

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

Frenty Berliana^{1*}, Demsa Simbolon¹, Dira Puspa Dewi¹, Merchi Dwi Anggeni¹,
Miftahurrohmah¹, Tisse Aprilia¹

¹ Bachelor of Applied Nutrition and Dietetics, Nutrition,
Health Polytechnic of the Ministry of Health Bengkulu

Corresponding author: fretyberlianna@gmail.com

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	$\bar{X} \pm SD$
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	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$	Min	Max	$\bar{X} \pm SD$
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	-0.041	0.475	-0.058
coefficient (r)	0.806	0.003	0.731
p-value			

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 diuresis osmotic. 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 (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 (≥ 4000 gram 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.

ACKNOWLEDGMENT

I am very grateful to all parties who have helped in completing and providing input on this manuscript. Hopefully this manuscript is useful not only to the author but also to readers and everyone.

CONFLICT OF INTEREST

All authors have no conflict of interest.

REFERENCES

- Amelia, C. M., & Fayasari, A. (2020). Faktor yang Mempengaruhi Remaja Siswa SMP Negeri 238 Jakarta Konsumsi Sayur dan Buah. *J.Gipas*, 4(1), 94–105. <https://doi.org/10.20884/1.jgps.2020.4.1.2642>
- Anisa, N. A., & Indarjo, S. (2021). Perilaku Sehat Pasien Diabetes Mellitus Tipe 2 yang Mengalami Gangren di Puskesmas Halmahera Kota Semarang. *Indonesian Journal of Public Health and Nutrition*, 1(1), 72–68. <https://doi.org/10.15294/ijphn.v1i1.45150>
- Fitriani, R. (2017). Analisis Faktor Risiko Kejadian Diabetes Melitus Gestasional Di Wilayah Kerja Puskesmas Kecamatan Somba Opu Kabupaten Gowa Tahun 2016. *Molucca Medica*, 10(1), 110–126. <https://doi.org/10.30598>
- Hardianto, D. (2021). Telaah Komprehensif Diabetes Melitus: Klasifikasi, Gejala, Diagnosis, Pencegahan, Dan Pengobatan. *Jurnal Bioteknologi & Biosains Indonesia (JBBi)*, 7(2), 304–317. <https://doi.org/10.24252/psb.v7i1.24229>
- Hutapea, Y. F. U., Paninsari, D., Andrayani, K. H., & Harefa, L. (2024). Hubungan Diabetes Melitus Gestasional dengan Masalah Pada Bayi Baru Lahir. *MAHESA : Malahayati Health Student Journal*, 4(8), 3282–3296. <https://doi.org/10.33024/mahesa.v4i8.15156>
- Ispriantari, A., & Priasmoro, D. P. (2017). Penerimaan Diri pada Remaja Dengan Diabetes Tipe 1 di Kota Malang. *Dunia Keperawatan*, 5(2), 115–120. <https://doi.org/10.20527/dk.v5i2.4116>
- Kemendes. (2023). Survei Kesehatan Indonesia. In *Badan Kebijakan Pembangunan Kesehatan*.
- Kuwanti, E., Budiharto, I., & Fradianto, I. (2023). Hubungan Pola Makan dengan Kadar Gula Darah Penderita Diabetes Melitus Tipe 2: Literature Review. *MAHESA : Malahayati Health Student Journal*, 3(6), 1736–1750. <https://doi.org/10.33024/mahesa.v3i6.10495>
- Lasmawati, E., Putri, D. F., & Nuryani, D. D. (2023). Analisis faktor yang berhubungan dengan kejadian diabetes melitus tipe 2. *Holistik Jurnal Kesehatan*, 17(4), 334–344. <https://doi.org/10.33024>
- Lestari, Zulkarnain, Sijid, & Aisyah, S. (2021). Diabetes Melitus: Review Etiologi, Patofisiologi, Gejala, Penyebab, Cara Pemeriksaan, Cara Pengobatan dan Cara Pencegahan. *UIN Alauddin Makassar*, 1(2), 237–241. <https://doi.org/10.24252>
- Marzel, R. (2021). Terapi pada DM Tipe 1. *Jurnal Penelitian Perawat Profesional*, 3(1), 51–62. <https://doi.org/10.37287/jppp.v3i1.297>
- Milita, F., Handayani, S., & Setiaji, B. (2021). Kejadian Diabetes Mellitus Tipe II pada Lanjut Usia di Indonesia (Analisis Riskesdas 2018). *Jurnal Kedokteran Dan Kesehatan*, 17(1), 9–20. <https://doi.org/10.24853/jkk.17.1.9-20>
- Nur, A., Fitria, E., Zulhaida, A., & Hanum, S. (2016). Hubungan Pola Konsumsi dengan Diabetes Melitus Tipe 2 pada Pasien Rawat Jalan di RSUD Dr. Fauziah Bireuen Provinsi Aceh. *Media Penelitian Dan Pengembangan Kesehatan*, 26(3), 145–150. <https://doi.org/10.22435/mpk.v26i3.4607>
- Sari, K. N. F. P., Cintari, L., & Kusumayanti, G. A. D. (2019). Gambaran Pola Konsumsi Sayur dan Buah Serta Kadar Glukosa Darah Penderita Diabetes Mellitus di Rumah Sakit Umum Daerah Wangaya Denpasar. *Jurnal Ilmu Gizi: Journal of Nutrition Science*, 9(1), 59–67. <http://ejournal.poltekkes-denpasar.ac.id/index.php/JIG/article/view/jig799>

- Sihombing, A. G. G. (2022). Rasionalitas Pengobatan Diabetes Melitus Tipe II. *Medika Utama*, 3(1), 2175–2179. <http://jurnalmedikahutama.com>
- Silalahi, L. (2019). Hubungan Pengetahuan dan Tindakan Pencegahan Diabetes Mellitus Tipe 2. *Jurnal PROMKES*, 7(2), 223. <https://doi.org/10.20473/jpk.v7.i2.2019.223-232>
- Sulistiyorini, E., Noviati, T. D., & Ma'arif, M. Z. (2023). Konsumsi Buah dan Sayur dan Kejadian Diabetes Melitus pada Usia Produktif. *Jurnal Kesehatan Mahardika*, 10(1), 7–12. <https://doi.org/10.54867/jkm.v10i1.146>
- Syahrani, M. S., Soelistyorini, D., & Dwipajati, D. (2024). Hubungan Urutan Waktu Makan Buah, Sayur, dan Kualitas Tidur Terhadap Gula Darah dan Tekanan Darah Pasien Diabetes Melitus Tipe 2. *ARGIPA (Arsip Gizi Dan Pangan)*, 9(1), 86–98. <https://doi.org/10.22236/argipa.v9i1.12890>
- Wati, R., Dahliah, & Abdullah, F. (2024). Faktor – Faktor yang Mempengaruhi Kejadian Diabetes Melitus Gestasional. *Jurnal Kesehatan Masyarakat*, 8(2), 2802–2807. <https://doi.org/10.31004/prepotif.v8i2.28377>
- Yosmar, R., Almasdy, D., & Rahma, F. (2018). Survei Risiko Penyakit Diabetes Melitus Terhadap Masyarakat Kota Padang. *Jurnal Siains Farmasi & Klinis*, 5(2), 134–141. <https://doi.org/10.25077/jsfk.5.2>