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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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