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The Relationship Between Physical Activity and Blood Glucose Levels in Patients with Diabetes Mellitus at Narang Community Health Center

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ABSTRACT
Diabetes mellitus (DM), commonly known as diabetes, is a serious chronic condition characterized by elevated blood glucose levels due to the body's inability to produce or effectively use insulin. Physical activity refers to movements involving skeletal muscles that require more energy than resting, typically planned, continuous, and repetitive in nature, with the aim of improving physical fitness. The purpose of this study is to examine the relationship between physical activity and blood glucose levels in patients with diabetes mellitus. This study used a quantitative descriptive correlational approach with a cross-sectional design. The sampling technique was non-probability sampling, involving a total of 50 respondents. Data were analyzed using univariate and bivariate methods, specifically Kendall's Tau B. The statistical analysis yielded a p-value of 0.000 ($p < 0.05$), indicating a significant relationship between physical activity and blood glucose levels among patients with diabetes mellitus at Narang Community Health Center. The findings indicate a positive correlation between physical activity and blood glucose levels in diabetic patients at Narang Community Health Center. Future researchers are encouraged to enhance the study design and broaden the sample selection. Additionally, attention should be given to unexplored factors that may influence blood glucose levels and were not communicated to respondents, in order to obtain more comprehensive results.

Keywords: Blood Glucose Levels, Diabetes Mellitus, Physical Activity

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INTRODUCTION

Diabetes mellitus (DM), commonly referred to as diabetes, is a serious long-term (chronic) disease that occurs when blood glucose levels become elevated due to the body's inability to produce or effectively use the hormone insulin (1). This results in a disruption in insulin production by the pancreas. Insulin is a hormone that regulates the use of glucose by muscles, fat, and other cells in the body. When insulin production decreases, it leads to elevated blood sugar levels, causing impaired metabolism of carbohydrates, proteins, and fats in the body (1).

According to the International Diabetes Federation (2019), there were 351.7 million individuals aged 20–64 years living with diabetes mellitus, and this number is projected to rise to 417.3 million by 2030 and 486.1 million by 2045 (2). This increase is expected to primarily affect low- to middle-income countries.

The World Health Organization (WHO) estimated that the number of people with DM in Indonesia, which stood at 8.4 million in 2000, would rise significantly to around 21.3 million by 2030. Similarly, data from the World Diabetes Association showed an increase in the prevalence of DM in

Indonesia from 9.1 million in 2014 to 14.1 million by 2035 (3). In Indonesia, DM ranks as the third leading cause of death (6.7%), following stroke (21.1%) and heart disease (12.9%) (1). According to Basic Health Research (Riskesdas) in 2013, the prevalence of DM in Indonesia was 1.5%, which increased to 2.0% in the 2018 Riskesdas, reflecting a 0.5% rise. Additionally, the prevalence of DM based on blood glucose testing among individuals aged over 15 years increased from 6.9% in 2013 to 8.5% in 2018, indicating about 25% new cases (4).

According to the Ministry of Health of the Republic of Indonesia (2018), the province with the highest DM prevalence is DKI Jakarta at 3.4%, while the lowest is East Nusa Tenggara (NTT) at 0.9%. The number of people with DM increases significantly among those aged 55–64 years (6.3%). From a gender perspective, women are more affected than men, with 1.8% compared to 1.2%, respectively. Most people with DM live in urban areas (1.9%) compared to rural areas (1.0%) (1).

Based on the East Nusa Tenggara provincial Riskesdas report (2018), Manggarai Regency ranks seventh in the province, with 0.55% of its population diagnosed with DM (5). According to the 2022 Manggarai Regency Health Profile, the highest number of DM cases in the district occurred at the La'o Health Center. No cases were reported at the Loce, Langke Majok, or Langgo Health Centers. The Narang Health Center ranked ninth in the district, with a total of 45 people diagnosed with diabetes mellitus in 2022 (6).

Preliminary studies conducted at the Narang Health Center in Cambir Leca Village, West Satarmese District, on November 4, 2023, showed that four villages in the Narang Health Center's service area had a total of 75 confirmed DM cases. According to the disease pattern data at Narang Health Center, diabetes mellitus ranks third among the most commonly reported diseases. Interviews with DM patients revealed that seven respondents stated they did not engage in regular physical activity prior to their diagnosis. When they reached the age of 55–60, their outdoor activity significantly decreased, as they could no longer perform physical tasks as before and often felt fatigued when engaging in strenuous activities.

This study aims to identify the physical activity levels of the respondents, measure their blood glucose levels, and analyze the relationship between physical activity and blood glucose levels. The urgency of this research lies in the fact that previous studies have shown varying results regarding the impact of physical activity on blood glucose levels. Therefore, the researchers were motivated to further explore this factor. The findings of this study are expected to raise awareness about the importance of physical activity in the prevention of diabetes mellitus.

METHODS

This research was conducted at the Narang Health Center, Cambir Leca Village, West Satarmese District, Manggarai Regency, from March 26 to April 26, 2024. This study employed a quantitative research approach. The research design used was a cross-sectional design. The population in this study consisted of all individuals with diabetes mellitus aged 45–75 years, totaling 50 people. The sampling technique applied was non-probability sampling with a saturated sampling (total sampling) method, in which all members of the population were included as study

participants. Thus, the sample size in this study was 50 individuals.

Data were collected using the Global Physical Activity Questionnaire (GPAQ) to assess physical activity and by measuring blood glucose levels in individuals with diabetes mellitus. Data analysis was conducted using the Kendall's Tau-b correlation test. The independent variable in this study was physical activity, while the dependent variable was the blood glucose level of individuals with diabetes mellitus.

RESULTS AND DISCUSSION

Based on Table 1, it can be concluded that out of the 50 respondents, the majority were aged 56–65 years, totaling 30 individuals (60.0%), while the smallest groups were those aged 45–55 years and 66–75 years, with 10 respondents (20.0%) each. Furthermore, the majority of respondents were female, totaling 28 individuals (56.0%), while the remaining 22 respondents (44.0%) were male.

Table 1. Distribution of Group Frequency Based on Age, Gender, Education, and Occupation

Characteristic	f	%
Age (Years)		
45-55	10	20.0
56-65	30	60.0
66-75	10	20.0
Gender		
Male	22	44.0
Female	28	56.0
Education		
Elementary	21	42.0
Junior High School	15	30.0
Senior High School	8	16.0
Bachelor's Degree	6	12.0
Occupation		
Unemployed	20	40.0
Housewife	12	24.0
Farmer	16	34.0
Civil Servants	2	4.0
Total	50	100

In terms of educational background, the majority of respondents had completed only elementary school, accounting for 21 individuals (42.0%), while the lowest number of respondents held a bachelor's degree, totaling 6 people (12.0%). Regarding occupation, most respondents (20 individuals or 40.0%) were unemployed, while the fewest were civil servants, totaling only 2 respondents (4.0%).

Based on Table 2, it was found that most of the 50 respondents engaged in light physical activity (35 individuals or 70.0%), followed by 15 respondents (30.0%) who engaged in moderate physical activity. None of the respondents reported engaging in vigorous physical activity.

According to Table 3, out of the 50 respondents, 26 individuals (52.0%) had high blood glucose levels, while 24 respondents (48.0%) had normal blood glucose levels. Bivariate analysis was conducted to examine the relationship between physical activity and blood glucose levels in patients with diabetes mellitus at Narang Health Center, Cambir Leca Village, West Satarmese District.

Table 2. Distribution of Respondents Based on Physical Activity

Physical Activity	f	%
Light	35	70.0
Moderate	15	30.0
Vigorous	0	0
Total	50	100

Table 3. Distribution of Respondents Based on Incidence of DM

Blood Glucose Levels	f	%
Normal	24	48.0
High	26	52.0
Total	50	100

Table 4. The Relationship Between Pysical Activity and Incidence of Diabetes Melitus at Narang Health Center, Cambir Leca Village, West Satarmese District

Blood Sugar Levels	Physical Activity								P-value
	Light		Moderate		Vigorous		Total	%	
	f	%	f	%	f	%			
Normal	11	22.0	13	26.0	0	0	24	48.0	0.000
High	24	48.0	2	4.0	0	0	26	52.0	
Total	35	70.0	15	30.0	0	0	50	100	

Based on the crosstabulation, among 50 respondents, 24 individuals (48.0%) with light physical activity had high blood glucose levels, and 11 individuals (22.0%) with light physical activity had normal blood glucose levels. Meanwhile, among those who engaged in moderate physical activity, 13 respondents (26.0%) had normal blood glucose levels and only 2 respondents (4.0%) had high blood glucose levels. No respondents engaged in vigorous physical activity.

The results of the statistical analysis using Kendall's Tau-b showed a p-value of 0.000, indicating a significant relationship between physical activity and blood glucose levels in patients with diabetes mellitus at the Narang Health Center, Cambir Leca Village, West Satarmese District ($p < 0.05$).

The results of the study on physical activity among respondents with diabetes at the Narang Health Center showed that most respondents engaged in light physical activity, totaling 35 people (70.0%).

Light physical activity refers to activities that require minimal energy and generally do not cause noticeable changes in breathing. The energy expended is less than 3.5 kcal/minute. Such activities include casual walking at home, in the office, or shopping centers, sitting in front of a computer, reading, writing, driving, or operating machines while sitting or standing. Lack of physical activity can increase the risk of disease and elevate blood glucose levels. When a person engages in physical activity, the body uses glucose to produce energy, thereby depleting glucose stored in the muscles (10).

Several factors can influence light physical activity, one of which is age. As individuals age, their risk of developing diabetes increases. Generally, aging is accompanied by a decline in physiological functions, including the endocrine function of the pancreas, which reduces its ability to produce insulin (8). According to Komariah, K., & Rahayu, S., people over 40 tend to be less physically active, gain weight, and lose muscle mass, all of which contribute to aging and the decline of pancreatic beta cells (9).

The findings of this study differ from those of Mala Azhita (2018), who found that 70% of respondents engaged in light physical activity and 30% in vigorous physical activity (10). However, the current study is consistent with the findings of Jahidul Fikri Amrullah, who also identified a relationship between physical activity and blood glucose levels among elderly individuals with diabetes mellitus (11).

Based on this explanation, the researchers conclude that light physical activity is any activity that helps expend

energy, thereby reducing fat accumulation in the body, which can contribute to the development of diabetes mellitus. One factor that may lead to physical inactivity is age. Increasing age is associated with a decline in both the quantity and quality of physical activity. The results of this study at the Narang Health Center, Cambir Leca Village, West Satarmese District, showed that most respondents had uncontrolled blood glucose levels (26 respondents or 52.0%), while 24 respondents (48.0%) had controlled blood glucose levels.

Diabetes mellitus is a disease that occurs when the body cannot adequately release or use insulin, resulting in high levels of glucose (simple sugar) in the blood. According to Cicilia L., Kaunang, W.P., & Langi L.F.G., diabetes mellitus is a group of non-communicable diseases characterized by elevated glucose levels due to abnormalities in insulin secretion (12). It is a chronic condition that can cause long-term deterioration and damage to other organs in the body (13). One contributing factor is age: the older a person is, the more likely they are to develop insulin resistance, where insulin is still produced but in small amounts (14). Another factor is education. Nugroho & Sari found that educational level influences lifestyle choices related to diabetes mellitus. Individuals with higher education levels are more likely to be aware of health issues and to engage in preventive behavior (13).

From the above explanation, the researchers conclude that diabetes mellitus is characterized by elevated blood glucose levels, primarily due to the ineffectiveness of insulin. One key risk factor is age, particularly among individuals over 40 years old. Another important factor is education, as it affects an individual's access to health-related knowledge. At the Narang Health Center, most diabetic patients had lower levels of education, which may have limited their understanding of the disease and its prevention.

The results of this study showed a significant relationship between physical activity and blood glucose levels in individuals with diabetes mellitus at the Narang Health Center, Cambir Leca Village. This was evidenced by the results of Kendall's Tau-b statistical test, which showed a p-value of 0.000, indicating a significant association between the two variables. These findings contrast with those of Mala Azitha et al. (2018), who reported no significant relationship between physical activity and fasting blood glucose levels among diabetic patients at M. Jamil Padang Hospital (10). Similarly, a study by Ningrum A.N. also found no significant relationship between physical activity and the incidence of diabetes mellitus (7). However, other studies have shown the opposite. For instance, research conducted by Karolus Siregar found a significant relationship between physical activity and blood glucose levels among diabetic patients at Jakarta City Hospital (13).

One of the major risk factors for diabetes mellitus is an unhealthy lifestyle, particularly lack of physical activity. Physical activity involves the movement of skeletal muscles that require more energy than when at rest. It is typically planned, continuous, and repetitive, aimed at improving physical fitness (15). Physical activity is one of the core components of diabetes management because it enhances insulin sensitivity and helps maintain physical fitness (10). Inadequate physical activity can result in fat accumulation and slow the body's secretion processes. Individuals with lower body fat levels tend to have a lower risk of developing diabetes mellitus (16). Physical activity is directly

related to the muscles' ability to recover blood glucose. During physical activity, muscles use their stored glucose, prompting them to draw glucose from the bloodstream to replenish those stores, thereby lowering blood glucose levels (17). The benefits of AMPK-mediated physical activity include increased glucose uptake and transporter translocation. AMPK acts as an intracellular energy sensor activated by rising levels of intracellular AMP (18).

Based on the findings, the researchers conclude that most respondents with diabetes mellitus at the Narang Health Center engaged in light physical activity. Diabetes results from elevated blood glucose levels, which may be due to insufficient physical activity. Regular physical activity is essential for optimal blood glucose control and can slow or prevent the onset of complications. This study confirms that physical activity is significantly related to blood glucose levels in patients with diabetes mellitus.

LIMITATIONS

This study has a limitation in terms of the number of respondents, as the sample size may not be sufficient to fully represent the correlation between physical activity and blood glucose levels.

RESEARCH ETHIC

This study adhered to ethical principles, including informed consent, anonymity, and mutual confidentiality. Ethical clearance was obtained from the Ethics Committee of Catholic University of Santu Paulus.

CONFLICT OF INTEREST

All authors declare that there is no conflict of interest related to this study.

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CONCLUSION

Based on the interpretation of the research results and discussion on "The Relationship between Physical Activity and Blood Glucose Levels in Patients with Diabetes Mellitus at the Narang Health Center, Cambir Leca Village, West Satarmese District," it can be concluded that there is a significant relationship between physical activity and blood glucose levels. This is supported by the results of the Kendall's Tau B statistical test, which yielded a p-value of 0.000, indicating significance at $p < 0.05$.

Based on these findings, the following suggestions are made: Health workers at the Narang Health Center are encouraged to consistently monitor and improve the quality of care for individuals with diabetes mellitus. Additionally, it is recommended to implement educational programs emphasizing the importance of physical activity for all individuals managing diabetes mellitus.

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