



The Risk Level of Type 2 Diabetes Mellitus in University Students: A Descriptive Study

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A B S T R A C T

University students are vulnerable to sedentary lifestyles, characterised by poor diet and minimal physical activity, which increase the risk of type 2 diabetes mellitus (T2DM). Early detection is essential to reduce the prevalence of T2DM among young individuals. This study aimed to assess the risk levels of T2DM among university students using the FINDRISC-BI screening tool and analysed the distribution of risk levels—low, slightly increased, moderate, and high—along with contributing factors. A descriptive quantitative method with a cross-sectional design was utilised, conducted in March 2025. A total of 251 respondents participated using a convenience-cluster sampling technique. The study found 64.1% of participants at low risk, 25.1% at slightly increased risk, 6.8% at moderate risk, and 4.0% at high risk of T2DM. Many students showed inadequate physical activity and lacked daily consumption of vegetables and fruits. In conclusion, while most students were at low risk, a significant portion exhibited elevated risk levels, highlighting the need for further medical assessment and preventive strategies.

INTRODUCTION

Diabetes mellitus (DM) is a prevalent non-communicable disease that continues to rise in incidence globally, posing a significant public health challenge. According to the International Diabetes Federation (IDF), as of 2021, an estimated 537 million individuals aged 20–79 years were affected by DM. This number is projected to increase to 643 million by 2030 and further to 783 million by 2045, highlighting the growing burden of diabetes on healthcare systems worldwide (IDF, 2022). In 2021, the prevalence of DM in Southeast Asia reached 90 million individuals, with projections indicating an increase to 113 million by 2030 and 151 million by 2045. Notably, approximately 73.7% of DM cases in the region remain undiagnosed, suggesting a significant gap in disease detection and management. Given this high proportion of undiagnosed cases, the actual global prevalence of DM is likely to surpass the reported figures provided by the International Diabetes Federation (IDF), underscoring the need for improved screening and diagnostic efforts worldwide.

According to the Basic Health Research conducted by the Indonesian Ministry of Health in 2013, the prevalence of DM among individuals aged over 15 years in Indonesia was recorded at 1.5%. By 2018, this figure had risen to 2.0%, reflecting a 0.5% increase over five years (KEMENKES RI, 2019). In Yogyakarta Province, 2.4% of the total population across all age groups were diagnosed with DM, while the prevalence among individuals aged over 15 years was higher at 3.1% (KEMENKES RI, 2019). The

rising incidence of DM is closely associated with various risk factors that contribute to its development (Delfina et al., 2021). Preventive measures play a crucial role in mitigating the growing burden of DM, particularly through early detection strategies aimed at assessing risk factors from a young age. Early screening and intervention efforts are essential in reducing the prevalence and impact of DM in affected populations.

Early detection of DM risk plays a crucial role in preventing the increasing incidence of the disease (Savitri et al., 2022). Several risk factors contribute to the development of DM, including genetic predisposition, hormonal influences, family history, age, obesity, and lifestyle-related factors such as an unhealthy diet, physical inactivity, and smoking (KEMENKES RI, 2024). Among the at-risk populations, university students represent a vulnerable group due to lifestyle habits that may predispose them to DM (Sattu et al., 2024). Implementing preventive strategies, including early screening and promoting healthier lifestyles, is essential to mitigating the long-term impact of DM.

Students are typically individuals in the early stages of adulthood, generally ranging in age from 18 to 24 years (Fitriani et al., 2022). The demands of academic life, coupled with unhealthy habits, can significantly influence students' lifestyles (Sattu et al., 2024). According to Murtiningsih et al. (2021), contemporary student lifestyles are often characterised by the frequent consumption of fast food, junk food, and foods high in carbohydrates and sugars, alongside limited physical activity and prolonged sedentary behaviour. These patterns place students at an elevated risk of developing T2DM (Murtiningsih et al., 2021). With the advancement of technology, young individuals increasingly utilise mobile applications to order food and beverages online, a trend that has contributed to the rise of sedentary behaviour among this population (Asriati, 2023). In campus environments, the growth of culinary businesses, such as cafeterias, and the academic demands placed on students encourage the frequent use of these establishments, whether for social interactions or completing assignments. Many cafeterias predominantly offer fast food and sugary beverages, further exacerbating sedentary habits and unhealthy dietary patterns. Sedentary lifestyles have been linked to an elevated risk of T2DM in young adults, increasing the likelihood of developing the condition by 1.55 times. This is attributed to the lack of physical activity, which impairs the body's ability to convert glucose into energy (Nurfauziah et al., 2023).

In line with the explanation, the American Diabetes Association (ADA) states that individuals over the age of 45 are at increased risk of developing DM, with T2DM most commonly occurring among those aged 45 to 64 years (ADA, 2024). However, in recent years, the incidence of DM has been observed among individuals in early adulthood, particularly those aged 18 to 24 years. Nugroho et al. (2023) found that following the initial diagnosis of T2DM in adolescents and young adults aged 15 to 24 years, 3.3% of participants were classified as having excess abdominal circumference, and 6.7% were identified as being

overweight, both of which are recognised risk factors for the development and progression of T2DM. (Nugroho et al., 2023).

Based on the phenomenon, early identification and assessment of T2DM risk factors play a critical role in preventing the rising incidence of diabetes. One effective strategy involves screening for T2DM risk factors among young adults, including university students.

METHOD

This study employed a descriptive quantitative design with a cross-sectional approach. The research was conducted at the Nursing Study Program, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, from March 6 to 8, 2025. The population consisted of active nursing students from 2021, 2022, 2023, and 2024 cohorts, totaling 676 individuals. A sample of 251 respondents was selected using a convenience-cluster sampling technique. The researcher divided the population into four clusters based on academic year and selected 63 students from each cohort who were most accessible, easily contacted, or willing to participate. The inclusion criteria were active nursing students from FKIK UMY in the specified cohorts, aged 18 to 24 years, and willing to participate in the study. The exclusion criteria included students from programs other than nursing, inactive nursing students, and those outside the 18–24 age range.

The research instrument used in this study was the Finnish Diabetes Risk Score–Bahasa Indonesia (FINDRISC-BI) questionnaire, which is an effective tool for assessing the 10-year risk of developing T2DM. This instrument identifies T2DM risk in otherwise healthy individuals through a risk scoring system, thereby contributing to early prevention efforts and helping to curb the increasing prevalence of diabetes in Indonesia (Pertiwi et al., 2021). FINDRISC-BI demonstrated excellent predictive validity for T2DM in cross-sectional assessments, with an area under the curve (AUC) value of 0.935. Furthermore, the reliability of the instrument, as measured by Cronbach's alpha, was 0.727. These findings indicate that the questionnaire's reliability falls within the acceptable range, supported by an AUC between 0.7 and 0.79 (Pertiwi et al., 2021).

This study received ethical approval from the Health Research Ethics Committee (Komite Etik Penelitian Kesehatan/KEPK) of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta (FKIK UMY), with approval no. 035/EC-KEPK FKIK UMY/I/2025. Prior to data collection, researchers informed the student coordinators of 2021, 2022, 2023, and 2024 cohorts that a risk screening for T2DM would be conducted, with 63 participants to be selected from each cohort. Participants were selected based on accessibility, ease of contact, availability, and willingness to participate. Data collection was conducted according to the prearranged schedule for each class year. Before completing the questionnaire, all respondents received a detailed explanation of the study and provided informed consent.

Participants were given access to the questionnaire via a Google Form barcode and were provided with measuring tools to record their height, weight, and waist circumference. These measurements were conducted directly by the researcher to ensure accuracy. Upon completing the questionnaire, respondents received a small token of appreciation. The collected data were subsequently reviewed for completeness and accuracy prior to analysis.

RESULT

Table 1 Frequency distribution of T2DM risk factors based on FINDRISC-BI

Sub-Variables Risk Factors	Category	Total	
		N	Percentage (%)
Age	Under 45 years	251	100.0
	45-54 years	0	0.0
	55-64 years	0	0.0
	Above 64 years	0	0.0
IMT	Less than 25 kg/ m ²	168	66.9
	25-30 kg/m ²	57	22.7
	More than 30 kg/m ²	26	10.4
Circumference Waist	Women <80 cm, Male <90 cm	182	72.5
	Women 80-88 cm, Male 94-102 cm	29	11.6
	Women > 88 cm, Men >102 cm	40	15.9
Activity Physique	Yes, vigorous physical activity 30 minutes/day	72	28.7
	No, moderate physical activity (walking, housework/ vigorous physical activity 30 minutes/week)	179	71.3
Consumption of Fruits and Vegetables	Every day (eat vegetables and fruit 5x/day)	74	29.5
	Not every day (consume vegetables and fruit <5x/day)	177	70.5
Consumption of Anti- Hypertensive Drugs	No	235	93.6
	Yes	16	6.4
History of High Blood Sugar	No	208	82.9
	Yes	43	17.1
Family History of DM	No	164	65.3
	Yes: grandparents, aunts, uncles, or first cousins (not biological)	61	24.3
	Yes: parents, older or younger siblings	26	10.4
DMT2 Risk Level	Risk Low	161	64.1
	Risk A little Increase	63	25.1
	Medium Risk	17	6.8
	High Risk	10	4.0
	Very High Risk	0	0.0

DISCUSSION

Factors associated with T2DM risk are based on FINDRISC-BI.

1. Age

In this study, all respondents were under the age of 45 years (100%), and therefore, age did not contribute as a risk factor for T2DM in the sample population. This finding is consistent with the study by Suharno et al. (2024), which reported that individuals aged 45 to 65 years are at a higher risk of developing DM compared to those aged 18 to 44 years (Suharno & Nisa, 2024). Age is one of the factors associated with

the incidence of T2DM, as increasing age is linked to a higher likelihood of glucose intolerance. This condition results in a decline in the body's ability to metabolize glucose effectively, thereby elevating the risk of developing T2DM (Delfina et al., 2021). As individuals age, the functional capacity of various organs declines, which can lead to reduced insulin sensitivity and diminished metabolic activity, including impaired glucose metabolism. These physiological changes contribute to an increased risk of developing T2DM (Haris & Kristianti, 2020). However, the findings of this study offer a different perspective, indicating that T2DM is not solely influenced by age. Several respondents in this study, despite being under 45 years old, were identified as having multiple risk factors for developing T2DM. This aligns with the findings of Andini et al. (2024), who reported that their study participants were also under the age of 45 and demonstrated the presence of several risk indicators for T2DM. These results suggest that young adults may also be at significant risk and should be included in early screening and preventive efforts (Andini et al., 2024). This may occur because young adulthood is considered a productive stage of life, during which individuals often engage in numerous activities and responsibilities. As a result, they may neglect healthy lifestyle practices, thereby increasing the risk of developing DM and failing to engage in preventive behaviors (Ramadhani & Khotami, 2023).

2. Body Mass Index (BMI)

Based on the results of this study, most respondents had a BMI below 25 kg/m², with 168 individuals (66.9%) classified in the normal BMI category. This suggests that most participants had a proportionate body weight relative to height. However, 57 respondents (22.7%) had a BMI ranging from 25 to 30 kg/m², while 26 respondents (10.4%) had a BMI greater than 30 kg/m². According to the general BMI classification, a BMI between 25 and 30 kg/m² falls into the Obesity Class I category, while a BMI exceeding 30 kg/m² is classified as Obesity Class II (KEMENKES RI, 2025). Previous research has demonstrated a significant association between BMI and the risk of developing T2DM, indicating that individuals with higher levels of body fat are at greater risk of developing the disease (Ruku et al., 2022). Supporting previous findings, this study identified 83 young adults who were at risk of developing T2DM, which may be attributed to obesity. An increased BMI is influenced by various lifestyle-related factors, including excessive body weight, physical inactivity, and high consumption of carbohydrate, all of which are recognized risk factors for obesity and, subsequently, for T2DM (Hafizi et al., 2024). The substantial academic workload, combined with a sedentary lifestyle often influenced by prolonged use of social media, may contribute to an increased BMI among medical faculty students (Badaruddin et al., 2024). According to Strati et al. (2024), obesity resulting from unhealthy lifestyle behaviors is a major contributing factor to the early onset of T2DM in young adults (Strati et al., 2024).

3. Waist Circumference

In this study, the waist circumference of respondents was predominantly within the normal range, with 182 individuals (72.5%) having a waist circumference of less than 80 cm for women and less than 90 cm for men. This suggests that most respondents either had a normal waist circumference or were free from central obesity. However, 40 individuals (15.9%) had waist circumferences between 80–88 cm for women and 94–102 cm for men, while 29 individuals (11.6%) had waist circumferences exceeding 88 cm for women and 102 cm for men, indicating a higher risk for central obesity. These findings indicate that 69 respondents had waist circumferences exceeding the normal range. An elevated waist circumference is a clinical indicator of overweight or central obesity, which is a major risk factor for the development of degenerative diseases such as DM. Therefore, waist circumference measurement is considered an effective method for predicting central obesity and assessing the risk of related health conditions (Panna et al., 2021). Central obesity can be influenced by several factors, including dietary habits characterized by high glycemic index foods, frequent consumption of fast food, physical inactivity, and socio-economic conditions (Nugroho & Sudirman, 2020). Consistent with the researcher's findings, several students reported that they frequently consumed fast food due to its convenience and quick availability. Moreover, with the advancement of technology, many respondents reported using electronic devices such as smartphones to order food online, a behavior that contributes to physical inactivity and sedentary habits. This is supported by the physical activity distribution data, which indicates that a considerable number of respondents engage in insufficient physical activity thereby increasing the risk of central obesity. Central obesity is a critical public health concern, as it is strongly associated with various metabolic disorders and increases the risk of chronic diseases. (Rahmaniah et al., 2023). According to Cao et al. (2024), central obesity is associated with a 1.72 times increased risk of developing DM (Cao et al., 2024).

4. Physical Activity

The table shows that many respondents, 179 individuals (71.3%), engaged in moderate physical activity. In this study, moderate physical activity such as walking, performing household chores, or engaging in vigorous physical activity for 30 minutes per week was identified as a risk factor for T2DM. The lack of sufficient physical activity among respondents can be attributed to their demanding schedules as health students, which leaves them with limited time for exercise. When free time is available, many respondents choose to rest rather than engage in physical activity. Physical activity is closely linked to metabolic diseases, as a lack of regular exercise, defined as at least 30 minutes of physical activity per day or 3 times per week, can lead to the accumulation of fat in the body. This accumulation, combined with insufficient insulin to convert glucose into energy, results in an increased risk of developing T2DM and elevated blood glucose levels (Murtiningsih et al., 2021). The lack of physical activity among respondents can lead to elevated blood sugar levels, as insufficient physical activity prevents the proper

utilization of glucose. As a result, glucose remains in the bloodstream, causing an increase in blood sugar levels beyond normal ranges (Sattu et al., 2024). Furthermore, as technology continues to advance, it has led to negative health consequences, including a reduction in physical activity. This decrease in physical activity contributes to the accumulation of body fat, which can result in overweight or obesity. (Badaruddin et al., 2024). The lack of physical activity can increase the likelihood of obesity, which, in turn, is a significant risk factor for T2DM among the respondents in this study.

5. Consumption of vegetables and fruits

The results of this study revealed that many respondents, 177 individuals (70.5%), did not consume vegetables and fruit daily (<5 times/day). This suggests that insufficient daily consumption of vegetables and fruits may increase the risk of developing T2DM among young adults. This finding aligns with the research conducted by Sarifah et al. (2023), which found that individuals who consume fewer fruits and vegetables have a 6.889 times greater risk of developing T2DM compared to those who consume an adequate amount (Sarifah & Siyam, 2023). The findings of this study revealed that the presence of eateries offering fast food and sugary drinks, particularly in campus cafeterias, contributes to students' dietary habits. The researchers also found that students tend to consume more fast food due to its convenience and appeal. This is consistent with the research by Sattu et al. (2024), who noted that many students, particularly those living away from home in boarding houses, opt for fast food because it is easily accessible, often available through quick online ordering options (Sattu et al., 2024). Research by Wahyudi et al. (2024) demonstrates that students primarily consume fast food due to its convenience, speed, and appealing taste (Wahyudi et al., 2024). Additionally, the types of fast food consumed by students include burgers, pizza, kebabs, snacks, instant noodles, fried foods, and fried chicken. Consumption of fast food at least once a week has been shown to have a positive correlation with high fat intake, thereby increasing the risk of developing T2DM. (Murtiningsih et al., 2021).

6. Consumption of Anti-Hypertensive Drugs

The results indicated that many respondents (235 individuals, 93.6%) did not take antihypertensive medications, suggesting that most did not have a history of hypertension. However, 16 respondents (6.4%) were using antihypertensive drugs, which may indicate a history of high blood pressure. This could be attributed to various factors, such as genetic predisposition, stress, or an imbalanced diet, including the consumption of foods high in sodium, such as fast food or junk food. Junk food refers to foods that are typically high in calories, fat, sugar, and salt (Fardlillah, 2024). In line with the research conducted by Haris et al. (2023), the type, quantity, and timing of food consumption must be considered, as these factors can significantly affect an individual's blood pressure (Haris & Kristianti, 2020). According to Meher et al. (2023), hypertension is influenced by several factors, including age, overweight (obesity), alcohol consumption, family history of hypertension, and the intake of foods high in salt

(Meher et al., 2023). Supported by Damayanti et al. (2023), the study identified both modifiable and non-modifiable risk factors for hypertension in individuals with DM. Non-modifiable risk factors include age, gender, education, marital status, blood type, family history of hypertension, family history of DM, and the duration of DM. In contrast, modifiable factors include smoking habits, occupation, physical activity, and BMI (Damayanti et al., 2023).

7. History of High Blood Sugar

The results of this study indicated that many respondents, 208 individuals (82.9%), did not have a history of elevated blood sugar levels. However, 43 respondents (17.1%) reported having a history of high blood sugar. Other studies have shown a significant relationship between blood sugar levels and the incidence of T2DM, with individuals who have abnormal blood sugar levels being at 93.302 times greater risk of developing T2DM compared to those with normal blood sugar levels (Suci & Ginting, 2023). According to Nurita et al. (2024), factors that exacerbate the risk of T2DM in college students include a history of hyperglycemia (Nurita & Yulistiani, 2024). According to the researcher's findings, the occurrence of T2DM can be influenced by genetics or heredity. This is supported by the data showing that 87 respondents have family members, including grandparents or biological parents, with a history of DM. In line with the research by Andini et al. (2024), individuals with a family history of DM are at a significantly higher risk of developing the condition themselves (Andini et al., 2024). In addition, high blood sugar levels in these students may be attributed to excessive sugar consumption. While sugar serves as a source of energy necessary for physical activity and growth, excessive intake can lead to insulin dysfunction. In such cases, insulin becomes unable to effectively respond and carry out its role in converting sugar into energy, potentially leading to high blood sugar levels (Dewanti & Sukendra, 2024). Research by Wahidah et al. (2022) demonstrated that young adults with higher consumption of sugary drinks have a 2.87 times greater risk of developing T2DM compared to those with lower consumption of sugary drinks (Wahidah & Rahayu, 2022).

8. Family History of DM

The results revealed that many respondents, 164 individuals (65.3%), did not have a family history of DM. However, 61 respondents (24.3%) had a history of DM in their immediate family, while 26 respondents (10.4%) had a history of DM in their parents or siblings. Overall, 87 respondents (35.3%) had family members ranging from parents, siblings, grandparents, aunts, uncles, or first cousins (excluding siblings) with a history of DM. Research by Fatria et al. (2022) found significant results between family history and the incidence of T2DM (Fatria & Maidar, 2022). Individuals with family members who have a history of DM are at a higher risk of developing the condition compared to those without such a family history. Those with a family history of DM are at 2 to 4 times greater risk than individuals without a family history of the disease (Annashr, 2024). If one of an individual's parents has

DM, the risk of developing the condition increases by 15%. If both parents have DM, the risk is elevated by 75%. Additionally, the risk of developing DM is 10-30% higher if the mother has the condition, as genetic influences during fetal development are thought to be more significant from the mother than the father (Andini et al., 2024).

T2DM Risk Level

The results of this study indicated that 161 respondents (64.1%) were classified as being at low risk, meaning that 1 in 100 young adults in this group is expected to develop type 2 T2DM in the next 10 years. A total of 63 respondents (25.1%) were categorized as having a slightly increased risk, with 1 in 25 young adults in this group expected to develop T2DM in the same period. Additionally, 17 respondents (6.8%) were at moderate risk, implying that 1 in 6 young adults in this group will develop T2DM within the next 10 years. Lastly, 10 respondents (4.0%) were at high risk, meaning that 1 in 3 young adults in this category will develop T2DM over the next decade. These findings demonstrate that the risk levels for T2DM among the 251 students are distributed across low, slightly increased, moderate, and high-risk categories. The greater the deviation from the risk factors associated with T2DM, the higher the likelihood of developing the condition within the next 10 years (Andini et al., 2024).

CONCLUSION

In this study, all respondents were aged 18-24 years, with the majority being female. Most respondents had a BMI and waist circumference within the normal range. Additionally, most participants did not take antihypertensive medications, did not have a history of high blood sugar, and did not have a family history of DM. However, many respondents exhibited low levels of physical activity and infrequently consumed fruits and vegetables daily. The results indicated that most students were classified as being at low risk of developing T2DM within the next 10 years. Despite this, a portion of the students were identified as having risk factors that placed them in the slightly increased, moderate, and high-risk categories for T2DM.

Future researchers are encouraged to conduct further studies involving blood sugar and blood pressure examinations, as well as to explore other populations, including non-health students, and assess students' knowledge of risk factors and prevention strategies for T2DM. For healthcare professionals, this research can serve as a foundation for promoting preventive measures for T2DM at a younger age, not just in older adulthood. Health promotion efforts should focus on educating students about maintaining a healthy lifestyle within the campus environment, including proper diet, physical activity, and other healthy habits to reduce the risk of developing T2DM. For both respondents and readers, it is recommended to take preventive measures, improve unhealthy lifestyle habits, and seek further medical evaluations when necessary.

REFERENCES

- ADA. (2024). *American Diabetes Association*. <https://diabetes.org/about-diabetes/complications>
- Andini, N. P., Kurniawan, T., Pratiwi, S. H., & Nursiswati, N. (2024). Tingkat risiko diabetes melitus tipe 2 pada mahasiswa fakultas keperawatan. *Jurnal Ilmiah Kesehatan Keperawatan*, 20(2), 64–74.
- Annashr, N. N. (2024). Faktor risiko yang berhubungan dengan kejadian diabetes melitus tipe 2 di wilayah kerja Puskesmas Purbaratu Kota Tasikmalaya. *Journal of Religion and Public Health*, 6(1), 13–22.
- Asriati, A. (2023). Analisis perilaku konsumsi makanan dan minuman manis terhadap prediabetes remaja di Kota Jayapura. *Preventif: Jurnal Kesehatan Masyarakat*, 14(3), 495–511. <https://doi.org/10.22487/preventif.v14i3.970>
- Badaruddin, R., Fudail, M., Fitriana, Y., & Ramadhan, M. Z. (2024). Pengaruh latihan tes cooper terhadap indeks massa tubuh pada mahasiswa obesitas Fakultas Kedokteran Universitas Tadulako. *Healthy Tadulako Journal (Jurnal Kesehatan Tadulako)*, 10(3), 361–369.
- Cao, C., Wei, C., Han, Y., Luo, J., Xi, P., Chen, J., Xiao, X., Hu, H., & Qi, D. (2024). Association between excessive alcohol consumption and incident diabetes mellitus among Japanese based on propensity score matching. *Scientific Reports*, 14, Article 17274.
- Ch Panna, F., Mahakena, I. H., Pratiwi, N., Rambu, A., & Agustina, V. (2021). Deteksi risiko diabetes mellitus tipe 2 menggunakan Findrisc. *Magistrorum et Scholarium: Jurnal Pengabdian Masyarakat*, 2(2), 357–362.
- Damayanti, V. W., Yonata, A., & Kurniawaty, E. (2023). Hipertensi pada diabetes melitus: Patofisiologi dan faktor risiko. *Medical Profession Journal of Lampung*, 13(7), 1253–1257.
- Delfina, S., Carolita, I., & Habsah, S. (2021). Analisis determinan faktor risiko kejadian diabetes mellitus tipe 2 pada usia produktif. *Jurnal Kesehatan Tambusai*, 2(4), 141–151.
- Dewanti, N. P., & Sukendra, D. M. (2024). Lifestyle dengan diabetes melitus tipe II pada wanita usia produktif di Puskesmas Kedungmundu. *HIGEIA (Journal of Public Health Research and Development)*, 8(3), 371–383.
- Fardlillah, Q. (2024). Dampak pemberian makanan junk food pada usia dini. *Al-Athfal: Jurnal Pendidikan Anak*, 5(1), 241–250.
- Fatria, I., & Maidar, V. N. A. (2022). Faktor-faktor yang berhubungan dengan penyakit diabetes melitus pada lansia di wilayah kerja Puskesmas Kecamatan Sukakarya Kota Sabang tahun 2022. *Journal of Health and Medical Science*, 29–40.
- Fitriani, N. S., Wurjanto, A., Kusariana, N., & Yuliawati, S. (2022). Hubungan tingkat pengetahuan dan pengaruh media sosial dengan perilaku konsumsi makanan berisiko diabetes melitus pada mahasiswa Universitas Diponegoro. *Jurnal Epidemiologi Kesehatan Komunitas*, 7(1), 404–410. <https://ejournal2.undip.ac.id/index.php/jekk/article/view/13308/6978>
- Hafizi, A., Hasbie, N. F., Febriyani, A., & Kurniati, M. (2024). Hubungan antara usia, jenis kelamin dan indeks massa tubuh dengan kejadian diabetes mellitus tipe 2 di Rumah Sakit Pertamina Bintang Amin Husada. *Jurnal Medika Malahayati*, 8(4).
- Haris, F., & Kristianti, L. Y. (2020). The correlation between the knowledge level of diabetes management toward the preprandial glucose levels. *IJNP (Indonesian Journal of Nursing Practices)*, 4(1), 21–27.
- IDF. (2022). *IDF Atlas 2021; Indonesia, Key Information*. <https://diabetesatlas.org/atlas/tenth-edition/>

- Kementerian Kesehatan Republik Indonesia. (2019). *Laporan Riskesdas 2018 Nasional*. <https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/>
- Kementerian Kesehatan Republik Indonesia. (2024). *Diabetes pada usia produktif*. <https://ayosehat.kemkes.go.id/topik-penyakit/pencegahan-infeksi-pada-usia-produktif/diabetes-pada-usia-produktif>
- Kementerian Kesehatan Republik Indonesia. (2025). *Klasifikasi obesitas*. <https://p2ptm.kemkes.go.id/infographic-p2ptm/obesitas/klasifikasi-obesitas-setelah-pengukuran-imt>
- Meher, M., Pradhan, S., Pradhan, S. R., & Pradhan, D. S. (2023). Risk factors associated with hypertension in young adults: A systematic review. *Cureus*, 15(4). <https://doi.org/10.7759/cureus.37935>
- Murtiningsih, M. K., Pandelaki, K., & Sedli, B. P. (2021). Gaya hidup sebagai faktor risiko diabetes melitus tipe 2. *e-CliniC*, 9(2), 328–333.
- Nugroho, F. C., Banase, E. F., & Peni, J. A. (2023). Deteksi awal penyakit diabetes mellitus tipe II dan peningkatan kesadaran dalam pencegahan penyakit diabetes mellitus tipe II pada remaja melalui emotional demonstration. *Jurnal Kreativitas Pengabdian Kepada Masyarakat (PKM)*, 6(4), 1562–1572.
- Nugroho, P. S., & Sudirman, S. (2020). Analisis risiko kegemukan pada remaja dan dewasa muda. *Jurnal Dunia Kesmas*, 9(4), 537–544.
- Nurfauziah, D., Dewi, M. D., & Tanuwidjaja, S. (2023). Gambaran risiko DM tipe 2 pada mahasiswa tingkat 3 angkatan 2019 Fakultas Kedokteran UNISBA tahun 2022. <https://proceedings.unisba.ac.id/index.php/BCSMS/article/view/5613/2984>
- Nurita, D. R., & Yulistiani, M. (2024). Penilaian tingkat risiko sebagai prediksi angka kejadian diabetes melitus tipe 2 pada mahasiswa keperawatan S1 Universitas Muhammadiyah Purwokerto dalam waktu 10 tahun ke depan. *Jurnal Ilmiah Wahana Pendidikan*, 10(4), 192–195.
- Pertiwi, P., Perwitasari, D. A., & Satibi, S. (2021). Validation of Finnish Diabetes Risk Score Indonesia version in Yogyakarta. *Borneo Journal of Pharmacy*, 4(1), 57–67. <https://doi.org/10.33084/bjop.v4i1.1747>
- Rahmaniah, R., Pratiwi, S. E., & Liana, D. F. (2023). Gambaran risiko diabetes melitus tipe 2 pada guru sekolah dasar di Kecamatan Mempawah Timur Kabupaten Mempawah. *Al Makki Health Informatics Journal*, 1(2), 81–92.
- Ramadhani, A. A., & Khotami, R. (2023). Hubungan tingkat pendidikan, pengetahuan, usia dan riwayat keluarga DM dengan perilaku pencegahan diabetes mellitus tipe 2 pada usia dewasa muda. *SEHATMAS: Jurnal Ilmiah Kesehatan Masyarakat*, 2(1), 137–147.
- Ruku, D. M., Pitoy, F. F., & Paral, M. V. (2022). Faktor risiko kejadian diabetes melitus tipe II pada masyarakat Desa Lilang Minahasa Utara. *Klabat Journal of Nursing*, 4(2), 17–26.
- Sarifah, M. A., & Siyam, N. (2023). Determinan diabetes melitus tipe II di Posbindu PTM Puskesmas Pegandon Kabupaten Kendal Tengah. *HIGEIA (Journal of Public Health Research and Development)*, 7(3), 365–375.
- Sattu, M., Balebu, D. W., Dokoleng, E., & Handayani, L. (2024). Gambaran faktor risiko diabetes melitus tipe 2 pada mahasiswa di Universitas Tompotika Luwuk. *Buletin Kesehatan MAHASISWA*, 2(3), 120–130.

- Savitri, P. D. H. S., Saraswati, M. R., Bagiada, I. M., & Suega, K. (2022). Gambaran risiko DM tipe 2 pada mahasiswa Program Studi Sarjana Kedokteran dan Profesi Dokter angkatan 2018 di Fakultas Kedokteran Universitas Udayana.
- Strati, M., Moustaki, M., Psaltopoulou, T., Vryonidou, A., & Paschou, S. A. (2024). Early onset type 2 diabetes mellitus: An update. *Endocrine*, 85(3), 965–978. <https://doi.org/10.1007/s12020-023-03402-9>
- Suci, T., & Ginting, J. B. (2023). Pengaruh faktor usia, indeks massa tubuh, dan kadar gula darah terhadap kejadian penyakit diabetes melitus tipe 2. *Jurnal Keperawatan Priority*, 6(2), 12–19.
- Suharno, J. A., & Nisa, H. (2024). Hubungan indeks massa tubuh dan lingkar perut dengan diabetes melitus pada orang dewasa di Indonesia: Hasil analisis data Riskesdas 2018. *JURNAL NUTRISIA*, 26(1), 1–10.
- Wahidah, N., & Rahayu, S. R. (2022). Determinan diabetes melitus pada usia dewasa muda. *HIGEIA (Journal of Public Health Research and Development)*, 6(1). <https://journal.unnes.ac.id/sju/higeia/article/view/53512>
- Wahyudi, W., Hasibuan, A. D. M., Fadhilah, B., Ritonga, F. R., & Purba, R. Y. (2024). Tingkat pengetahuan diabetes melitus dan pola konsumsi junk food pada mahasiswa di Kota Medan. *Jurnal Berita Kesehatan*, 17(2), 163–172.