

FIBER INTAKE, PHYSICAL ACTIVITY, AND BLOOD SUGAR LEVELS IN TYPE 2 DM PATIENTS AT PUSKESMAS I DENPASAR TIMUR

Ni Putu Pande Prawidhi Mahasanti¹, G.A Dewi Kusumayanti¹, I Wayan Juniarsana¹, I Putu Suiraoka^{1,2}

¹Nutrition Department, Poltekkes Kemenkes Denpasar, Bali, Indonesia

²CoE Health Tourism, Poltekkes Kemenkes Denpasar, Indonesia

Corresponding author: suiraoka@gmail.com

ABSTRACT

Background: Diabetes Mellitus (DM) is a chronic disease that occurs when the pancreas is unable to produce insulin or when the body cannot use properly produced insulin. Normal blood sugar levels are below 200 mg/dl. The purpose of this study is to find out the correlation of fiber intake and physical activity with blood sugar levels in patients with type 2 diabetes mellitus at Public Health Center (Puskesmas) of Denpasar Timur I.

Method: This type of study is observational using *cross sectional* design. This study was conducted in December 2022. The number of samples in this study was 50 people. Fiber intake data are collected using the SQ-FFQ form, physical activity data are collected using the GPAQ (Global Physical Activity Questionnaire), blood sugar levels by blood strip using a glucometer.

Result: The data was processed with statistical analysis of Spearman Rank correlations. The results showed that 58% had sufficient fiber intake, 16% had high-category physical activity, and 42% had blood sugar levels <200 mg/dl. The results showed there was a relationship between fiber intake and blood sugar levels ($p < 0.05$) and also a significant relationship of physical activity with blood sugar levels ($p < 0.05$).

Conclusion: The final result is there was a relationship between fiber intake and blood sugar levels and also a significant relationship of physical activity with blood sugar levels.

Keywords: Fiber intake, Physical activity, Blood sugar levels

INTRODUCTION

1. Background

Diabetes mellitus is a metabolic disorder characterized by hyperglycaemia due to abnormalities in insulin action, insulin secretion or both. According to the World Health Organization (WHO), diabetes mellitus is one of the diseases that causes the most deaths in the world. The International Diabetes Federation (IDF) confirms diabetes as one of the fastest growing global health crises of the 21st century. Based on 2019 International Diabetes Federation (IDF) data, Indonesia ranks 7th out of 10 countries in the world with the highest number of diabetes sufferers, namely 10.7 million (Kemenkes, 2020).

Basic Health Research Data Riskesdas, 2018, the prevalence of diabetes mellitus in

Indonesia was 2%. According to the results of Basic Health Research (Riskesdas, 2018), the prevalence of diabetes mellitus in Bali Province was 1.74%. Based on the 2020 Bali Province Health Profile, Denpasar City ranks first with the highest number of diabetes mellitus sufferers at 14,353 people (Dinkes Prop Bali, 2021). Puskesmas (Public Health Centre) Denpasar Timur I is one of the public health centres with the highest number of DM sufferers in Denpasar City with a total of 1,376 sufferers (Dinkes Kota Denpasar, 2020). Data results from Puskesmas Denpasar Timur I in 2021 recorded the number of people suffering from type 2 DM as 1,546 people.

Type 2 DM is influenced by several factors, namely age, physical activity, lifestyle, heredity, diet, gender, social and economic aspects, level of education, and sugar levels in

the body (Delfina, et al, 2021). DM management is known for its four main pillars, namely, education, food planning, physical activity, and medicine (Mujisari, 2021). The most important part in diabetes management is nutritional therapy which is carried out by regulating diet, such as consuming foods sourced from complex carbohydrates or foods with a low glycemic index and consuming high fiber foods. Blood sugar levels in DM sufferers can be controlled if the fiber intake consumed is sufficient. The results of research by Adhi, et al (2020) show that people in Denpasar City tend to have a high fat and low fiber consumption pattern with a fiber consumption percentage of 65.0%. Changes in people's lifestyles with fast-food diets containing high calories, fat and low fiber from traditional diets are one of the causes of this consumption (Adhi, et al, 2020).

Physical activity in diabetes mellitus sufferers plays an important role in controlling blood sugar. During physical activity, there is an increase in glucose use by working muscles which directly causes a decrease in blood sugar (Amrulah, 2020). Insulin will increase during activity so that blood glucose will decrease (Mayawati dan Isnaeni, 2017). The results of research from Kresniari, et al (2022) showed that the physical activity of the elderly in Denpasar City was mostly included in the sufficient category with a percentage of 53.2%. This is supported by data that some elderly people only often do light physical activity. In fact, there are still many elderly people who have low physical activity.

2. Objective

In general, this study aims to determine the relationship between fiber intake and physical activity with blood sugar levels in Type 2 DM sufferers at Puskesmas Denpasar Timur I. Meanwhile, the specific aim of this research is to assess fiber intake, physical activity, measure blood sugar levels and analyze the relationship between fiber intake and physical activity with blood sugar levels in Type 2 DM patient at Puskesmas Denpasar Timur I.

METHODS

This research was conducted at Puskesmas Denpasar Timur I on December 7-24th 2022. This type of research was observational with a cross-sectional design. The population in this study were all Type 2 DM patients who visited Puskesmas Denpasar Timur I, both men and women. The sample in this study was 50 people with a sampling technique in the form of Non Probability Random Sampling with the Purposive Sampling method. Fiber intake data was collected by interview using an instrument in the form of the SQ-FFQ form and physical activity data by interview using the Global Physical Activity Questionnaire (GPAQ) instrument. Meanwhile, blood sugar level data is measured using a glucometer.

Fiber intake data is processed using the Nutrisurvey application and then given low (< 25 grams/day) and sufficient (\geq 25 grams/day) categories. Meanwhile, physical activity data results are given categories of low (< 600 METs per week), medium ($3000 > \text{MET} \geq 600$ METs per week), and high ($\text{METs} \geq 3000$ METs minutes per week). Data on blood sugar levels are categorized as controlled (< 200 mg/dl) and uncontrolled (\geq 200 mg/dl). Hypothesis testing was carried out using the Spearman Rank correlation test.

RESULTS AND DISCUSSION

UPTD Puskesmas Denpasar Timur I is located on Jl. Pucuk No.1, Sumerta, East Denpasar District began operations on October 10th 1957 with a working area of 7,509 km². UPTD Puskesmas Timur I is one of two community health centers in the East Denpasar District area. The number of DM sufferers recorded at Puskesmas Denpasar I in 2021 was 1,546 people.

1. Samples Characteristics

The identity data for this research sample includes gender, age, highest level of

education, occupation and nutritional status as described in Table 1, as follows:

Table 1 Sample Characteristics

Sample Characteristic	n	%
Gender		
a. Male	28	56.0
b. Female	22	44.0
Age (year)		
a. 36-45	4	8.0
b. 46-55	11	22.0
c. 56-65	21	42.0
d. 66-75	14	28.0
Education level		
a. Low	12	24.0
b. Middle	22	44.0
c. High	16	32.0
Job status		
a. Housewife	19	38.0
b. Private sector employee	14	28.0
c. Retired	10	20.0
d. Civil servants	3	6.0
e. Trader	2	4.0
f. Laborer	1	2.0
g. Jobless	1	2.0
Nutritional Status		
a. Thin	3	6.0
b. Normal	24	48.0
c. Obese	23	46.0
Total	50	100

The results of data analysis on 50 samples were 28 people (56.0%) male. A total of 21 people (42.0%) were in the age range 56-65 years. Age can increase the incidence of type 2 DM because aging triggers physiological decline which affects the decline in organ function which ultimately reduces insulin sensitivity which can affect blood sugar levels. Most of them had a secondary education level, namely 22 people (44.0%). The level of education influences the occurrence of DM. People who are highly educated usually have a lot of knowledge about health. Looking at other characteristics, namely work, the majority work as housewives, namely 19 people (38.0%). Judging from nutritional status, 23 people (46%) had a nutritional status in the obese category. This is in accordance with the theory that DM tends to be caused by obesity which is related to insulin resistance, which causes an increase in blood sugar levels due to the accumulation of body fat which can inhibit insulin action.

2. Fiber Intake

Fiber intake is the average amount of fiber intake per day that comes from food

consumed in the last month by the sample. The recommended fiber consumption for DM sufferers is 25 grams/day. From the 50 samples taken, the lowest fiber intake in the sample was 14.5 grams and the highest fiber intake in the sample was 26.2 grams with the average fiber intake obtained by the samples being 19.8. The sample fiber intake is described in Table 2, namely as follows:

Table 2 Sample distribution based on fiber intake

Fiber intake	f	%
Low (< 25 gram/day)	29	42.2
Enough (\geq 25 gram/day)	21	40.0
Total	50	100.0

Based on Table 2, it can be seen that 21 samples (42.0%) had fiber intake in the sufficient category, while 29 samples (58.0%) had fiber intake in the low category.

3. Physical Activity

Physical activity is any body movement produced by skeletal muscles that requires energy. Physical activity data was obtained from the results of physical activity interviews conducted by the sample in the last week with the help of the GPAQ (Global Physical Activity Questionnaire) questionnaire. Of the 50 samples taken, the lowest MET value in the sample was 240 and the highest MET value was 3140 with the average MET value obtained in the sample being 1052.39. Physical activity in the sample is described in Figure 1, as follows:

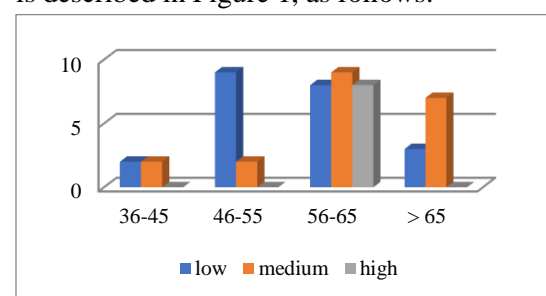


Figure 1. Distribution of samples according to physical activity

A total of 22 samples (44.0%) had low physical activity while 8 people (16.0%) had high physical activity.

4. Blood Sugar Levels

Current blood sugar levels are categorized into two, namely controlled if < 200 mg/dl and uncontrolled if \geq 200 mg/dl.

The lowest blood sugar level in the sample was 102 mg/dl and the highest blood sugar level in the sample was 363 mg/dl with the average blood sugar level obtained in the sample being 190.86. Blood sugar levels during the sample are described in Table 3, as follows:

Table 3 Distribution of samples based on temporary blood sugar levels

Temporary Blood Sugar Levels	f	%
Under control	24	48,0
Uncontrollable	26	52,0
Total	50	100

Based on Table 3, it can be seen that 26 samples (52.0%) had blood sugar levels in the uncontrolled category and 24 people (48.0%) had blood sugar levels that were controlled or normal.

5. Relationship between fiber intake and blood sugar levels

The results showed that 26 samples (100%) had insufficient fiber intake with blood sugar levels ≥ 200 mg/dl. Of the 24 samples with controlled blood sugar levels, there were 3 samples (12.5%) with low fiber intake, 21 samples (87.5%) with sufficient fiber intake. Details regarding the relationship between fiber intake and blood sugar levels can be seen in Table 4, as follows:

Table 4. Bivariate analysis of blood sugar levels based on fiber intake

Fiber intake	Blood sugar level				Total		p	r
	< 200		≥ 200		n	%		
Low	3	12.5	26	100.0	29	58.0	0,000	-0,658
Medium	21	87.5	0	0	21	42.0		
Total	24	100	26	100	50	100		

After carrying out the Spearman correlation test, a significant value of 0.0000 was obtained ($p < 0.05$), so it can be said that there is a significant relationship between fiber intake and blood sugar levels. The strength of the relationship is shown by the r value or correlation coefficient, which is -0.658, which means the level of correlation is strong. The relationship between these two variables is unidirectional so it can be interpreted as the more adequate fiber intake, the lower the blood sugar level or the lower the fiber intake, the higher the blood sugar level.

6. Relationship between physical activity and blood sugar levels

The results showed that of the 26 samples with uncontrolled blood sugar levels, there were 18 samples (69.8%) whose physical activity was classified as low and 8 samples (30.2%) whose physical activity was classified as moderate. Of the 24 samples with controlled blood sugar levels, there were 4 samples (16.7%) whose physical activity was classified as low, 12 samples (50.0%) were classified as moderate, and 8 samples (33.3%) were classified as high. Details regarding the relationship between physical activity and blood sugar levels can be seen in Table 5, as follows:

Table 5. Bivariate Analysis of blood sugar levels and physical activity

Physical Activity	Blood sugar level				Total		p	r
	< 200		≥ 200		n	%		
Low	4	16.7	18	69.8	22	44.0	0,000	-0,609
Medium	12	50.0	8	30.2	20	40.0		
High	8	33.3	0	0	8	16.0		
Total	24	100	26	100	50	100		

Based on the results of the Spearman correlation test, it can be concluded that there is a significant relationship between physical activity and blood sugar levels ($p < 0.05$). The strength of the relationship is shown by the r value or correlation coefficient, which is -0.609, which means the level of correlation is strong. The relationship between these two variables is unidirectional so it can be interpreted as the higher the physical activity, the lower the blood sugar level of the sample.

7. Discussion

Dietary fiber is the main component of plant cell walls such as fruits, vegetables, cereals and various tubers. Dietary fiber influences the GI value of food due to its role as a physical inhibitor in the digestive process. Dietary fiber has a hypoglycemic effect because it can slow gastric emptying, glucose diffusion, and glucose absorption which can reduce blood sugar (9). A total of 3 samples (12.5%) out of 24 samples had fiber intake < 25 grams (low) and 21 samples (87.5%) had fiber intake ≥ 25 grams (sufficient) with blood sugar levels under control. Meanwhile, 26 samples with uncontrolled blood sugar levels had fiber intake < 25 grams (low).

The results of this study are in line with research conducted (Rosa, 2015) which states that low fiber intake has a significant relationship to blood glucose levels in type 2 DM patients, where patients who have low fiber intake have high blood glucose levels. In the digestive tract, fiber forms a layer that can inhibit digestion and absorption. Fiber has the effect of lowering blood sugar, by slowing the absorption of sugar. The longer time it takes for fiber to be digested by the body can reduce the workload of the pancreas to produce insulin, reduce insulin use, and slow blood sugar spikes.

One form of non-available carbohydrate is fiber found in vegetables and fruit. The body cannot digest non-available forms of carbohydrates which is why it has a low GI (Afandi, et al, 2019). The Glycemic Index (GI) is a number that shows the potential of carbohydrates in food to increase blood sugar or can be said to be a level or assessment of food according to its effect on blood sugar. There is an increase in blood sugar after consuming carbohydrate source foods. There are 3 categories for classification of the glycemic index of food ingredients, namely food ingredients with a low glycemic index ($IG < 55$), food ingredients with a medium glycemic index ($55 \leq IG \leq 70$), and food ingredients with a high glycemic index ($IG > 70$). Eating foods with a low glycemic index causes blood sugar levels to be more controlled. This is due to the slow digestive process so that the rate of gastric emptying becomes slow. As a result, suspended food components move more slowly to the small intestine, thereby slowing glucose absorption.

Physical activity is one of the basic principles of clinical management of type 2 DM patients. Absorption of glucose in body tissues at rest requires insulin, while insulin levels in active muscles do not increase even though glucose requirements increase. This is because when a person does physical activity the sensitivity of insulin receptors in active muscles increases. Insulin resistance, which causes glucose not to enter the cells, is the

main problem that occurs in type 2 DM. Muscles have insulin-like properties where when muscles contract, membrane permeability to glucose increases. Therefore, exercise reduces insulin resistance (Efendi, et al, 2022).

Based on physical activity data, it shows that the majority of the sample, namely 22 people (44%) have low activity with a METs value of <600 minutes per week. The physical activities most frequently carried out by the sample were daily household activities such as sweeping, cooking and washing. The low physical activity in the sample could be because most of them were elderly. This has to do with the activities carried out interspersed with rest and not being too strenuous. This is in accordance with the theory that there is no significant effect on blood sugar levels if physical activity is followed by a long period of rest. Excessive rest or too little exercise can worsen the decline in insulin sensitivity because physical activity functions to stimulate cell insulin sensitivity again and reduce the amount of central fat and changes in muscle tissue (Azhita, et al, 2018). Physical activity according to the CRIPE principle (continuous, rhythmical, interval, progressive, endurance training) and carried out for approximately 30 minutes regularly (3-4 times a week) and trying to reach 75-85% of the maximum heart rate is recommended for people with type 2 DM (Anggraeni and Alfarisi, 2018).

CONCLUSION

Most Diabetes Mellitus sufferers have low fiber intake and relatively low physical activity with uncontrolled blood sugar levels. It is recommended that education be provided regarding DM management and the recommended diet for patients. The educational activities in question are counselling and education to DM patients, especially regarding fiber consumption, such

as recommendations for good fiber for DM patients and food ingredients that have high fiber content. Apart from that, the posyandu for the elderly should be more active in providing health services and regularly carry out healthy exercise activities so that the elderly can actively participate in the posyandu's activities and it is hoped that this will increase the awareness of the elderly about the importance of health.

ACKNOWLEDGMENT

We would like to thank all respondents and the Community Health Center who have helped facilitate the collection of data for this research.

CONFLICT OF INTEREST

There is no conflict of interest in this research.

REFERENCES

- Adhi, K. T. *et al.* (2020) 'Konsumsi zat gizi dan parameter lemak tubuh pada wanita umur lebih dari 40 tahun', *Jurnal Gizi Klinik Indonesia*, 16(3), p. 114. doi: 10.22146/ijcn.41403.
- Afandi, F. *et al.* (2019) 'Hubungan antara Kandungan Karbohidrat dan Indeks Glikemik pada Pangan Tinggi Karbohidrat', *Jurnal Pangan*, 28(2), pp. 145–160.
- Amrullah, J. F. (2020) 'Hubungan Aktivitas Fisik dengan Kadar Gula Darah Sewaktu Pada Lansia Penderita Diabetes Melitus Di Wilayah Kerja Upt Puskesmas Babakan Sari Kota Bandung', *Jurnal Sehat Masada*, 14(1), pp. 42–50.
- Anggraeni, I. and Alfarisi, R. (2018) 'Hubungan Aktifitas Fisik Dengan Kadar Gula Darah Puasa Pada Penderita Diabetes Melitus Tipe II Di Rumah Sakit Umum Daerah Dr. H. Abdul Moeloek', *Jurnal Dunia Kesmas*, 7(3), pp. 140–146.
- Azitha, M., Aprilia, D. and Ilhami, Y. R. (2018) 'Hubungan Aktivitas Fisik dengan Kadar Glukosa Darah Puasa pada Pasien Diabetes Melitus yang Datang ke Poli Klinik Penyakit Dalam Rumah Sakit M. Djamil Padang', *Jurnal Kesehatan Andalas*, 7(3), p. 400. doi: 10.25077/jka.v7i3.893.
- Delfina, S. *et al.* (2021) 'Literature Review : Analisis Determinan Faktor Risiko Kejadian Diabetes Mellitus Tipe 2 Pada Usia Produktif', 2(Dm), pp. 141–151.
- Dinas Kesehatan Kota Denpasar (2020) 'Profil Dinas Kesehatan Kota Denpasar'. Available at: <https://www.diskes.baliprov.go.id/profil-kesehatan-provinsi-bali/>.
- Dinas Kesehatan Provinsi Bali (2021) 'Profil Kesehatan Provinsi Bali Tahun 2020', *Dinas Kesehatan Provinsi Bali*, pp. 2013–2015.
- EFENDI, P., BUSTON, E. and HERIYANTO, H. (2022) 'Pengaruh Implementasi 4 Pilar Penatalaksanaan Diabetes Mellitus Terhadap Aktivitas Fisik Pada Penderita Diabetes Mellitus Di Puskesmas Kandang Kota Bengkulu Tahun 2020', *Journal of Nursing and Public Health*, 10(1), pp. 33–39. doi: 10.37676/jnph.v10i1.2363.
- Inda Mujisari, Sididi, M. and Sartika (2021) 'Hubungan Penerapan Empat Pilar Pengendalian Diabetes Melitus Tipe 2 dengan Rerata Kadar Gula Darah di Puskesmas Banabungi', *Window of Public Health Journal*, 2(1), pp. 924–932. doi: 10.33096/woph.v2i1.108.
- Kemenkes RI (2020) 'Infodatin 2020', *Pusat Data dan Informasi Kementerian Kesehatan RI*.
- Mayawati, H. and Isnaeni, F. N. (2017) 'Hubungan Asupan Makanan Indeks Glikemik Tinggi dan Aktivitas Fisik dengan Kadar Glukosa Darah pada Pasien Diabetes Mellitus Tipe Ii Rawat Jalan di RSUD Karanganyar', *Jurnal*

Kesehatan, 10(1), p. 75. doi:
10.23917/jurkes.v10i1.5495.

Roza, M. (2015) 'Faktor-Faktor Yang
Berhubungan Dengan Kadar Glukosa
Darah Sewaktu Pasien DM Tipe 2',
Jurnal Keperawatan, XI(2), pp. 352–
361.