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Original Research

Association of Physical Activity and Nutritional Status with Blood Glucose Levels Among Patients of Diabetes Mellitus Type 2 at Puskesmas Sei Langkai Kota Batam

Hubungan Aktivitas Fisik dan Status Gizi dengan Kadar Glukosa Darah pada Pasien Diabetes Melitus Tipe 2 di Puskesmas Sei Langkai Kota Batam

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Abstract: *Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia due to inadequate insulin production or impaired insulin utilization. In Indonesia, the prevalence of DM reaches 11.7% in adults, with a significant burden in Batam, particularly at Puskesmas Sei Langkai. This study aims to determine the relationship between physical activity and nutritional status with blood glucose levels in type 2 DM patients aged 45–69 years. This is an observational analytical study with a cross-sectional design conducted in October 2025, involving 120 respondents selected purposively. Physical activity was measured using a short IPAQ questionnaire and converted to MET-minutes/week, nutritional status was measured using Body Mass Index (BMI), and random blood glucose levels were measured using a glucometer. Data analysis was performed using the Spearman correlation test. The results showed that the majority of respondents were aged 45–59 years (76.7%), female (70.8%), had a high school education (65.8%), were unemployed (67.5%), and had suffered from DM for 1–5 years (62.5%). Most had moderate physical activity (65.8%) and normal nutritional status (77.5%), but 53.3% had uncontrolled blood glucose levels. Analysis showed a significant negative relationship between physical activity and blood glucose levels (r = -0.305, p = 0.001), while nutritional status showed no significant relationship (r = 0.159, p = 0.083). These findings confirm that physical activity plays an important role in blood glucose control, while nutritional status alone is not the main determining factor. DM management should include regular physical activity, a balanced diet, adherence to therapy, and routine glucose monitoring.*

Key word: blood glucose levels, diabetes mellitus type 2, nutrition status, physical activity

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic disease characterized by hyperglycemia due to the pancreas' inability to produce adequate insulin or the body's inability to use insulin effectively (1). DM is a metabolic disorder that affects carbohydrate, fat, and protein metabolism and tends to be progressive, with early symptoms such as polyuria, polydipsia, and polyphagia (2). This condition is a significant concern because most sufferers are unaware of the disease in its early stages, resulting in suboptimal blood glucose management.

Prevalence data indicates that DM is a major health problem both globally and nationally. According to the International Diabetes Federation (3), 537 million adults have diabetes, and this figure is expected to increase to 643 million by 2030. In Indonesia, the prevalence of DM among people aged 15 years and older reaches 11.7%, placing the country in the fifth-highest number of sufferers in the world.

Meanwhile, the highest prevalence of diabetes mellitus (DM) in Batam is found at Puskesmas Sei Langkai amount 1,484 patients in 2024, indicating a significant burden of disease at the primary care level.

The age group over 45 years is of particular concern due to the transition from productive to elderly. This group experiences decreased insulin sensitivity, reduced muscle mass, and increased visceral fat accumulation, which exacerbates insulin resistance (4). In addition to biological factors, modern lifestyles such as an unbalanced diet, lack of physical activity, stress, and irregular sleep patterns also worsen metabolic conditions (5). These factors increase the risk of DM complications, including coronary heart disease, kidney failure, diabetic retinopathy, and peripheral neuropathy, impacting quality of life and the public health burden.

Physical activity and nutritional status are two key factors that play a role in managing blood glucose levels. Regular physical activity can increase insulin sensitivity and improve Glucose Transporter type 4 (GLUT-4) function, allowing glucose to be more effectively absorbed by muscle cells (6,7). Conversely, physical inactivity can reduce the body's ability to utilize glucose and worsen insulin resistance (5).

Nutritional status also affects blood glucose metabolism. Individuals who are overweight or obese are more susceptible to insulin resistance, while malnutrition can disrupt the balance of glucose metabolism (8,9). Therefore, monitoring nutritional status and implementing a healthy diet are important strategies in controlling type 2 diabetes.

Based on this description, this study aims to determine the relationship between physical activity and nutritional status and blood glucose levels in patients with DM type 2 at Puskesmas Sei Langkai. This study is expected to provide important information for planning non-pharmacological interventions in the management of DM, while also adding scientific evidence regarding factors that influence blood glucose control in the transitional age group from productive to elderly.

2. METHODS

This is an observational analytical study using a cross-sectional approach. The population was all patients od DM type 2 at Puskesmas Sei Langkai, Batam in 2024, totaling 1,064 patients aged 45–69 years. A sample of 120 respondents was selected using a purposive sampling technique. The inclusion criteria were: patients undergoing routine outpatient check-ups, not experiencing severe complications, able to communicate in Indonesian, willing to sign an informed consent, and able to undergo anthropometric measurements and random blood glucose levels. Exclusion criteria included patients with special conditions such as fasting or significant edema.

The study was conducted in October 2025 at Puskesmas Sei Langkai. The independent variables were physical activity and nutritional status, while the dependent variable was random blood glucose levels. Physical activity was measured using by IPAQ questionnaire and converted to MET-minutes/week. Nutritional status was measured using Body Mass Index (BMI), and random blood glucose levels were measured using a glucometer.

Data collection was conducted through anthropometric measurements (body mass index), physical activity levels, and blood glucose levels. Physical activity levels were

measured using the International Physical Activity Questionnaire (IPAQ) and blood glucose levels were measured using glucometer from finger prick. Classification of Body Mass Index (BMI) are underweight (<18.5kg/m^2), normal (18.5 – 25.0kg/m^2), overweight (>25.0 – 27.0kg/m^2), and obesity (>27.0kg/m^2). Physical activity levels are expressed in MET minutes/week, with walking equivalent to 3.3 METs, moderate-intensity activity equivalent to 4.0 METs, and vigorous intensity activity equivalent to 8.0 METs. These values are multiplied by duration (in minutes) and frequency (in days), then summed to calculate the total physical activity score. Based on IPAQ scoring guidelines, physical activity is categorized as light (<600 MET-minutes/week), moderate (≥600 MET-minutes/week), and vigorous (≥1500–3000 MET minutes/week). Blood glucose levels is categorized ad controlled (200mg/dL) and uncontrolled (≥200mg/dL). All of data was analyzed using the Spearman Rank Correlation Test to determine the association of physical activity and nutritional status with blood glucose levels. This study was approved by the Research Ethics Committee of Institut Kesehatan Mitra Bunda, under protocol number 062/K/KEP/IKMB/VII/2025.

3. RESULTS

Table 1. Characteristic of Respondents

Characteristic	Total (n)	Percentage (%)
Age	92	76,7
45 – 59 years old	28	23,3
60 – 69 years old		
Total	**120**	**100**
Gender	35	29,2
Male	85	70,8
Female		
Total	**120**	**100**
History of DM		
< 1 years	6	5,0
1 – 5 years	75	62,5
6 – 10 years	37	30,8
>10 years	2	1,7
Total	**120**	**100**

The majority of respondents were in the 45–59 age group (76.7%), indicating that middle-aged individuals are more susceptible to Type 2 Diabetes Mellitus due to decreased pancreatic β-cell function and increased insulin resistance. The majority of respondents were female (70.8%), indicating a higher risk in women due to hormonal factors and postmenopausal central obesity. The majority had had DM for 1–5 years (62.5%), and were still in the early to intermediate stages of the disease, requiring blood glucose monitoring.

Table 2. Physical Activity in Patients DM Type 2 at Puskesmas Sei Langkai

Physical Activity	Total (n)	Percentage (%)
High	5	4,2
Moderate	79	65,8
Low	36	30,0
Total	**120**	**100**

Based on Table 2, the majority of respondents, 79 (65.8%), reported moderate levels of physical activity. This indicates that most of patienst of DM Type 2 has a good level of physical activity in their daily activities.

Table 3. Nutritional Status in Patients DM Type 2 at Puskesmas Sei Langkai

Nutritional Status	Total (n)	Percentage (%)
Underweight	5	4,2
Normal	93	77,5
Overweight	6	5,0
Obesity	16	13,3
Total	**120**	**100**

Based on Table 3, the majority of respondents, 93 (77.5%), had normal nutritional status. This result indicates that the majority of patients DM type 2 at Puskesmas Sei Langkai has nutritional status that is still within the normal category.

Table 4. Blood Glucose Levels in Patients DM Type 2 at Puskesmas Sei Langkai

Blood Glucose Levels	Total (n)	Percentage (%)
High	56	46,7
Low	64	53,3
Total	**120**	**100**

Based on Table 4, it is known that the majority of respondents had uncontrolled blood glucose levels, namely 64 people (53.3%), while respondents with controlled blood glucose levels were 56 people (46.7%). These results indicate that more than half of patients DM type 2 at Puskesmas Sei Langkaiare not able to optimally control their blood glucose levels.

Table 5 Association of Physical Activity with Blood Glucose in Patients DM Type 2 at Puskesmas Sei Langkai

Variable	Median ± SD	r	p-*value*
Physical Activity	939 ± 774,177	-0,305	0,001
Blood Glucose Levels	202 ± 45,357		

Based on Table 5, the median physical activity of respondents was 939 MET-minutes/week (SD = 774.177) and the median random blood glucose was 202 mg/dL (SD = 45.357), indicating moderate physical activity and uncontrolled blood glucose. The Spearman Rank test showed p = 0.001 with r = -0.305, indicating a moderate and negative significant relationship, meaning that the higher the physical activity, the more controlled the blood glucose levels tend to be.

Table 1 Association of Nutritional Status with Blood Glucose in Patients DM Type 2 at Puskesmas Sei Langkai

Variable	Median ± SD	r	p-*value*
Nutritional Status	23,0 ± 3,771	0,159	0,083
Blood Glucose Levels	202 ± 45,357		

Based on Table 6, the median nutritional status of respondents was 23.0 kg/m^2 (SD = 3.771) and the median random blood glucose was 202 mg/dL (SD = 45.357), indicating normal nutritional status and uncontrolled blood glucose. Spearman Rank analysis

showed r = 0.159 and p = 0.083, indicating no significant relationship between nutritional status and blood glucose levels, although there was a weak positive.

4. DISCUSSION

Based on a study of 120 respondents showed that the median physical activity of 939 MET-minutes/week (SD = 774.177) is classified as moderate, while the median random blood glucose level of 202 mg/dL (SD = 45.357) is categorized as uncontrolled/hyperglycemia. The Spearman Rank test showed a correlation coefficient of r = -0.305 with a p-value of 0.001, indicating a statistically significant negative relationship between physical activity and blood glucose levels. This means that the higher the physical activity, the more controlled the blood glucose levels.

A correlation of -0.305 is considered moderate, indicating that physical activity has a significant impact on glucose control in people with Type 2 Diabetes. Individuals with low physical activity are more likely to experience hyperglycemia due to impaired glucose uptake into muscle cells, increased insulin resistance, and reduced GLUT-4 protein function. Conversely, physical activity increases glucose utilization as an energy source and facilitates glucose entry into muscle cells (5). The effects of physical activity are acute and persist for several days, so random glucose monitoring remains relevant. Muscle activity increases insulin sensitivity, GLUT-4 activation, and the AMPK enzyme, which enhances glucose utilization without insulin (10). Physical activity in the past seven days can affect random glucose levels because these metabolic mechanisms are continuous (11).

The results of this study align with several previous studies by Sudoyo et al. (2017), who stated that physical activity increases insulin sensitivity and GLUT-4 translocation through both insulin-dependent and insulin-independent pathways (12). According to Anggraeni (2018), lack of physical activity decreases insulin sensitivity, increases insulin resistance, and triggers hyperglycemia (6). According to Sundayana (2023), regular physical activity improves muscle response to insulin, resulting in better glucose control (7). Based on previous study Wartana (2022), regular activity increases metabolism, burns calories, reduces body fat accumulation, improves insulin sensitivity, and lowers the risk of diabetes complications, including cardiovascular disease (13).

Physical activity is significantly associated with blood glucose levels. Regularly increasing physical activity improves insulin sensitivity, improves glucose transport mechanisms via GLUT-4, increases glucose utilization by muscles, and overall helps control blood glucose and reduces the risk of diabetes complications (14). Based on research on the relationship between nutritional status and blood glucose levels in patients with DM type 2 showed that median nutritional status of respondents was 23.0 kg/m^2 with a standard deviation of 3.771, indicating that most respondents had normal nutritional status. Meanwhile, the median random blood glucose level was 202 mg/dL with a standard deviation of 45.357, indicating that the majority of respondents experienced hyperglycemia or uncontrolled glucose levels.

Statistical analysis using the Spearman Rank test showed a p-value of 0.083 and a correlation coefficient (r) of 0.159. A p-value > 0.05 indicates no statistically significant relationship between nutritional status and blood glucose levels. A positive and low r-value indicates a positive relationship, meaning that an increase in BMI tends to be

followed by an increase in blood glucose levels. However, the strength of the relationship is very weak and not statistically significant. This suggests that differences in blood glucose levels between nutritional statuses are likely influenced by other factors, such as diet, physical activity, stress levels, adherence to treatment, and duration of diabetes. These results align with previous research. Suryanti et al. (2019) found that even though respondents ranged from normal to obese nutritional status, blood glucose levels remained high, and there was no significant relationship between BMI and blood glucose, as glucose control is more influenced by the body's ability to respond to insulin and adherence to treatment (15). Study of Mia (2018) study emphasized the influence of eating habits and physical activity, while Budiamal (2020) stated that dietary management, duration of diabetes, and adherence to therapy play a greater role than nutritional status. Overweight patients can still control their blood glucose levels if their diet and medication adherence are good (16, 17).

Research at Puskesmas Sei Langkai confirmed that nutritional status is not the sole determinant of blood glucose control. The positive but weak correlation indicates a direction of the relationship consistent with the theory that body weight tends to influence glucose levels, but other factors such as medication adherence, physical activity, diet, stress levels, and duration of diabetes have a more dominant influence. This could be influenced by several factors, such as dietary management, duration of diabetes, and adherence to medication, which play a greater role than nutritional status (18). Furthermore, a good diet is more influential in controlling blood glucose levels than body weight. Overweight patients who manage their diet well can still maintain controlled blood glucose levels. In the other hands, physical activity improves insulin sensitivity and glucose uptake through the GLUT-4 mechanism, allowing blood glucose to be controlled even in overweight individuals (19). This study has limitations because random blood glucose levels were measured only once and it did not further identify other related factors that influence blood glucose levels, such as dietary compliance.

5. CONCLUSION

Based on the results of a study of 120 respondents with Type 2 Diabetes Mellitus in the Sei Langkai Community Health Center (Puskesmas) in Batam City, the majority of respondents were aged 45–59 years (76.7%), female (70.8%), had a high school education (65.8%), were unemployed (67.5%), and had had diabetes for 1–5 years (62.5%). Most reported moderate physical activity (65.8%) and normal nutritional status (77.5%), but more than half of respondents had uncontrolled blood glucose levels (53.3%). The analysis showed a significant relationship between physical activity and blood glucose levels, while nutritional status had no statistically significant relationship. This confirms that blood glucose control in patients with Type 2 Diabetes Mellitus is more influenced by physical activity and other factors such as adherence to treatment, diet, and duration of diabetes, rather than nutritional status alone. Patients are advised to engage in regular physical activity, maintain a balanced diet, monitor blood glucose, and adhere to treatment. Puskesmas are expected to improve patient education and monitoring. Further researchers are advised to examine other factors such as diet, stress, medication compliance, and disease duration.

REFERENCES

1. Schleicher, E., Gerdes, C., Petersmann, A., Müller-Wieland, D., Müller, U. A., Freckmann, G., ... & Landgraf, R. (2022). Definition, classification and diagnosis of diabetes mellitus. *Experimental and Clinical Endocrinology & Diabetes*, *130*(S 01), S1-S8.
2. Zahroh, S., & Musriana, R. (2016). Diabetes mellitus: Gangguan metabolik dan gejala awal. *Jurnal Kesehatan Indonesia, 8*(2), 15–22.
3. IDF (International Diabetes Federation). (2023). *IDF Diabetes Atlas, 10th edition.* Brussels: International Diabetes Federation.
4. Kemenkes RI. (2022). *Profil kesehatan Indonesia 2022.* Jakarta: Kementerian Kesehatan Republik Indonesia.
5. PERKENI. (2021). *Pedoman pengelolaan dan pencegahan diabetes mellitus tipe 2 di Indonesia.* Jakarta: Perkumpulan Endokrinologi Indonesia.
6. Anggraeni, R. (2018). Pengaruh aktivitas fisik terhadap kadar glukosa darah pada penderita diabetes mellitus tipe 2. *Jurnal Ilmu Kesehatan, 7*(1), 12–18.
7. Sundayana, A. (2023). Efek aktivitas fisik teratur terhadap pengendalian glukosa darah. *Jurnal Ilmu Gizi dan Kesehatan, 16*(1), 12–19.
8. Valentina, A. (2021). Pengaruh obesitas terhadap resistensi insulin pada penderita diabetes. *Jurnal Gizi dan Diet, 8*(3), 55–61
9. Harsari, D. (2018). Status gizi dan risiko resistensi insulin pada pasien diabetes mellitus tipe 2. *Jurnal Gizi Klinik, 11*(1), 34–42
10. McGee, S. L., & Hargreaves, M. (2024). Exercise performance and health: Role of GLUT4. *Free Radical Biology and Medicine*, *224*, 479-483.
11. Noor Cholifah. (2016). Aktivitas fisik dan sensitivitas insulin pada penderita diabetes mellitus tipe 2. *Jurnal Kesehatan, 5*(1), 23–29.
12. Sudoyo, A., Nugroho, H., & Wibowo, S. (2017). Aktivitas fisik dan translokasi GLUT-4 pada diabetes mellitus tipe 2. *Jurnal Metabolisme dan Endokrin, 9*(2), 45–53.
13. Wartana, T. (2022). Aktivitas rutin dan sensitivitas insulin pada pasien diabetes mellitus tipe 2. *Jurnal Endokrinologi, 10*(1), 40–47.
14. Wang, Y., Dzubur, E., James, R., Fakhouri, T., Brunning, S., Painter, S., ... & Shah, B. R. (2022). Association of physical activity on blood glucose in individuals with type 2 diabetes. *Translational Behavioral Medicine*, *12*(3), 448-453.
15. Suryanti, E., Rahman, A., & Lestari, P. (2019). Hubungan status gizi dengan kontrol glukosa darah pada pasien DM tipe 2. *Jurnal Gizi Klinik Indonesia, 12*(1), 20–28.
16. Mia, A. (2018). Peranan kebiasaan makan dan aktivitas fisik terhadap kontrol glukosa darah. *Jurnal Gizi dan Diet, 6*(2), 57–64.
17. Budiamal, D. (2020). Pengaruh pengaturan diet, kepatuhan terapi, dan lama menderita diabetes terhadap kontrol glukosa darah. *Jurnal Endokrinologi Klinis, 9*(1), 23–30.
18. Hossain S, Chowdhury AI, Sarwer MN, Akter F, Mukta NA. Association Between Blood Glucose and Body Mass Index With Dietary Diversity and Physical Activity: A Cross-Sectional Study on Marma Tribes of Bandarban in Bangladesh. Health Science Reports. 2025 Jul;8(7):e71113.
19. Syeda UA, Battillo D, Visaria A, Malin SK. The importance of exercise for glycemic control in type 2 diabetes. American Journal of Medicine Open. 2023 Jun 1;9:100031.