

RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND NUTRITIONAL STATUS WITH BLOOD SUGAR LEVELS OF TYPE 2 DIABETES MELLITUS PATIENTS AT PUSKESMAS I WEST DENPASAR

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ABSTRACT

Background: According to the 2021 Denpasar Health Profile, Denpasar has the highest number of DM sufferers, which is 10.353 people. This study aims to determine the relationship between physical activity and nutritional status with fasting blood glucose levels in type 2 diabetes patients at Puskesmas I West Denpasar.

Method: This type of study is observational with a cross sectional design. The population is type 2 DM patients who come to Puskesmas I West Denpasar and a total of 40 samples with purposive sampling techniques. The data collected are primary and secondary data. The primary data collected were sample identity, physical activity, weight, height, and fasting blood glucose levels. The data analysis technique used is univariate and bivariate analysis using the spearman rank test in SPSS.

Result: The results showed that from 40 samples, there were 62,5% who had controlled fasting blood glucose, 72,5% had normal nutritional status, and 42,5% had moderate physical activity levels.

Conclusion: The conclusion of this study is that there is a relationship between physical activity levels and fasting blood glucose levels (p value = 0.015) and there is no relationship between nutritional status and fasting blood glucose levels (p value = 0.623).

Keywords: Fasting Blood Glucose; Physical Activity; Nutritional Status; Diabetes Mellitus

INTRODUCTION

The quality and management of individual health have been affected by changes in people's lifestyles and lifestyles that are more sedentary. Diabetes mellitus (DM) is one of the degenerative diseases that has dominated the shift in infections and nutritional diseases. Every year, 41 million people die from Non-Communicable Diseases (NCDs), or 71% of all deaths worldwide. More than 15 million people die from NCDs in the age range of 30 to 69 years, and 85% of these deaths occur in lower-middle-income countries. Diabetes contributes as many as 1.5 million people to deaths from non-communicable diseases every year (WHO, 2018). WHO estimates that the number of

people living with type 2 diabetes in Indonesia will increase from 8.4 million in 2000 to around 21.3 million by 2030. In addition, the World Diabetes Federation estimates that from 2013 to 2017, the number of people with diabetes mellitus will increase from 10.3 million to 16.7 million by 2045 (Soelistijo et al., 2019). Indonesia is ranked 7th with the most people with diabetes mellitus, with a total of 10.7 million people. Indonesia is the only country in Southeast Asia that is in the top 10 diabetics (Infodatin, 2020).

The prevalence of diabetes mellitus based on a doctor's diagnosis at the age of ≥ 15 years according to the national Riskesdas in 2018 is 2%, this data shows an increase from 1.5% in the 2013 Riskesdas. According to the Bali Provincial Riskesdas in 2018,

Denpasar City was ranked fourth "in the prevalence of diabetes mellitus in residents over 15 years old", which is 1.81%, still higher than the average of the province of Bali, which is 1.74%. Meanwhile, according to the Denpasar Health Profile 2021, Denpasar has the highest number of DM sufferers, which is 10,353 people. Diabetics who received health services in 2021 have exceeded the target, namely 148.4% or as many as 15,366 people have received health services. This percentage is the highest percentage compared to other districts/cities and also compared to the province of Bali itself. Diabetic mellitus patients in Denpasar City itself have experienced unstable development, in 2018 there were 9,123 people which then increased to 14,353 people in 2020, in 2021 itself there was a decrease to 10,354 people but Denpasar City is still ranked first with the most people with diabetes mellitus.

Diabetes mellitus is the most common endocrine disease. There are several classifications of diabetes mellitus, one of which is type 2 diabetes mellitus. Type 2 DM requires controlling blood glucose levels to prevent complications from occurring. One of the pillars of DM management to control blood sugar levels is physical activity. When doing activities, individuals with sufficient physical activity can experience an increase in glucose consumption by active muscles so that it can directly cause a decrease in blood glucose (Wisnawa & Priandini, 2021). Physical activity is a step to control type 2 diabetes mellitus that centers on the individual's ability to manage himself. The pandemic period has made people accustomed to technological developments and lifestyle habits that lead to a sedentary lifestyle where there is a decrease in physical activity to the point that it does not meet the standards of physical activity that must be done in a day (Sagita et al., 2023). Based on data on the proportion of physical activity, in 2018 low physical activity in Bali increased by 45.38%

from 2013 (Bali Health Office, 2018). Research by Widagdyo shows that 56.08% of people with type 2 diabetes still have poor physical activity for a week. Poor physical activity in question means that in a week the sufferer has light physical activity including sitting at work, watching television, and not exercising. Low physical activity can affect one of the pillars of diabetes mellitus. Previous research found that 100% of diabetic mellitus patients with low physical activity had high blood glucose levels (Karwati, 2022).

The management of type 2 diabetes can be supported by ideal nutritional status because nutritional status is an expression of the state of balance between nutrient intake from food and nutrient needs, so nutritional status is a description of the results of eating arrangements of DM patients (Wulandari, 2020). Undernutrition makes a person vulnerable to infectious diseases, while overnutrition can interfere with insulin signaling pathways that cause insulin resistance (Mukhayarjon, 2021). In a study at the Sinjai Regional Secretariat Office, individuals with non-ideal nutritional status had higher blood sugar levels than individuals with normal nutritional status (Febriza et al., 2019). Based on Health Profile data, West Denpasar Health Center I has the highest number of type 2 diabetes mellitus patients in the Denpasar City area, which is 1,498 people. Research by Wisnawa in 2021 showed that as many as 41.9% of DM patients at Puskesmas I West Denpasar had non-ideal physical activity (Wisnawa & Priandini, 2021). In addition, based on monthly visit reports, there are 65.53% of DM patients with suboptimal nutritional status at the West Denpasar I Health Center.

Based on previous exposure to physical activity and nutritional status, the researcher was interested in conducting research at the Puskesmas I West Denpasar related to the self-management of diabetics, namely by controlling blood sugar levels and doing

physical activity. Therefore, the researcher has an interest in conducting research on the relationship between physical activity and nutritional status with blood sugar levels in patients with type 2 diabetes mellitus at the Puskesmas I West Denpasar.

METHODS

This research was carried out at UPTD Puskesmas I West Denpasar from December to March 2024. The selection of this place is based on the number of people with type 2 diabetes mellitus of 1,498 people. This study is an observational research with *a cross sectional design*. The implementation of this research uses direct interview and recording methods. The variables in this study consisted of independent variables in the form of physical activity and nutritional status of people with diabetes mellitus and the bound variable was the fasting blood sugar level of people with diabetes mellitus.

The population in this study is type 2 DM patients who came to Puskesmas I West Denpasar for the past month. The samples in this study were sorted by sampling techniques in the form of *purposive sampling* based on inclusion and exclusion criteria. The inclusion criteria in this study are DM patients who are domiciled in the working area of Puskesmas I West Denpasar, aged 30-60 years, can communicate well, their weight and height can be measured, and can perform normal physical activity. The number of samples used in this study is 40 samples.

The type of data collected is primary data in the form of sample identity with direct interviews which are then analyzed by descriptive methods, fasting blood sugar level data samples are collected based on examinations by health center officers and then categorized according to PERKENI, physical activity data is obtained by interviews using guidelines in the form of *Global Physical Activity Questionnaire* (GPAQ) was then categorized, the nutritional

status of the samples was assessed based on body weight weighing using digital scales and height measurement using *microtoise* directly and then classified according to the nutritional status category by the Ministry of Health. This study also collected secondary data in the form of the number of type 2 DM patients in the working area of Puskesmas I West Denpasar. The data that has been collected will then be processed and analyzed using *the Spearman Rank* correlation test.

RESULTS AND DISCUSSION

3.1 Characteristics of the research sample

Based on the interviews that have been conducted on 40 research samples, the results regarding the characteristics of the research sample are as follows.

Table 1. Characteristics of the research sample

Sample Characteristics	Frequency (f)	Percentage (%)
Gender		
Man	14	35
Woman	26	65
Amount	40	100
Age		
30-39	4	10
40-49	11	27.5
50-59	25	62.5
Amount	40	100
Last Education		
Not in school	1	2.5
Elementary School	6	15
Middle School	9	22.5
High School	12	30
Bachelor	10	25
Master	2	5
Amount	40	100
Occupation		
Civil servants	3	7.5
Private	12	30
Self employed	9	22.5
Laborer	1	2.5
IRT	10	25
Other	5	12.5
Amount	40	100
Long Suffering		
<5 years	21	52.5
>5 years	19	47.5
Amount	40	100

Diabetes mellitus is a metabolic disease caused by the pancreatic gland being unable to produce insulin strongly. Insulin is a hormone that can regulate the balance of blood sugar levels. Insulin deficiency can lead to an increase in sugar levels in the blood (Priyanto,

2022). Based on the results of the research that has been carried out, as many as 40 samples of type 2 diabetes mellitus patients were obtained in the working area of the West Denpasar I Health Center. Most of the samples were female. During menopause, women experience a decrease in the chemicals estrogen and progesterone, which then leads to fat building that leads to insulin disruption as well as increased blood glucose levels. A decrease in progesterone can make cells more sensitive to insulin (Rusydi, 2020). In addition, women have a tendency to experience a higher body mass index physically, the prevalence of type 2 diabetes in women is higher (Komariah, 2020).

Looking at other characteristics, namely the age of the samples, most of which are in the age range of 50-59 years (62.5%), this is in line with research by Komariah that there is an increased risk of diabetes in samples with an age of more than 40 years due to the aging process causing a decrease in the ability of pancreatic beta cells to produce insulin. Physiological decline in humans is common, drastically decline occurs at age after 40 years which can have an impact on the pancreatic organs. Blood sugar levels are also more susceptible to increase due to decreased insulin sensitivity so that it can affect glucose levels in the blood (Trisnawati, 2013 in Komariah, 2020).

3.2 Physical activity

Physical activity level data was obtained based on the results of interviews on each sample using the *Global Physical Activity Questionnaire* (GPAQ) form. Based on interviews on the research sample, the results of the level of physical activity were obtained as follows.

The graph of physical activity level in figure 1 shows the results of the interviews which are then processed into three categories.

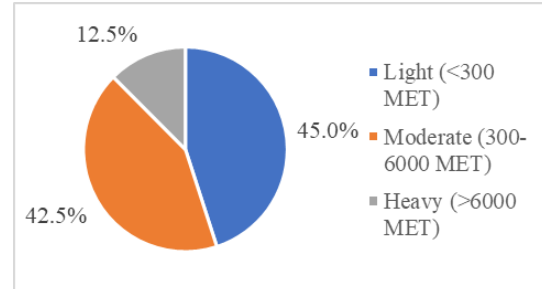


Figure 1. Distribution of samples according to physical activity level

The sample with the largest number was a sample with a light activity level of 18 samples (45%) with the most types of activities being washed dishes, ironing, and sitting and working in front of a computer. Meanwhile, the sample with a moderate activity level amounted to 17 samples (42.5%) with activities carried out were gymnastics, cycling, and *jogging*. In addition, the least sample was a sample with a heavy activity level, namely 5 samples (12.5%) with the activities carried out being work that involved lifting heavy weights regularly.

One of the pillar of diabetes mellitus control is physical activity. Physical activity in this study was measured using the *Global Physical Activity Questionnaire* (GPAQ) form. The level of nutritional activity obtained ranges from mild to severe. Most of the samples had a light activity level of 18 samples (45%). Lack of physical activity indicates that the sample has a high sedentary time. Sedentary time or time spent sitting or sleeping for a long time can increase the risk of heart disease, cancer, and other complications in patients with type 2 diabetes mellitus (Haseler, 2022).

3.3 Nutritional Status

Based on the results of weight and height measurements on the research sample, the following results were obtained.

In the collection of sample nutritional status data, the nutritional status of 40 samples in this study ranged from 18.7-32.4 kg/m² with the average nutritional status at 24.2 kg/m². This shows that the sample consists of normal nutritional status to overweight at the

severe level. Most of the samples had normal nutritional status according to the BMI, which was 29 samples (72.5%).

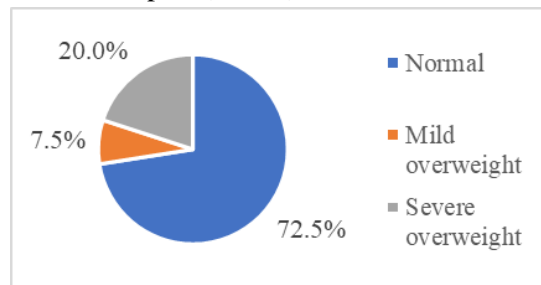


Figure 2. Distribution of samples according to nutritional status

Nutritional status is a state that results from the balance between nutrient intake from food and nutrient needs by the body (Candra, 2020). Samples with normal nutritional status showed that there was a balance between nutrient intake from food and energy expended by the body, both needed to meet basal energy and needed to meet daily activities. Patients with type 2 diabetes mellitus are encouraged to achieve and maintain normal nutritional status because it is to prevent a decrease in insulin sensitivity due to fat loss (Rihi Leo, 2021). Therefore, nutritional status is also one of the parameters in the goal of controlling diabetes mellitus (PERKENI, 2021).

3.4 Fasting blood glucose

Based on the results of examining fasting blood glucose levels in the research sample, the following results were obtained.

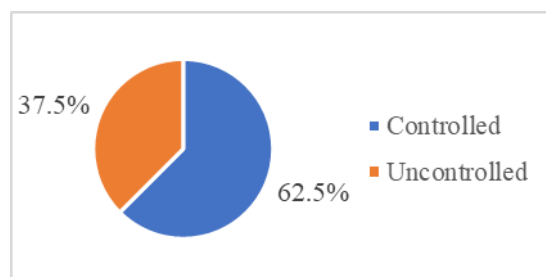


Figure 3. Distribution of samples according to fasting blood glucose levels

According to PERKENI (2021), the target range of fasting blood glucose levels, namely blood glucose measured after the patient fasts for 8-12 hours, for people with diabetes mellitus is 80-130 mg/dl. Based on

40 samples that have been assessed for fasting blood glucose levels, the fasting blood glucose levels of the samples ranged from 97-178 mg/dl with an average fasting blood glucose level of 128 mg/dl. Most of the samples had controlled blood glucose levels, which was 25 samples (62.5%). Patients with diabetes mellitus need to regulate and control high blood glucose levels to avoid other disease complications. The reduction of diabetes mellitus complications is carried out by the implementation of five pillars of diabetes mellitus control, one of which is the independent examination of blood sugar levels.

3.5 Relationship between Physical Activity Level and Fasting Blood Sugar Levels

One of the treatments for diabetes mellitus is physical activity. This study showed that of the 40 research samples, there were 12 samples (30%) with moderate activity levels that had controlled fasting blood glucose levels and 10 samples (25%) with light activity levels that had uncontrolled fasting blood glucose levels. The relationship between physical activity level and fasting blood glucose level was then tested using the spearman rank correlation test and obtained a p value of 0.015 ($p < 0.05$), so it can be said that there is a significant relationship between physical activity level and fasting blood glucose levels. The strength of the relationship is shown by a correlation coefficient (r) of -0.380.

Table 2. Relationship between Physical Activity Level and Fasting Blood Sugar Levels

Physical Activity	Blood Glucose				p-value
	Controlled		Uncontrolled		
	f	%	f	%	
Light	8	20	10	25	0.015
Moderate	12	30	5	12,5	
Heavy	5	12,5	0	0	
Amount	25	62,5	15	37,5	

This study is in line with research by Rahayuningsih (2023) which showed that there was a relationship between physical activity and blood glucose levels in type 2 DM patients at the Penebel I Health Center (p

value = 0.01). The research sample had a diverse physical activity routine. Based on the physical activity data taken, the average physical activity of the research sample was 1771 METs per week which was at a moderate activity level. This moderate activity was caused by a study sample that had a habit of exercising.

Based on interviews, the sample with moderate activity had the habit of exercising in the form of gymnastics, walking, jogging or cycling with a duration of 30-45 minutes for three to five days a week. Samples with light activity tend to be samples with jobs that are mostly done by sitting or being housewives while samples with high activity consist of samples with jobs such as labor or routinely lifting heavy objects. Blood glucose absorption during physical activity is not accompanied by an increase in insulin (Rahayuningsih, 2021).

Physical activity helps the absorption of glucose into cells without the need for insulin because muscle contraction increases insulin receptor sensitivity, cell permeability increases in active state, especially when doing aerobic physical exercise which causes an increase in oxygen in the blood (Tua H., 2020). This oxygen then provides an insulin-like effect that causes an increase in glucose transport from the blood into the cell (Rahayuningsih, 2021). Physical activities that involve muscle movements will use glucose stored in the muscles, if there is a glucose deficiency, the muscles will take glucose from the blood which helps lower blood glucose levels so that it plays a role in controlling diabetes mellitus (Arania, 2021).

The results of this study are also in line with research by Karolus (2023) that there is a relationship between physical activity and blood glucose levels in type 2 DM patients at Koja Hospital (p value = 0.000). People with type 2 diabetes are advised to carry out physical activities such as moderate intensity aerobic exercise for at least 150 minutes every week (PERKENI, 2021). In addition to

physical activity, there are other pillars that affect blood glucose levels in the management of diabetes mellitus. In samples with a light level of physical activity but with controlled blood glucose levels, it can be affected from other pillars, one of which is education about the management of diabetes mellitus, education is carried out with the aim of increasing knowledge and interest in doing a healthy lifestyle which is important in the management of diabetes.

Another pillar in the management of diabetes mellitus is eating arrangements. Eating arrangements in people with diabetes mellitus are nutritionally balanced and in accordance with the calorie needs of each individual. The eating regimen of DM patients emphasizes three principles, namely a consistent meal schedule, the type of carbohydrates consumed, and the number of calories contained. In addition, pharmacological therapy can also affect the patient's blood glucose levels. Pharmacological therapy itself is given along with eating arrangements and physical exercise to support a healthy lifestyle for DM sufferers (PERKENI, 2021).

3.6 Relationship between Nutritional Status and Fasting Blood Sugar Levels

Based on the nutritional status of the samples, it was shown that there were 19 samples with normal nutritional status having controlled blood glucose and 10 samples with normal nutritional status having uncontrolled blood glucose.

Table 3. Relationship between Nutritional Status and Fasting Blood Sugar Levels

Nutritional Status	Glucose Levels				P-value
	Controlled		Uncontrolled		
	f	%	f	%	
Normal	19	47.5	10	25	0.623
Mild overweight	1	2.5	2	5	
Severe overweight	5	12.5	3	7.5	
Amount	25	62.5	15	37.5	

Based on the results of the relationship analysis using the spearman rank test, it was found that there was no meaningful relationship between nutritional status and fasting blood glucose levels. It is known that

most of the samples have uncontrolled blood glucose levels even though they have normal nutritional status. The assessment of nutritional status in this study uses the Body Mass Index (BMI). BMI is not only determined by fat proportion, but also determined by bone density and muscle density (Setyawati, 2023). The BMI also does not show the distribution of fat in the body although it can indicate a person's nutritional status. BMI is vulnerable in determining nutritional status, especially to determine obesity status because it does not take into account the distribution and function of adipose tissue, so that the measurement of nutritional status should be accompanied by other anthropometric measurements such as abdominal circumference and waist-hip circumference measurements (ADA, 2023). Fat distribution needs to be known because visceral fat causes higher metabolic activity than subcutaneous fat. This visceral fat stored in the cavity will increase the number of hormones and cytokines which will then lead to an increase in blood sugar (Jo, 2009 in Paleva, 2019). This is in line with Sari's (2023) research, which showed an insignificant relationship between nutritional status and fasting blood glucose levels (p value = 0.098) due to the accumulation of fatty tissue in the abdomen which produces excessive amounts of free fatty acids that release cytokines and produce insulin resistance.

Assessment of nutritional status in addition to using BMI needs to be accompanied by abdominal circumference measurements for accuracy of assessment (Feller, 2010 in Sari, 2023). In addition, blood glucose levels in general can also be affected by factors such as adherence to taking medication, dietary adherence, and positive family support. This study is also in accordance with Suryanti (2019) that there is no relationship between nutritional status and fasting blood glucose levels due to low medication adherence factors can be related to high blood sugar

levels, dietary adherence which affects individual nutrient intake which can also be influenced by family support can have an impact on the management of diabetes mellitus. Unhealthy consumption such as the consumption of coconut milk, fat, or excess sugar can affect blood glucose levels (Suryanti, 2019).

CONCLUSION

This study showed that the level of physical activity and fasting blood glucose levels of people with type 2 diabetes at Puskesmas I West Denpasar had a significant relationship, while the nutritional status and fasting blood glucose levels of people with type 2 diabetes at Puskesmas I West Denpasar had no relationship. The suggestion that can be given based on this study is to increase the role of nutritionists at the West Denpasar I Health Center in providing education to patients who come every month to control blood glucose to ensure that DM patients carry out DM management compliantly.

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CONFLICT OF INTEREST

There is no conflict of interest in this research.

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