



PHYSICAL ACTIVITY AND BLOOD GLUCOSE LEVELS IN DIABETES MELLITUS PATIENTS

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ABSTRACT	Keywords
Diabetes mellitus is a metabolic disease characterized by hyperglycemia. One of the risk factors and management of patients with diabetes mellitus is physical activity which can control blood glucose levels. This study aimed to determine the relationship between physical activity and blood glucose levels. The study design used correlation analysis with a cross-sectional approach. The population in this study was all type 2 diabetes mellitus patients at Abdoel Moeloek General Hospital Lampung. The sample used in this study was 52 respondents with consecutive sampling techniques. The research instrument for measuring physical activity was the physical activity level (PAL), and blood glucose level was measured using a glucometer, and data was analyzed using the Spearman Rho Test. The results showed that 32 respondents (61.5%) had mild physical activity, and 41 respondents (78.8%) had high blood glucose levels. The results showed a significant relationship between physical activity with blood glucose levels ($p\text{ value}=0,000$; $\alpha<0,05$) in patients with diabetes mellitus at the Abdoel Moeloek General Hospital, Lampung. Physical activity can help the body to lower blood glucose by way of metabolism involving glucose stored in the muscles so that glucose in the blood will fill the glucose vacancies in the muscles. Higher the physical activity in patients with diabetes mellitus, the lower the glucose level.	Physical Activity, Blood Glucose Levels, Diabetes Mellitus

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease that results from defects in insulin secretion, insulin action or both, characterized by hyperglycemia. DM is a chronic disorder characterized by a relative deficiency of insulin in fat and carbohydrate metabolism. DM is classified into two categories, namely type I diabetes (Insulin Dependent Diabetes Mellitus, IDDM) and type II diabetes (Non-Insulin Dependent Diabetes Mellitus, NIDDM) (Siregar et al., 2023). According to the World Health

Organization, more than 180 million people suffer from DM worldwide. The International Diabetes Federation (2019) reports deaths of 4.6 million people due to DM. At the age of more than 20 years, it is estimated to experience complications from DM, while at the age of 65 years and above, DM cases increase 1-4 times (IDF, 2019).

According to the Data and Information Center of the Ministry of Health of the Republic of Indonesia, in 2021, almost all provinces in Indonesia experienced an

increase in the prevalence of DM from 2013 to 2018. Regions with the highest DM incidence rate in 2018 were still the same as those in 2013, namely the Yogyakarta, Jakarta, North Sulawesi and East Kalimantan provinces. The results showed that the prevalence of DM at the age of 20-25 years was 23.73%. One of the factors that can cause the occurrence of DM is the habit of doing physical activity. The habit of doing mild physical activity to moderate physical activity has a 3,198 times chance of experiencing DM compared to someone with high physical activity (Ramadhani et al., 2022).

Physical activity is directly related to increasing the rate of muscle glucose recovery. When a person performs an activity, the muscles use the glucose stored in the muscles. When glucose is reduced, the muscles fill the void by taking glucose from the blood. This process can lower blood glucose and improve blood glucose control (Suprayitna et al., 2023). Suppose physical activity is carried out only occasionally or in the mild to moderate activity category. In that case, it can cause energy requirements that are produced through the breakdown of glucose in the blood without any process of breaking down fat cells. The mechanism can cause blood glucose levels to increase again after carbohydrate intake returns to the body (Pakpahan & Tarigan, 2021). This study aimed to determine the relationship between physical activity and blood glucose levels at the Abdoel Moeloek General Hospital, Lampung.

METHOD

The study design used correlation analysis with a cross-sectional approach. The population in this study was all type 2 diabetes mellitus patients at Abdoel Moeloek General Hospital Lampung. The sample used in this study was 52 respondents with consecutive sampling techniques. The research instrument for measuring physical activity was the physical activity level (PAL), and blood glucose level was measured using a glucometer, and data was analyzed using the Spearman Rho Test.

RESULTS

Table 1 Respondent's Characteristics

Variable	Mean	Median	SD	Min - Max	95% CI Lower - Upper
Age*	56.38	56.50	10.17	36.00-85.00	53.50-59.20
Suffering DM	4.79	3.00	4.16	0-18.00	5.95-3.63
Variables		n	%		
Gender	Man	15	28.8		
	Women	37	71.2		
Marital Status	Single	0	0		
	Married	45	86.5		
	Widower/Widow	7	13.5		
Education Level	Illiterate	2	3.8		
	Elementary School	22	42.3		
	Junior High School	12	23.1		
	Senior High School	12	23.1		
	College	4	7.7		
Employment	Unemployed	32	61.5		
	Private Employee	18	34.6		
	Civil Engineer	2	3.8		
Body Mass Index	Underweight	0	0.00		
	Normal/Healthy	10	19.2		
	Overweight	8	15.4		
	Obesity	34	65.4		

*Data was normally distributed

Respondent Characteristics

The results showed that the mean age in patients with DM at Abdoel Moeloek Hospital was 56.38 years with a standard deviation of 10.17 years. The median length of suffering from DM was three years, with the newest sufferer being one year and the longest sufferer being 18 years. Most of the sex prevalence was female, with as many as 37 respondents (71.2%). The majority of marital status was married, with as many as 45 respondents (86.5). The prevalence of education level was elementary school, with 22 respondents (42.3%). The majority of employment was mainly unemployed as many as 32 respondents (61.5%). The body

mass index's prevalence was mainly obesity, with as many as 34 respondents (65.4%).

Table 2 Physical Activity and Blood Glucose Level

Variable		n	%
Physical Activity	Mild	32	61.5
	Moderate	12	23.1
	High	8	15.4
Blood Glucose Levels	Low	1	1.9
	Normal	10	19.2
	High	41	78.8

Physical Activity

The results based on Table 2 showed that most of the physical activity in DM patients was mild, with as many as 31 respondents (61.5%).

Blood Glucose Levels

The results based on Table 2 showed that most of the blood glucose levels in DM patients were high, with as many as 41 respondents (78.8%).

Bivariate Analysis

Table 3 Bivariate Analysis

Variable	Blood Glucose Levels						<i>P</i> <i>value</i>
	Low		Normal		High		
	n	%	n	%	n	%	
Physical Mild	0	0.0	0	0.0	32	61.5	0.000*
Activity Moderate	0	0.0	3	5.8	9	17.3	
High	1	1.9	7	13.5	0	0.0	
Total	1	1.9	10	19.2	41	78.8	

* Significant at $p\text{-value} < 0.05$

Physical Activity and Blood Glucose Levels

The results of the analysis based on Table 3 showed that most of the respondents with mild physical activity had high blood glucose levels of 32 respondents (61.5%), respondents with moderate physical activity mostly had elevated blood glucose levels, and respondents with mild physical activity

mostly had normal blood glucose levels of 7 respondents (13.5 %). Further analysis showed a significant relationship between physical activity and blood glucose levels in DM patients at the Abdoel Moelok General Hospital, Lampung ($p\text{-value} = 0.000$; $\alpha < 0.05$).

DISCUSSION

Physical Activity

The results showed that most of the physical activity of DM patients was mild physical activity of 61.5%. The research was in line with Karwati's study (2022), which showed that most physical activity in DM patients is mild physical activity at 46.7%. Daily physical activity is defined as body movements carried out continuously through skeletal muscle contractions, and physical activity can increase energy metabolism. Physical activity is an excellent treatment choice for diabetes patients (Suardi, 2021). Physical activity performed by DM patients has many benefits, including 1) a decrease in blood pressure; 2) A better glycemic profile; 3) An optimization of lipid profiles; 4) An increase in insulin sensitivity in musculoskeletal; 5) Increasing insulin sensitivity and reducing insulin doses; 6) Improve renal function; 7) Improve the cardiorespiratory system; 8) Increase antioxidants (Cannata F et al., 2020).

The study showed that 19 respondents (36.5%) had mild physical activity for unemployed DM patients. The research was in line with research conducted by Arania et al. (2021), which showed that most of the physical activity of DM patients was mild physical activity at 39.7%. Further analysis showed a significant relationship between employment and physical activity in DM patients ($p\text{-value} = 0.000$; $\alpha < 0.05$). According to the American Diabetes Association, someone who works has benefits in controlling blood glucose levels through physical activity and can prevent complications. The physical activity of someone unemployed is not as much as that of someone working. Mild physical activity causes a lack of energy burning in the body

so that energy is stored as fat. These conditions can cause a person to be obese, and obesity is a factor in the incidence of diabetes mellitus (Cicilia et al., 2018; Ramadhani et al., 2022).

Blood Glucose Levels

The results showed that most of the blood glucose in patients with DM was high blood glucose levels of 78.8%. The research was in line with Karwati (2022), which showed that most of the blood glucose levels of DM patients were high blood glucose levels of 46.6%. Blood glucose is the primary carbohydrate material in the blood as fuel for the body's organs. Glucose is used as the primary source of energy formation, and glucose can also be stored in the form of glycogen. Blood glucose levels are an indicator to find out that someone has diabetes mellitus (Putri et al., 2019).

The results showed that DM patients with obese BMI had high blood glucose levels in as many as 41 respondents, 78.8%. A study by Adnan et al. (2013) showed that there was a significant relationship between body mass index and blood glucose levels in patients with DM ($p\text{-value} = 0.000$; $\alpha < 0.05$). The analysis results obtained $r = 0.201$, meaning that the higher the body mass index, the higher the blood glucose level. For someone who is overweight (obese), the level of leptin in the body will increase. Leptin is a hormone associated with the obesity gene. Leptin in the body plays a role in the hypothalamus to regulate body fat levels and the ability to burn fat into energy. In someone with obesity, there is resistance, namely leptin inhibits insulin receptor substrate-1 (IRS) phosphorylation, causing obstacles to glucose uptake and increasing blood glucose levels (Azizah, 2020).

Physical Activity and Blood Glucose Levels

The results showed a significant relationship between physical activity and blood glucose levels in patients with DM ($p\text{-value} = 0.000$; $\alpha < 0.05$). The research was in line with Karwati's Karwati (2022), which showed

that there was a significant relationship between physical activity and blood glucose levels ($p\text{-value} = 0.000$; $\alpha < 0.05$). The results of a study conducted by Setyawan & Sono (2015) showed that there was a significant relationship between physical activity and blood glucose levels in patients with DM ($p\text{-value} = 0.04$; $\alpha < 0.05$). Physical activity can cause muscle contractions, significantly lower extremity muscle contractions. During workouts, insulin and exercise increase glucose uptake by translocating glucose transporters. Insulin provides a signal so that phosphorylation occurs to the insulin receptor, insulin-1/2 substrate in tyrosine residues and tyrosine residues and phosphatidylinositol 3-kinase is activated (Ahmad et al., 2021; Chiang et al., 2019).

Physical activity is directly related to increasing the rate of muscle glucose recovery. When a person performs an activity, the muscles use the glucose stored in the muscles. When glucose is reduced, the muscles fill the void by taking glucose from the blood. This process can lower blood glucose and improve blood glucose control. When the oxidative phosphorylation mechanism occurs, the breakdown of one glucose molecule becomes 36 ATP to meet the body's energy needs. Suppose physical activity is carried out only occasionally or in the mild to moderate activity category. In that case, it can cause energy requirements that are produced through the breakdown of glucose in the blood without any process of breaking down fat cells. The mechanism can cause blood glucose levels to increase again after carbohydrate intake returns to the body (Pakpahan & Tarigan, 2021; Suprayitna et al., 2023).

CONCLUSIONS

Physical activity can help the body to lower blood glucose by way of metabolism involving glucose stored in the muscles so that glucose in the blood will fill the glucose vacancies in the muscles. Higher the

physical activity in patients with diabetes mellitus, the lower the glucose level.

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