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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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