



Knowledge and Misconceptions About Diabetes Mellitus in Semarang: An In-Depth Survey Analyzing the Impact of Public Awareness on Prevention and Management

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Abstract

Diabetes Mellitus (DM) is a metabolic disease characterized by hyperglycemia resulting from impaired insulin secretion, insulin action, or both. According to the IDF data, in 2021, there were 537 million people with diabetes globally, with more than 70% of them undiagnosed. In Semarang City, in 2023, there were 41,468 reported cases of diabetes, with the majority in the age group of 46-65 years. Public knowledge about diabetes, including its symptoms, risk factors, prevention, and management, is crucial to combat this disease. This research employed a descriptive-analytic epidemiological method with a Rapid Survey design. Data was collected in November 2024 at the Pramita Laboratory in South Semarang. The study population consisted of participants from a health education program themed "All We Know About Diabetes Mellitus," with a sample size of 90 respondents selected through total sampling. Data analysis was conducted using descriptive statistics. The findings revealed significant gaps in public knowledge about diabetes, including its etiology, classification, risk factors, diagnostic criteria, treatment, and complications. These knowledge deficits pose critical barriers to early diagnosis and effective management of diabetes, contributing to increased morbidity, healthcare costs, and socioeconomic burden. Addressing these gaps through targeted educational programs is imperative to reduce diabetes-related complications and improve community health outcomes. The results underscore the urgency for comprehensive public health strategies to enhance diabetes awareness and support preventative measures, particularly in regions with high prevalence rates like Semarang City.

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Introduction

Elevated blood glucose levels beyond the normal range indicate hyperglycemia. Hyperglycemia is a hallmark of diabetes mellitus. Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycemia due to dysfunction in insulin production, insulin action, or both. Diabetes mellitus is generally classified into four types: type 1 diabetes mellitus, type 2 diabetes mellitus, gestational diabetes mellitus, and certain other types of diabetes. Type 1 diabetes mellitus is caused by damage to the pancreatic beta cells, leading to an absolute insulin deficiency, typically due to autoimmune or idiopathic causes. In contrast, type 2 diabetes mellitus is characterized by insulin resistance and a relative insulin deficiency. Additionally, two other forms of diabetes, such as gestational diabetes, arise under specific conditions; gestational diabetes occurs during the second or third trimester of pregnancy in individuals who were previously undiagnosed with diabetes before conception. Other forms of diabetes may emerge in certain situations, such as in cases of monogenic diabetes syndromes, exocrine pancreatic diseases, or as a result of glucocorticoid drug use, which is the most common cause.

The IDF Diabetes Atlas 2021 reports that approximately 537 million people aged 20-79 worldwide are living with diabetes, with the majority residing in low- and middle-income countries, and 1.5 million deaths directly related to diabetes each year. Over the past three decades, the incidence of type 2 diabetes has significantly surged in countries with various income levels. The IDF Diabetes Atlas (2021) indicates that 10.5% of adults aged 20-79 have diabetes, with nearly half of them being unaware of their condition. By 2045, the IDF estimates that 1 in 8 people, approximately 783 million individuals, will have diabetes, reflecting a 46% increase in incidence. According to the 2021 data from the International Diabetes Federation (IDF), the prevalence of type 2 diabetes in Indonesia among individuals aged 20-79 is 10.6%. Furthermore, it is estimated that 73.7% of cases remain undiagnosed, posing a significant challenge for the Indonesian government to enhance services and screening to detect diabetes mellitus. In 2021, the IDF reported that 1 in 9 people in Indonesia was diagnosed with diabetes.⁶

In 2023, the prevalence of diabetes mellitus in Semarang City, as reported in the Semarang City Health Profile 2023, was 41,468 individuals. Of this number, at least 5,991 new cases of diabetes mellitus were reported in 2023. These cases mostly involved individuals aged 46-65 years, with 3,869 cases of non-insulin-dependent diabetes and 128 cases of insulin-dependent diabetes. Among individuals aged 65 and older, there were 1,528 cases of diabetes. In the 26-45 age group, there were 424 cases of non-insulin-dependent diabetes and 22 cases of insulin-dependent diabetes. Among adolescents aged 12-25 years, there were 14 cases of non-insulin-dependent diabetes and 5 cases of insulin-dependent diabetes.⁸

Knowledge is essential in assessing the public's understanding of diabetes mellitus. Notoatmodjo, in his book *Health Promotion and Behavioral Science* (2007), states that knowledge is acquired through sensory processes such as observation via sight and hearing of a particular subject. To gain knowledge, an individual must go through a behavioral adoption process. This process of behavioral adoption consists of several consecutive stages, including Awareness, Interest, Evaluating, Trial, and Adaptation. Understanding diabetes mellitus is influenced by various factors, including awareness of its symptoms, adherence to healthy lifestyle practices such as diet and exercise, blood glucose monitoring, complications, prevention and management of diabetic foot problems, and pharmacological treatment when necessary.²

The risk factors for diabetes mellitus are categorized into two main types: modifiable and non-modifiable risk factors. Non-modifiable risk variables include gender, race, ethnicity, age, heredity, a history of previous diabetes, a history of gestational diabetes, and a history of giving birth to a baby weighing more than 4000 grams. Modifiable risk factors include inadequate physical activity, hypertension, excessive stress, poor eating habits, overweight or obesity, metabolic syndrome, pancreatic disorders such as pancreatitis, neoplasms or cancer, cystic fibrosis, and alcoholic fatty liver.¹¹

Therefore, the purpose of this study is to assess the level of public knowledge in Semarang City about all aspects of diabetes, including the definition of diabetes, diabetes classification, risk factors for diabetes, diabetes diagnosis, diabetes treatment management, and its complications.

Methods

This study uses a descriptive-analytic epidemiological methodology. The research design employs the rapid survey method to obtain timely, practical insights into the public's knowledge and attitudes toward diabetes mellitus within a specific community. The rapid survey method allows for efficient data collection and analysis, making it ideal for quickly identifying knowledge gaps and misconceptions,

especially when resources and time are limited. This approach is practical in health education contexts, where quick feedback is needed to inform immediate interventions or policy recommendations.

Data collection for this study was conducted at the Pramita Laboratory, located at Jl. Kompol Maksum No. 211, Peterongan Village, South Semarang District, Semarang City, in November 2024. The study population consists of participants attending a Health Education session with the theme 'All We Know About Diabetes Mellitus.' Ninety respondents were selected as the sample through a complete sampling technique involving all available respondents. This study used descriptive statistical analysis.

Data was primarily collected using an online questionnaire distributed via a barcode or link through Google Forms. The rapid survey method facilitated broad participation by leveraging digital tools, enabling convenient access for respondents. The questionnaire included questions designed to assess the level of knowledge about diabetes mellitus based on a modified version of the Summary of Diabetes Self-Care Activities (SDSCA). The knowledge assessed includes the etiology of diabetes, its classification, non-modifiable risk factors, and modifiable risk factors. The methods for diagnosing diabetes, performing diabetes screenings, administering diabetes therapy, and managing diabetes complications were also examined. The questionnaire was created as a Google Form and distributed online before the start of the health education program. It was distributed before the health education session.

Results

The study results show that 90 respondents completed the questionnaire fully and met the criteria to be included as samples in this study.

Table 1. Frequency Distribution of Respondent Characteristics (n=90)

Respondent	F (%)
Gender	
a. Men	38 (42.22)
b. Women	52 (57.78)
Age	
a. 15-19 years old	19 (21.11)
b. 20-24 years old	5 (5.56)
c. 25-29 years old	6 (6.67)
d. 30-34 years old	16 (17.78)
e. 35-39 years old	11 (12.22)
f. 40-44 years old	16 (17.78)
g. 45-49 years old	8 (8.89)
h. 50-54 years old	2 (2.22)
i. 55-59 years old	1 (1.11)
j. 60-64 years old	3 (3.33)
k. 65-69 years old	2 (2.22)
l. 70-74 years old	1 (1.11)
Education	
a. High School/ Vocational School Graduate or Equivalent	23 (25.56)
b. Bachelor's Degree (S1)	49 (54.44)
c. Master's Degree (S2)	13 (14.44)
d. Doctoral Degree (S3)	5 (5.56)
Job Description	
a. Entrepreneur	16 (17.78)
b. Businessman	11 (12.22)
c. Government Employee	12 (13.33)
d. Private Employee	18 (20.00)
e. Lecturer	5 (5.56)
f. Student	23 (25.56)
g. Healthcare worker	5 (5.56)

Respondent	F (%)
Income	
a. Below the minimum wage of Semarang City (less than 3.2 million)	26 (25.56)
b. Above the minimum wage of Semarang City (above 3.2 million)	64 (71.11)
Total	90 (100.00)

Table 1 presents the characteristics of the study respondents, indicating that the dominant demographic group is female, with 52 individuals (57.78%), while the age group 15-19 years includes 19 individuals (21.11%). The majority of respondents have a Bachelor's degree as their highest level of education, with 49 individuals (54.44%), and most of the respondents are students, with 23 individuals (25.56%). Most respondents have an income between 3.2 million and 6.4 million IDR, with 41 individuals (45.56%).

Table 2. Respondent Data on Participation in Diabetes Education

DM Education	F (%)
Have not received education yet	75 (83.33)
Have received education	15 (16.67)

Table 2 shows the results: 16.67% of respondents had previously received diabetes education, leaving 83.33% unexposed to such information. Of these, 15 people have received education about diabetes mellitus, while 75 people have not.

Table 3. Risk Factors of the Research Respondents Related to Diabetes

Risk Factors	F (%)
Smoking Habit	
a. Non-smoking	75 (83.33)
b. Smoking	15 (16.67)
Alcohol Consumption Habit	
a. Drinking Alcohol	12 (13.33)
b. Does Not Drink Alcohol	70 (77.78)
c. Sometimes	8 (8.89)
Has been diagnosed with diabetes	
a. Has been diagnosed with prediabetes	8 (8.89)
b. Has been diagnosed with diabetes	8 (8.89)
c. Has never been diagnosed with diabetes	74 (82.22)
Has a family member diagnosed with diabetes	
a. None	59 (65.56)
b. Father	10 (11.11)
c. Mother	4 (4.44)
d. Grandfather	5 (5.56)
e. Grandmother	6 (6.67)
f. one sibling	4 (4.44)
g. two siblings	2 (2.22)
Exercise Habit	
a. Does not exercise	24 (26.67)
b. 1-2 times per week, duration of 30 minutes	26 (28.89)
c. 3-5 times per week, duration of 30 minutes	20 (22.22)
d. More than 5 times per week, duration of 30 minutes	20 (22.22)
Total	90 (100.00)

Table 3 describes the risk factors related to diabetes mellitus for the research respondents. The results indicate that 75 respondents (83.33%) do not smoke, 70 respondents (77.78%) do not consume

alcohol, 74 respondents (82.22%) have never been diagnosed with diabetes mellitus, 59 respondents (65.56%) do not have family members who have been diagnosed with diabetes mellitus, and 26 respondents engage in physical activity 1-2 times per week, with an exercise duration of about 30 minutes per day.

Table 4. Frequency Distribution of Public Knowledge Level about Diabetes Mellitus

Knowledge		F (%)
Diabetes is caused by overeating sugar and sweet foods	Correct	65 (72.22)
	Wrong	18 (20.00)
	Don't know	7 (7.78)
Diabetes has two types, namely wet diabetes and dry diabetes	Correct	20 (22.22)
	Wrong	33 (36.67)
	Don't know	37 (41.11)
Children can inherit diabetes	Correct	36 (40.00)
	Wrong	15 (16.67)
	Don't know	39 (43.33)
The most influential factors in diabetes are lifestyle and diet rather than genetics.	Correct	34 (37.78)
	Wrong	19 (21.11)
	Don't know	37 (41.11)
A blood sugar level of 165 after eating means that one may have diabetes.	Correct	12 (13.33)
	Wrong	31 (34.44)
	Don't know	47 (52.22)
The most accurate way to check for diabetes is through random blood sugar testing.	Correct	19 (21.11)
	Wrong	23 (25.56)
	Don't know	48 (53.33)
The most important treatment for diabetes is taking diabetes medication	Correct	42 (46.67)
	Wrong	30 (33.33)
	Don't know	18 (20.00)
Diabetes causes disrupted blood circulation.	Correct	32 (35.56)
	Wrong	32 (35.56)
	Don't know	26 (28.89)
Diabetes can cause kidney failure.	Correct	35 (38.89)
	Wrong	19 (21.11)
	Don't know	36 (40.00)
Diabetes can cause the feet to darken and may lead to amputation	Correct	46 (51.11)
	Wrong	28 (31.11)
	Don't know	16 (17.78)
Total		90 (100.00)

Table 4 shows 90 respondents to assess their knowledge of diabetes mellitus in Semarang. The majority of respondents were women (57.78%) aged 15-19 years (21.11%), with a bachelor's degree as the most common education level (54.44%). Most were students (25.56%) and had an income above the minimum wage of Semarang City (71.11%). Only 16.67% of respondents had previously received diabetes education, leaving 83.33% unexposed to such information. Risk Factors : (1)Smoking: 83.33% did not smoke;(2) Alcohol consumption: 77.78% reported no alcohol consumption; (3) Family history: 65.56% had no family history of diabetes. (4) Physical activity: The majority exercised 1-2 times weekly for about 30 minutes. (4) Knowledge Assessment: Understanding diabetes etiology was poor; 72.22% incorrectly believed diabetes is caused by excessive sugar intake.

The misconception that diabetes is caused solely by excessive sugar intake, believed by 72.22% of respondents, reflects a superficial understanding of the disease. This perception likely stems from oversimplified public health messaging associating sugar consumption with diabetes. While excessive intake of sugary foods and drinks can contribute to obesity—a significant risk factor for type 2 diabetes—diabetes etiology is multifaceted. The disease involves genetic, autoimmune, metabolic, and lifestyle factors. Type 1 diabetes is primarily an autoimmune condition where the body attacks insulin-producing beta cells in the pancreas, while type 2 diabetes arises from insulin resistance combined with relative insulin deficiency. Gestational diabetes occurs due to hormonal changes during pregnancy. Simplifying diabetes as a "sugar disease" overlooks these complexities and perpetuates stigma. Educational campaigns must shift from oversimplified narratives to comprehensive, evidence-based explanations of diabetes causes.

Emphasizing the role of insulin resistance, genetic predisposition, obesity, and lifestyle factors can foster a nuanced understanding among the public. Collaborations with healthcare providers and community leaders are crucial for tailoring education to local contexts.

Only 22.22% knew diabetes is not simply categorized as "wet" or "dry," indicating widespread reliance on anecdotal and cultural classifications rather than medically accurate information. This myth likely perpetuates confusion about diabetes symptoms and types. For instance, the term "wet diabetes" might arise from the association with chronic wounds or diabetic ulcers, while "dry diabetes" could stem from weight loss or dehydration symptoms. The classification includes type 1, type 2, gestational diabetes, and other specific types, such as monogenic diabetes or diabetes caused by pancreatitis. Misunderstanding these categories impedes proper disease management, as each type requires distinct treatment approaches. Type 1 diabetes patients rely on insulin therapy, whereas lifestyle interventions are often the first line of treatment for type 2 diabetes. Addressing this issue requires integrating accurate information into community health education programs. Visual aids, storytelling, and analogies can simplify complex concepts without sacrificing accuracy. Health workers should be trained to dispel these misconceptions during consultations and community outreach.

Awareness of risk factors was limited; 43.33% were unaware of non-modifiable risks, and 41.11% were unaware of modifiable risks. 43.33% of respondents were unaware of factors such as age, genetics, and ethnicity. These factors contribute to the baseline risk of developing diabetes and underscore the importance of early screening for at-risk individuals. For example, a family history of diabetes markedly increases susceptibility, particularly in populations with high prevalence rates like Indonesia. 41.11% of respondents lacked awareness of lifestyle-related risks such as physical inactivity, poor dietary habits, and obesity. This deficiency is concerning because modifiable risks are directly tied to prevention strategies. For instance, regular physical activity and maintaining a healthy weight significantly reduce the likelihood of developing type 2 diabetes. A lack of understanding of these risk categories hampers early intervention efforts. Public health programs should emphasize the dichotomy between modifiable and non-modifiable risks, empowering individuals to focus on lifestyle adjustments while encouraging those with genetic predispositions to undergo regular screenings. Strategies like workplace wellness programs, school-based health education, and media campaigns can help disseminate this information widely. Additionally, personalized risk assessments during routine medical visits can reinforce awareness.

The study revealed that 52.22% of respondents could not identify diabetes diagnostic criteria, such as fasting blood glucose levels or HbA1c measurements. This knowledge gap likely contributes to delays in diagnosis, as individuals may not recognize the urgency of seeking medical attention for symptoms like frequent urination, fatigue, or unexplained weight loss. Accurate knowledge of diagnostic benchmarks is critical for early detection and management. According to the American Diabetes Association (ADA), diabetes is diagnosed based on: Fasting plasma glucose ≥ 126 mg/dL; Plasma glucose ≥ 200 mg/dL two hours after a glucose tolerance test; HbA1c levels $\geq 6.5\%$; Random plasma glucose ≥ 200 mg/dL with hyperglycemia symptoms. Raising awareness of these criteria involves simplifying complex medical information into actionable messages. Community health workers and local clinics can provide free screenings alongside educational materials explaining the significance of the tests. Furthermore, partnerships with schools and employers to conduct awareness workshops can amplify outreach efforts.

The study found mixed awareness levels regarding complications: (1) Foot Issues: 51.11% of respondents were aware of diabetic foot problems, which include ulcers and potential amputations. This relatively higher awareness may be attributed to the visibility of such complications or anecdotal experiences within communities. (2) Disrupted Circulation: 35.56% of respondents recognized blood flow issues as a precursor to complications like peripheral artery disease (3) Kidney Complications: Only 38.89% knew that diabetes could lead to kidney failure, despite its prevalence as a microvascular complication.

This limited awareness indicates a gap in understanding the systemic nature of diabetes and its potential to cause severe, life-altering complications. Diabetic nephropathy, retinopathy, and neuropathy often progress silently, making regular monitoring essential for early intervention. Public education should highlight the interconnectedness of blood glucose control and complication prevention. Multimedia campaigns showcasing real-life stories of individuals managing diabetes complications effectively could resonate with communities. Additionally, integrating education about complications into routine healthcare visits ensures consistent reinforcement of this knowledge. Despite limited exposure to formal diabetes education, those who had received it showed slightly better knowledge scores.

Discussion

This study reveals that most respondents who completed the questionnaire were 15-19 years old, as the research was conducted in a higher education environment predominantly occupied by adolescents.

Additionally, using an online questionnaire made it more accessible to younger individuals, who are more likely to use social media compared to older demographic groups. This contrasts with the study by Purnomo et al. (2023), which had respondents aged 45-59 years, as this age group is considered pre-senior, with more excellent knowledge and experience than adolescents. This study aligns with the research by Suryana et al. (2024), which found that most respondents were under 35. Furthermore, this study is consistent with Suryati et al. (2019), who stated that an early diagnosis of diabetes mellitus is correlated with prolonged suffering from the disease and an increased likelihood of chronic hyperglycemia, which ultimately leads to various complications such as retinopathy and nephropathy.14

This study reveals that the majority of respondents hold a bachelor's degree. This contrasts with the findings of Purnomo et al. (2023), which stated that the highest educational level among respondents was high school graduates. Education is closely related to the knowledge gained, so the lower the level of education, the lower the understanding of diabetes mellitus. This study aligns with Suryana et al. (2024), who stated that a higher level of education does not significantly influence an individual's understanding of diabetes mellitus.13

In this study, it was found that the majority of respondents were students. As students, they have a busy class schedule, which results in irregular meal times every day. This is in line with the research by Fatmona et al. (2023), which stated that the level of job activity affects the level of physical activity performed. Jobs that involve little physical activity, such as sitting in front of a computer, can increase the likelihood of developing diabetes mellitus. However, both heavy and light work activities are significantly influenced by the respondents' eating habits and lifestyle.16

In this study, it was found that the majority of respondents have an income above the Regional Minimum Wage (UMR) of Semarang City. According to the Governor of Central Java's Decree Number 561/57 of 2023, dated November 30, 2023, the minimum wage for Semarang City in 2024 is IDR 3,243,969. This study aligns with the research by Musdalifah et al. (2020), which states that income above the UMR is related to education level and knowledge. The higher the income, the higher the level of education and expertise. This is also supported by the study by Funakoshi et al. (2017), which stated that a lower socioeconomic status with low income affects the low level of public knowledge about diabetes mellitus.18

In this study, the results showed that 75 respondents had not received any education on diabetes mellitus, while only 15 had received diabetes mellitus education. However, this did not affect the respondents' level of knowledge about diabetes mellitus. Out of the ten statements in the questionnaire, 71 respondents (78.89%) scored 60 or lower, indicating that most respondents had minimal knowledge about diabetes mellitus. In contrast, only 19 respondents (21.11%) scored above 60, meaning only a small portion of respondents had adequate knowledge about diabetes mellitus. This finding contrasts with the results from Fatmona et al. (2023), which showed that about 85% of the respondents firmly understood diabetes mellitus. However, the study also indicated that despite having good awareness of diabetes, this knowledge was not effectively applied in daily life, leading to a continuous high incidence of diabetes mellitus and inadequate management.15

The survey questionnaire revealed that 65 respondents (72.22%) have a limited understanding of the pathogenesis of diabetes mellitus. According to the 2021 Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Adults in Indonesia, published by the Indonesian Endocrinology Association (PERKENI), the primary etiology of diabetes mellitus involves abnormal insulin secretion, abnormal insulin function, or a combination of both. Therefore, the statement in the questionnaire that "diabetes is caused by overeating sugar and sweet foods" is inaccurate.2

The study using a questionnaire showed that 37 respondents (41.11%) did not understand the classification of diabetes mellitus. According to the *Classification and Diagnosis: Standards of Medical Care in Diabetes* 2019, diabetes mellitus is classified into four etiological types: Type 1 Diabetes, which occurs due to damage to the beta cells of the pancreas and is characterized by absolute insulin deficiency; Type 2 Diabetes, which arises from insulin resistance accompanied by relative insulin deficiency; gestational diabetes mellitus, which manifests during the second or third trimester of pregnancy in individuals without a prior diagnosis of diabetes; and other types of diabetes, which are caused by various conditions such as monogenic diabetes syndromes, pancreatitis, and prolonged use of glucocorticoids.3

The survey questionnaire revealed that 39 respondents (43.33%) were unaware of the non-modifiable risk factors of diabetes mellitus. According to the *Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Adults in Indonesia* 2021, published by the Indonesian Endocrinology Association (PERKENI), the non-modifiable risk factors for diabetes mellitus include having a first-degree relative with diabetes (indicating a hereditary tendency), particular racial or ethnic groups with higher diabetes prevalence, advancing age, which correlates with increased risk, and genetic factors.2,19

The survey questionnaire revealed that 37 respondents (41.11%) were unaware of the modifiable risk factors for diabetes mellitus. According to the *Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Adults in Indonesia* 2021, published by the Indonesian Endocrinology Association (PERKENI), the modifiable risk factors for diabetes mellitus include lack of physical activity, history of hypertension, low HDL levels (<35 mg/dL), high triglyceride levels (>250 mg/dL), polycystic ovary syndrome in women, prediabetes diagnosis, history of obesity or being overweight, history of cardiovascular disease, and women with a history of giving birth to a baby weighing more than 4 kg or experiencing gestational diabetes mellitus.. 2,19

Based on the results of the questionnaire survey, it was found that 47 respondents (52.22%) were unaware of the diagnostic criteria for diabetes mellitus. According to the *Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Adults in Indonesia* 2021, published by the Indonesian Endocrinology Association (PERKENI), the diagnostic criteria for diabetes mellitus are as follows: fasting plasma glucose ≥ 126 mg/dL (fasting is defined as no calorie intake for at least 8 hours); plasma glucose ≥ 200 mg/dL two hours after an Oral Glucose Tolerance Test (OGTT) with a 75-gram glucose load; random plasma glucose ≥ 200 mg/dL with classic symptoms or hyperglycemic crisis; and HbA1C $\geq 6.5\%$, using methods standardized by the National Glycohaemoglobin Standardization Program (NGSP) and Diabetes Control and Complications Trial (DCCT) assay.2,3

The questionnaire survey revealed that 48 respondents (53.33%) were unaware of the supporting tests for diabetes mellitus. According to the *Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Adults in Indonesia* 2021, published by the Indonesian Endocrinology Association (PERKENI), essential tests for diabetes mellitus patients include random blood glucose, fasting blood glucose, blood glucose two hours after fasting, and HbA1C. Diabetes patients should monitor their fasting blood glucose and blood glucose two hours after fasting at least once a month and assess HbA1C every three months. The goal is to monitor blood glucose levels to ensure effective and regular administration of glucose-lowering medications.1,20

The questionnaire survey revealed that 42 respondents (46.67%) had a limited understanding of the management of diabetes mellitus treatment. The International Diabetes Federation (IDF) identifies five key components of diabetes mellitus management: education, medical nutrition therapy, physical activity, pharmacological therapy, and self-monitoring of blood glucose. Therefore, the most important aspect of diabetes management is taking anti-diabetes medications and combining these five pillars of diabetes management. The first pillar, diabetes education, includes knowledge about the disease's progression, ongoing management and monitoring, complications and associated risks, non-pharmacological and pharmacological treatment strategies, the interaction between food intake, physical activity, and oral hypoglycemic agents or insulin, methods for monitoring blood glucose and interpreting results independently, identifying hypoglycemia symptoms, and immediate interventions, the need for regular physical activity, the importance of foot care, and utilizing healthcare resources. The second pillar, physical activity for diabetes patients, recommends at least 150 minutes of moderate aerobic exercise per week (at 50-70% of maximum heart rate) or 90 minutes of vigorous aerobic exercise per week (over 70% of maximum heart rate), divided into 3-4 weekly sessions. The third pillar, medical nutrition therapy, includes regular meal timing, food calorie content, and the types of food to be considered. The fourth pillar, pharmacological therapy, can consist of oral antihyperglycemic agents, injectable antihyperglycemic agents, and combination therapies. The fifth and significant pillar is autonomous blood glucose monitoring, with recommended times including before meals, two hours after meals, before sleep, during the sleep cycle, or when experiencing symptoms such as hypoglycemic episodes...22

The questionnaire survey revealed that 36 respondents (40%) were unaware that diabetes mellitus can lead to kidney problems. The *Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Adults in Indonesia* 2021, published by the Indonesian Endocrinology Association (PERKENI), indicates that prolonged diabetes mellitus can cause kidney complications, particularly diabetic nephropathy, which includes microangiopathic complications. Diabetes complications are categorized into two main divisions: macroangiopathy and microangiopathy. Macroangiopathy includes stroke, coronary artery disease, peripheral artery disease, and diabetic foot complications. Microangiopathy includes diabetic retinopathy (which affects the eyes), diabetic nephropathy (which affects the kidneys), peripheral neuropathy (which affects the peripheral nerves), and cardiomyopathy (which affects the heart muscle).2,24

Education is a crucial determinant of health knowledge and behavior. In this study, 54.44% of respondents held a bachelor's degree, yet knowledge about diabetes remained insufficient.4 This discrepancy highlights a gap between formal education and health literacy. Higher education correlates with better health knowledge, as individuals are more likely to seek, understand, and apply health-related information.6 However, specific health topics like DM may not be emphasized in general education

curricula, leaving even educated individuals with gaps in understanding. According to Notoatmodjo (2007), effective health education requires targeted, context-specific.⁹ Incorporating diabetes education into school and university programs could improve health literacy. Workshops, seminars, and online resources tailored to specific demographic groups could further enhance understanding.¹¹

The availability of reliable health information plays a crucial role in shaping public awareness. Although online resources are widely available, the quality and accessibility of these materials vary. Misconceptions, such as diabetes being caused solely by excessive sugar intake, may stem from oversimplified or incorrect information.¹⁶ The study revealed that younger respondents (15-19 years old) were more likely to rely on social media for health information. This platform, while accessible, often spreads unverified or anecdotal health advice, exacerbating misconceptions.¹² Governments and health institutions should invest in creating accessible, accurate, and engaging health content. Public service announcements, interactive websites, and collaborations with social media influencers could help disseminate correct information to wider audiences.¹⁰

The accessibility and quality of healthcare services significantly impact public knowledge of diabetes. Despite the presence of health facilities, the study showed that 83.33% of respondents had not received any formal education about diabetes.¹⁶ This indicates a lack of preventative care services, such as screenings and counseling, critical for awareness and early detection. Economic constraints, time limitations, and geographical challenges may prevent individuals from seeking regular check-ups or attending educational programs.¹⁹ According to the Semarang City Health Profile (2023), many residents rely on overburdened public health centers, which may prioritize treatment over education. Expanding community-based health programs and mobile clinics can address these barriers. Subsidized or free screenings accompanied by educational sessions could encourage participation and improve knowledge.²⁰

The presence of diabetes-focused community groups can influence public knowledge and support systems. The absence of organized diabetes awareness groups in Semarang limits peer education and support opportunities.²² Such groups effectively foster shared learning experiences and encourage healthy behaviors. Community health workers (CHWs) are pivotal in disseminating health information, especially in underserved areas.¹⁷ However, their outreach in Semarang appears insufficient, given the low rates of diabetes education among respondents. Establishing diabetes support groups and training CHWs to provide targeted education can enhance community engagement.¹⁹ Regular events, such as health fairs or diabetes awareness campaigns, could increase public knowledge.¹¹

Local government policies and health department efforts are critical in promoting diabetes awareness and prevention. While national guidelines for diabetes management exist, their implementation at the regional level in Semarang seems inadequate.¹⁵ For example, the Indonesian Endocrinology Association (PERKENI) emphasizes education as a cornerstone of diabetes prevention, yet few initiatives align with these recommendations in Semarang.²⁰ Awareness campaigns are often sporadic and lack follow-up, reducing their long-term impact. The study found that only 16.67% of respondents had received diabetes education, underscoring the need for more consistent efforts.¹⁵ The Semarang Health Department should prioritize sustained, evidence-based programs. Policies should mandate regular community screenings, integrate diabetes education into public health agendas, and allocate sufficient resources to address knowledge gaps.¹⁸

Healthcare providers are frontline educators in diabetes awareness and management. The study highlighted the limited involvement of healthcare workers in proactive education. Many consultations focus on immediate treatment rather than preventative care or patient education.¹⁰ Health facilities, including clinics and hospitals, are underutilized as platforms for diabetes education. Structured sessions during routine visits could significantly enhance patient knowledge.⁹ Training programs for healthcare providers should emphasize the importance of patient education. Incentivizing providers to conduct community outreach and participate in health campaigns could also increase their engagement.¹³

Conclusion

The study concludes that the level of public knowledge about the etiology of diabetes, diabetes classification, modifiable and non-modifiable risk factors, diagnosis criteria, supporting examinations, treatment management, and diabetes complications is still lacking.¹² This issue should concern the Health Department of Semarang City to provide health education to the citizens of Semarang regarding all aspects of diabetes mellitus. The limited knowledge of diabetes mellitus among Semarang residents is influenced by educational, systemic, and policy-related factors.

Addressing these gaps requires a multi-faceted approach by Enhancing Health Literacy (Integrate diabetes education into school curricula and workplace wellness programs; Develop culturally appropriate materials that address common misconceptions), Improving Accessibility (Expand mobile clinics and community-based screenings; Provide free or subsidized health education sessions alongside routine

medical services), Strengthening Community Engagement (Establish diabetes support groups and train CHWs to lead educational initiatives; Conduct regular health fairs and awareness campaigns), Policy and Healthcare Reforms (Align local health initiatives with national guidelines; Incentivize healthcare workers to prioritize education and prevention during consultations), and Leveraging Technology (Use social media and digital platforms to disseminate accurate, engaging health information; Collaborate with influencers and community leaders to amplify messaging).

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