, hypertension, and several types of cancer

(Malik *et al.*, 2019). The purpose of this study was to analyze the prevalence and distribution of nutritional status of overweight and obesity in adult men in Indonesia based on data from Riskesdas 2010, 2018, and the Indonesian Health Survey (IHS) 2023.

METHODS

This type of research uses an analytical survey with a cross-sectional study approach with a quantitative descriptive research method to identify the prevalence of overweight and obesity in adult men in Indonesia based on the 2010 and 2018 Basic Health Research data and the 2023 Indonesian Health Survey (IHS) data. This research can be carried out in all provinces in Indonesia. The population used in this study was adult men > 18 years old who lived throughout Indonesia. The data used to conduct this study came from the 2010 and 2018 Basic Health Research data and the 2023 Indonesian Health Survey (IHS), which were conducted in the period from August to October 2023. The survey conducted collected several health-related information, one of which was regarding Anthropometric data. The research variables used were the prevalence of overweight and the prevalence of obesity. Determination of overweight and obesity nutritional status based on Body Mass Index (BMI) with the formula: BMI = Body Weight (kg) / Height (m)². Weight measurement in the 2010 and 2018 Basic Health Research data and the 2023 IHS data used a digital scale with a precision of 0.1 kg, and height measurement used a height-measuring instrument with a precision of 1 mm. Based on BMI data, the nutritional status category in the 2010, 2018, and 2023 Basic Health Research data is stated as overweight if the BMI value is ≥ 25.0 kg/m² to <27.0 kg/m² and is said to be Obese if the BMI value is ≥ 27.0 kg/m².

The prevalence of overweight according to the 2010, 2018, and 2023 Basic Health Research data is calculated using the formula for dividing the number of overweight residents > 18 years by the number of residents > 18 years measured by Body Weight and Height x 100%. Obesity prevalence according to Basic Health Research 2010, 2018, and IHS 2023 data is calculated using the formula for dividing the number of obese people > 18 years by the number of people > 18 years measured by Body Weight and Height x 100%. The prevalence of overweight and obesity in adult males > 18 years is presented per province in Indonesia. The research instrument used an individual questionnaire developed by the IHS team in 2023 including information related to the weight and height of adult males > 18 years. Anthropometric measurements were carried out by trained enumerators with a minimum educational background of D3 health to ensure the accuracy of the data obtained. Data analysis was carried out using the SPSS version 22 application.

Univariate analysis used measures of distribution (minimum, maximum, average, and standard deviation). The analysis in this study was used to describe the prevalence of overweight and obesity in 38 provinces in Indonesia and divided into 7 regional areas, namely Sumatra (Aceh Province, North Sumatra, West Sumatra, Riau, Jambi, South Sumatra, Bengkulu, Lampung, Bangka Belitung, Riau Islands), Java-Bali (DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Banten, Bali), Nusa Tenggara (West Nusa Tenggara and East Nusa Tenggara), Kalimantan (West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan, North Kalimantan), Sulawesi (North Sulawesi, Central Sulawesi, South Sulawesi, Southeast Sulawesi, Gorontalo, West Sulawesi), Maluku (Maluku and North Maluku), Papua (West Papua, Southwest Papua, Papua, South Papua, Central Papua, Papua Pegunungan).

RESULTS AND DISCUSSION

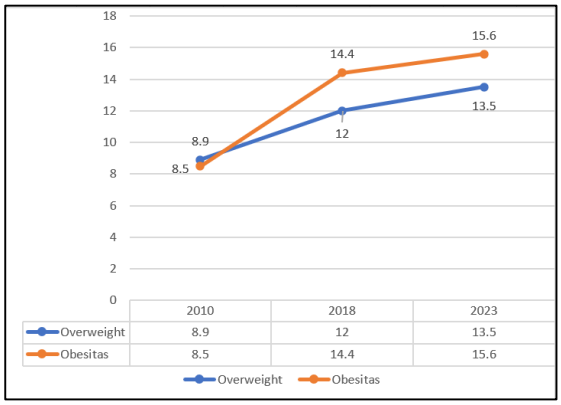


Figure 1. The Prevalence of Overweight and Obesity in Adult Males > 18 years in Indonesia

Figure 1. Presents data on the distribution of average trends in overweight and obesity nutritional status based on national. Based on the graphic above, shows an increase in the prevalence of overweight and obesity every year.

Table 1. Prevalence of Overweight Nutritional Status in Adult Men > 18 Years Based on Indonesian Regions in 2010. 2018. 2023

Regions	n	2010 (%)		2018 (%)		2023 (%)	
		Min-Max	$\bar{X}$ ±SD	Min-Max	$\bar{X}$ ±SD	Min-Max	$\bar{X}$ ±SD
Sumatera	10	6.2-11.7	8.7±2.2	9.6-14.6	12.0±1.5	11.4-17.9	14.4±2.3
Java-Bali	7	7.8-12.1	9.2±1.6	11.0-15.3	12.8±1.8	12.3-16.8	14.1±1.8
NusaTenggara	2	5.9-6.4	6.2±0.4	7.1-9.0	8.1±1.3	9.3-10.4	9.8±0.8
Kalimantan	5	6.1-10.8	8.4±2.0	11.5-14.2	12.5±1.1	12.0-19.0	14.6±2.6
Sulawesi	6	7.7-13.7	9.0±2.3	10.4-16.8	12.4±2.4	12.2-17.4	13.7±1.9
Maluku	2	8.3-12.6	10.5±3.0	11.1-13.6	12.3±1.7	11.4-13.7	12.5±1.6
Papua	6	9.0-12.3	10.6±2.3	13.6-15.1	14.3±1.0	13.5-18.8	15.2±1.9
Indonesia	**1**	**5.9-13.7**	**8.9±0.8**	**7.1-16.8**	**12.0±0.5**	**9.3-19.0**	**13.5±0.6**

Table 1 shows the results of the prevalence of overweight nutritional status in 2010 nationally at 8.9%, the highest occurred in the Papua regional area with a percentage of 10.6% and the lowest occurred in the Nusa Tenggara regional area with a percentage of 6.2%. In 2018 nationally 12.0%, the highest occurred in the Papua regional area with a percentage of 14.3% and the lowest occurred in the Nusa Tenggara regional area with a percentage of 8.1%. In 2023 nationally 13.5%, the highest occurred in the Papua regional area with a percentage of 15.2% and the lowest occurred in the Nusa Tenggara regional area with a percentage of 9.8%.

Figure 2 Presents data on the distribution of the average trend of overweight nutritional status in adult males > 18 years in the period 2010, 2018, and 2023 based on 7 regional areas in Indonesia. Based on the graphic image above, it shows that the highest prevalence of overweight is in Papua and has increased every year, while the lowest prevalence of overweight is in Nusa Tenggara and has increased every year.

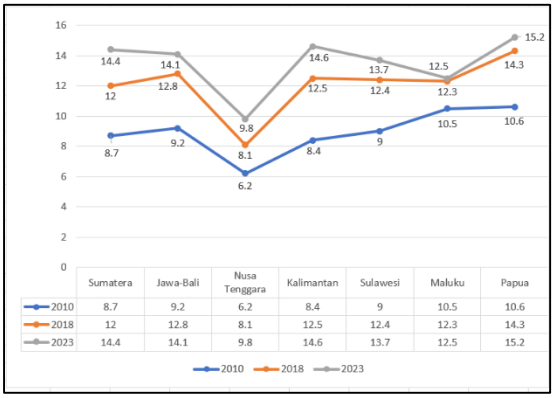


Figure 2. The average prevalence of overweight in adult males > 18 years based on 7 Indonesian Region

Table 2. Prevalence of Obesity Nutritional Status in Adult Men > 18 Years Based on Indonesia Regional Year 2010. 2018. 2023

Regions	n	2010 (%)		2018 (%)		2023 (%)	
		Min-Max	$\bar{X}$ ±SD	Min-Max	$\bar{X}$ ±SD	Min-Max	$\bar{X}$ ±SD
Sumatera	10	4.3-15.1	8.1±3.0	9.4-20.6	14.1±3.6	10.0-19.7	14.1±3.4
Jawa-Bali	7	6.2-12.5	8.5±1.9	13.1-23.2	16.7±3.7	14.8-24.7	18.2±3.8
NusaTenggara	2	5.0-5.2	5.1±0.1	7.2-7.7	7.4±0.4	9.4-10.1	9.7±0.5
Kalimantan	5	6.3-13.1	8.6±3.1	11.1-21.6	15.4±4.8	12.2-21.8	16.2±3.8
Sulawesi	6	5.0-14.3	8.7±3.3	11.7-23.0	14.8±4.1	12.4-23.3	15.6±4.4
Maluku	2	9.2-11.4	10.3±1.5	13.7-15.8	14.7±1.5	13.9-15.7	14.8±1.3
Papua	6	9.6-10.9	10.3±0.9	16.0-19.1	17.5±2.2	14.4-26.3	20.8±5.1
Indonesia	**1**	**4.3-15.1**	**8.5±1.2**	**7.2-23.2**	**14.4±1.6**	**9.4-26.3**	**15.6±1.6**

Table 2 shows the results of the prevalence of obesity nutritional status in 2010 nationally at 8.5%, the highest occurred in the Maluku regional area with a percentage of 10.3% and the lowest occurred in the Nusa Tenggara regional area with a percentage of 5.1%. In 2018 nationally 14.4%, the highest occurred in the Papua regional area with a percentage of 17.5% and the lowest occurred in the Nusa Tenggara regional area with a percentage of 7.4%. In 2023 nationally 15.6%, the highest occurred in the Papua regional area with a percentage of 20.8% and the lowest occurred in the Nusa Tenggara regional area with a percentage of 9.7%.

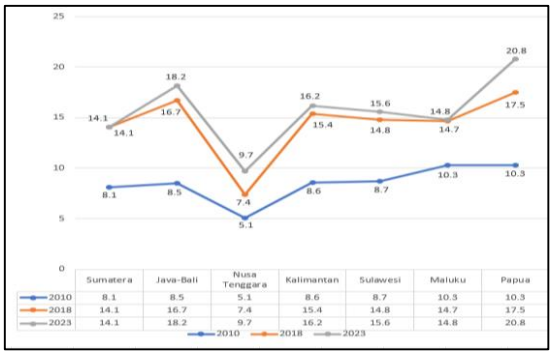


Figure 3. The average prevalence of obesity in adult males > 18 years based on 7 Indonesian Region

Figure 3 presents data on the distribution of the average trend of overweight nutritional status in adult males > 18 years in the period 2010, 2018, and 2023 based on 7 regional areas in Indonesia. Based on the graph above, shows that the highest prevalence of obesity is in Papua and has increased every year, while the lowest prevalence of obesity is in Nusa Tenggara and has increased every year.

This study shows that the prevalence of overweight and obesity in adult men in Indonesia has increased from 2010 to 2023, nationally it can be seen in Figure 1, the prevalence of overweight increased from 8.9% (2010) to 13.5% (2023), while obesity increased from 8.5% (2010) to 15.6% (2023). Regionally it can be seen that the data shows that the Papua region has the highest prevalence of overweight and obesity, with the percentage of overweight increasing from 10.6% (2010) to 15.2% (2023) and the percentage of obesity increasing from 10.3% (2010) to 20.8% (2023), while Nusa Tenggara has the lowest prevalence for both categories of nutritional status. When compared globally according to WHO data, more than 1 billion adults are overweight and 300 million people are overweight. Obesity is common in developing countries with more than 115 million sufferers, this is in line with a study stating that in several countries in Latin America, the highest prevalence of obesity is in Uruguay (18.1%), Costa Rica (12.4%), Chile (11.9%) and Mexico (10.5%). More than 50% of obese people in the world are in ten countries, namely the United States, China, India, Russia, Brazil, Mexico, Egypt, Germany, Pakistan, and Indonesia. The United States contributes 13% of obese people worldwide. This study shows that 62% of obese people in the world are in developing countries and one

of them is Indonesia (Noor, Edi Sugiarto and Adenia Siti Fatimah, 2022). The findings in this study indicate that significant overnutrition problems among adult men are in the Papua region. The consistent increase in the prevalence of overweight and obesity throughout Indonesia, especially in Papua, can be caused by dietary habits and lifestyle, High-calorie, fat, and sugar dietary habits, as well as decreased physical activity with urbanization, are likely the main causes, Research by (Dahlia *et al*,, 2022) shows that a diet high in energy and low in fiber contributes to obesity. Papua is famous for its staple food in the form of sago plants which are often consumed in various forms, according to research (Watumlawar, Warouw, and Gunawan, 2015) sago has a high starch content, which is around 84.70% of its dry matter, higher than the starch content in rice which is around 78.90%, the results of the study stated that in the group of mice given sago experienced an increase in body weight of 33 grams this is because sago contains more amylopectin than amylose, so it is digested faster and produces more energy, therefore this is in line with the high prevalence of overweight and obesity in the Papua region.

The problem of overweight and obesity that a person experiences can cause various non-communicable diseases, such as stroke, heart disease, and type 2 diabetes mellitus which were the leading causes of death in 2012. However, not only that, several other diseases such as musculoskeletal (osteoarthritis, injury) and several types of cancer including endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon are also the impact of overweight and obesity problems (Marbun, Sugiyanto and Dea, 2021), especially in adult men, it has an impact on increasing the risk of sexual dysfunction (Husain, Tendean and Queljoe, 2015).

This study has a wide scope, covering 38 provinces and 7 regional areas in Indonesia, thus providing a comprehensive national picture. In addition, the use of Basic Health Research 2010, 2018, and IHS 2023 data provides a strong trend analysis. However, this study still has limitations in terms of data collection which is only based on anthropometric measurements (BMI) without considering other factors such as body fat distribution, diet, and physical activity. In addition, this study has not examined socio-economic and cultural factors that may influence differences in prevalence between regions. The results of this study are useful for health practitioners in designing intervention programs that target reducing the prevalence of overweight and obesity through several solutions, including conducting lifestyle interventions that are important for changing behaviors that are not in accordance with nutritional principles, nutritional education interventions to be able to increase nutritional knowledge and then the nutritional knowledge possessed can influence behavior in choosing and consuming foods that meet the requirements of individual nutritional needs (Rosdiana, 2018), it can also be done by promoting a healthy lifestyle such as patterns, eating behaviors and physical activity which include increasing fruit and vegetable consumption habits, reducing consumption of sweet foods and drinks, reducing consumption of foods high in energy and fat, reducing consumption of junk food, and increasing physical activity and reducing sedentary lifestyle (lazy lifestyle) (Kinansi *et al.*, 2023).

Further research is recommended to integrate data on eating behavior, physical activity levels, and economic status as additional variables. In addition, longitudinal studies can be conducted to understand the factors that cause obesity and overweight over time. Research also needs to identify the role of genetics and the local environment, especially in areas with high prevalence such as Papua.

CONCLUSION

Based on the results of the study, it can be concluded that the prevalence of overweight and obesity in adult men in Indonesia has increased significantly from 2010 to 2023, the Papua region shows the highest prevalence for both categories, while the Nusa Tenggara region has the lowest prevalence, This finding shows that overweight and obesity are serious nutritional problems in Indonesia and require immediate treatment because they will continue into adulthood, The increase in the prevalence of overweight and obesity indicates a shift in the eating patterns and lifestyles of the Indonesian people, especially in adult men,

This has an impact on accelerating the aging process, impaired intelligence, insulin resistance which will manifest as hypertension, dyslipidemia, hyperuremia, endothelial dysfunction and lipotoxicity to beta cells, then also has an impact on cancer, osteoarthritis, cholelithiasis, chronic degenerative diseases such as coronary heart disease, stroke, cancer and type 2 diabetes, and death at a young age, Therefore, public health interventions are needed that focus on promoting healthy eating patterns, increasing physical activity, and education about the importance of maintaining ideal body weight, In addition, further research is recommended to identify the determinant factors that influence the prevalence overweight and obesity, and evaluate the effectiveness of intervention programs that have been implemented.

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CONFLICT OF INTEREST

The author declares no conflict of interest in the publication of this article.

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THE RELATIONSHIP BETWEEN CARBOHYDRATE INTAKE AND NUTRITIONAL STATUS IN PHYSICAL FITNESS AMONG STUDENTS OF THE 2023 CLASS OF PHYSICAL EDUCATION, HEALTH, AND RECREATION AT UNIVERSITAS MUHAMMADIYAH MUARA BUNGO

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ABSTRACT

Background: *University students are in the transitional age group towards adulthood and require sufficient carbohydrate and energy intake to support physical activity and fitness. One way to monitor nutritional status is by measuring body mass index (BMI). Food sources that supply adequate energy are crucial for daily consumption to positively impact physical fitness. The aim of this study is to determine the relationship between carbohydrate intake and nutritional status in physical fitness among students of the 2023 class of physical education, health, and recreation at Universitas Muhammadiyah Muara Bungo.*
Methods: *This study employed an observational approach with a cross-sectional design to analyze the relationship between the independent variables, namely carbohydrate intake and nutritional status. The study population consisted of 75 students, with a sample of 42 students. Inclusion criteria included students who participated, were at least 19 years old, and in good health. Primary data collected included respondent identity, carbohydrate intake, nutritional status, and physical fitness, obtained through interviews using a quantitative research questionnaire.*
Results: *The study found that 61.9% of students had inadequate carbohydrate intake, while 59.5% had normal nutritional status. Statistical analysis using the Spearman Rank test showed no significant relationship between carbohydrate intake and nutritional status with physical fitness, with a p-value of -0.189 for carbohydrate intake and 0.096 for nutritional status.*
Conclusion: *These findings indicate that adequate carbohydrate intake and good nutritional status do not significantly contribute to improving the physical fitness of students in the 2023 class of Physical Education, Health, and Recreation at Universitas Muhammadiyah Muara Bungo.*

Keywords: *physical fitness, nutritional status, carbohydrate intake*

INTRODUCTION

Students are an age group that is in a transition period towards adulthood, usually between the ages of 18 and 25. At this stage, they are required to be responsible for developing themselves, including maintaining health and implementing a healthy lifestyle as a provision for facing adulthood (Huluki, W & Djibran, 2018). However, attention to health among young people is still often neglected, even though this group is very vulnerable to malnutrition and other health problems. This period is also known as a period with dense activity, so a good balance is needed between physical activity and appropriate nutritional intake to support optimal growth and maintain body fitness (Dini et al., 2024).

Carbohydrates are one type of macronutrient that plays an important role as the main source of energy for the body, including the brain. In general, carbohydrates are divided into two types, namely simple carbohydrates and complex carbohydrates. Simple carbohydrates have a lower glucose content and are more easily absorbed by the body compared to complex carbohydrates (Diana Laila Rahmatillah, Kurnia Hendi Prayogi, Made Deny Sapta Giri, 2022). Examples of foods containing complex carbohydrates include potatoes, bananas, brown rice, oatmeal, and sweet potatoes.

Meanwhile, sources of simple carbohydrates can be found in foods such as candy, cakes, biscuits, concentrated fruit juices, and breakfast cereals.

The recommended composition of a balanced diet consists of around 60–65% carbohydrates, 20% fat, and 15–20% protein of the total daily energy requirement. For example, if someone needs 3000 calories per day, then carbohydrate intake should be around 1800–1950 calories, fat around 600 calories, and protein between 450–600 calories. One common obstacle experienced by athletes who undergo heavy training is prolonged fatigue or difficulty in recovering energy between training sessions. For athletes, energy needs—especially from carbohydrates—during training are much higher than during competition (Daryanto, 2015). Therefore, it is important to ensure daily carbohydrate reserves are restored, especially for those undergoing intensive training programs. A lack of daily carbohydrate intake can lead to reduced glycogen stores in the muscles and liver. Studies have shown that a gradual decrease in glycogen reserves can have an impact on decreased endurance and athlete performance. All elements in a balanced diet will go through the digestion process before being converted into energy, either through the aerobic or anaerobic system. In this case, carbohydrates play a crucial role in the chemical process of breaking down food into nutrients that can be absorbed by the small intestine, then utilized by the body to support various activities.

For teenagers who have a lot of physical activity or have excessive physical activity, such as being a soccer athlete or futsal athlete, it is expected to consume foods that contain a lot of carbohydrates, pay attention to meal times because the food is when they are training and playing. The food that is eaten is not digested immediately and takes time, because what is intended at the time before carrying out physical activity the player's body so that it can digest food optimally which has an impact on the ability to carry out activities optimally. The need for additional food for teenagers or players aged 13 to 15 years who have excessive physical activity because they participate in activities at school or participate in soccer and futsal sports activities, will require more energy when compared to other people, because they have an excessive activity load (Afandi & Avandi, 2022). Sports players need more food because high levels of activity mean they need more additional food compared to the average person, but these needs can be met by eating food every day, such as food that is high in carbohydrates and protein (Wijayanti, 2013).

There are various factors that influence physical fitness, including heredity, maturity level, age, nutritional intake, and other behavioral factors, as well as the surrounding environment (Hendrawati, 2017). Nutritional intake plays a crucial role in sports performance, where proper diet and dietary behavior can improve physical fitness. One important element that influences this is carbohydrate intake, which is needed for the production of ATP as an energy source. Adequate carbohydrate intake is essential for athletes to maintain energy reserves in the form of glycogen in the muscles. Low glycogen stores can result in faster fatigue, reducing the intensity and performance of athletes. Physical activity also contributes to physical fitness; active individuals tend to have better cardiovascular fitness than inactive individuals (Triandari et al., 2021).

METHODS

This study used an observational approach with a cross-sectional design to analyze the relationship between independent variables, namely carbohydrate intake and nutritional status, with the dependent variable, namely physical fitness, in Physical Education, Health and Recreation students of Class of 2023 at Muhammadiyah University of Muara Bungo. The study population consisted of 75 students

with inclusion criteria that included participating students aged at least 19 years, healthy. In collecting data, this study used primary data that included respondent identity, carbohydrate intake, nutritional status and physical fitness. Primary data were obtained through interviews using quantitative research questionnaire questions.

After the data collection process is complete, the final stage of this study is to analyze the data using coding methods and statistical analysis techniques to evaluate the relationship between variables. The analysis carried out includes univariate analysis to describe the frequency distribution of each variable, as well as bivariate analysis involving normality tests and correlation tests to determine the existence of a significant relationship between carbohydrate intake, nutritional status, and physical fitness levels of students.

In the data processing process, the results of the statistical analysis will be interpreted and compiled in the form of a report. This study is expected to provide deeper insight into the effect of carbohydrate intake and nutritional status on students' physical fitness, as well as offer relevant recommendations to improve fitness conditions in physical education study program students. With a structured and systematic approach, this study aims to provide a clear picture of the factors that influence physical fitness, along with their implications for students' health and performance in daily activities.

RESULTS AND DISCUSSION

Carbohydrate Intake

Based on the research findings, 26 students (61.9%) had a low carbohydrate intake, while 15 students (35.7%) had a normal carbohydrate intake, and 1 student (2.4%) had an excessive intake. Given this, carbohydrate consumption should generally be higher. This aligns with the theory stating that carbohydrates are the primary source of energy and are relatively cheaper food sources compared to other nutrients. Carbohydrates are primarily converted into glucose, which then serves as the body's main energy source. Excess carbohydrate intake will be converted into fat and stored in the body in unlimited amounts. Conversely, when the body lacks energy intake, it will break down these fat reserves (Bculu, 2017).

Table 1 Carbohydrate Intake Among Students of The 2023 Class of Physical Education, Health, and Recreation at Universitas Muhammadiyah Muara Bungo

Carbohydrate Intake	n	%
Low	26	61.9
Normal	15	35.7
High	1	2.4
Total	42	100

When food intake is insufficient, the energy expended by the body also decreases. This occurs when the energy consumed through food is not enough to compensate for the energy that has been used. An individual may experience undesirable outcomes, such as a normal body weight becoming underweight. Conversely, someone who aims to have excess energy must be mindful of how much energy they expend. After accounting for the energy used, any remaining energy is converted and stored by the body as fat, which can lead to excessive weight gain (Wahidah, 2023).

Nutritional Status

Table 2 Nutritional Status Among Students of The 2023 Class of Physical Education, Health, and Recreation at Universitas Muhammadiyah Muara Bungo

Nutritional Status	n	%
Underweight	15	35.7
Normal	25	59.5
Overweight	2	4.8
Total	42	100

Based on the results of the study, students who have underweight are 15 people (35.7%), normal nutritional status is 25 people (59.5%) and overweight is 2 people (4.8%). Nutritional status is a description of the balance of the body receiving nutrients with what is

needed by the body. (Putro & Winarno, 2022). The nutritional needs of men are different from women, the cause of malnutrition is due to an unbalanced diet. Women prioritize maintaining proportional body weight so that not enough nutrients are consumed. While men tend to have more energy intake, they have unknowingly fulfilled the nutrients needed by the body. Men experience a more rapid increase than women in terms of height, weight, lean body mass so that they need more energy than women (Putro & Winarno, 2022).

A person must need energy to meet their daily needs as a mover and to care for the body so that when doing activities they can be optimal, at least the energy needed is around 70-80% of their daily activities. Knowing their age, weight as what has been determined to know the energy needs. Absorbing food into the body that produces energy is played by the body to digest and manage food for the smooth running of daily activities that a person does in general (Afandi & Avandi, 2022).

Physical Fitness

Table 3 Physical Fitness Among Students of The 2023 Class of Physical Education, Health, and Recreation at Universitas Muhammadiyah Muara Bungo

Physical Fitness	n	%
Low	28	66.7
Good	14	33.3
Total	42	100

Based on the results of the study, students who have low physical fitness are 28 people (66.7%) and good category is 14 people (33.3%). There are differences in physical fitness between men and women related to maximum muscle strength. Although the physical fitness of men and women is almost the same, the differences tend to increase after puberty, especially in terms of cardiorespiratory power. This is due to several factors, including differences in body composition, where women tend to have more fat tissue, as well as hormonal differences characterized by different levels of testosterone and estrogen, and lower hemoglobin levels in women. In addition, the results of physical fitness measurements show that men generally have higher physical activity than women (Azka & Winarno, 2020).

Table 4 Distribution of Students Based on Physical Fitness

Variable	Minimal	Maximal	Mean ± SD
Physical Fitness	1	3	2.33 ± 0,954

Based on the table above, the physical fitness scores of students show that the lowest number is 1 time, while the highest number reaches 3 times. The average physical fitness measured is 2.33 with a standard deviation of 0.95. Physical fitness is a physical condition that shows the body's capacity and the individual's ability to complete certain tasks efficiently without experiencing excessive fatigue. In other words, a fit person is able to carry out physical activities without feeling very tired. This concept also involves the efficiency of the body's cell function and metabolic processes during daily activities (Sudiana, 2014). From the concept of physical fitness, each person needs different physical fitness, depending on the nature of the physical challenges they face.

Physical fitness will increase if there is an increase in muscle strength, muscle endurance, and cardiovascular and respiratory endurance, which are generally influenced by physical activity. Physical fitness itself is the body's ability to adapt to the environment and the demands of physical activity. In basketball, the elements of fitness that play a role include balance, agility, strength, speed of movement and reaction, muscle and cardiovascular endurance, flexibility, and coordination. A basketball athlete with a good level of fitness is able to shoot the ball a longer distance thanks to optimal muscle strength (Daryanto, 2015).

The Relationship Between Carbohydrate Intake In Physical Fitness

Table 5 The Relationship Between Carbohydrate Intake In Physical Fitness Among Students Of The 2023 Class Of Physical Education, Health, And Recreation At Universitas Muhammadiyah Muara Bungo

Carbodyrate Intake	Physical Fitness				Total		P value
	Low		Good				
	n	%	n	%	n	%	
Low	17	65,4	9	34,6	26	100,0	0.189
Normal	11	73,3	4	26,7	15	100,0	
High	0	0	1	100,0	1	100,0	
Total	28	66,7	14	33,3	42		

Based on calculations using the Spearman test, a p-value of -0.189 was obtained, so it can be concluded that H0 is accepted and H1 is rejected, meaning that there is no significant relationship between carbohydrate intake and physical fitness. This is not in line with the research of Triandari et al. (2021) which supports this finding, showing a relationship between carbohydrate intake and physical fitness with the results of the study as many as 57.1% of respondents having good carbohydrate intake with good physical fitness. The relationship between carbohydrate intake and physical fitness shows that carbohydrates play an important role in the body. Carbohydrates are the main source of energy, and the need for their intake increases during exercise, because glucose circulation in the blood also increases during long-lasting activities (Sa'adah et al., 2023).

Imbalance of carbohydrate intake that does not meet the needs of students. The main source of energy and plays a very important role especially for an athlete in doing sports especially endurance sports is carbohydrates. Glucose and glycogen in the body obtained from carbohydrates will be stored in the muscles and liver. The formation of energy and the provision of carbohydrates aims to replenish muscle and liver glycogen reserves that have been used in muscle contractions is the role of glycogen stored in the muscles. Based on the Ministry of Health (1997), an athlete or athlete who has very little glycogen will experience fatigue quickly, fatigue quickly and lack achievement.

The Relationship Between Nutritional Status In Physical Fitness

Table 6 The Relationship Between Nutritional Status In Physical Fitness Among Students Of The 2023 Class Of Physical Education, Health, And Recreation At Universitas Muhammadiyah Muara Bungo

Nutritional Status	Physical Fitness				Total		P value
	Low		Good				
	n	%	n	%	n	%	
Underweight	13	86,7	2	13,3	15	100,0	0.096
Normal	14	56,0	11	44,0	25	100,0	
Overweight	1	50,0	1	50,0	2	100,0	
Total	28	66,7	14	33,3	42		

Based on the calculation using the Spearman test, a p-value of 0.096 was obtained, so it can be concluded that H0 is accepted and H1 is rejected, meaning that there is no meaningful or significant relationship between nutritional status and physical fitness. The results of the hypothesis test indicate that there is no significant relationship between the level of energy adequacy and the level of physical fitness of students in the physical education, health and recreation study program. Judging from the results obtained, this study is in line with the results of research conducted by (Pratiwi et al., 2022). The results of the study

showed results that were not in line with the theory that states that improving nutritional status, increasing physical endurance, and increasing productivity can be obtained by consuming balanced energy and nutrients. Balanced energy and nutrient levels are the main requirements for determining the level of work productivity (Depkes, 2010).

CONCLUSION

The conclusion obtained from this study is that there is a negative relationship between carbohydrate intake and fitness. There is a negative relationship between nutritional status and fitness. Variations in the amount of carbohydrates consumed are needed to have a significant effect on students' fitness conditions. Differences in nutritional status are also not directly related to students' fitness levels.

CONFLICT OF INTEREST

The author declares no conflict of interest in the publication of this article.

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CORRELATION OF HbA1C LEVELS AND ERYTHROCYTE INDICES IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: *Hyperglycemia is a leading indicator of type 2 diabetes mellitus (T2DM). Long-lasting hyperglycemia has an effect on all body tissues. This effect is related to protein glycation namely HbA1C, and changes in structure and function of erythrocyte. The erythrocyte indices consist of MCV, MCH, and MCHC. This study aims to determine the correlation of HbA1C levels with erythrocyte indices in patients with T2DM.*
Methods: *This cross-sectional study was conducted on patients with T2DM visiting at the Multiwahana and Kampus Health Center Palembang from November to December 2024. After taking laboratory test of HbA1C, MCV, MCH, and MCHC, data were collected and computed by using Spearman correlation test.*
Results: *A total of 50 diabetic patients were eligible for this study with a mean HbA1C was 7.36±1.76%, MCV 83.69±6.70fL, MCH 27.96±2.70pg, MCHC 33.32±1.18%. Spearman's correlation analysis showed that HbA1C significantly correlated with MCHC, inversely correlated with MCV, but there was no significant correlation of HbA1C and MCH.*
Conclusion: *The study highlighted that MCHC significantly correlated with HbA1C, it's affordable and readily accessible test, it may be used as an indicator of glycemic status. It's important for diabetic patients to prevent long-lasting hyperglycemia by monitoring glycemic index and taking medication regularly.*

Keywords: *Diabetes mellitus, HbA1C, erythrocyte indices, hyperglycemia.*

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to insulin resistance and/or deficiency (PERKENI, 2021). Type 2 diabetes mellitus (T2DM) is a growing global concern. In Indonesia, the number of people with diabetes is increasing significantly. According to the International Diabetes Federation (IDF), Indonesia ranked fifth in the world for diabetes cases, with 19.5 million people affected in 2021 and a projected rise to 28.6 million by 2045.

Chronic hyperglycemia in DM can lead to serious complications and is often monitored using glycated hemoglobin (HbA1C), which reflects blood glucose control over the past 2–3 months. In addition to indicating glycemic control, high HbA1C levels may influence red blood cell characteristics, such as shape, flexibility, and lifespan, which are reflected in erythrocyte indices: mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC)(Chinmay, et.al. 2015).

Several studies have explored the relationship between HbA1C and these indices, with mixed results. Some found significant correlations, while others did not. These conflicting findings suggest the need for further investigation. Therefore, this study aims to examine the correlation between HbA1C levels and erythrocyte indices (MCV, MCH, and MCHC) in patients with type 2 diabetes mellitus.

METHODS

This study was an analytical observational method with a cross-sectional design. The study population included all patients with T2DM enrolled in the Chronic Disease Management Program (Prolanis) at Multiwahana and Kampus Primary Healthcare Centers in Palembang. A purposive sampling technique was used to select T2DM patients scheduled for HbA1C testing between November and December 2024. HbA1C was measured using the Standard F HbA1C analyzer, while erythrocyte indices (MCV, MCH, and MCHC) were obtained through direct examination using a Sysmex XP-100 hematology analyzer. All data were recorded and statistically analyzed. The total sample comprised all eligible patients who met the criteria and underwent testing during the specified period. Data were analyzed using Spearman correlation tests with significance level set at $p < 0.05$.

RESULTS AND DISCUSSION

This study was conducted in November to December 2024. A total of 50 patients diagnosed with T2DM were eligible for this study

Respondent Characteristics

The respondent characteristics in this study were analyzed based on age group and gender. Based on the data in Table 1, among the 50 respondents diagnosed with T2DM, the majority were female, accounting for 78% (n=39), while male respondents comprised only 22% (n=11). This indicates a predominance of female patients in the studied T2DM population. This aligns with a study by Komariah, et al (2020) at the Proklamasi Primary Clinic Depok of West Java Province, which also reported a higher number of female T2DM patients (60,4%).

The distribution of characteristics can be seen in the table below.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Frequency (f)	Percentage (%)
Age (years)		
26-32	1	2
33-39	0	0
40-46	2	4
47-53	9	18
54-60	14	28
61-67	16	32
68-74	8	16
Total	**50**	**100**
Gender		
Male	11	22
Female	39	78
Total	**50**	**100**

Women are at greater risk of developing diabetes due to physiological factors such as a higher body mass index (BMI), hormonal fluctuations associated with the menstrual cycle (premenstrual syndrome), and postmenopausal changes that lead to increased fat accumulation. These hormonal processes contribute to a higher susceptibility to type 2 diabetes mellitus.

In terms of age distribution, the highest proportion of respondents was in the 61–67-year age group, representing 32% (n=16) of the total sample. This was followed by the 54–60-year age group with 28% (n=14). The overall age range of respondents varied from a minimum of 26 years to a maximum of 74 years, suggesting that T2DM affects individuals across a broad age spectrum, with a tendency toward older age groups.

These align with a 2020 study by Latifah, which also reported a mean of T2DM was 61,79-year age, the majority was in the 65-79-year age group. This may be due to the fact that in elderly individuals (over 60 years of age), the risk of developing diabetes and glucose intolerance increases due to degenerative factors, particularly the decline in the body's ability to metabolize glucose, including reduced function of pancreatic β-cells in producing insulin. Yosmar et al., (2018)

identifies that advanced age influences the progression of diabetes, as physiological functions decline, leading to decreased insulin secretion or increased insulin resistance. As a result, the body's ability to regulate elevated blood glucose levels becomes less effective.

Average HbA1C Levels and Erythrocyte Indices in Patients with T2DM

Table 2. Average HbA1C Levels and Erythrocyte Indices in Patients with T2DM

Variable	N	Mean	Min	Max	Std. Deviation
HbA1C Levels (%)	50	7.36	5.4	12.9	1.76
MCV (fL)	50	83.69	61.2	93.8	6.70
MCH (pg)	50	27.96	18.9	31.5	2.70
MCHC (%)	50	33.32	30.5	35.7	1.18

Table 3.2 presents the descriptive statistics of HbA1C levels and erythrocyte indices (MCV, MCH, and MCHC) in 50 patients diagnosed with T2DM. The findings of this study indicate that patients with T2DM exhibit elevated levels of HbA1C, with a mean value of 7.36% ± 1.76, exceeding the normal threshold of <5.7%. The HbA1C levels ranged from 5.4% to 12.9%, reflecting poor glycemic control among the majority of respondents. This elevation is consistent with the pathophysiology of type 2 diabetes, in which chronic hyperglycemia leads to increased glycation of hemoglobin. Over time, episodic spikes in blood glucose cause a non-enzymatic glycation of a portion of hemoglobin A, forming glycated hemoglobin (HbA1C) (Chinmay et al., 2015).

Interestingly, despite the elevated HbA1C values, the erythrocyte indices of the patients remained within normal ranges.The mean MCV was 83.69 ± 6.70 fL (normal range: 81–96 fL), mean MCH was 27.96 ± 2.70 pg (normal range: 27–31 pg), and mean MCHC was 33.32 ± 1.18% (normal range: 30–36%). These findings suggest that in this patient population, red blood cell morphology and hemoglobin concentration per cell were not significantly altered despite the presence of hyperglycemia.

This outcome differs from the findings of Bhutto et al. (2019), who reported a decreased MCV (76.65 ± 11.12 fL) and MCHC (28.21 ± 4.75%), although MCH values remained within the normal range (30.22 ± 23.87 pg). The discrepancy between studies may be attributed to several contributing factors, including differences in sample characteristics such as age, comorbidities, duration of diabetes, and the presence of chronic inflammation. Furthermore, conditions affecting red blood cell lifespan—such as blood transfusions, hemorrhage, or chronic kidney disease—can influence erythrocyte indices and HbA1C levels independently (Saraswati, 2019).

Correlation of HbA1C Levels and Erythrocyte Indices in Patients with T2DM

The correlation between HbA1C levels and erythrocyte indices (MCV, MCH, and MCHC) was analyzed using the Spearman correlation test, and the results are presented in Table 3.

Table 3. Spearman Correlation Test Between HbA1C Levels and Erythrocyte Indices

Variables	*Correlation Coefficient* (*r*)	*p-value*
HbA1C Levels MCV	-0.290	0.041
HbA1C Levels MCH	-0.170	0.239
HbA1C Levels Nilai MCHC	0.348	0.013

The analysis revealed a significant and moderately strong negative correlation between HbA1C levels and MCV (r = -0.290, p = 0.041). This indicates that as HbA1C levels increase, MCV values tend to decrease. No significant correlation was found between HbA1C levels and MCH (r = -0.170, p = 0.239), while a significant positive correlation was observed between HbA1C and MCHC (r = 0.348, p = 0.013), suggesting that higher HbA1C levels are associated with increased MCHC values.

The findings of this study highlight important relationships between long-term glycemic control, as measured by HbA1C, and

erythrocyte indices in patients with type 2 T2DM.

A statistically significant and moderately strong negative correlation was found between HbA1C levels and MCV ($r = -0.290$, $p = 0.041$), suggesting that increased HbA1C levels are associated with a reduction in red blood cell volume. This finding aligns with the hypothesis that chronic hyperglycemia may alter erythrocyte morphology and structure. Alsalhi et al. (2018) described how glucose infiltration into erythrocyte membranes could change their shape from biconcave discs to flatter or convex forms. This morphological shift reduces the number of functional, normal erythrocytes and may increase the proportion of structurally impaired cells, contributing to diabetes-related complications (Wang et al., 2021).

Moreover, hyperglycemia is known to cause premature erythrocyte lysis through increased osmotic fragility of the cell membrane, resulting in a shortened red blood cell lifespan and ultimately lowering MCV (Handayati et al., 2020). Hyperglycemia also impacts erythropoiesis, cellular deformability, and the physiological function of red blood cells, particularly in the presence of chronic diabetic complications that alter viscosity, membrane stiffness, and erythrocyte survival (Aliviameita et al., 2021). Other contributing factors to MCV reduction may include advanced age (over 45 years), chronic inflammation, and diabetic complications (Rochman et al., 2022).

In contrast, this study found no significant correlation between HbA1C levels and MCH ($r = -0.170$, $p = 0.239$), indicating that hemoglobin content per red blood cell is not substantially influenced by glycemic control in this population. This result is consistent with findings from Bhutto et al. (2019), who observed no relationship between HbA1C and MCH in T2DM patients, as well as with Tayati (2021), who found similar outcomes in individuals with prediabetes.

A significant positive correlation was found between HbA1C levels and MCHC ($r = 0.348$, $p = 0.013$), indicating that higher HbA1C levels are associated with greater hemoglobin concentration within red blood cells. This may result from disruptions in the hematopoietic microenvironment, leading to increased internal viscosity and membrane rigidity, thereby altering erythrocyte composition and count. Jaman et al. (2018) also reported that MCHC could be used as a marker of systemic inflammation in diabetic patients.

Comparative analysis with prior studies reveals variability in findings. Bhutto et al. (2019) reported no significant correlations between HbA1C and any of the erythrocyte indices (MCV, MCH, or MCHC), while Tayati (2021) similarly observed no associations in prediabetic subjects. However, Jaman et al. (2018) found positive correlations between HbA1C and both MCH and MCHC, but not with MCV. These discrepancies may arise due to differences in sample characteristics, disease duration, and the presence of complications.

In summary, this study supports a significant inverse association between HbA1C and MCV, and a direct association with MCHC, suggesting that prolonged hyperglycemia in T2DM may lead to measurable hematological changes. Monitoring erythrocyte indices alongside HbA1C may provide additional insight into the systemic effects of chronic hyperglycemia and potential complications in diabetic patients.

CONCLUSION

The study highlighted that MCHC significantly positive correlated with HbA1C, indicating that higher HbA1C levels are associated with greater MCHC. MCHC is affordable and readily accessible test, it may be used as an marker of glycemic status. It's important for diabetic patients to prevent long-lasting hyperglycemia by monitoring glycemic index and taking medication regularly.

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CONFLICT OF INTEREST

The authors declare there is no any conflict of interest during this study.

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DIFFERENCES IN MATERIAL QUALITY CONTROL EXAMINATION RESULTS ON HEMATOLOGY ANALYZER EQUIPMENT BEFORE AND AFTER PASSING THE OPEN STABILITY PERIOD

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ABSTRACT

Background *: Internal Quality Improvement (PMI) is a preventive and monitoring activity carried out by each laboratory continuously to prevent or reduce the occurrence of errors/deviations so that correct inspection results are obtained. Quality Control on the Hematology Analyzer tool is important to carry out an analysis of accuracy, precision, and then evaluated using the Levey-Jennings chart which aims to determine any measurement deviations in the tool QC Level-N, QC Level-L, QC Level-H should be stored at 2-8°C before and after opening. If treated like this, unopened products are guaranteed to be stable until the expiry date stated on the packaging. Once opened, the product is stable for 7 days if returned immediately to the refrigator after use. Research purposes is knowing the differences in material quality control inspection results on the hematology analyzer before and after going through the open stability period.*
Methods*: This research uses a descriptive observational study with a cross sectional design. This research was carried out in November-December 2024.*
Result*: The average results of the material quality control examination on the hematology analyzer before going through the open stability period were at low level WBC 3.47, RBC 2.64, HGB 6.2, HCT 18.07, and PLT 93.29, at a normal WBC level 7.06. RBC 4.40, HGB 11.87, HCT 33.24, PLT 219.71, at high level WBC 17.24, RBC 5.29, HGB 15.91, HCT 43.87, PLT 522.14. The average results of the material quality control examination on the hematology analyzer after passing through the open stability period were at low levels WBC 3.54, RBC 2.64, HGB 6.2, HCT 18.21, and PLT 91.29, at normal levels WBC 7.13, RBC 4.42, HGB 11.89, HCT 33.54, PLT 221.57, at high WBC level 17.26, RBC 5.30, HGB 15.96, HCT 44.07, PLT 524.71.*
Conclusion*: There was no difference in the results of material quality control checks on the hematology analyzer before and after going through the open stability period.*

Keywords: *Internal Quality Improvement, Quality Control, Hematology Analyzer*

INTRODUCTION

Laboratory examinations, especially hematology, are widely used by doctor to establish a diagnosis, therefore a diagnostic examination must be carried out according to existing procedures so that the results are obtained. accurate, fast and reliable. This hematology examination is divided into two, namely routine blood tests and complete blood tests, parameters Hematology includes hemoglobin tests, leukocyte tests, erythrocyte tests, and platelets. (Riyanti, 2022).

Indication he did inspection hematology complete that is detecting existence abnormality cell blood like anemia, white blood cell disorders, allergies, blood clotting disorders due to abnormalities amount platelets as well as disturbance function hemostasis. Inspection hematology complete own a number of function that is detecting disturbance hematology Which is abnormality amount and function cell Sarah red, show abnormality function hemostasis, help to uphold diagnosis with see go on or the descent amount leukocytes and count the type (Saputra, 2022).

Hematology examination has experienced quite rapid progress over time. Hematology examinations generally use automatic *Hematology Analyzer tools* so that results can be issued quickly. The *Hematology Analyzer tool* is very easy to operate but still has tool limitations. The *Hematology Analyzer tool* can make mistakes in reading leukocyte cells if there are nucleated erythrocytes, giant platelets, platelet aggregation or agglutination, fibrin precipitation, protein or lipids, fragile red blood cells, malaria parasites, and samples are left for too long (Corporation, 2018; Restu Maharani & Dyah Astudi nd.).

Internal Quality Assurance (PMI) is a preventive and supervisory activity carried out by each laboratory continuously to prevent or reduce the occurrence of errors/deviations so that accurate examination results are obtained (Siregar, et. al., 2018; Stibis & Dyah Astuti nd).

Quality control on the Hematology Analyzer tool is important to analyze accuracy and precision and then evaluate it using the *Levey-Jennings chart* which aims to... For know existence deviation measurement on the tool (Vis & Huisman, 2016)

The reliability of the instrument and reagents is monitored through Quality Control. By using control blood or control materials, the stability of the measured values is monitored over a period of time, and problems can be detected and prevented early. EIGHTCHECK-3WP-N, EIGHTCHECK-3WP-L, EIGHTCHECK-3WP-H should be stored at 2-8°C before and after opening. If treated like this, the unopened product is guaranteed to be stable until the expiration date stated on the package. Once opened, the product is stable for 7 days if returned to the refrigerator immediately after use. (Sysmex Corporation, 2012).

Quality Control must be performed before analyzing samples, after reagent replacement, after treatment, if there is any doubt about the accuracy of the analytical values, as required by regulations. (Sysmex Corporation, 2012).

Based on the research of Rahayu Tri Ningsih, Tri Dyah Astuti S.ST, M.Kes, 2022 regarding the analysis of quality control in the examination of erythrocytes, leukocytes, and platelets with a hematology analyzer in the laboratory of Nyi Ageng Serang Hospital, where the results of the study showed that the three examinations had good precision and accuracy, while in the examination of leukocytes after being evaluated with a Levey-Jennings graph, the 13s rule was found to be caused by random error, the 31s and 8x rules were caused by systematic error.

Based on research by Adela Caesaria, Anik Handayati, Ayu Puspitasari, 2023 regarding the stability of three-level whole blood control stored at a temperature of 2-8°C using a hematology analyzer. Based on The test results obtained p- *values* for each parameter at all levels of the number parameter. erythrocytes, number leukocytes, hematocrit, hemoglobin and amount platelets. Based on results can concluded that No There is change stability *whole blood control* with storage for 10 weeks at a temperature of 2-8oC on the number of parameters *low* and *normal* leukocyte levels, *low* and *high* hematocrit levels, and all levels of the count parameters leukocytes, hemoglobin and amount platelets. While the hematocrit parameter is at a *normal* level and the number of *high* level leukocytes are present change stability.

Based on field observations still many have not know related to the open stability period of the control material

Based on this background, the author wants to conduct research on the Comparison of Material Quality Control Examination Results on Hematology Analyzer Tools Before and After Passing the Open Stability Period.

METHODS

Type and Design Study

Study This using descriptive observational studies with a *cross-sectional design*

Population and sample

Population

Population study This is all control material

Sample

Sample study This is all control material using total sampling technique.

Time and Place

Study will have implemented using a hematology analyzer. Time study This will implemented on November-December 2024

RESULTS AND DISCUSSION

RESULTS

The results of the study of the examination of the results of the material quality control on the hematology analyzer device before and after going through the open stability control period at low, normal, and high levels which was carried out in November-December 2024 using the hematology analyzer obtained the results with SPSS data processing.

3.1 Results Test Statistics

Univariate analysis was conducted to see the frequency distribution and bivariate analysis was conducted to determine whether or not there was a difference in the results of the material quality control examination on the hematology analyzer before and after passing the open stability period and to see the comparison of two variables, namely the independent and dependent variables. To see the comparison of the number of leukocytes, erythrocytes, hemoglobin, hematocrit, and platelets using the paired T test.

Paired Difference Test

Before conducting a bivariate test to see whether or not there is a difference in the results of the material quality control examination on the hematology analyzer before and after passing the open stability period, a normality test is first carried out.

Normality Test

Table 1. Results of the Shapiro-Wilk Normality Test

		Sig.	Decision
Level 1	WBC_before	.086	Normally Distributed
	WBC_after	.609	Normally Distributed
	RBC_before	.752	Normally Distributed
	RBC_after	.215	Normally Distributed
	HGB_before	.	Not Normally Distributed
	HGB_after	.086	Normally Distributed
	HCT_before	.098	Normally Distributed
	HCT_after	.685	Normally Distributed
	PLT_before	.501	Normally Distributed
	PLT_after	.492	Normally Distributed
Level 2	WBC_before	.263	Normally Distributed
	WBC_after	.008	Not Normally Distributed
	RBC_before	.011	Not Normally Distributed
	RBC_after	.247	Normally Distributed
	HGB_before	<.001	Not Normally Distributed
	HGB_after	<.001	Not Normally Distributed
	HCT_before	.451	Normally Distributed
	HCT_after	.842	Normally Distributed
	PLT_before	.883	Normally Distributed
	PLT_after	.746	Normally Distributed
Level 3	WBC_before	.481	Normally Distributed
	WBC_after	.982	Normally Distributed
	RBC_before	.986	Normally Distributed
	RBC_after	.549	Normally Distributed
	HGB_before	.099	Normally Distributed
	HGB_after	.020	Not Normally Distributed
	HCT_before	.217	Normally Distributed
	HCT_after	.436	Normally Distributed
	PLT_before	.494	Normally Distributed
	PLT_after	.708	Normally Distributed

Based on the results of the Normality Test using the Shapiro-Wilk Test (N <50), it is known that some data at each level are not normally distributed, namely at level 1 the HGB value data after treatment, at level 2 the WBC value after treatment, the RBC value before treatment, the HGB value before and after treatment. Therefore, the results of the normality test show that the research data is not normally distributed, the Hypothesis Test uses the Non-Parametric Test, namely the Wilcoxon Test.

Wilcoxon test

Level 1

Results of the Difference Test of Material Quality Control on the Hematology Analyzer Tool before and after passing the open

stability period using level 1, namely the low level on the material quality control.

Table 2. Results of the Difference Test *of Quality Control Materials* on the Hematology Analyzer Device Before and After Passing the *Open Stability Period* at Level 1

		Mean	SD	p-value
WBC	Before	3.47	0.07	0.102
	After	3.54	0.09	
RBC	Before	2.64	0.01	0.605
	After	2.64	0.01	
HGB	Before	6.2	0.00	0.317
	After	6.2	0.07	
HCT	Before	18.07	0.16	0.221
	After	18.21	0.18	
PLT	Before	93.29	4.62	0.352
	After	91.29	2.96	

Based on the results of the Wilcoxon Test, it is known that there is no significant difference in *the Material Quality Control* of the hematology analyzer tool as seen through the WBC, RBC, HGB, HCT, and PLT values at level 1. These results are shown through the p-value of each variable more than 0.05 (p-value> 0.05). So it can be concluded that the Open Stability Level 1 Period does not have a significant effect on *the Material Quality Control* of the Hematology *Analyzer Tool* . It is known that the average WBC value before treatment was 3.47 $x10^3/\mu L$ and after treatment was 3.54 $x10^3/\mu L$. As for the RBC value, it is known that the average value before treatment was 2.64 $x10^6/\mu L$ and after treatment remained 2.64 $x10^6/\mu L$. In the HGB value, it is known that the average value before treatment was 6.2 g/dl and after treatment remained 6.2 g/dl. The average value of HCT before treatment was 18.07% and after treatment was 18.21%. The average value of PLT before treatment was 93.29 $x10^3/\mu L$ and after treatment was 91.29 $x10^3/\mu L$.

Level 2

Results of the Difference Test of Material Quality Control on the Hematology Analyzer Tool before and after passing the open stability period using level 2, namely the normal level for material quality control.

Table 3. Results of the Difference Test of Material Quality Control on the Hematology Analyzer Device Before and After Passing the Open Stability Period at Level 2

		Mean	SD	p-value
WBC	Before	7.06	0.12	0.347
	After	7.13	0.09	
RBC	Before	4.40	0.03	0.343
	After	4.42	0.03	
HGB	Before	11.87	0.05	0.317
	After	11.89	0.03	
HCT	Before	33.24	0.35	0.309
	After	33.54	0.30	
PLT	Before	219.71	2.91	0.31
	After	221.57	5.12	

Based on the results of the Wilcoxon Test, it is known that there is no significant difference in *the Material Quality Control* of the hematology analyzer tool as seen through the WBC, RBC, HGB, HCT, and PLT values at level 2. These results are shown through the p-value of each variable more than 0.05 (p-value> 0.05). So it can be concluded that the Open Stability Level 2 Period does not have a significant effect on *the Material Quality Control* of the Hematology *Analyzer Tool* . It is known that the average WBC value before treatment was 7.06 $x10^3/\mu L$ and after treatment was 7.13 $x10^3/\mu L$. As for the RBC value, it is known that the average value before treatment was 4.40 $x10^6/\mu L$ and after treatment remained 4.42 $x10^6/\mu L$. In the HGB value, it is known that the average value before treatment was 11.87 g/dl and after treatment remained 11.89 g/dl. The average value of HCT before treatment was 33.24% and after treatment was 33.54%. The average value of PLT before treatment was 219.71 $x10^3/\mu L$ and after treatment was 221.57 $x10^3/\mu L$.

Level 3

Results of the Difference Test of Material Quality Control on the Hematology Analyzer Tool before and after passing the open stability period using level 3, namely the high level on material quality control.

Table 4. Results of the Difference Test of Quality Control Materials on the Hematology Analyzer Device Before and After Passing the Open Stability Period at Level 3

		Mean	SD	p-value
WBC	Before	17.24	0.22	0.739
	After	17.26	0.21	
RBC	Before	5.29	0.03	0.674
	After	5.30	0.02	
HGB	Before	15.91	0.06	0.414
	After	15.96	0.07	
HCT	Before	43.87	0.32	0.596
	After	44.07	0.33	
PLT	Before	522.14	5.99	0.345
	After	524.71	9.74	

Based on the results of the Wilcoxon Test, it is known that there is no significant difference in *the Material Quality Control* of the hematology analyzer tool as seen through the WBC, RBC, HGB, HCT, and PLT values at level 3. These results are shown through the p-value of each variable more than 0.05 (p-value> 0.05). So it can be concluded that the Open Stability Level 3 Period does not have a significant effect on *the Material Quality Control* of the Hematology *Analyzer Tool* . It is known that the average WBC value before treatment was 17.24 x10³/µL and after treatment was 17.26 x10³/µL. As for the RBC value, the average value before treatment was 5.29 x10⁶/µL and after treatment was 5.30 x10⁶/µL. In the HGB value, the average value before treatment was 15.91 g/dl and after treatment was 15.96 g/dl. The average value of HCT before treatment was 43.87% and after treatment was 44.07%. The average value of PLT before treatment was 522.14 x10³/µL and after treatment was 524.71 x10³/µL.

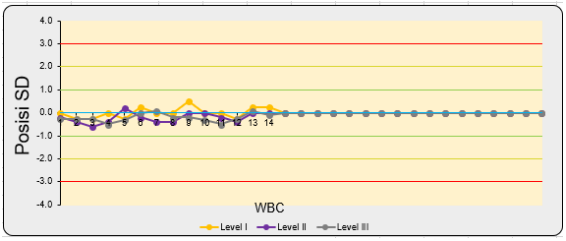


Figure 1. *Levey-Jennings* WBC chart

Based on Figure 4.1, it is known that the graph of the results of *material quality control* on the *WBC parameter* and the results obtained on the *WBC parameter* at level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are still within the range of ±2SD. This indicates that *the material quality control* level 1 (*Low*), level 2 (*Normal*), and Level 3 *(High)* are stable within 14 days.

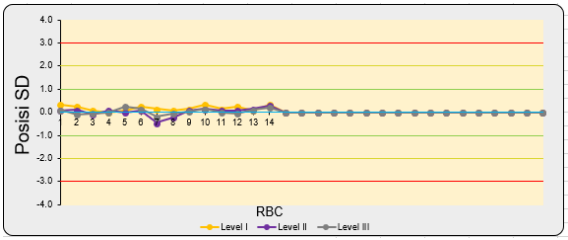


Figure 2. *Levey-Jennings* RBC Chart

Based on Figure 4.2, it is known that the graph of the results of *material quality control* on the *RBC parameter* and the results obtained on the *RBC parameter* at level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are still within the range of ±2SD. This indicates that *the material quality control* level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are stable within 14 days.

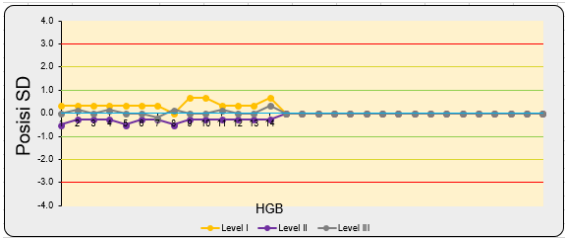


Figure 3. *Levey-Jennings* HGB Chart

Based on Figure 4.3, it is known that the graph of the results of *material quality control* on the *HGB parameter* and the results obtained on the *HGB parameter* at level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are still within the range of ±2SD. This indicates that *the material quality control* level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are stable within 14 days.

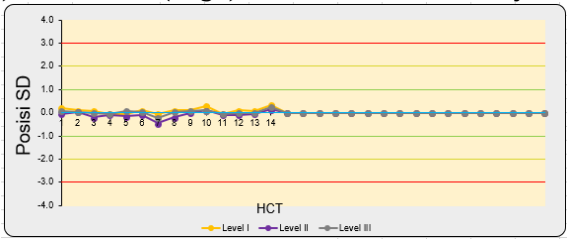


Figure 4. *Levey-Jennings* HCT graph

Based on Figure 4.4, it is known that the graph of the results of *material quality control* on the *HCT parameter* and the results obtained on the *HCT parameter* at level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are still within the

range of ±2SD. This indicates that *the material quality control* level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are stable within 14 days.

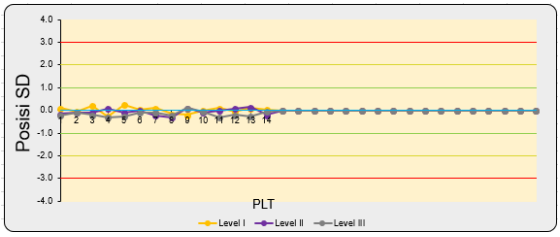


Figure 5. *Levey-Jennings* PLT Chart

Based on Figure 4.5, it is known that the graph of the results of *material quality control* on *the PLT parameter* and the results obtained on the *PLT parameter* at level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are still within the range of ±2SD. This indicates that *the material quality control* level 1 (*Low*), level 2 (*Normal*), and level 3 *(High)* are stable within 14 days.

DISCUSSION

Research data on differences in the results of material quality control examinations on hematology analyzers before and after passing the open stability period which was carried out in November-December 2024 with three levels of material control, namely low, normal, and high level control using a hematology analyzer. The results of the statistical test P Value > 0.05 It means No There is difference Which significant impact on the results of the material quality control examination before and after passing through the open stability period.

Based on the results of the study, it is known that there is no significant difference in *the Material Quality Control* of the hematology analyzer tool as seen through the WBC, RBC, HGB, HCT, and PLT values at level 1. These results are shown through the p-value of each variable more than 0.05 (p-value> 0.05). So it can be concluded that the Open Stability Level 1 Period does not have a significant effect on *the Material Quality Control* of the Hematology *Analyzer Tool* . It is known that the average WBC value before treatment was 3.47 $x10^3/\mu L$ and after treatment was 3.54 $x10^3/\mu L$.

As for the RBC value, the average value before treatment was 2.64 $x10^6/\mu L$ and after treatment remained 2.64 $x10^6/\mu L$. The HGB value was known to have an average value before treatment of 6.2 g/dl and after treatment remained 6.2 g/dl. The average HCT value before treatment was 18.07% and after treatment was 18.21%. The average PLT value before treatment was 93.29 $x10^3/\mu L$ and after treatment was 91.29 $x10^3/\mu L$.

Based on the results of the study, it is known that there is no significant difference in *the Material Quality Control* of the hematology analyzer tool as seen through the WBC, RBC, HGB, HCT, and PLT values at level 2. These results are shown through the p-value of each variable more than 0.05 (p-value> 0.05). So it can be concluded that the Open Stability Level 2 Period does not have a significant effect on *the Material Quality Control* of the Hematology *Analyzer Tool* . It is known that the average WBC value before treatment was 7.06 $x10^3/\mu L$ and after treatment was 7.13 $x10^3/\mu L$. As for the RBC value, it is known that the average value before treatment was 4.40 $x10^6/\mu L$ and after treatment remained 4.42 $x10^6/\mu L$. In the HGB value, it is known that the average value before treatment was 11.87 g/dl and after treatment remained 11.89 g/dl. The average value of HCT before treatment was 33.24% and after treatment was 33.54%. The average value of PLT before treatment was 219.71 $x10^3/\mu L$ and after treatment was 221.57 $x10^3/\mu L$.

Based on the results of the study, it is known that there is no significant difference in *the Material Quality Control* of the hematology analyzer tool as seen through the WBC, RBC, HGB, HCT, and PLT values at level 3. These results are shown through the p-value of each variable more than 0.05 (p-value> 0.05). So it can be concluded that the Open Stability Level 3 Period does not have a significant effect on *the Material Quality Control* of the Hematology *Analyzer Tool* . It is known that the average WBC value before treatment was 17.24

x10³/µL and after treatment was 17.26 x10³/µL. As for the RBC value, the average value before treatment was 5.29 x10⁶/µL and after treatment was 5.30 x10⁶/µL. In the HGB value, the average value before treatment was 15.91 g/dl and after treatment was 15.96 g/dl. The average value of HCT before treatment was 43.87% and after treatment was 44.07%. The average value of PLT before treatment was 522.14 x10³/µL and after treatment was 524.71 x10³/µL.

This study is in line with the research of Adela Caesaria, Anik Handayati, Ayu Puspitasari, 2023 regarding the Stability of three-level whole blood control stored at a temperature of 2-8°C using a hematology analyzer. Based on The test results obtained p-*values* for each parameter at all levels of the number parameter. erythrocytes, number leukocytes, hematocrit, hemoglobin and amount platelets. Based on results can concluded that No There is change stability *whole blood control* with storage for 10 weeks at a temperature of 2-8oC on the number of parameters *low* and *normal* leukocyte levels, *low* and *high* hematocrit levels, and all levels of the count parameters leukocytes, hemoglobin and amount platelets. While the hematocrit parameter is at a *normal* level and the number of *high* level leukocytes are present change stability.

CONCLUSION

Results study Which has done about Differences in the results of the material quality control examination on the hematology analyzer before and after passing the open stability period, then you can conclude as follows:

The average results of the material quality control examination on the hematology analyzer before passing the open stability period at low levels WBC 3.47, RBC 2.64, HGB 6.2, HCT 18.07, and PLT 93.29, at normal levels WBC 7.06, RBC 4.40, HGB, 11.87, HCT, 33.24, PLT 219.71, at high levels WBC 17.24, RBC 5.29, HGB 15.91, HCT 43.87, PLT 522.14 x10³/µL

The average results of the material quality control examination on the hematology analyzer after passing the open stability period at low level WBC 3.54, RBC 2.64, HGB 6.2, HCT 18.21, and PLT 91.29, at normal level WBC 7.13, RBC 4.42, HGB, 11.89, HCT, 33.54, PLT 221.57, at high level WBC 17.26, RBC 5.30, HGB 15.96, HCT 44.07, PLT 524.71

There is no difference in the results of the material quality control examination on the hematology analyzer before and after passing the open stability period.

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CONFLICT OF INTEREST

The authors declare there is no any conflict of interest during this study.

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THE RELATIONSHIP BETWEEN THE DURATION OF TREATMENT WITH THE RATIO OF PLATELETS TO LYMPHOCYTES AND THE RATIO OF NEUTROPHILS TO LYMPHOCYTES IN PULMONARY TUBERCULOSIS

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ABSTRACT

Background: *Mycobacterium tuberculosis infection triggers a systemic inflammatory response, reflected by hematological changes such as increased Platelet-to-Lymphocyte Ratio (PLR) and Neutrophil-to-Lymphocyte Ratio (NLR). This study aims to determine the relationship between the duration of treatment and PLR and NLR values in pulmonary TB patients*
Methods: *The type of research used was descriptive research with a cross-sectional study. Data was collected to determine the Relationship between Duration of Treatment with PLR and NLR in TB Patients in Jambi City in 2025.*
Results: *This study found that the mean values of PLR and NLR tend to increase during the early phase of tuberculosistreatment and decrease in the advanced phase. These results are consistent with our initial hypothesis regarding the relationship between treatment phases and changes in inflammatory parameters. Laboratory analysis data, including descriptive data and PLR and NLR values based on treatment duration, were analyzed using statistical tests. Although the analysis revealed no significant association between treatment duration and PLR or NLR values in pulmonary tuberculosispatients*
Conclusion: *The duration of treatment does not directly influence changes in PLR and NLR levels. Several studies have also demonstrated that inflammatory parameters such as PLR and NLR can be affected by individual factors, particularly the body's immune response, which are not necessarily dependent on the length of treatment. Therefore, individual factors and other clinical conditions may substantially influence PLR and NLR parameters.*

Keywords: *Pulmonary Tuberculosis, Duration of Treatment, Systemic Inflammatory Response, Platelet-to-Lymphocyte*

INTRODUCTION

Pulmonary Tuberculosis (TB) is a contagious infectious disease caused by the acid-fast bacterium *Mycobacterium tuberculosis*. TB spreads through respiratory droplets when an infected person coughs or sneezes. The bacteria can also affect organs outside the lungs, such as the intestines, bones, and joints. The droplets released during coughing or talking can be inhaled by healthy individuals, leading to TB infection (Kemenkes RI, 2022).

In 2023, it was estimated that there were 10.8 million global TB cases, including 6 million men, 3.6 million women, and 1.3 million children. TB resulted in 1.25 million deaths, including 161,000 people with HIV (WHO, 2024). In Indonesia, 2023 TB cases reached 77%, with 820,789 reported cases and 134,000 deaths annually, including 134,528 cases in children. In Jambi Province, 5,308 TB cases were reported in 2022, with 209 TB patients per 100,000 residents in Jambi City, and a mortality rate of 6 per 100,000 residents (Dinkes Provinsi Jambi, 2023).

TB significantly impacts the immune system and hematological profile of patients. Inflammation caused by TB infection results in hematological abnormalities such as increased

platelet count (thrombocytosis), increased neutrophils (neutrophilia), and decreased lymphocytes (lymphocytopenia), indicating inflammation. Laboratory tests such as Platelet-to-Lymphocyte Ratio (PLR) and Neutrophil-to-Lymphocyte Ratio (NLR) are used to detect inflammation (Mansyur, Ramdani, & Santoso, 2018).

In the early stages of TB infection, an increased PLR is induced by the bacteria, leading to thrombocytosis and lymphocytopenia, reflecting inflammation. Studies have shown a significant increase in PLR in TB patients compared to healthy individuals, with an average of 201.7 in TB patients versus 78.7 in controls (Abakay, Sen, & Tanrikulu, 2015). Research also highlights neutrophils as a primary immune response against TB infection (Sormin et al., 2018). Furthermore, lymphocyte depletion is linked to the migration of lymphocytes to infected tissues (Cahyadi & Steffanus, 2022).

In TB patients, both PLR and NLR typically increase. High PLR values are due to platelet increase and lymphocyte reduction, while NLR is a key immune system response during TB infection (Makarim, 2019). TB is treatable with a two-phase treatment regimen: an intensive phase lasting about two months, followed by a continuation phase for less than six months to prevent relapse (Kemenkes RI, 2022).

Studies have shown that platelet count drops during treatment (Prameswari, Wahyudi, & Achmad, 2015), and lymphocytes are crucial in combating *Mycobacterium tuberculosis*. Research also indicates that pre- treatment NLR can predict treatment failure (Sormin et al., 2018). Over time, changes in PLR and NLR may be seen as markers of treatment progress (Makarim, 2019; Nabilah, 2020).

In 2023, several health centers in Jambi City reported varying TB cases, with the highest number (15 cases) at Puskesmas Simpang IV Sipin and the lowest (4 cases) at Puskesmas Paal Merah I. This background has motivated the author to investigate the relationship between treatment duration and PLR and NLR in pulmonary TB patients in Jambi City.

METHODS

This analytical observational study examined pulmonary tuberculosis (TB) patients based on duration of treatment at Puskesmas Simpang IV, Puskesmas Putri Ayu, Puskesmas Pakuan Baru, Puskesmas Paal Merah I and Puskesmas Paal V from January to May 2025. The sample included 30 outpatients with positive AFB results. The study analyzed Platelet and Leukocyte counts and types, focusing on the Platelet-to-Lymphocyte Ratio (PLR) and Neutrophil-to-Lymphocyte Ratio (NLR). These results are consistent with our initial ypothesis regarding the relationship between treatment phases and changes in inflammatory parameters. Although, the analysis revealed no significant association between treatment duration with PLR and NLR values in pulmonary tuberculosis patients in Jambi City.

RESULTS AND DISCUSSION

This study aimed to evaluate the changes in Platelet and Leukocyte counts and types, focusing on the Platelet-to-Lymphocyte Ratio (PLR) and Neutrophil-to-Lymphocyte Ratio (NLR) in tuberculosis patients based on duration of treatment at Puskesmas Simpang IV, Puskesmas Putri Ayu, Puskesmas Pakuan Baru, Puskesmas Paal Merah I, and Puskesmas Paal. Tuberculosis, caused by *Mycobacterium tuberculosis*, elicits a significant inflammatory response, and effective treatment is crucial for reducing the bacterial load.

Tuberculosis, caused by *Mycobacterium tuberculosis*, elicits a significant inflammatory response, and effective treatment is crucial for reducing the

bacterial load. By analyzing hematological parameters, including total platelet and leukocyte counts and their differential components, the research sought to assess the immune status of patients throughout their treatment journey. The methodology involved collecting and comparing laboratory data before and after the intensive phase, utilizing appropriate statistical tests to determine any significant differences. The results are expected to shed light on the immunological effects of intensive anti-tuberculosis therapy, providing valuable insights into patient management. This research contributes to understanding how hematological changes can reflect treatment efficacy and overall patient outcomes in tuberculosis management.

Respondent Characteristics

Gendersection

Table 1. Table of Frequency Distribution of Characteristics by Gender

Gender	Frequency	Percentage (%)
Male	20	66.7%
Female	10	33.3%
Total	30	100.0%

Based on the data presented in the Table of Frequency Distribution of Characteristics by Gender, it can be interpreted that out of a total of 30 study subjects, there is a significant difference in the distribution of genders among tuberculosis patients undergoing treatment at Puskesmas Simpang IV, Puskesmas Putri Ayu, Puskesmas Pakuan Baru, Puskesmas Paal Merah I, and Puskesmas Paal. The majority of patients are male, totaling 20 individuals or 66,7% of the total sample. Meanwhile, female patients number 10, representing 33,3% of all study subjects.

Age

Based on the Table of Frequency Distribution of Respondent Characteristics by Age, it can be observed that tuberculosis patients undergoing treatment at Puskesmas Simpang IV, Puskesmas Putri Ayu, Puskesmas Pakuan Baru, Puskesmas Paal Merah I, and Puskesmas Paal have a varied age distribution. The most prevalent age group is 18-59 years, comprising 20 patients or 66,7% of the total sample. Meanwhile, ≥60 years age group comparising 10 patients or 33,3% of all study subjects.

Table 2. Table of Frequency Distribution of Respondent Characteristics by Age

Age	Frequency	Percentage (%)
18-59 years	20	66,7%
≥60 years	10	33,3%
Total	30	100,0%

This age distribution indicates that tuberculosis tends to affectthe elderly population more significantly, with a total of 66,7% of patients over the age of 18-59. This age distribution shows that tuberculosis tends to affect the elderly population more, with 66,7% of patients aged 18-59 years. This indicates a higher risk factor in this age group, which may be due to increased social and work activity, raising the risk of exposure to TB bacteria through contact with infected individuals. In addition, high stress, economic challenges, and unhealthy lifestyles can weaken the immune system, making them more susceptible to infection. Meanwhile, the lower proportion in the older age groups (33,3% for ≥60 years) reflects differences in exposure or resistance to tuberculosis infection.

Table 3. Table of Comparison of PLR Values Based on Duration of Anti- Tuberculosis Treatment

Variable	Mean ± SD	Median (Min – max)
≤ 2 months	142 ± 44,52	137 (41 - 216)
> 2 months	137 ± 53,98	139 (47 - 218)

This study demonstrates a significant difference in Platelet-to-Lymphocyte Ratio (PLR) values before and after anti-tuberculosis treatment. The median PLR before treatment was 137, indicating an abnormal level, while after treatment, it decreased to a median of 139, which ups when compared to before. This reduction in PLR reflects a no improvement in the inflammatory response.

In this study, of the 30 samples, the average PLR in Pulmonary TB patients

undergoing treatment for ≤2 months has an average PLR of 142 with a range of 41–216. Meanwhile, in Pulmonary TB patients with a treatment duration of >2 months, the average PLR is 137 with a range of 47–218.These findings indicate that anti-tuberculosis therapy effectively reduces inflammatory responses, suggesting a positive therapeutic outcome for patients.

Table 4. Table of Comparison of NLR Values Based on Duration of Anti- Tuberculosis Treatment

Variable	Mean±SD	Median (min- max)
≤ 2 months	2,86 ± 2,10	2,39 (2,18 - 9,34)
> 2 months	1,70 ± 0,64	1,53 (0,4 - 3,17)

This study demonstrates a significant difference in Neutrophil-to-Lymphocyte Ratio (NLR) values before and after anti- tuberculosis treatment. The median NLR before treatment was 2,86, indicating an abnormal level, while after treatment, it decreased to a median of 1,70, which falls within the normal range. This reduction in NLR reflects an improvement in the inflammatory response.

The NLR, calculated by dividing the number of neutrophils by lymphocytes, serves as a critical parameter for assessing inflammation. Normal NLR values in healthy adults range from 0.78 to 3.53, with values above 3.0 considered pathological. Notably, NLR values in the gray zone (2.3–3.0) can signal potential pathological processes, including infections or inflammation.

In this study, of the 30 samples, 15 (50%) exhibited an increased neutrophil-to-lymphocyte ratio in ≤2 months. After >2 months treatment, 15 samples (50%) showed an decline ratio. These findings indicate that anti-tuberculosis therapy effectively reduces inflammatory responses, suggesting a positive therapeutic outcome for patients.

CONCLUSION

In conclusion, the data presented in the Frequency Distribution Table of Characteristics by Gender reveals a notable disparity in the distribution of tuberculosis patients undergoing intensive treatment in Jambi City, with a clear predominance of male patients. The age distribution shows varied range among patients, with the elderly representing the productive age. This suggests that the productive age may face a higher risk of tuberculosis, potentially due to factors like In addition, high stress, economic problems, and unhealthy lifestyles can weaken the immune system, making them more susceptible to infection. Additionally, there is a statistically no significant reduction in the PLR and NLR as treatment duration progresses, linked to increases in platelet and lymphocyte counts, along with a decrease in neutrophil levels. This decrease in PLR and NLR can be affected by individual factors, particularly the body's immune response, which are not necessarily dependent on the length of treatment.

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CONFLICT OF INTEREST

This research, there are no conflicts of interest regarding funding, including names in published articles, and the data collection process.

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GADGET ADDICTION AND ADOLESCENT BEHAVIOR: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: *The use of gadgets among Indonesian teenagers has rapidly increased with the development of global information technology. Although it is a matter of pride, the negative impacts of gadget use are starting to be felt, especially by parents who have difficulty controlling their children. Therefore, this study aims to determine the relationship between gadget use and changes in adolescent behavior.*
Methods: *This study used a cross-sectional design. The sampling technique used was quota sampling on 186 adolescents. Gadget addiction was measured using the Smartphone Addiction Index—Short Version (SAS-SV) questionnaire, and Behavior in this study was calculated using the Strengths and Difficulties Questionnaire (SDQ). Data were analyzed using chi-square.*
Results: *The study showed that almost all teenagers (97%) were in the medium and high category of gadget users and experienced negative behavioral changes. Based on the results of the analysis test, there was a significant relationship between gadget use and behavioral changes in teenagers (p = 0.001)*
Conclusion: *Gadget addiction in adolescents is related to behavioral changes in adolescents.*

Keywords: *Teenagers, gadge adictiont, behaviour change*

INTRODUCTION

Indonesia is currently one of the countries with the highest gadget users in the world. Indonesians spent an average of 5.4 hours per day playing gadgets in 2021, increased to 5.7 hours per day in 2022 (CNBC.ai, 2023). Total of 2,933 teenagers experienced an increase in online duration from 7.27 hours to 11.6 hours per day (Kristana, 2021).

According to the Indonesian Internet Service Providers Association in 2022–2023, the number of internet users in Indonesia increased from 210.03 million to 215.63 million, or an increase of around 1.17%. Based on the provincial area in Indonesia, East Java is in fifth place with a percentage of internet service users of 81.26% (APJJI, 2023). KOMINFO data also states that based on age, children who are vulnerable to gadget addiction are in the 13-18 year age range (KOMINFO, 2018).

Whether we realize it or not, the development of gadget technology has brought both positive and negative impacts. Almost all over the world, the use of gadgets has affected all aspects of human life, such as physical/health, psychological, academic, social, spiritual, and economic relationships and behavior. Uncontrolled and uncontrolled use of gadgets mostly leads to addiction. Various research results have revealed a lot of data about this. Among them, addiction to online games causes teenagers health to decline. Teenagers who are addicted to online games have weak immune systems due to a lack of physical activity, lack of sleep, and often eating late (Männikkö, Billieux, & Kääriäinen, 2015).

Psychological aspects, the many online game scenes that show criminal and violent acts, such as fighting, vandalism, and murder,

can indirectly affect the subconscious of teenagers that real life is the same as in the online game. The characteristics of teenagers who experience mental disorders are due to the influence of online games, for example, easy to get angry, become emotional, and easily say bad words (Patra and Barida, 2021).

Academic aspect, teenagers are of school age and have a role as students at school. Addiction to online games can reduce academic achievement, (Kim and Lee, 2022) (Lim et al., 2015). Free time that should be used to study lessons at school is used more often to complete missions in online games. Teenagers' concentration is generally disturbed so their ability to absorb lessons delivered by teachers is also not optimal.

Social aspect, some teenagers with gaming addiction feel they find their identity when they play online games through emotional attachment in the formation of avatars, which causes them to be immersed in a fantasy world they create themselves. This can make them lose touch with the real world, which can lead to reduced interaction (Marcovitz, 2012). Although it was found that there was an increase in online socialization, at the same time, there was also a decrease in real-life socialization (Li et al., 2020; Patra and Barida, 2021). The characteristics of teenagers who are addicted to online games include antisocial attitudes and no desire to mingle with society, family, and friends (Patra and Barida, 2021). Spiritual aspect, children with gadget addiction will spend most of their time playing with gadgets, so they forget to eat, sleep, bathe, and pray (Wardhani, 2018).

Based on the results of an initial survey at a school in Tuban, it was shown that several students behaved in a solitary manner, did not like to socialize, and lacked concentration in studying due to excessive use of gadgets. Factors affecting teenagers behavior due to gadgets are internal, external, social, and situational factors. Using too many electronic devices in teenagers can have a negative impact because it can reduce their ability to concentrate and increase their dependence on things they have to do themselves (Gabriela & Mau, 2021).

As a result of gadget addiction, teenagers behave individually, prioritizing using the technology in their hands rather than greeting people around them (Marpaung, 2018). Many children who are addicted to gadgets have to be taken to psychologists, psychiatrists, and special rehabilitation centers because their minds and souls are disturbed (KPAI, 2018). Playing with gadgets can cause children to become antisocial individuals. Interaction time directly is reduced because time is taken up to enjoy everything in solitude. Gadgets can also affect children's behavior (Adelia et al., 2021). Playing with gadgets can cause children to become antisocial individuals. Teenagers' time to interact directly with friends is reduced because most of their time is spent enjoying everything alone. Gadgets can also affect children's behavior (Adelia et al., 2021).

Some ways to overcome teenage gadget addiction, according to Yumarni (2022), are: (1) Spend More Time with Friends. Parents can arrange vacations with their children or get together on weekends. If alone, teenagers will always play with gadgets. When teenagers gather with friends, advise them not to take out their gadgets. Use the time together to chat and joke around; 2) Turn off gadgets before going to bed. The next step in overcoming addiction to electronic devices is to turn off devices 30 to 60 minutes before going to bed. At first, this method may seem difficult. However, if parents do it regularly, teenagers will become accustomed to that behavior. In addition, it speeds up the sleep of teenagers and makes sleep deeper, so they wake up with a fresher mind, body, and eyes; (3) Delete Apps that Cause Addiction. Everyone must have several apps that are frequently used. These apps can cause addiction. By deleting the app, teens can take a break from gadgets and do not need to open the device to check the app. Teens can

read books as a way to fill their free time instead of playing with electronic devices; (4) Knowing the impact of gadget addiction.

METHODS

This study used a correlational analytic design with a cross-sectional approach to analyze the relationship between gadget use and changes in teenagers behavior. The population in this study was 349 teenagers. Sampling was done using the Quota sampling technique. So a sample of 186 teenagers was obtained. The inclusion criteria in this study were teenagers aged 15-18 years teenagers who were not willing to be respondents were exclusion criteria.

Gadget usage was measured using the Smartphone Addiction Index – Short Version (SAS-SV) questionnaire. This questionnaire contains a series of questions that are structured and unstructured (Lubis, 2018). The gadget usage questionnaire contains 10 statements about difficulty in scheduling, difficulty concentrating, wrist or neck pain, restlessness if there is no gadget, dependence on gadgets, and using gadgets for too long. The results of the gadget usage questionnaire will be categorized into low (10-16), medium (17-23), and high (24-30).

Behavior in this study was measured using the Strengths and Difficulties Questionnaire (SDQ), a short behavioral screening instrument designed to provide a profile of the behavior, emotions, and social relationships of children and teenagers. SDQ screening is a tool developed by Robert Goodman in 1997 SDQ. This tool provides a wealth of information and is useful for providing a brief overview of children's and teenagers' behavior, focusing on their strengths and difficulties. The teenagers behavior change questionnaire contains 13 statements about being self-absorbed, paying attention to the environment, liking to play pranks on friends, walking with one's head bowed, greeting others, playing with gadgets when gathering, solving problems emotionally, solving problems by discussing, playing with gadgets before going to bed, and using time as well as possible. Researchers divide the categories of levels of change in teenagers behavior into two, namely the positive category with a value range of ≤ 23 and the negative category with a range of ≤ 39. This study used the Indonesian version of the questionnaire. The researcher also identified the characteristics of the respondents, including age and gender. Data was collected online using a Google form distributed via WhatsApp. Guidance and counseling teachers helped distribute questionnaires to students. This questionnaire was preceded by informed consent; respondents who agree to the informed consent can continue to fill out the research questionnaire.

Data analysis using the Chi-Square Test to analyze the relationship between gadget use and behavioral changes in teenagers. All data were analyzed using IBM SPSS 25. This study has obtained ethical approval from the Research Ethics Committee of the Surabaya Ministry of Health Polytechnic with reference number No.EA/ 2524 /KEPK-Poltekkes_Sby/V/2024.

RESULTS AND DISCUSSION

As presented in Table 1, the majority of teenagers, based on age characteristics, are 16 years old (71%), and based on gender characteristics, the majority of teenagers are female, as many as 113 teenagers (61%).

Table 1. Distribution of Respondent Characteristics

Respondent characteristics	f (n=186)	%
Age		
15 years	20	11
16 years	132	71
17 years	31	17
18 years	3	1
Gender		
Male	73	39
Female	113	61

Table 2 shows that almost all teenagers are gadget users with medium and high frequency, namely 181 teenagers (97%).

Table 2. Categories of gadget use among teenagers

Use of Gadgets	f (n=186)	%
Low	5	3
Medium	87	47
High	94	50

Based on Table 3, it is known that almost all teenagers experience behavioral changes that tend to be negative (97%).

Table 3. Behavioral Changes in Teenage Gadget Users

Behavior Change	f (n=186)	%
Positive	6	3 %
Negative	180	97 %

Bivariate analysis reported a relationship between gadgets and behavioral changes. (p=0.001 : CI : 95%).

According to several previous related studies, the results are mixed. Such as the high use of gadgets among teenagers due to technological developments, requiring teenagers to use gadgets every day. Based on Jarmi's research results, out of 92 people, 50 people were included in the high gadget usage category (Jarmi, 2017). Teenagers feel anxious, annoyed, and angry if they are kept away from gadgets, indicating that teenagers use gadgets excessively (Fitriana, 2020). Subagio and Hidayati's (2017) research found that teenagers who use gadgets excessively find it hard to pay attention and do assignments because they cannot separate the function of gadgets as a tool for playing or learning. According to Yanti's research (2021), it shows that of the 86 respondents, the majority, namely 77 people, were teenagers with risky gadget use; respondents used gadgets to play online games, listen to music, or watch YouTube. Research (Mukti and Nurchayati, 2019) (Cha and Seo, 2018) found a tendency towards excessive use of gadgets in teenagers students use gadgets to play games, surf the internet, and play on social media.

This study found that most teenagers fall into the category of high gadget use, including those who find it difficult to concentrate when studying and are more individuals. Many of them, use the weekend to play with gadgets rather than play with peers just playing ball on the field. When teenagers are too busy playing with gadgets, teenagers can ignore and not care about the surrounding environment. So, they do not understand the ethics of socializing with people around them. In addition, age can also affect the use of gadgets. Teenagers in this study were between 15-18 years old, the age they grew up in the era of technology and were accustomed to using gadgets from a young age. They use gadgets to communicate, access information, and for entertainment.

This study found that the behavior of teenagers almost entirely tends to be negative. Most teenagers answered that they were more interested in playing with gadgets, were not interested in their surroundings, did not greet people when they met older people, were more focused on gadgets when walking, remained focused on gadgets even when they were hanging out with friends, tended to be emotional when solving problems, and were always with gadgets before going to bed at night.

According to Yanti (2021), out of 86 respondents, more than half, namely 50 teenagers respondents, were teenagers who experienced behavioral changes. Teenagers become more solitary, antisocial, and socially deviant. Indrayani's research (2021) found that teenagers no longer have morals and ethics, so teenagers now have no respect and courtesy toward their parents. According to Asroni & Ajhuri (2022), teenagers become indifferent to their surroundings and prefer to be alone. Teenagers cannot control their emotions and tend to solve problems emotionally. According to research by Syahputri & Ahmad (2022), today's teenagers tend to have a less cooperative attitude, a lack of empathy in teenagers, a lack of friendliness, and an attitude of selfishness toward others around them. Putri's research (2021) from the results of her research shows

that teenagers become withdrawn individuals, have sleep disorders, like to be alone, violent behavior, fade creativity, and the threat of cyberbullying.

The results of this study found that there was a relationship between gadget use and changes in teenagers behavior. According to Yanti's researc(2021), there is a significant relationship between gadget use and changes in teenagers behavior, characterized by lack of concentration while studying, using gadgets to cheat or cheat on exams, having difficulty doing homework because they are busy playing with gadgets, teenagers forget to sleep and stay up late. Indrayani's research (2021) shows that gadgets hurt teenagers behavior, namely free association and criminal acts. Gadgets affect the values of politeness and create deviant behavior in teenagers who can access anything on their gadgets. The results of Hanita's (2023) research show that there is a relationship between gadget use and changes in teenagers behavior, namely that teenagers greet their surroundings less, teenagers tend to skip lessons, and teenagers prefer to solve problems by fighting. According to Rahmad's (2022) research, students are busy with their respective gadgets during recess. Interaction between students is very minimal because students are busy with the gadgets in their hands. Students follow the movements or dance from the videos on their gadgets.

Pratiwi and Malwa's (2022) research shows a correlation between gadget use and changes in teenagers behavior. Teenagers become less social and spend most of their time playing and carrying gadgets wherever they go. From the results of this study and other supporting studies, it can be concluded that a correlation between gadget use and behavioral changes in teenagers.

CONCLUSION

This study shows that gadget use is related to behavioral changes in teenagers. So, it is necessary to take preventive measures so that gadget use does not cause addiction so that the negative impacts that arise can be prevented and anticipated early.

This research provides a major contribution as a basis for determining appropriate interventions as a preventive measure so that gadget use in teenagers does not continue into addictive behavior. However, this study has limitations because the identification of behavioral changes is only measured using a questionnaire. It would be better if changes in behavior in teenagers were carried out by direct observation to get more valid results.

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CONFLICT OF INTEREST

There is no conflict of interest in this research.

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ANALYSIS OF BEHAVIOURAL FACTORS CONTRIBUTING TO CHRONIC ENERGY DEFICIENCY (CHD) AMONG PREGNANT WOMEN IN DEVELOPING COUNTRIES: A SYSTEMATIC REVIEW

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ABSTRACT

Background: *The nutritional condition of pregnant women is still a problem that needs serious attention in developing countries. In Indonesia, many pregnant women still experience nutritional problems, especially Chronic Energy Deficiency (CED). This achievement shows that efforts to reduce the number of CEDs have not reached the expected target, indicating the importance of increasing nutritional interventions for pregnant women. This systematic literature review aims to identify and analyze various behavioral risk factors of malnourished pregnant women through an article review.*
Methods: *Inclusion criteria in this study were community-based studies in developing countries with analytical observational research designs such as cross-sectional, case-control, and cohort. Exclusion criteria were literature review studies and studies that did not report relevant results.*
Results: *Behavioural risk factors contributing to undernutrition or CED in pregnant women consist of knowledge, attitudes, and actions such as ANC utilization, diet, and food aversion. Pregnant women's knowledge can influence their attitudes toward efforts to prevent or overcome malnutrition or chronic energy deficiency. Pregnant women who have positive behavioral risk factors are less likely to experience malnutrition or chronic energy deficiency than pregnant women who have negative behavioral risk factors.*
Conclusion : *Behavioral risk factors such as knowledge, attitudes, and actions related to ANC, diet, and food aversion contribute to malnutrition in pregnant women with CED, so community empowerment through health workers is needed to overcome this..*
Keywords: *Behavioural Risk Factors; Undernutrition; Chronic Energy Deficiency; Pregnant Women*

INTRODUCTION

Nutritional problems that often occur in pregnant women include chronic energy deficiency (CED). CED in pregnant women is one of the health problems in developing countries. As in Ethiopia, the prevalence of malnourished pregnant women is still high (Zewude et al., 2024). Indonesia, based on the results of the Indonesian Health Survey (IHS) 2023, published in 2024, reported that CED in pregnant women was 16.9% (Kementerian Kesehatan RI, 2023). This figure has not met the target set in the National Medium-Term Development Plan 2020-2024 of 11.5% by 2023 (Kementerian Kesehatan RI, 2020). CED can occur when a pregnant woman experiences energy deficiency that lasts for a long period, which can have a negative impact not only on maternal health but also on fetal development (Tanoto Foundation, 2023). Energy deficiency is often caused by inadequate nutritional intake, which can worsen health conditions during pregnancy (Fitri & WIji, 2019). Preterm labor, low birth weight kids, and maternal and fetal death are among the pregnancy issues that are more likely to occur in pregnant women with CED. This condition affects the mother's health and threatens the quality of health of the next generation (Tanoto Foundation, 2023).

Previous studies have found that the risk factors for malnutrition, especially SEA in pregnant women, are many, including illiteracy, and lack of dietary advice. (Zewude et al., 2024). Other factors such as knowledge, (Hasriantirisna, 2023), (Meri Agritubella &

Delvira, 2020), attitudes (Palimbo et al., 2014) Antenatal care (ANC) visits (Fitrianingtyas et al., 2018), and the diet of pregnant women can influence CED. Age, spacing of pregnancies, economic status, and social and family support can also influence CED in pregnant women. (Ummah & Woro Tri Utami, 2024). In addition, dietary diversity, iron supplementation, food intake, maternal education, income, and ambition to become pregnant (Getaneh et al., 2021). There is also a substantial correlation between the incidence of CED in pregnant women and other factors that affect the consumption of calories, protein, vitamins, folate, and calcium (Wati et al., 2024). Various risk factors related to malnutrition or CED problems in pregnant women indicate that not only can food intake factors can affect the problem of CED in pregnant women, but the behavioral problems of pregnant women are also worth noting.

However, previous studies have highlighted behavioral variables partially. There has been no research that discusses the behavioral risk factors of pregnant women comprehensively. A person's behavior in adopting a behavior can involve three main domains: knowledge, attitude, and action. (Notoatmodjo, 2014). This process begins with an individual's understanding of the meaning or benefits of the behavior for themselves and their family. After gaining knowledge, individuals then form an attitude or judgment towards the stimulus or object. The final stage is action, where individuals are expected to practice what they have known and perceived positively. (Salim, 2014).

This systematic review aims to identify and analyze behavioral risk factors that contribute to undernutrition or chronic energy deficiency in pregnant women. With a deeper understanding of these factors, it is hoped that it can be used to develop more effective behavioral interventions to prevent and address CED in pregnant women and improve the health of mothers and their babies.

METHODS

The research method used was a literature review of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Checklist. (Matthew J Page, Joanne E McKenzie, Patrick M Bossuyt, Larissa Shamseer, Jennifer M Tetzlaff, Cynthia D Mulrow, Larissa Shamseer, Jennifer M Tetzlaff, 2021) The literature was collected using three English databases, namely Scopus, ScienceDirect, and PubMed. Articles in these databases were published from 2019 to 2024, or the last five years, using English with the document type article and sourced from journals with open access, or articles can be downloaded for free. Articles were searched using the keywords “chronic energy deficiency” OR “maternal undernutrition” AND pregnancy OR “pregnant women” AND “risk factors” OR predictors. The inclusion criteria in this study were research with an analytical observational design using cross-sectional, case-control, and cohort approaches. Respondents in the study were only pregnant women, and the location of the study was in developing countries. Exclusion criteria in this study were Systematic Literature Review studies and studies that reported irrelevant results. There were 134 articles found based on predetermined keywords which were then selected according to the inclusion criteria, 9 articles were obtained and reviewed by four reviewers.

RESULTS AND DISCUSSION

RESULTS

Nine kinds of literature were found based on the results of literature screening using the PRISMA Checklist. Literature was searched through three databases, such as Scopus, ScienceDirect, and Pubmed, using the keywords “chronic energy deficiency” OR “maternal undernutrition” AND pregnancy OR

"pregnant women" AND "risk factors" OR predictors. The following is a literature review based on the PRISMA 2020 checklist.

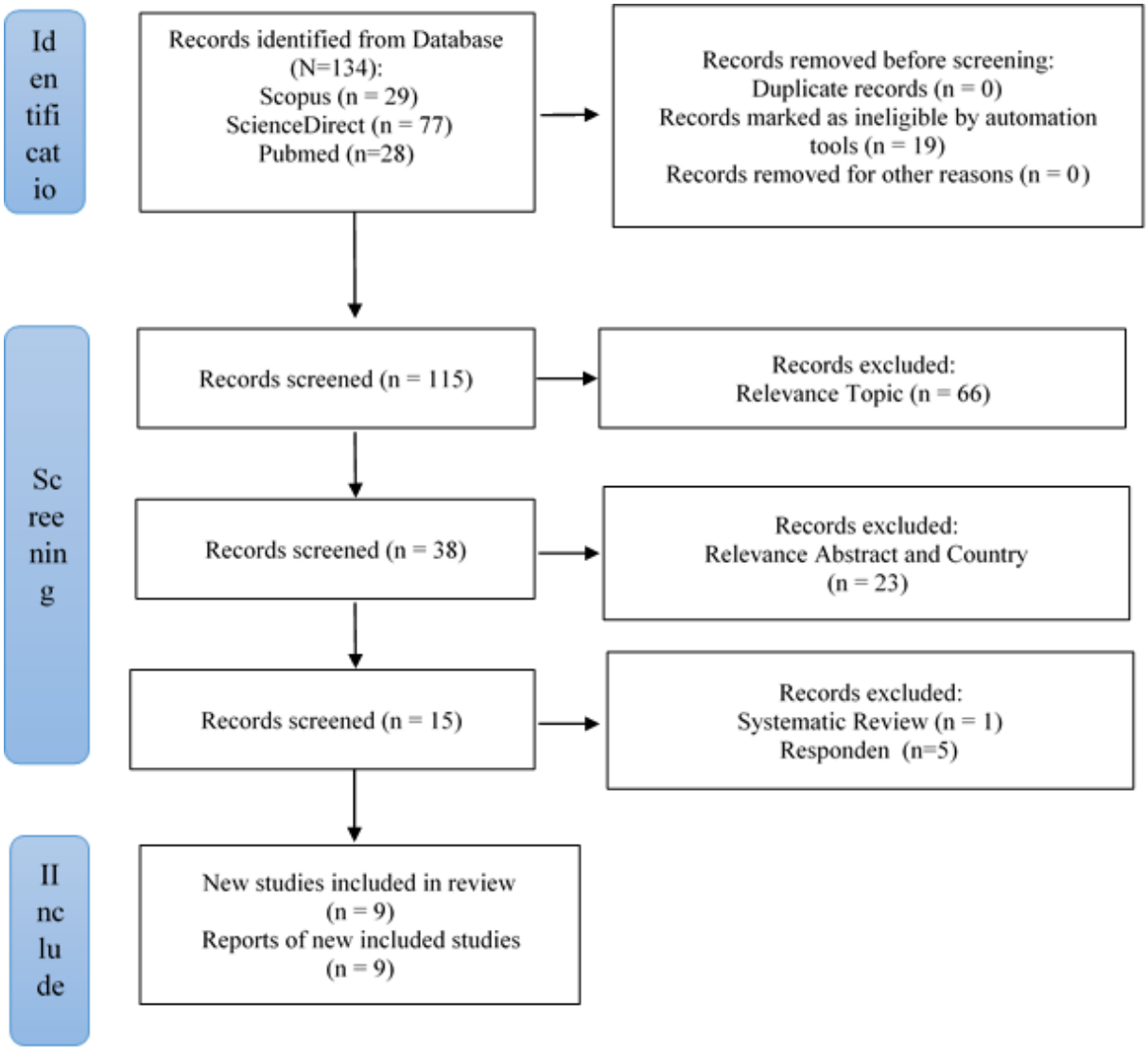


Figure 1. Search Flow Using PRISMA Checklist

Table 1. Summary of literature

No	Author, Title	Method	Sample	Results	Conclusion
1	Meron Demisew, Habtamu Fekadu Gemede, Kassahun Ayele Prevalence of undernutrition and its associated factors among pregnant women in north Shewa, Ethiopia: A multi-center cross-sectional study.	Cross-Sectional Study	334 respondents were pregnant women.	The prevalence of undernutrition was 22.2%. Significant contributing factors included low household income (AOR = 3.69), limited maternal education (AOR = 1.24), poor nutritional attitudes (AOR = 2.54), and low dietary diversity score (AOR = 4.42).	The prevalence of maternal undernutrition was exceptionally high based on WHO standards. Contributing factors included low average monthly household income, limited education among pregnant women, poor nutritional practices, and low dietary diversity scores.

No	Author, Title	Method	Sample	Results	Conclusion
2	Erna K. Wati, Retno Murwani, Martha I. Kartasurya, Sulistiyani Determinants of chronic energy deficiency (CED) incidence in pregnant women: A cross-sectional study in Banyumas, Indonesian	Cross-Sectional Study	100 respondents were pregnant women.	CED affected 32% of pregnant women. Key risk factors included extreme maternal age (OR: 3.49), low education (OR: 4.12), short pregnancy interval (OR: 7.30), infrequent ANC visits (OR: 3.06), and low protein intake (OR: 6.80), based on multivariate analysis. Significant associations were also found with poor nutritional knowledge and inadequate intake of energy, vitamin C, folate, and calcium.	The conclusion of this study indicates that 32% of pregnant women experience chronic energy deficiency (CED), influenced by several determinant factors. Significant factors contributing to the occurrence of CED include extreme age, short pregnancy intervals, low educational levels, low frequency of antenatal care (ANC) visits, and inadequate protein intake. Good nutritional knowledge and adequate dietary intake also contribute to the nutritional status of pregnant women.
3	Asmaul Husna, Fauziah Andika Factors Related to Nutritional Status of Pregnant Women in the Working Area of Baiturrahman Health Center, Banda Aceh	Case-Control Study	80 respondents were pregnant women.	The population in this study consisted of all pregnant women in their second and third trimesters, with 80 individuals selected as the sample. The results indicated that knowledge (P=0.015, OR=4.608), attitude (P=0.008, OR=7.933), family support (P=0.035, OR=3.857), and family income level (p=0.598, OR=1.593) had an impact. Multivariate analysis revealed that the most dominant variable related to the nutritional status of pregnant women was attitude (OR = 8.576)	There was a relationship between knowledge, attitudes, and family support and the nutritional status of pregnant women. In contrast, family income level did not show a significant association with the nutritional status of pregnant women. The attitude variable emerged as a key risk factor for Chronic Energy Deficiency (CED).
4	Solomon Zewdie, Sagni Girma Fage, Abera Kenay Tura, Fitsum Weldegebreal Undernutrition among Pregnant Women in Rural Communities in Southern Ethiopia	Cross-Sectional Study	376 respondents were pregnant women.	The prevalence of undernutrition among pregnant women was found to be 41.2% (95% CI 36.3%–46.3%). Unintended pregnancies (AOR 2.06, 95% CI 1.27–3.36) and nonparticipation in	Undernutrition among pregnant women was significantly common in the study area. Efforts to mitigate undernutrition should prioritize discouraging teenage and unintended pregnancies, addressing household

No	Author, Title	Method	Sample	Results	Conclusion
				Women's Health Development Army meetings (AOR 3.64, 95% CI 1.51–8.77) were identified as independent predictors of undernutrition. Conversely, having a minimum dietary diversity of five or more food groups (AOR 0.24, 95% CI 0.07–0.82), attending at least one antenatal care visit (AOR 0.46, 95% CI 0.27–0.78), being aged 20 years or older at first pregnancy (AOR 0.39, 95% CI 0.21–0.76), and coming from food-secure households (AOR 0.26, 95% CI 0.16–0.43) were independent protective factors against undernutrition.	food insecurity, promoting antenatal care visits, and encouraging women to consume a diverse diet. Enhancing the current network of the Women's Health Development Army appears to be crucial.
5	Berhe Gebremichael , Tadesse Misgana, Dawit Tamiru, Mandaras Tariku, Dejene Tesfaye, Daniel Alemu, Adisu Birhanu Weldesenbet, Merga Dheresa Undernutrition and associated factors among rural pregnant women in Eastern Ethiopia	Cross-Sectional Study	1.834 Pregnant women in Kersa and 1.036 Pregnant women in Haramaya.	The prevalence of undernutrition among pregnant women was found to be 43.8% (95% confidence interval: 40.8, 47.0). Significant predictors of undernutrition included early marriage (adjusted odds ratio = 2.63, confidence interval: 2.00, 3.47), lack of antenatal care follow-up (adjusted odds ratio = 1.73, 95% confidence interval: 1.31, 2.29), inadequately diversified diet (adjusted odds ratio = 2.48, 95% confidence interval: 1.77, 3.48), current substance use (adjusted odds ratio = 1.50, 95% confidence interval: 1.02, 2.19), history of mental illness (adjusted odds ratio = 2.44, 95%	Undernutrition represented a major public health concern for pregnant women in rural areas. Factors such as the age at which they first married, attendance at antenatal care, dietary diversity, current substance use, past mental health issues, and common mental disorders were identified as independent predictors of undernutrition. Consequently, the health authorities in the Kersa and Haramaya districts should focus their efforts on preventing undernutrition among pregnant women by providing nutrition counseling and education, as well as mental health and psychosocial support.

No	Author, Title	Method	Sample	Results	Conclusion
				confidence interval: 1.02, 5.82), and common mental disorders (adjusted odds ratio = 1.81, 95% confidence interval: 1.34, 2.43)	
6	Tona Zema Diddana Factors associated with dietary practice and nutritional status of pregnant women in Dessie town, northeastern Ethiopia: a community-based cross-sectional study	Cross-Sectional Study	604 respondents were pregnant women.	Approximately 54.8% of pregnant women exhibited poor dietary practices, and 19.5% were found to be undernourished. Factors significantly associated with poor dietary practices included being in the first trimester of pregnancy (AOR = 0.46; 95% CI: 0.26, 0.80), having no history of illness two weeks before data collection (AOR = 0.42; 95% CI: 0.22, 0.80), poor perceived severity of the situation (AOR = 1.64; 95% CI: 1.15, 2.33), poor perceived benefits of good nutrition (AOR = 1.63; 95% CI: 1.14, 2.32), and low self-efficacy (AOR = 4.74; 95% CI: 2.94, 7.65). Additionally, factors significantly linked to undernutrition included not attending antenatal care (ANC) (AOR = 3.46; 95% CI: 2.07, 5.78), having an illness (AOR = 1.93; 95% CI: 1.10, 3.5), inadequate dietary diversity (AOR = 5.92; 95% CI: 3.59, 9.76), poor nutrition knowledge (AOR = 3.03; 95% CI: 1.87, 4.92), poor dietary practices (AOR = 3.25; 95% CI: 1.91, 5.54), and low perceived self-efficacy (AOR = 5.59; 95% CI: 3.56, 8.79), all of which were	Dietary practices among pregnant women were inadequate, leading to a relatively high prevalence of nutritional issues. Factors such as being in the first trimester and having no illness history were linked to better practices, while poor perceptions of malnutrition severity, benefits of good nutrition, and self-efficacy were associated with inadequate practices. Additionally, not attending antenatal care (ANC), illness history, low dietary diversity, poor nutritional knowledge, and low self-efficacy were linked to undernutrition. To improve this situation, government and health workers should encourage ANC attendance, promote health during pregnancy, and provide support to enhance dietary diversity and practices, focusing on positive beliefs about nutrition.

No	Author, Title	Method	Sample	Results	Conclusion
				statistically significant (P < 0.05).	
7	**Turufat Paskal Gebre**, **Temesgen Tafesse**, **Teshome Abuka Abebo** Food aversion and its association with pregnant women's nutritional status in Teticha Woreda, Sidama Region, Ethiopia: A community-based mixed comparative cross-sectional study.(Gebre et al., 2024)	Cross-Sectional Study	446 respondents were pregnant women.	Maternal undernutrition was identified in 109 pregnant women (48.9%; 95% CI: 42.4%–55.4%) who experienced food aversion, while 69 women (30.9%; 95% CI: 25.1%–37.2%) without food aversion were also assessed (with a mid-upper arm circumference of 23 cm). A notable portion of mothers, specifically 95 (42.6%), reported that their food aversion was related to the taste or smell of certain foods. Some mothers avoided "Enset," while others refrained from consuming foods such as cereals, milk, and coffee. The Chi-square test indicated that pregnant women with food aversion had a higher likelihood of experiencing maternal undernutrition compared to those without food aversion (p-value of 0.000)	This study revealed a greater prevalence of undernutrition in pregnant women who experienced food aversion compared to those who did not. To address maternal undernutrition effectively, it is crucial to implement nutritional interventions, particularly counseling that addresses food aversion.
8	Abel Girma Tilahun, Dinaol Abdissa Fufa, Rahel Dereje Taddesse Undernutrition and its associated factors among pregnant women at the public hospitals of Bench-Sheko and Kaffa zone, southwest Ethiopia	Cross-Sectional Study	566 Pregnant Women	A total of 566 pregnant women were involved in our study, resulting in a response rate of 98.3%. The prevalence of undernutrition among these women was 42.4% (95% CI: 38.3, 46.5). The multivariate logistic regression analysis identified several significant factors related to undernutrition, including mothers aged 16-24 years (AOR = 3.9, 95% CI: 1.60, 9.70), household food	Based on the findings of this study, the prevalence of undernutrition was notably high in the study area, significantly associated with women aged 16–24 years, poor dietary knowledge, and household food insecurity. Therefore, strategies and programs aimed at reducing and preventing undernutrition among pregnant women should be implemented at all levels to enhance

No	Author, Title	Method	Sample	Results	Conclusion
				insecurity (AOR = 1.81, 95% CI: 1.04, 3.15), and inadequate dietary knowledge (AOR = 3.25, 95% CI: 1.94, 5.47).	their nutritional status, along with providing health information, nutrition counseling, and food assistance.
9	Mohammed Muze, Mubarek Yesse, Shemsu Kedir, and Abdilmejid Mustafa Prevalence and associated factors of undernutrition among pregnant women visiting ANC clinics in Silte zone, Southern Ethiopia.	cross-sectional study	422 Pregnant Women	In this study, the overall prevalence of undernutrition among the participants was found to be 21.8%. Factors significantly associated with undernutrition included being over 31 years of age (AOR = 0.15; 95% CI: 0.03, 0.93), having birth intervals greater than 2 years (AOR = 0.18; 95% CI: 0.04, 0.76), possessing good nutritional knowledge (AOR = 0.34; 95% CI: 0.17, 0.67), and not experiencing any dietary changes due to the current pregnancy (AOR = 6.02; 95% CI: 2.99, 12.14).	The prevalence of undernutrition among pregnant women was found to be 21.8%. This current estimate is lower than what was previously reported in the study area but higher than figures from developed countries. Key risk factors or predictors of undernutrition (MUAC < 23 cm) included the age of women, birth intervals, dietary changes due to the current pregnancy, and nutritional knowledge. It is recommended that interventions focus on maternal nutrition education and child spacing, particularly emphasizing the needs of adolescent pregnant women.

DISCUSSION

Based on the results of the literature review that meets the inclusion criteria in this systematic literature review, nine articles found that the risk factors for malnutrition in pregnant women and chronic energy deficiency (CHD) consist of many factors. This study's systematic review is limited only to pregnant women's behavioral risk factors. The following are the findings of behavioral risk factors contained in the nine kinds of literature that have been collected.

3.1. Knowledge

Nutritional knowledge in pregnant women is a crucial factor that influences eating decisions and behaviors during pregnancy. Recent studies have shown that many pregnant women have inadequate nutritional knowledge, which may negatively impact their nutritional status. For example, research by Demisew et al, (2024) showed that only 30.8% of the participants had good knowledge of nutrition, while the other 69.2% had inadequate. This result aligns with research by Wati EK et al. (2024) carried out in one city in Indonesia, revealing that 76% of expectant mothers lacked sufficient nutritional knowledge. (Wati et al., 2024).

Statistics show that there is a significant relationship between the level of nutritional knowledge and the incidence of CED. (Wati et al., 2024), (Husna & Andika, 2019). As seen from the results of Husna A et al (2019), out of 80 respondents, 27 pregnant women had low knowledge, and among them, 37% experienced CED. In contrast, only 11.3% of 53 pregnant women with high knowledge experienced

CED. The analysis results showed a p=0.015 value and an Odds Ratio (OR) of 4.608, indicating that pregnant women with low knowledge had a 4.6 times greater risk of experiencing CED compared to those with high knowledge. (Husna & Andika, 2019).

Diddana TZ's 2019 study confirmed that pregnant women with poor nutrition knowledge were at a higher risk of malnutrition. The Odds Ratio (AOR) for women with poor nutrition knowledge was 3.03, which means they were 3.03 times more likely to experience malnutrition compared to women with good nutrition knowledge. (Diddana, 2019). A study in Southwest Ethiopia at Bench-Sheko and Kaffa Zone General Hospitals found that dietary knowledge among pregnant women showed a significant association with their nutritional status. Findings indicated that pregnant women with inadequate dietary knowledge were 3.25 times more likely to experience undernutrition compared to those with good dietary knowledge (AOR = 3.25, 95% CI: 1.94, 5.47) (Tilahun et al., 2022). A subsequent study in Silte Zone, Southern Ethiopia, also found that there was a significant association between pregnant women's knowledge of nutrition and their nutritional status. Pregnant women who had good knowledge tended to have better nutritional status. The p-value obtained was 0.015, with an Odds Ratio (OR) of 4.608 (Muze et al., 2020).

Based on these results, it can be seen that pregnant women who have good nutrition knowledge tend to be better able to fulfill their nutritional needs, thus reducing the risk of CED. Good knowledge allows mothers to make healthier and more balanced food choices and understand the importance of adequate energy and protein intake during pregnancy. This low knowledge contributes to the prevalence of undernutrition among pregnant women. Studies have found that pregnant women with insufficient knowledge about nutrition are more likely to be undernourished compared to those with good knowledge. (Demisew et al., 2024), (Tilahun, Fufa, and Taddesse, 2022), (Muze et al., 2020).

Taken together, these results suggest that good nutritional knowledge among pregnant women contributes to better fulfillment of nutritional needs, thereby reducing the risk of CED. Conversely, low knowledge contributes to undernutrition in pregnant women, indicating the need for nutrition education interventions to improve understanding of the importance of nutrition during pregnancy.

3.2. Attitude

The perspective of pregnant women regarding nutrition plays a crucial role in shaping their dietary habits and nutritional choices throughout pregnancy. These attitudes include the perceptions, emotions, and motivations that pregnant women have regarding the importance of good nutrition. Recent research by Demisew et al. (2024) showed that unfavorable attitudes towards nutrition were associated with the prevalence of undernutrition in pregnant women. Pregnant women who have unfavorable attitudes towards nutrition are more likely to experience malnutrition, which can impact their health and that of their fetus. This study found that pregnant women who did not have a positive perspective or attitude towards nutrition were more likely to have a low dietary diversity score (DDS), indicating that they did not consume a variety of foods necessary to meet their nutritional needs.(Demisew et al., 2024)

Furthermore, statistical analyses showed a significant association between pregnant women's attitudes and their nutritional status. In one study, a *p*=0.008 value and an Odds Ratio (OR) of 7.933 were obtained, indicating that pregnant women with negative attitudes had almost eight times greater risk of developing nutritional energy deficiency (CED) compared to those with positive attitudes. This finding confirms the importance of positive attitudes towards nutrition as a protective factor against the risk of undernutrition. (Husna & Andika, 2019).

A positive attitude towards nutrition not only encourages pregnant women to choose healthier and more nutritious foods but also increases their awareness of the importance of a balanced nutritional intake during pregnancy. Therefore, interventions that aim to increase positive attitudes towards nutrition among pregnant women are essential. Effective nutrition education programs can help change pregnant women's perceptions and motivations so that they can better make food choices that support their health and fetal development. Overall, pregnant women's attitudes towards nutrition play a significant role in determining their nutritional status. This study highlights the need for more attention to psychological and social aspects in efforts to modify the nutritional status of pregnant women, with the hope of reducing the prevalence of undernutrition and improving maternal and child health.

3.3. Antenatal Care (ANC)

ANC visits are an essential component of monitoring maternal and fetal health during pregnancy. ANC provides an opportunity to educate women on proper nutrition, the importance of a balanced diet, and how to manage mental health. By attending ANC, women can receive the necessary information and support to maintain their health and optimal fetal development. Antenatal visits often include education on nutrition and health during pregnancy. Mothers who visit health facilities for ANC tend to be better informed about their nutritional needs, which can help them make healthier food choices and improve their nutritional status. Antenatal care (ANC) visits or utilization is a significant behavioral factor. ANC service utilization is low if pregnant women access the service less than twice during the first and second trimesters, and high if twice or more. Mothers who regularly utilize ANC services tend to get better information and support on nutrition and health during pregnancy, which can help prevent Chronic Energy Deficiency (CED) (Wati et al., 2024).

Research on the undernutrition of pregnant women in rural communities in Southern Ethiopia suggests that antenatal care (ANC) visits play an important role in preventing undernutrition. The study has found that pregnant women who had at least one antenatal visit had an odds ratio (AOR) of 0.46, meaning they were 54% less likely to be undernourished compared to women who did not have ANC. This suggests that antenatal visits serve as a protective factor against undernutrition. (Zewdie et al., 2021). Meanwhile, Eastern Ethiopia also showed the same thing, that pregnant women who did not attend ANC had a higher risk of being undernourished. In the logistic regression analysis, women who did not receive antenatal care had an adjusted odds ratio (AOR) of 1.73, with a 95% confidence interval between 1.31 and 2.29. This suggests that women who did not attend ANC were almost twice as likely to be undernourished compared to those who did attend ANC. (Gebremichael et al., 2022) In Northeast Ethiopia, Disse City also experienced the same thing. ANC services are also a risk factor for nutritional problems.(Diddana, 2019)

Overall, these studies strengthen the argument that ANC is important for maternal and fetal health and a key strategy in preventing malnutrition, especially in resource-limited settings. Thus, improving access to and utilization of ANC services should be a priority in reducing the risk of malnutrition among pregnant women, especially in vulnerable communities.

3.4. Diet (Diet Diversity and Frequency)

A balanced diet is essential during pregnancy to support fetal growth and development as well as maternal health. Pregnant women need to consume a variety of foods that are rich in nutrients, including protein, vitamins, and minerals. (Muze et al., 2020). Not only that, but the variety of foods and frequency of meals are also determinants.

Diet in terms of food variety is identified as one of the important factors affecting the nutritional status of pregnant women. A diverse diet is essential to ensure that pregnant women get all the necessary nutrients to support their health and fetal development. Adequate nutrition during pregnancy contributes to healthy growth and development and reduces the risk of complications.

Research shows that pregnant women who have a diet with low diversity are more likely to experience malnutrition. Analyses showed that women with low levels of dietary diversity had a higher risk of undernutrition compared to those with more diverse diets. Low dietary diversity was identified as an independent predictor of undernutrition. Women who did not consume a wide variety of foods, including vegetables, fruits, protein, and carbohydrate sources, showed a higher prevalence of undernutrition. (Gebremichael et al., 2022). Women who consumed less than five food groups in the 24 hours before data collection were considered to have poor dietary diversity. Those with poor dietary diversity had an AOR of 5.92, indicating a higher risk of undernutrition. (Diddana, 2019).

Research by Diddana TZ (2019 found that 54.8% of pregnant women had poor dietary practices. This suggests that more than half of the studied population did not meet the standards of healthy dietary practices during pregnancy, which may contribute to nutritional problems. Poor dietary practices are directly related to inadequate nutritional status. Pregnant women who had poor dietary practices had an odds ratio (AOR) of 3.25, indicating that they were 3.25 times more likely to be undernourished compared to those who had good dietary practices. The study noted the eating frequency of pregnant women, where about 47% of them consumed less than three meals per day. Low meal frequency may contribute to inadequate nutrient intake, which is important for maternal health and fetal development. (Diddana, 2019).

Low dietary diversity and minimal meal frequency are independent predictors of undernutrition in pregnant women. Therefore, ensuring a balanced, diverse diet and adequate meal frequency during pregnancy is crucial to prevent malnutrition and related complications.

3.5. Food aversion

In the study, it was found that most pregnant women experienced food aversions. A total of 95 (42.6%) pregnant women reported that they avoided certain foods, with the main reason being the food's unpalatable taste or smell. Frequently avoided food types included cereals, dairy products, and coffee. This suggests that food aversions may affect the intake of important nutrients during pregnancy. Food aversions can cause pregnant women to avoid nutrient-rich foods, which are important for their health and fetal development. For example, avoiding dairy products may reduce calcium intake, which is important for fetal bone development.

Furthermore, about 58.6% of pregnant women reported avoiding at least one type of food during pregnancy. The reasons for this avoidance vary, including personal dislikes, religious beliefs, and culture. Avoidance of certain foods may reduce the intake of essential nutrients required during pregnancy. (Diddana, 2019). Aversion to staple foods such as ‘Enset’ and cereals may result in a lack of carbohydrates and energy, which are necessary during pregnancy. Hormonal changes during pregnancy can affect the sense of smell and taste, making previously favored foods unappealing. Pregnancy symptoms such as nausea and vomiting can also exacerbate aversion to certain foods, making pregnant women more likely to avoid foods that trigger these symptoms. (Gebre et al., 2024).

The limitation of this study is that the researcher did not discuss all the risk factors found in the article, but only limited it to behavioral risk factors. Therefore, risk factor variables that correlate with malnutrition or chronic energy deficiency in pregnant women

were not included in this study. This study was also limited to English-language articles, so other valuable articles in local languages were not discussed in this study.

CONCLUSION

Meeting nutritional needs during pregnancy is closely related to behavioral risk factors, including knowledge, attitudes, and practices. Good nutrition knowledge enables pregnant women to understand the importance of a balanced nutritional intake, while positive attitudes towards nutrition encourage motivation to adopt healthy eating habits. Practices, such as a diverse diet, adequate meal frequency, and regular antenatal care (ANC) visits, are actions that support the fulfillment of nutritional needs. Conversely, lack of knowledge, negative attitudes, and poor practices, such as low dietary diversity and food aversions, increase the risk of undernutrition. Therefore, increasing knowledge, changing attitudes, and strengthening good nutritional practices are integral strategies to support maternal health and fetal development.

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CONFLICT OF INTEREST

All researchers declare that no conflict of interest arose in the process of preparing this article. All data used in this study were obtained objectively and transparently, without any influence from certain parties that could affect the results or interpretation of the research.

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FORMS OF SOCIAL SUPPORT FOR HEMODIALYSIS PATIENTS IN IMPROVING FLUID RESTRICTION ADHERENCE: A SCOPING REVIEW

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ABSTRACT

Background: *Hemodialysis is a renal replacement therapy that requires patient compliance with fluid restrictions to prevent complications and improve quality of life. Hemodialysis patients often experience difficulties complying with fluid restrictions, which can lead to fluid overload and affect the effectiveness of therapy. Social support from various parties, such as family, medical personnel, and fellow patients, is vital in increasing patient motivation and ability to comply with fluid restrictions. This article aims to explore the forms of social support for hemodialysis patients in improving fluid restriction compliance.*
Methods: *This scoping review design uses the Arksey and O'Malley model to analyze the scoping review. Literature sources used were through online databases, namely PubMed, Science Direct, Garuda, Proquest, Global Index Medicus, Wiley, and Cochrane from 2014 to 2024. Identification and analysis using Preferred Reporting Items for Systematic Reviews and Meta Analysis for Scoping Review (PRISMA-SR)*
Results: *With 13 articles analyzed, this article summarizes the effect of social support on fluid restriction compliance in the sense that it is effective for improving fluid restriction compliance with hemodialysis.*
Conclusion: *Social support is efficacious in improving compliance with fluid assurance in hemodialysis patients.*

Keywords: *Social Support, Haemodialysis, Chronic Kidney Disease*

INTRODUCTION

Chronic Kidney Disease (CKD) is characterized by structural or functional damage to the kidneys and/or a decrease in the glomerular filtration rate (GFR) to less than 60 mL/min/1.73m² for more than three months. It is a global health issue with a high prevalence rate and a significant financial burden (Bustam et al., 2022). According to the World Health Organization (WHO, 2018), CKD causes approximately 850,000 deaths annually and ranks 12th as a global cause of death. Based on data from CKD patients, the worldwide prevalence of CKD increased from approximately 2,786,000 people in 2018 to 3,018,860 people in 2019, reaching 3,200,000 people in 2020. CKD has various causes, including diabetes mellitus, hypertension, ischemia, infections, obstruction, toxins, autoimmune diseases, and infiltrative disorders. Progressive CKD can lead to serious complications, including cardiovascular disease, hypertension, anemia, bone mineral disorders, electrolyte imbalances, diabetes mellitus, and metabolic acidosis (Bello et al., 2017). Progressive CKD, without adequate management, can rapidly progress to the final stage, known as end-stage kidney disease (ESKD), requiring interventions such as dialysis (Hsu et al., 2016). As a result, hemodialysis is often the most commonly applied treatment for CKD patients

Hemodialysis is the final step in improving kidney function and is one treatment option for chronic kidney failure (Putri & Afandi, 2022). Hemodialysis is the most commonly used treatment method in Indonesia. According to the 2017 Indonesian Renal Registry (IRR) report, 77,892 patients actively underwent hemodialysis therapy that year, and 30,843 new patients started hemodialysis in the same year (IRR, 2018). Hemodialysis (HD) is

the most essential treatment for CKD patients (Guo et al., 2020). Therefore, it is necessary for patients with chronic kidney failure, regardless of its associated impacts.

One of the common issues faced by many hemodialysis patients is non-adherence, particularly in fluid intake restrictions. Non-adherence to fluid intake limitations can lead to an increase in body fluid volume, potentially causing complications in chronic kidney disease (Herlina & Rosaline, 2021). Patient non-adherence is influenced by beliefs, attitudes, personality, understanding of instructions, social isolation, and family support (Anugrah & Wahyudi, 2023). Patients undergoing hemodialysis need to adhere to fluid intake restrictions strictly (Hunter et al., 2023). A significant number of patients undergoing hemodialysis have a history of non-adherence to fluid intake restrictions (Nadri et al., 2020). The adherence rate of hemodialysis patients to the recommended fluid restrictions remains low (Beerendrakumar et al., 2018).

The success of dialysis treatment in patients with end-stage renal disease largely depends on their ability to adhere to clinical requirements and make necessary lifestyle changes. Studies show that the social support received by patients positively correlates with better health outcomes in various chronic diseases (Sousa et al., 2019). Therefore, this scoping review aims to provide an overview of social support for hemodialysis patients. Family support is a crucial component of social support, assisting and aiding patients undergoing therapy (Daniswara, 2015).

METHOD

This review was conducted to summarize information from previous studies, aiming to provide an overview of the types of social support implemented to improve hemodialysis patients' adherence to fluid restrictions. Additionally, this review offers recommendations for enhancing fluid restriction strategies in the future. The methodological framework used in this review follows the approach proposed by Arksey and O'Malley (Westphaln et al., 2021). This approach consists of five stages:

Stage 1: Research Question

The research question in this review is: What social support has been implemented to improve adherence to fluid restrictions in hemodialysis patients?

Stage 2: Relevant Studies and Search Terms

This review will examine the social support provided to hemodialysis patients to enhance adherence to fluid restrictions. The articles included must be published within the last ten years. The article search will be conducted through online databases, including PubMed, ScienceDirect, Garuda, ProQuest, Global Index Medicus, Wiley, and Cochrane.

Tabel 1. Keywords for databased

No	Database	Keywords	Articles	Date Access
1	Pubmed	((hemodialysis OR dialysis treatment OR renal dialysis OR kidney dialysis OR dialysis therapy[MeSH Terms]) AND (social support OR social care OR community support OR interpersonal support OR peer support OR support system[MeSH Terms])) AND (fluid restriction OR fluid management OR fluid intake limitation OR fluid control OR restricted fluid regimen [MeSH Terms])	54	May 17, 2024
2	Cochrane Library	hemodialysis OR dialysis treatment OR renal dialysis AND social support OR community support OR peer support AND fluid restriction OR fluid management OR restricted fluid regimen	75	May 17, 2024

No	Database	Keywords	Articles	Date Access
3	Garuda	hemodialysis and fluid restrictions	14	May 17, 2024
4	Global Index Medicus	hemodialysis OR dialysis treatment AND social support OR community support AND fluid restriction OR fluid management	10	May 17, 2024
5	wiley Online Library	((hemodialysis OR dialysis treatment OR renal dialysis OR kidney dialysis OR dialysis therapy[MeSH Terms]) AND (social support OR social care OR community support OR interpersonal support OR peer support OR support system[MeSH Terms])) AND (fluid restriction OR fluid management OR fluid intake limitation OR fluid control OR restricted fluid regimen [MeSH Terms])	69	May 24, 2024
6	Science direct	Forms of social support for hemodialysis patients in increasing compliance with fluid restrictions	81	June 29, 2024
7	Proquest	Forms of social support for hemodialysis patients in increasing compliance with fluid restrictions	245	June 29, 2024

The inclusion and exclusion criteria in this review are determined based on the Population, Concept, and Context (PCC) model and are listed in Table 2. The search is limited to full-text articles published in English and Indonesian from 2014 to 2024.

Table 2. Article Eligibility Criteria

Criteria	
Population	Focusing on patients diagnosed with chronic kidney disease undergoing hemodialysis
Consept	Social Support
Context	Fluid restrictions

Stage 3: Study Selection

Study Extraction from Databases

Figure 1 illustrates the process, screening results, and manuscript extraction criteria after the initial search based on the study's inclusion and exclusion criteria. In this stage, studies were selected by screening titles relevant to the research question, resulting in 548 articles. The screening then continued to the abstract level. A total of 124 duplicate articles were identified and excluded. Further selection based on titles removed 177 articles, as they contained only theoretical discussions and were not original research articles. After this filtering process, 247 articles remained. Additional exclusions were made for articles that did not examine the forms of social support for hemodialysis patients in improving adherence to fluid restrictions or lacked completeness. Ultimately, 13 articles were selected for analysis, focusing on the types of social support provided to hemodialysis patients to enhance adherence to fluid restrictions.

Challenges in Study Extraction

All abstracts retrieved from the article search were downloaded into Mendeley software. After deduplication, the abstracts were exported to the Rayyan software program for further screening and selection (Ouzzani et al., 2016; Simarmata et al., 2022).

Stage 4: Data Extraction

We extracted data on the characteristics of journal articles relevant to the research topic, including publication year, country of study, research findings, study design, and sample size. This step aims to facilitate the data extraction process for compiling the research.

Stage 5: Thematic Summary and Key Findings

The literature findings are used to identify results based on emerging keywords. This review will analyze all articles through titles, abstracts, and full texts, followed by a screening

process to identify differences and duplicate articles. All analyzed articles contain information on social support in improving adherence to fluid restrictions in hemodialysis patients.

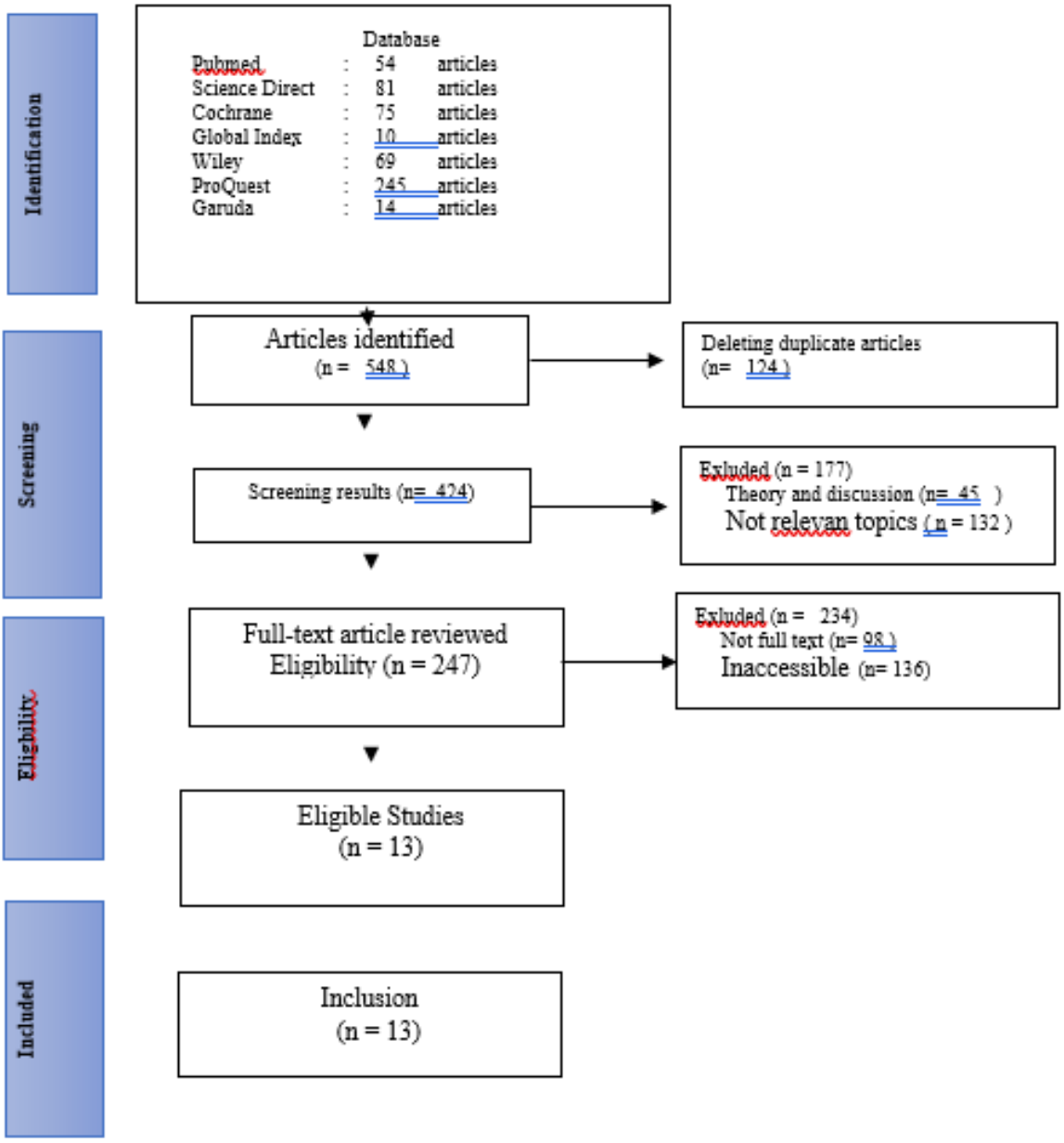


Figure 1. Prisma Diagram

Study Characteristics

Of the 13 research articles analyzed, 7studies were conducted in Indonesia. (Noviana & Zahra, 2022), (Wijaya & Padila, 2019), (Aini et al., 2017), (Susilawati et al., 2018), (Mailani et al., 2021), (Sulistyaningsih et al., 2020), (Eka et al., 2024). Iran 2 articles (Ahrari et al., 2014), (Asadizaker et al., 2022), Brazil 1 articles (da Silva et al., 2016) dan Yunani 1 articles (Theodoritsi et al., 2016), in korea 1 articles (Lee et al., 2021), and 1 articles in south africa (Chironda & Bhengu, 2019).

Table 3. Summary of literature

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
da Silva et al., (2016)	*Social support of adults and elderly with chronic kidney disease on dialysis*	A descriptive cross-sectional study with a sample size of 103 participants	Brazil	Patients with chronic kidney disease receive high levels of social support, both instrumental and emotional, primarily from their families. The average instrumental support score is 3.81, while the average emotional support score is 3.92.	"Instrumental support and emotional support." "The average instrumental social support is 3.81, indicating that individuals receive practical and material assistance at an adequate level. In contrast, emotional support has an average of 3.92, suggesting that the attention, empathy, and psychological support received are at a relatively high level."
Noviana & Zahra, (2022)	*Social support and self-management among end-stage renal disease patients undergoing hemodialysis in Indonesia*	Cross-sectional study (sample 107 participants)	Indonesia	High levels of social support contribute to improved self-management in patients with ESRD. This study emphasizes the importance of functional social support in self-management interventions, highlighting the need for collaboration among healthcare providers, chronic kidney disease communities, and patient companions. The reliability analysis showed a Cronbach's alpha of 0.815 for the MOS-SSS and 0.620 for the HDSMI, with a 95%	Functional support "More than half of the patients (51%) had high social support, and 53% had good self-management. There was a significant relationship between social support and self-management ($p=0.027$; $\alpha=0.05$; odds ratio 95% CI = 2.386)."

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
				confidence interval (CI) of 2.386 (1.097–5.193), indicating a significant relationship between social support and self-management effectiveness.	
Wijaya & Padila, (2019)	The relationship between family support, education level, and age with adherence to fluid intake restrictions in end-stage renal disease patients undergoing hemodialysis.	Cross-sectional Study (sample 108 participants)	Indonesia	Family support can enhance patients' adherence to fluid intake restrictions, which is crucial for reducing the risk of complications during hemodialysis therapy.	Family support "It is expected that family support can be maximized to create compliant behaviors, enabling clients to become aware of fluid intake restrictions by informing family members, especially through the hemodialysis clinical setting that continuously serves clients with End Stage Renal Disease undergoing hemodialysis treatment."
Ahrari et al., (2014)	*The Relationship Between Social Support and Adherence of Dietary and Fluids Restrictions among Hemodialysis Patients in Iran*	Korelational study (sample 237 partisipant)	Iran	Social support helps improve adherence to diet and fluid management. The reliability analysis showed a Cronbach's alpha of 0.71, with a confidence interval (CI) of 0.31 (0.18, 0.52) for other types of support and 0.51 (0.32, 0.80) for support from friends.	Other Support (Medical Professionals), friends and family support Patients receiving more social support tend to be more compliant with dietary and fluid restrictions and show lower levels of phosphorus and potassium in laboratory test results. Nurses play a crucial role in finding various ways to provide social support to patients and encouraging families to support their hemodialysis patients.

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
Theodoritsi et al., (2016)	*Factors Associated with the Social Support of Hemodialysis Patients*	Observasional study (interviews) (sample 258 partisipants)	Yunani	Higher levels of support are associated with better treatment outcomes and adherence to therapeutic regimens. The overall Cronbach's alpha is 0.804, with subscale scores of 0.78 for family support, 0.74 for friend support, and 0.78 for significant others.	Friends and Family support "Out of 258 participants, 53.9% were male, and 65% were over 60 years old. Patients felt very supported by their family and close relatives, but support from friends was lower. Family support and support from close relatives were significantly related to marital status, living arrangements, and the number of children. Meanwhile, support from friends was associated with age, marital status, and living arrangements."
Asadizaker et al., (2022)	*Predictors of Adherence to Treatment in Hemodialysis Patients : A Structural Equation Modeling*	Cross sectional study (sample 500 partisipants)	Iran	Social support and self-efficacy play crucial roles in adherence to treatment among hemodialysis patients. Higher levels of social support are correlated with better adherence rates. The scores are 0.89 for the Beck Depression Inventory (BDI), 0.86 for social support, and 0.51 (0.32, 0.80) for support from friends.	Support from friends Social support shows a medication adherence mean score of 720.7 (SD = 246.64). Higher levels of social support correlate with better adherence levels, with a correlation of 0.89 for the Beck Depression Inventory (BDI), 0.86 for social support, and 0.51 (95% CI: 0.32, 0.80) for support from friends.
Aini et al., (2017)	The relationship between family support and adherence to fluid intake	A quantitative correlational study with a cross-sectional approach was conducted, involving 86 respondents.	Indonesia	High family support improves patient adherence to fluid intake	Familiy support The family support with compliance to fluid intake restriction has a correlation of ρ

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
	restrictions among chronic kidney disease (CKD) patients undergoing hemodialysis in the hemodialysis unit of RSUD dr. H Soewondo Kendal.			restrictions. This study shows that family interventions in managing chronic kidney disease (CKD) can enhance therapy outcomes and the patient's quality of life. The results indicate a p-value = 0.000 and a correlation coefficient (r) = 0.789**,** demonstrating a strong positive relationship.	(Rho) 0.789 (P-value 0.000), indicating that there is a significant relationship between family support and adherence to fluid intake restrictions among patients undergoing hemodialysis.
Susilawati et al., (2018)	Self-Efficacy and Social Support in Hemodialysis Patients for Improving Adherence to Fluid Intake Restrictions	Mixed Methods, Sequential Explanatory (sample 76 quantitative, 6 qualitative respondents)	Indonesia	There is a significant relationship between self-efficacy and social support with adherence to fluid intake restrictions in hemodialysis patients. The findings indicate that self-efficacy has a moderate positive correlation (r = 0.476, p = 0.001)**,** while social support has a weak positive correlation (r = 0.308, p = 0.007) with adherence.	Familiy support "...yeah, it's life motivation, so don't complain because this is a trial... we have to be optimistic because we never know how long we'll live, but if we're healthy, we have to keep going..." "...oh, it's good, especially from my wife, kids, right... they are patient... they give support..." "...yeah, they take me and later pick me up... yeah, just support me, just go with it, enjoy it, as long as it goes smoothly..." "...yeah, they support everything... they all support me to do dialysis... sometimes they come here when I'm off from school... my kids are waiting for me while I'm on hemodialysis..." "...yeah, they just support me, just

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
					accept it... it's God's will... before, they used to take me... sometimes they pick me up... yeah, they support me, just be patient..." "...yeah, they're willing to take me, just accept it... actually, they like to remind me not to eat what I'm not allowed to... they motivate me... sometimes my husband or kids take me..." Support from friends: "...my friends also motivate me... they give advice..." "...Alhamdulillah, everyone supports me... yeah, just motivation, giving advice... just motivating..." "...they just cheer me on... they tell me to stay strong..."
Lee et al., (2021)	*Socioecological Factors Affecting Fluid Restriction Adherence Among Korean Patients Receiving Hemodialysis: A Qualitative Study*	Qualitative descriptive study (23 patients) and individual interviews (4 patients)	Korean	Socioecological Factors Influencing Adherence to Fluid Intake Restrictions in Hemodialysis Patients, Including Age, Gender, and Family Support	Family support "When I eat with my family, they say, 'Mom, please don't drink too much, or you'll suffer later.' They care about me very much. I will continue to control my fluid intake for the rest of my life."Lee et al., (2021) (p. 5) "Initially, my family cooked separately for me, but now the whole family eats renal-friendly meals. We no longer have soup. Because my family does so much to help me, I have to follow that plan closely."Lee et al., (2021) (p. 5)

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
					Other Support (Medical Professionals) "I appreciate that the nurses in the dialysis unit are helpful and supportive, so I eat and drink what they recommend. When we make a plan together, like promising to only gain a few kilograms by the next visit, it becomes easier to stick to that plan."Lee et al., (2021) (p. 5)
Mailani et al., (2021)	*The Fluid Management Experience in Patients with Chronic Kidney Disease Undergoing Hemodialysis in Indonesia: A Qualitative Study*	A qualitative study with a phenomenological approach was conducted (sample 14 respondents)	Indonesia	The study highlights the suffering and distress experienced by CKD patients who adhere to fluid intake restrictions. It emphasizes the importance of clear information regarding fluid prescriptions and the crucial role of family and dialysis staff support in helping patients manage their condition effectively.	Family support "... My children always remind me not to drink too much water. This practice helps keep my weight gain around 1 kg between dialysis sessions. However, sometimes it can go up to 2 kg, so it ranges between 1-2 kg." Mailani et al., (2021) (p. 6) Other Support (Medical Professionals) "...when the doctor comes, he always advises me to limit my fluid intake and manage my food consumption because my weight gain between dialysis sessions is always over 3 kg, and I experience edema in my legs."Mailani et al., (2021) (p. 8) Support from friends "... when I gain about 4 kg, Yaya (her name) ... monitors my appetite and fluid intake, or you'll get

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
					bigger... just kidding."Mailani et al., (2021) (p. 7)
Chironda & Bhengu, (2019)	*Motivators of adherence to integrated management among patients with chronic kidney disease: A qualitative study*	A phenomenological design (sample 12 respondents)	South Africa	Family support, anxiety about kidney transplant eligibility, support from other patients, awareness of non-adherence complications, and fear of being removed from the CKD program are the primary motivators for adherence in integrated management. These factors are crucial in encouraging patients to effectively follow fluid restrictions and treatment protocols.	Family support "My husband and children always remind me about my hemodialysis sessions at the hospital and the restrictions on medication, fluid intake, and diet at home. They always make sure that I have followed the correct diet, taken the prescribed medication, and consumed only 500 ml of fluid per day"Chironda & Bhengu, (2019) (p. 4)
Sulistyaningsih et al., (2020)	*The experience of adherence among hemodialysis patients undergoing therapeutic regimen: a qualitative study*	a qualitative phenomenological design (sample 10 respondents)	Indonesia	The study emphasizes the importance of self-care**,** the crucial role of nurses**,** the decline in physical activity ability**,** and the supporting and inhibiting factors of adherence. Nurses play a key role in educating and motivating patients, while physical limitations and external support systems influence adherence to	Support from friends "My colleagues support me..."Sulistyaningsih et al., (2020) (p. 5)

Author, Years	Title	Study Design (Sample Size)	Country	Result	Forms of Social Support
				fluid restrictions and treatment compliance.	
Eka et al., (2024)	Qualitative Study on Family Support for Adult Patients with Kidney Failure Undergoing Dialysis at Bahteramas Hospital, Southeast Sulawesi, 2023	Documentation techniques, recording, interviews, and observations.	Indonesia	Family support for patients with kidney failure includes informational, instrumental, evaluative, and emotional assistance.	Emotional & Instrumental Support Patients experience fear in facing their illness, and family members provide strength and encouragement through motivational words Eka et al., (2024) (p. 4) Families also consistently accompany patients during dialysis sessions, offering emotional and instrumental support Eka et al., (2024) (p.7)

RESULT AND DISCUSSION

RESULTS

This study indicates that patients with chronic kidney disease who have high social support, both instrumental and emotional, particularly from family, significantly influence adherence to fluid restriction (da Silva et al., 2016). Another study states that good family support can improve patient adherence to fluid restriction, which is crucial in reducing the risk of complications during hemodialysis therapy (Wijaya & Padila, 2019). A study indicates tactical support helps improve adherence to dietary and fluid management (Ahrari et al., 2014), Another study by Asadizaker et al. (2022), states that social support and self-efficacy play an essential role in adherence to treatment among dialysis patients.

Another study indicates that high family support enhances patients' adherence to fluid intake restrictions (Aini et al., 2017). Another study states that social support and self-efficacy are significantly related to adherence to fluid restriction (Susilawati et al., 2018). According to the study by Noviana & Zahra, (2022) high social support improves self-management in patients with ESR. Meanwhile, another study shows that higher support is associated with better treatment outcomes and adherence to therapeutic regimens (Theodoritsi et al., 2016). The study by Eka et al. (2024), found that family support impacts hemodialysis patients. Other studies indicate that family support and support from medical professionals can enhance adherence to fluid restriction (Lee et al., 2021). Mailani et al. (2021) It is stated that family support, support from medical professionals, and support from friends play a significant role in adherence to fluid restriction. According to Sulistyaningsih et al. (2020), support from friends is highly beneficial in adhering to fluid restrictions. Additionally, another study states that family support is highly beneficial for adherence to hemodialysis and fluid restriction (Chironda & Bhengu, 2019).

DISCUSIONS

This review aims to describe the forms of social support that influence adherence to fluid restriction in hemodialysis patients. The success of fluid restriction adherence is influenced by several factors, including beliefs, education, knowledge, information/educational media, psychological stress, attitudes, motivation, and family support. The media plays a crucial role in helping patients understand and retain information. Providing education on fluid restriction is highly beneficial for patients, as it serves as a comprehensive tool for health promotion and education, ultimately improving knowledge, attitudes, health behaviors, and quality of life (Gultom et al., 2020; Jamiatun et al., 2015; Zahroh & Giyartini, 2018). Another study shows that social support can enhance adaptability, depending on the source and type of support provided (Jiang et al., 2015). Family, emotional, instrumental, physical, and informational support can improve adherence to fluid restriction (Adinda Tifany & Nani Safuni, 2024). This indicates that social support has a significant positive impact on self-management. Mediation model analysis reveals that expectations fully mediate the effect of social support on self-management (Parviniannasab et al., 2024).

Hemodialysis patients generally experience moderate levels of hope, social support, anxiety, and depression while adhering to dietary and fluid restrictions. Considering the relationships between hope, social support, spiritual well-being, anxiety, depression, and stress, interventions incorporating these variables may enhance hope among hemodialysis patients (Disease et al., 2020). Another study recommends forming a multidisciplinary team to address the physical, emotional, and social needs of patients undergoing hemodialysis, which should also involve family members in the care process (Gebrie et al., 2023). Social support, sense of coherence (SOC), and self-management are closely interconnected, with research indicating that social support directly influences self-management and SOC. Social support and SOC account for 69% of the variation in self-management. These findings suggest that healthcare professionals can enhance self-management among hemodialysis patients by strengthening social support and SOC strategies (Song et al., 2022). Adherence to fluid restriction is influenced by various factors that can be categorized into three groups. Personal factors, such as physical symptoms, lack of self-control, and social relationship factors, including social stigma and social support, all play a crucial role. Organizational factors, such as a lack of practical education, cultural dietary habits (e.g., Korean food culture), and insufficient support from policies and public health systems, also affect adherence. The main barriers include physical issues and difficulties in self-control, while supporting factors include risk awareness, positive self-assessment, adequate knowledge, and sufficient social support (Lee et al., 2021). Social support provides not only physiological benefits, such as improving adherence to fluid restriction, dietary compliance, medication adherence, and hemodialysis but also psychological benefits, including enhancing confidence in the treatment and reducing stressors that are crucial for hemodialysis patients. Therefore, strengthening well-structured and sustainable social support for individuals can significantly improve fluid restriction adherence and overall quality of life. A multidisciplinary approach involving healthcare professionals, family, friends, and the community is essential to ensure successful fluid restriction in hemodialysis patients. Further research is also needed to optimize the most effective forms of social support and identify long-term strategies to enhance adherence through social support for hemodialysis patients. The limitation of this review is that it only includes studies in two languages, English and Indonesian, in the analysis.

CONCLUSION

Non-adherence to fluid restriction in hemodialysis patients is influenced by several factors, including beliefs, education, knowledge, the type of information or educational media used, psychological stress, and social support. Social support plays a crucial role in improving adherence to fluid restriction by enhancing family, peer, emotional, instrumental, and other forms of support (including medical professionals, religious organizations, and community groups). These social support systems are the most significant contributors to improving fluid restriction adherence in hemodialysis patients.

CONFLICT OF INTEREST

There are no conflicts of interest in this study

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PREVALENCE OF DIABETES MELLITUS AND PROPORTION OF TYPE OF DIABETES MELLITUS CONTROL IN INDONESIA: 2023 IHS DATA ANALYSIS

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ABSTRACT

Background: *Diabetes mellitus is the mother of all diseases in Indonesia, and if left untreated, it can cause various other diseases such as heart disease, stroke, and kidney disease. Based on IHS data in 2023, the types of diabetes mellitus control available in Indonesia include dietary control, exercise, and herbal choices. Based on the analysis of IHS data in 2023, this study aimed to examine the relationship between the prevalence of diabetes mellitus based on a doctor's diagnosis and the types of diabetes mellitus control available in Indonesia.*
Methods: *This research is quantitative and cross-sectional, using aggregate data from the 2023 Indonesian Health Survey report covering 38 provinces divided into seven regions. After the normality test was met, analysis was carried out using the Pearson correlation test.*
Results: *The results showed that the proportion of DM control type (diet management) was not related to the incidence of diabetes mellitus (p = 0.07), and the proportion of DM control type (exercise) (p = 0.36), but was related to the proportion of DM control type (herbal alternatives) (p = 0.00).*
Conclusion: *This study concludes that the type of DM control (eating and exercise management) is not related to the incidence of diabetes mellitus based on a doctor's diagnosis in Indonesia. In contrast, the type of DM control (herbal alternatives) is associated with the incidence of diabetes mellitus based on a doctor's diagnosis in Indonesia.*
Keywords: *Diabetes Mellitus, Eating Management, Exercise, Herbal Alternatives, Indonesian Health Survey (IHS).*

INTRODUCTION

Non-communicable diseases (NCDs) are diseases that are not contagious and are not caused by vector transmission, viruses, and bacteria but are more caused by behavior and lifestyle. The dominance of health problems in society today is shifting from infectious diseases to non-communicable diseases (Kemenkes, 2023).

Diabetes is a chronic metabolic disease characterized by elevated blood glucose (or blood sugar) levels, which over time can lead to serious damage to the heart, blood vessels, eyes, kidneys, and nerves. The most common is type 2 diabetes, usually in adults, which occurs when the body becomes resistant to insulin or does not make enough insulin. Type 1 diabetes, formerly known as juvenile diabetes or insulin-dependent diabetes, is a chronic condition in which the pancreas produces little or no insulin on its own (World Health Organization, 2024).

WHO says around 830 million people worldwide have diabetes, the majority living in low- and middle-income countries. More than half of people living with diabetes are not receiving treatment. Both the number of people with diabetes and the number of people with untreated diabetes have been steadily increasing over the past few decades (World Health Organization, 2024).

Diabetes mellitus is a non-communicable disease that is the mother of all diseases in Indonesia. The Director of Prevention and Control of Non-Communicable Diseases of the Ministry of Health, Dr. Eva Susanti, S. Kp., M. Kes., told Mediakom on Thursday, December 14, 2023, that "Diabetes is the mother of all diseases. If not controlled, it can cause heart disease, stroke, a kidney disease

which will be even more serious, the costs will be even more severe" (Rokom, 2024)

This is supported by data from the International Diabetes Federation (IDF) which states that Indonesia is ranked fifth in the country with the highest number of diabetes sufferers with 19.5 million sufferers in 2021 and is predicted to reach 28.6 million in 2045 (IDF, 2021)

The 2018 Basic Health Research report states that nationally the prevalence of diabetes mellitus based on a doctor's diagnosis in the population of all ages is at 1.5% with a total of 1,017,290 people. With DKI Jakarta as the first province with the highest prevalence, namely, 2.6%, followed by DI Yogyakarta at 2.4%, and East Kalimantan and North Sulawesi are ranked 3rd at 2.3% (Kementrian Kesehatan RI, 2018). This has become a concern for the Ministry of Health to be able to carry out prevention and control of diabetes mellitus.

Prevention and control of diabetes mellitus in Indonesia is carried out so that healthy individuals remain healthy, people who have risk factors can control their risk factors so as not to get diabetes and people who already suffer from DM can control their disease so that complications or premature death do not occur. Diabetes prevention efforts are carried out through education, early detection of NCD risk factors, and management according to standards.

Prevention of type 2 diabetes mellitus is primarily aimed at people who are at risk of developing type 2 DM. The goal is to slow down the onset of type 2 DM, maintain the function of insulin-producing cells in the pancreas, and prevent or slow down the onset of heart and blood vessel disorders. Risk factors for type 2 DM are divided into modifiable and non-modifiable factors. Prevention efforts are made by reducing modifiable risks (Kemenkes, 2013). Prevention of type 2 DM in people at risk is basically by changing lifestyles that include exercise, weight loss, and diet management. Based on an analysis of a group of people with intensive lifestyle changes, diabetes prevention is most related to weight loss. According to research, a 5-10% weight loss can prevent or slow the onset of type 2 DM. It is also recommended to have a healthy diet, consisting of complex carbohydrates, containing little saturated fat, and high in soluble fiber. Calorie intake is aimed at achieving the ideal body weight (Kemenkes, 2013).

In the 2023 Indonesian Health Survey (IHS) report, types of DM control include diet, exercise, and herbal alternatives (Kemenkes BKPK, 2023). Research on the relationship between the incidence of diabetes mellitus and DM control has existed before, some of which have discussed diet and physical activity. Research at the Manggis 1 Health Center showed a significant relationship between diet and physical activity with blood sugar levels in patients with type 2 diabetes mellitus at the Manggis 1 Health Center (Astutisari et al., 2022) Research in the Internal Medicine Polyclinic of Dr. Rasidin Padang Hospital also showed the same results regarding the relationship between diet and physical activity with the incidence of DM, namely, there is a relationship between diet and physical activity with the incidence of DM (Dafriani, 2017). Therefore, the author is interested in conducting the same research by adding another type of control, namely herbal alternatives.

This study aims to describe the proportion of DM control types (dietary management, exercise, and herbal alternatives) based on 7 regions of Indonesia, describe the prevalence of DM based on doctor's diagnosis at all ages in 7 regions of Indonesia, and analyze the relationship between the incidence of Diabetes Mellitus based on doctor's diagnosis and the proportion of DM control types in Indonesia. The results of this study are expected to provide a basis for more appropriate interventions in dealing with DM incidence in Indonesia.

METHODS

This study is a quantitative study with a cross-sectional design to identify the relationship between the proportion of DM control types and the incidence of Diabetes Mellitus in the population of all ages based on a doctor's diagnosis in Indonesia, the independent variable is the prevalence of diabetes mellitus based on the doctor's diagnosis, while the dependent variable is the proportion of the type of DM control (diet, exercise, and herbal alternative arrangements). This study uses aggregate data from the 2023 Indonesian Health Survey (IHS) Report. This 2023 IHS Report can be accessed by age by downloading it at the following link: https://www.badankebijakan.kemkes.go.id/SKI-2023-dalam-angka/. Indonesian Health Survey (IHS) 2023 is a national-scale evaluation activity with a cross-sectional, non-interventional, and observational design. This design allows researchers to measure the proportion of DM control types in the population of all ages based on a doctor's diagnosis at a certain point in all provinces in Indonesia.

The population in this study were residents of all ages diagnosed with DM in all provinces in Indonesia. The sample in this study were residents of all ages in 38 provinces in Indonesia, which are grouped into seven regions, namely Sumatra, Java-Bali, NTB-NTT, Kalimantan, Sulawesi, Maluku, and Papua. This study used a sampling technique in the form of a total population, which covered 514 districts/cities and involved 586 randomly selected households. The number of residents of all ages diagnosed with DM based on a doctor's diagnosis was 877,531 people.

The data used in this study are secondary data from the 2023 Indonesian Health Survey (IHS) Report, which was conducted in the period from August to October 2023. This survey collects health information, including data on doctor's diagnosis, namely diabetes mellitus (DM), and data on types of DM control in the population of all ages. The research variable is the proportion of types of DM control in the population of all ages which include dietary management, exercise, and herbal alternatives.

This research instrument uses a questionnaire developed by the IHS 2023 team, which includes information related to individual interview information, individual information, respondent identity, and non-communicable diseases. The prevalence of DM based on a doctor's diagnosis at all ages is calculated using the formula: the population of all ages who have been diagnosed with DM by a doctor divided by the respondents interviewed multiplied by 100%. The proportion of types of DM control in all ages based on a doctor's diagnosis is calculated using the formula: each type of DM control (dietary management, exercise, herbal alternatives) divided by the population of all ages who have been diagnosed by a doctor multiplied by 100%. The data collection process was carried out by means of direct interviews with respondents from each household selected as a sample.

Data analysis was performed using the SPSS version 25 application. Univariate analysis was performed to describe the characteristics of each variable, using the middle and variance measures (mean, standard deviation, minimum value, and maximum value). To analyze the relationship between the prevalence of Diabetes Mellitus based on a doctor's diagnosis and the type of DM control variables (dietary management, exercise, and herbal alternatives), bivariate analysis was performed, using the Pearson correlation test, after the assumption of data normality was met, if not met, bivariate analysis using the spearman test.

The implementation of the 2023 Indonesian Health Survey (IHS) has obtained ethical approval from the Health Research Ethics Commission HK.01.07/MENKES/156/2023, to ensure that

all research procedures meet the ethical standards applicable in health research in Indonesia.

RESULTS AND DISCUSSION

Table 1 shows that the proportion of DM control types in dietary management is highest in the Papua regional area, namely in the South Papua province (94.7%) and the proportion of DM control types in dietary management is lowest in the Java-Bali regional area, namely in the West Java province (73.4%). The proportion of DM control types in sports is highest in the Papua regional area, namely in the Papua province (59.7%) and the proportion of DM control types in sports is lowest in the Papua regional area, namely in the Papua Mountains province (24.2%). The proportion of DM control types in herbal alternatives is highest in the Papua regional area, namely in the Central Papua province (62.0%) and the proportion of DM control types in herbal alternatives is lowest in the Java-Bali regional area, namely in the DI Yogyakarta province (20.4%). Nationally, the proportion of DM control types in Indonesia is consecutively dietary management (85.0%), exercise (40.7%), and herbal alternatives (36.7%).

The results of this study indicate that there are significant differences in the proportion of types of DM control (dietary management, exercise, and herbal alternatives) and the incidence of diabetes mellitus based on doctor's diagnoses between regions in Indonesia. In general, the proportion of dietary management in Indonesia is at a higher level than the proportion of exercise and the proportion of herbal alternatives. The proportion of dietary management nationally is at 81.4%, the proportion of exercise is 41.7% and the proportion of herbal alternatives is at the lowest level, which is 29.2%.

Table 1. Distribution of the Proportion of types of DM control

Region	Dietary Management			Exercise			Herbal Alternatives		
	Min	**Max**	$\underline{X}$ ± **SD**	**Min**	**Max**	$\underline{X}$ ± **SD**	**Min**	**Max**	$\underline{X}$ ± **SD**
Sumatera	81.1	91.0	86.2 ± 3.3	27.8	48.2	39.1 ± 7.0	28.2	44.0	37.2 ± 4.5
Jawa and Bali	73.4	90.2	82.2 ± 5.0	40.1	53.6	44.9 ± 5.2	20.4	29.7	24.4 ±3.9
Nusa Tenggara	87.3	87.4	87.4 ± 0.1	41.6	43.5	42.6 ± 1.3	36.6	39.9	38.2 ± 2.3
Kalimantan	74.4	89.3	81.8 ± 6.2	29.5	46.6	37.7 ± 8.0	32.5	44.4	37.0 ± 4.5
Sulawesi	81.4	90.4	84.6 ± 3.5	32.9	39.5	35.7 ± 2.5	26.5	48.4	38.8 ± 7.6
Maluku	85.1	90.7	87.9 ± 4.0	31.4	40.0	35.7 ± 6.1	37.4	43.9	40.7 ± 4.6
Papua	80.6	94.7	87.4 ± 5.4	24.2	59.7	47.3 ±13.2	27.7	62.0	45.9 ± 13.5
Indonesia	**73.4**	**94.7**	**85.0 ± 4.7**	**24.2**	**59.7**	**40.7 ± 8.1**	**20.4**	**62.0**	**36.7 ± 9.3**

This result illustrates the vast difference between the three types of DM control and the type of control that is still rarely applied is herbal alternatives and exercise while dietary management has been widely implemented. Even so, the balance of the three types of DM control has a significant impact on the incidence of diabetes mellitus in Indonesia. The proportion of types of DM control (dietary management, exercise, and herbal alternatives) are all highest found in the Papua region, while the proportion of dietary management and the lowest herbal alternatives are found in the Java and Bali regions, while the lowest proportion of exercise is found again in the Papua region, precisely in the Papua mountainous province. This shows that there is inequality in the implementation of DM control between regions, the highest and lowest proportion of sports are all found in the Papua region, and only different provinces from one region can show very significant inequality.

Table 2 shows that the highest prevalence of Diabetes Mellitus is in the Java and Bali regional areas (3.1%) and the lowest prevalence of DM is in the Papua regional area

(0.2%). The national prevalence rate of Diabetes Mellitus in Indonesia is at an average of 1.4%. Table 2 shows the highest incidence of diabetes mellitus based on doctor's diagnosis was found in the Java and Bali regions with a percentage of 3.1% while in the Papua region, the incidence of diabetes mellitus was in the lowest position with a percentage of 0.2%.

Table 2. Distribution of Diabetes Mellitus Prevalence Based on Doctor's Diagnosis

Region	Minimum	Maximum	$\underline{X} \pm$ SD
Sumatera	0.9	2.1	1.4 ± 0.3
Jawa and Bali	1.7	3.1	2.2 ± 0.6
Nusa Tenggara	0.7	1.3	1.0 ± 0.4
Kalimantan	1.2	2.3	1.6 ± 0.4
Sulawesi	1.0	2.1	1.5 ± 0.4
Maluku	0.6	0.9	0.8 ± 0.2
Papua	0.2	1.2	0.9 ± 0.4
Indonesia	**0.2**	**3.1**	**1.4 ± 0.6**

This shows that there are several factors that can influence the incidence of diabetes mellitus based on a doctor's diagnosis, namely the factor of access to fast food which is more widely available, the factor of low physical activity, and the wrong lifestyle factor. This difference is what creates the inequality between the Java Bali and Papua regions which have a very significant percentage difference.

DM can occur at any age, whether in children, adults, or the elderly, but is more common in adults over 45 years of age (Veridiana & Nurjana, 2019). DM is one of the non-communicable diseases that tend to increase both globally and nationally and has been threatening since a young age. Morbidity and mortality due to DM tend to increase in almost all countries including Indonesia. DM is known as a silent killer because sufferers are often unaware and when it is discovered after complications occur (Veridiana & Nurjana, 2019).

Table 3 shows that the proportion of DM control types (dietary management) is not related to the incidence of diabetes mellitus (p-value 0.074), and the proportion of DM control types (exercise) (p-value 0.359), but is related to the proportion of DM control types (herbal alternatives) (p-value 0.0001).

Table 3. Relationship between the prevalence of Diabetes Mellitus and the proportion of types of DM control in Indonesia

Diabetes Mellitus Incidence	Proportion of DM Control Types		
	Dietary Management	Exercise	Herbal Alternatives
Beta	-2.331	2.121	-8.538
Costans	88.343	37.662	49.017
Correlation Coefficient (r)	-0.293	0.153	-0.538
p-value	**0.074**	**0.359**	**0.0001**

Based on the beta coefficient value on the proportion of DM control types (dietary management and herbal alternatives) shows that the higher the level of proportion of DM control types, the lower the incidence of diabetes mellitus, while the proportion of DM control types (exercise) shows that the higher the level of proportion of DM control types, the lower the incidence of diabetes mellitus. The high proportion of DM control types (herbal alternatives) is strongly related to the low incidence of diabetes mellitus (r = -0.538).

DM control with Dietary Management

The proportion of dietary management in Table 2 shows the highest percentage found in the Papua region with a figure of 97.4%, which is inversely proportional to Table 1 showing the lowest percentage in the Papua region with a figure of 0.2%. This shows a relationship between dietary regulation and the incidence of diabetes mellitus in the region. However, this is not in line with the results of the analysis that has been carried out as a whole (nationally). Table 3 shows that there is no significant relationship between the prevalence of diabetes mellitus and the proportion of DM control with Dietary Management (p-value 0.07> 0.05). This raises the argument that a doctor's diagnosis is less accurate than direct blood sugar measurements, which makes the results of the analysis very different from reality. In contrast to the research of Faradilla et al., this study emphasizes the importance of

a good diet and balanced physical activity in preventing and managing diabetes mellitus. With the results of this study, a poor diet can increase the risk of DM up to 0.23 times compared to individuals who have a good diet (Faradilla Diwanta, Suci Maghfirah, 2024).

Research conducted by Nurlaili et al on the relationship between the four pillars of type 2 DM control with average blood sugar levels showed that most respondents with appropriate dietary arrangements had an average blood sugar level of <160 mg/dl, which was 50.9%. Most respondents with inappropriate dietary arrangements had an average sugar level of ≥160 mg/dl, which was 22.7%. Based on the statistical test conducted, $\rho = 0.002$ ($\rho < \alpha$) was obtained, which means that this study has a relationship between dietary arrangements obtained with average random blood sugar (Putri & Isfandiari, 2013).

The wrong diet is 9.5 times more at risk of developing type 2 diabetes compared to the right diet. This statement was revealed by a study by Yessica and Dewi in 2021 which examined the relationship between diet and the incidence of diabetes mellitus, with the results of the study showing a significant relationship between Diet and the incidence of Type 2 Diabetes Mellitus at the Namorambe Health Center, Deli Serdang Regency in 2021 (Tarihoran & Silaban, 2022).

Controlling normal blood sugar levels requires good and correct DM diet management with the recommended 3J diet control (Amount, Schedule, and Type) so that blood sugar levels can be controlled. (Susanti & Bistara, 2019). The solution to lowering blood sugar levels is to increase physical activity and change diet. (Faradilla Diwanta, Suci Maghfirah, 2024). The results of the study conducted with 90 respondents showed that there is a relationship between diet and blood glucose levels in type II Diabetes mellitus sufferers (Kurniasari et al., 2021).

DM control with Exercise

Table 2 on the proportion of sports also shows the highest percentage found in the Papua region with a figure of 59.7%, which is inversely proportional to Table 1 showing the lowest percentage in the Papua region with a figure of 0.2%. Table 3 shows that there is no significant relationship between the prevalence of diabetes mellitus and the proportion of DM control with exercise (p-value 0.36> 0.05). This shows many differences with several studies that state that there is a relationship between sports and the incidence of diabetes mellitus. Yora and Silvia's research shows that physical exercise can lower blood glucose levels because physical exercise will increase glucose use by active muscles. One of the physical exercises is leg gymnastics (Nopriani & Silvia Ramadhani Saputri, 2021). This also shows that the doctor's diagnosis is less accurate, because it only diagnoses from clinical symptoms that are similar to symptoms of other diseases, thus increasing the risk of misdiagnosis. The doctor's diagnosis without blood sugar measurement laboratory tests is very inaccurate and different from the reality. And this discrepancy may also be caused by differences in the intensity and type of exercise performed as well as other factors such as a person's genetics.

In a study on the relationship between the four pillars of type 2 DM control with average blood sugar levels conducted by Nurlaili et al., they took blood samples from long-term patients with Diabetes Mellitus who routinely checked their random blood sugar levels for three consecutive months at the Pacarkeling Health Center in Surabaya, totaling 53 respondents with several independent variables, one of which was exercise. This study showed that most respondents who exercised had an average blood sugar level of <160 mg/dl, which was 50.9%. Most respondents who did not exercise had an average sugar level of ≥160 mg/dl, which was 18.8% with a p-value of 0.017. This shows that

there is a relationship between exercise and average random blood sugar levels (Putri & Isfandiari, 2013).

A decrease in average blood sugar levels can occur with a regular walking exercise program. In this study, walking in the elderly has a significant effect on blood sugar levels in type 2 diabetes mellitus (Hasanuddin et al., 2020). The American Diabetes Association states that regular physical activity has a major impact on blood glucose and overall health in patients with type 2 diabetes (Rahmadiya & Dahlia, 2022).

Regular physical activity can control blood sugar levels. Light activity has a greater chance (3.198 times) than moderate activity (1.933 times) of getting DM when compared to people who do heavy activity. Research conducted by Nyoman et al. stated that the more intense the physical activity, the less likely it is to get DM (Veridiana & Nurjana, 2019).

DM Control with Herbal Alternatives

In Table 2, the proportion of DM control types (herbal alternatives) shows the highest percentage found in the Papua region with a figure of 62.0%, which is inversely proportional to Table 1 showing the lowest percentage in the Papua region with a figure of 0.2%. This shows a relationship between dietary regulation and the incidence of diabetes mellitus in the region. In line with this, the results of the analysis have been carried out as a whole (nationally). Table 3 shows that there is a significant relationship between the prevalence of diabetes mellitus and the proportion of DM control with Herbal Alternatives (p-value 0.00 <0.05). Different from the two previous types of DM control, herbal alternatives are strongly negatively related to the incidence of diabetes mellitus in Indonesia. This statement leads to the implementation of DM control with herbal alternatives according to the incidence of diabetes mellitus based on a doctor's diagnosis. The research at the Palimanan Health Center, Cirebon Regency in 2024 is in line with the results of this analysis which states that there is a significant effect between Moringa leaf tea on reducing random blood sugar levels (GDS) in diabetes mellitus patients (Rakhmawati & Futriani, 2024).

Research at Arjawinangun Regional Hospital, Cirebon Regency show the relationship between diabetes control behavior and blood glucose levels of outpatients with diabetes mellitus, showed that there was a relationship between the regularity of drug consumption and the blood glucose levels of respondents (Anani et al., 2012). The behavior of regular consumption of anti-diabetic drugs by respondents is one of the efforts to control blood glucose control or complications that can arise. If DM patients are not compliant in carrying out the treatment program recommended by doctors, nutritionists or other health workers, it can worsen their condition (Anani et al., 2012).

CONCLUSION

This study concludes that the method of obtaining data on the incidence of diabetes mellitus greatly influences the results of the analysis, where in this study the incidence of diabetes mellitus based on a doctor's diagnosis shows that dietary regulation is the most widely applied method of controlling diabetes mellitus (DM) in Indonesia compared to exercise and herbal alternatives. The prevalence of DM was not significantly related to DM control through dietary management and exercise, but DM prevalence was significantly related to DM control through herbal alternatives. Regional differences in the implementation of DM control and the incidence of this disease indicate the need for a more specific approach in its management strategy. These findings emphasize the importance of a balance of control methods and diagnostic accuracy in overcoming DM in Indonesia. For further researchers, it is hoped that they will be better

and try to analyze the relationship between the incidence of diabetes mellitus based on blood sugar measurements and the type of DM control in Indonesia in order to obtain more accurate results.

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CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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