

ORIGINAL ARTICLE

Dietary Arrangements and Exercise Activities were Associated with Glycemic Control in Diabetes Patients at Grogol Petamburan Subdistrict Public Health Center

Pengaturan Makan dan Aktivitas Olahraga Berhubungan dengan Pengontrolan Gula Darah pada Pasien Diabetes di Puskesmas Kecamatan Grogol Petamburan

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ABSTRACT

Background

Diabetes Mellitus (DM) is a disorder of the body's metabolism with the main characteristic of which is increased blood glucose levels caused by interference of insulin secretion and action. One of the efforts to prevent complication is to check and control blood glucose levels in DM patients. To monitor blood glucose levels requires non-pharmacological management, such as eating arrangements and exercise activities. This study aim was to assess the association between eating arrangements and exercise activities with blood sugar control in adult diabetic patients.

Methods

Study desain was an observational analytic with a cross-sectional approach. Study was conducted at Grogol Petamburan Health Center, in September-November 2022, as many as 63 diabetes patients aged 18-60 years were selected consecutively by taking into inclusion and exclusion criteria. Data were collected using the 24 hours food recalls, Baecke Habitual Physical Activity Questionnaire and measuring non-fasting blood sugar levels. Statistical analysis using Chi – Square test with a significance level of $p < 0.05$.

Results

Age of the subjects ranged from 41-50 years as many as 47.6% and 69.8% were women, as many as 50.8% had a normal BMI. Subjects who did not make meal arrangements as many as 63.5% and 50.8% were categorized as active in sports activities. Subjects with uncontrolled GDS levels were 52.4%. The Chi-Square test to assess the association between eating regulation and exercise activity with blood sugar control in adult diabetic patients showed $p = 0.009$ and $p = 0.000$.

Conclusions

Dietary arrangements and exercise activities were associated with blood sugar control in adult diabetic patients.

Keywords: blood sugar level; diabetes mellitus; diet; exercise

ABSTRAK**Latar Belakang**

Diabetes Mellitus (DM) merupakan gangguan metabolisme tubuh dengan ciri utama meningkatnya kadar glukosa darah yang diakibatkan gangguan dari kerja insulin dan sekresi insulin. Salah satu upaya pencegahan terjadinya komplikasi adalah dengan melakukan pemeriksaan dan pengontrolan kadar glukosa darah pada pasien DM. Untuk memantau kadar glukosa darah membutuhkan manajemen penatalaksanaan non farmakologis seperti pengaturan makan dan aktivitas olahraga. Penelitian ini bertujuan menilai hubungan antara pengaturan makan dan aktivitas olahraga dengan pengontrolan kadar glukosa darah pada pasien diabetes usia dewasa.

Metode

Desain penelitian observasional analitik dengan pendekatan *cross sectional*. Lokasi dan waktu penelitian adalah di Puskesmas Grogol Petamburan Jakarta Barat pada bulan September-November 2022, sebanyak 63 pasien DM berusia 18-60 tahun dipilih secara consecutive non-random dengan memperhatikan kriteria inklusi dan eksklusi. Pengumpulan data menggunakan kuesioner *24 hours food recalls*, *Baecke Habitual Physical Activity Questionnaire* dan mengukur gula darah sewaktu subjek. Analisis statistik menggunakan uji *Chi - Square* dengan tingkat kemaknaan $p < 0.05$.

Hasil

Usia subjek berkisar 41-50 tahun 47.6% dan yang berjenis kelamin perempuan sebanyak 69.8%, sebanyak 50.8% memiliki IMT normal. Subjek yang tidak melakukan pengaturan makan sebanyak 63.5% dan 50.8% dikategorikan aktif dalam aktivitas olahraga. Subjek dengan kadar GDS tidak terkontrol sebanyak 52.4%.

Uji *Chi-Square* untuk menilai hubungan pengaturan makan dan aktivitas olahraga dengan pengontrolan glukosa darah pada pasien diabetes usia dewasa menunjukkan nilai $p = 0.009$ dan $p = 0.000$.

Kesimpulan

Pengaturan makan dan aktivitas olahraga berhubungan dengan pengontrolan glukosa darah pada pasien diabetes usia dewasa.

Kata Kunci: diabetes mellitus; glukosa darah; makan; olahraga

INTRODUCTION

Diabetes mellitus (DM) is a global health problem that occurs due to metabolic disorders in the body.¹ The main characteristic of hyperglycemia or increased blood glucose levels is impaired insulin work and secretion. In adults in Indonesia over the last 5 years has increased, from 2013 around 6.9% to 8.5% in 2018.² One of the risk factors for this disease, obesity has also increased from 13.5% to 15.4% and the World Health Organization (WHO) recorded that diabetes mellitus is the cause of 4% of deaths in the world.³ The IDF diabetes atlas report states that there will be an increase in the prevalence of diabetes sufferers aged 20-79 years globally, namely 10.5% (536.6 million people) in 2021, increasing to 12.2% (783.2 million) in 2045.⁴

DM disease has an impact on reducing quality of life, increasing the risk of disability and life-threatening health problems. Prolonged high blood glucose levels cause serious health problems in body organs such as the heart, blood vessels, kidneys, eyes, and other organs.⁵ Various factors such as age, marital status, duration of suffering from DM, complications experienced, including psychological factors such as anxiety will affect the quality of life of DM sufferers. As we age, there are changes in the body's organs, physiological and biochemical, and this triggers an increase in sensitivity to disease and a reduction in the body's ability to carry out homeostasis.⁶ The patient's perception of disease greatly influences the quality of his life.⁷ Diabetes mellitus sufferers will experience a decrease in quality of life if the patient has a negative perception, and vice versa, if the patient believes he is in good condition he will have positive physical, and mental health and

mood.⁸ DM sufferers who have had the disease for years may have efficacy a good self because they have experience managing their illness and have good coping.⁶ Apart from that, having a life partner who supports and accompanies the sufferer can increase enthusiasm in carrying out daily activities.

Improving the quality of life of DM sufferers needs to be achieved, one of which is through preventing microvascular complications due to DM.⁹ This can be done by checking and controlling blood glucose levels regularly. Successful management of type 2 DM patients involves monitoring blood glucose levels and non-pharmacological management such as diet and exercise. Efforts to maintain normal blood glucose levels through implementing a healthy diet and exercise are expected to control the appearance of DM symptoms.¹⁰

Diet is an important aspect of DM management. Efforts to lose weight and maximize the benefits of the body's metabolism can be done through regulating carbohydrate calories. Another effort to control DM is exercise, and both (calorie restriction and exercise) need to be combined so that remission of DM can be achieved.¹¹ Research by Nursihhah M, et al. concluded that dietary compliance is related to controlling blood glucose levels in DM patients.¹² However, research by Gardiarini P, et al. stated that diet quality is not related to blood glucose levels in DM patients.¹³

Sports activities are very beneficial for DM sufferers because they can reduce blood sugar levels. When exercising, the body requires energy so that glucose usage increases, which causes blood sugar to decrease.¹⁴ Research by Nurman K, et al. concluded that structured exercise activities are very good to apply to DM patients so that blood sugar levels can be controlled.¹⁵ However, research conducted by Mayawati H, et al. obtained results that sports activities were not related to blood glucose levels in DM patients.¹⁶ The incidence of DM in Indonesia is still a challenge in itself. This study aims to assess the relationship between eating regulation and exercise activity on blood glucose control in adult diabetes patients.

METHODS

The research used an analytical observational design with a cross-sectional approach. The location and time of the research were at the Grogol Petamburan District Health Center, West Jakarta in September – November 2022. The research population was Diabetes Mellitus (DM) sufferers who sought treatment at the Grogol Petamburan District Health Center, West Jakarta. The sample size calculation used the infinite-finite formula and obtained the minimum sample size required of 63 subjects who met the inclusion criteria, namely patients who were diagnosed by a doctor as diabetes mellitus patients aged between 18 – 60 years and who had been receiving treatment for approximately one month and were drinking diabetes medication regularly for one month. DM patients with physical limitations in the upper and lower extremities and patients with mental disorders will be excluded.

Sampling used a consecutive non-random sampling technique. Primary data was obtained from the results of observations, measurements, and surveys using the 24-hour food recall questionnaire, Baecke Habitual Physical Activity Questionnaire, and measuring the subjects' blood sugar (GDS).

The food recalls questionnaire was used to obtain information on the subject's identity and eating arrangements which consisted of several questions regarding breakfast, morning snack, lunch, afternoon snack, dinner, and evening snack. The interview process was carried out using a food photo book (Individual Food Consumption Survey Food Photo Book (SKMI - 2014)) and described the food eaten and drunk by the subject including how it was processed during the previous day from waking up to going back to sleep. The next stage is that the amount of food and drink will be estimated into household measurements (URT) and estimated in grams, then the

calories for each food consumed by the subject are calculated using the application (fat secret.co.id and valuegizi.com). After knowing the calories in one portion of food consumed by the subject, add up the total number of calories consumed during the day, then assess the suitability of the calories consumed with the calories needed in a day. If the total calories consumed by the subject are more than or less than what is recommended then the subject does not make eating arrangements (not appropriate), but if the total calories consumed by the subject are as recommended, namely 1,500 – 2,000 for women and 2,000 – 2,500 for men then the category is appropriate or the patient makes eating arrangements.¹⁷

Baecke Habitual Physical Activity Questionnaire (BHPAQ) is used to determine whether the subject does sports or not. This questionnaire consists of three physical activities, namely work activities, sports activities, and free time activities. This study uses sports activity indications to assess the subject's sports activity. The first stage is to interview the subjects with the questions in the questionnaire whether they are following their habits. Calculation of sports activity data (Sport index) uses the following formula:

$$\frac{(B10.1a \times B10.1b \times B10.1c) + (B10.2a \times B10.2b \times B10.2c) + B11 + B12 + B13}{4}$$

Note:

B10.1a : The intensity of exercise most frequently performed,

B10.1b : How many hours do you exercise in one week?

B10.1c : How many months do you exercise in a year?

B10.2a : The second most frequently performed exercise intensity

B10.2b : How many hours do you exercise in one week?

B10.2c : How many months do you exercise in a year?

B11 : Compared to people of the same age, the amount of physical activity they do in their free time

B12 : Duration of exercise during free time

B13 : Duration of sweating during free time

The results of the sports activity assessment from the Baecke questionnaire use a Likert scale, namely in the range 1-5, a higher score indicates a higher level of sports activity.¹⁸

Assessment of the subject's blood sugar levels was carried out using a GCU Easy Touch glucometer. The patient's fingertip is cleaned using an alcohol swab and then pricked with a lancet. The first drop of blood is cleaned and the next drop of blood is placed on the surface of the glucose strip and waited until the glucose device shows the results of assessing the subject's GDS level. Temporary blood sugar assessment is categorized as controlled (GDS <200 mg/dL) on one examination and uncontrolled (GDS ≥200 mg/dL) on one examination when taking instant blood sugar levels.¹⁹

Statistical analysis used the Statistical Package for Social Sciences (SPSS) version 25 program. The relationship between variables used the Chi-Square test with the statistical significance limit being α (0.05). If the p-value < α (0.05) it is concluded that there is a relationship between the variables. This research has received ethical approval from the Ethics Commission of the Faculty of Medicine, Trisakti University with number: 56/KER-FK/VII/2022, and permission to conduct research from the West Jakarta City Administration Health Department and the Grogol Petamburan District Health Center, West Jakarta City.

RESULTS

The subject characteristics obtained from the research results were as follows: 44 subjects (69.8%) were female, 30 subjects aged 41-50 years (47.6%). Nutritional status based on BMI found that 32 people (50.8%) were in the normal BMI category, 40 subjects (63.5%) did not regulate their eating and 32 subjects (50.8%) were categorized as active in sports activities. Thirty-three subjects had uncontrolled GDS levels (52.4%) (Table 1).

Based on Table 2, there were 6 subjects with appropriate eating arrangements and controlled blood sugar, while there were 16 subjects with inappropriate eating arrangements and uncontrolled blood sugar (40.0%). Statistical analysis using the Chi-Square test obtained a p-value = 0.009 and it was concluded that there was a significant relationship between eating arrangements and blood sugar control in adult diabetes patients.

Subjects who actively exercised and had their blood sugar controlled were 27 people (84.4%) while subjects who were not actively exercising and whose blood sugar was not controlled were 28 people (90.3%). The results of the Chi-Square test show that there is a significant relationship between exercise activity and blood sugar control in adult diabetes patients with a value of $p = 0.000$.

Table 1. Characteristics of research subjects

Characteristic	(n)	Percentage (%)
Gender		
Men	19	30.2
Women	44	69.8
Age		
31 – 40 years old	7	11.1
41 – 50 years old	30	47.6
51 – 60 years old	26	41.3
Body Mass index		
Underweight	2	3.2
Normal	32	50.8
Overweight	7	11.1
Obese	22	34.9
Eating management		
Appropriate	23	36.5
Not Appropriate	40	63.5
Sports Activities		
Active	32	50.8
Not active	31	49.2
Blood Sugar Control		
Controlled	30	47.6
Uncontrolled	33	52.4

Table 2. The Relationship between Eating Management and Blood Sugar Control

Variable	Blood Sugar Control				p-value*
	Controlled		Uncontrolled		
	n	%	n	%	
Eating Management					
Appropriate	6	26.1	17	73.9	0.009*
Not appropriate	24	60.0	16	40.0	
Sports Activities					
Active	27	84.4	5	15.6	0.000*
Not active	3	9.7	28	90.3	

#Chi – Square test, * $p < 0.05$ statistically significant

DISCUSSION

The results of this study showed that the majority of diabetes patients were women, this was because the proportion of women in the sample was twice as large as men. Research by Aniska T reported that more women suffer from diabetes mellitus. This occurs due to hormonal influences where women will experience an increase in body fat accumulation, especially during menopause.²⁰ However, this study did not ask for data on the menopause of female subjects. The monthly cycle syndrome (premenstrual syndrome) and menopause experienced by a woman cause the accumulation of body fat distribution to easily occur so that the body mass index increases.²¹

Based on age group, diabetes patients in this study were mostly in the 41 to 50-year age group. The results of this study are following research by Rofikoh et al. which states that age has a significant relationship with the incidence of DM where subjects aged more than 45 years are more at risk of suffering from diabetes. Increasing age causes the body's function to decrease physiologically, resulting in a decrease in insulin secretion and resistance, which results in a less-than-optimal ability of the body's function to control high blood glucose.²² Nutritional status based on BMI found that more subjects experienced normal nutritional status, followed by obesity. The results of research by Handayanti ST et al. concluded that obesity has a significant relationship with the incidence of diabetes. Subjects who are obese have a higher risk of developing diabetes.²³ Obesity harms the body's physiological functions and is a threat to public health because it increases the risk of various diseases such as DM.²⁴

This research shows that there is a relationship between eating management and blood sugar control in adult diabetes patients. This is following research by Syarifah A., et al. concluded that there is a significant relationship between dietary compliance and blood sugar levels in diabetes mellitus sufferers. Diet arrangements are made to achieve ideal body weight so that health is maintained. One of the factors responsible for causing diabetes is an uncontrolled diet. To balance the insulin produced by the body of diabetics, the intake of carbohydrate sources needs to be divided evenly throughout the day.²⁵ Research by Myette-Côté E, et al. states that the LCHF (Low Carbohydrate High Fat) diet has been proven to reduce HbA_{1c} levels and fasting glucose levels quickly.²⁶

Research conducted by Dalle A et al concluded that there is a significant relationship between diet and temporary blood sugar levels.²⁷ Research by Wulandari D, et al. concluded that a high-carbohydrate diet has a positive effect on blood sugar levels over time. This research showed that there was an increase in the GDS score due to an increase in the score on a high-carbohydrate diet.²⁸ DM sufferers who consume high-energy or carbohydrate-rich foods with low fiber composition will cause interference in the stimulation of pancreatic beta cells in secreting insulin. Therefore, it is necessary to calculate calorie and nutrient needs following the nutritional condition and activities of DM patients by paying attention to and controlling the glycemic index of the food consumed.²⁸ The aim of regulating eating in diabetes patients is that their blood glucose levels reach normal values and are maintained stable so that symptoms -diabetes symptoms can be prevented.^{23,26} However, research by Gusasi FF, et al. stated that the effectiveness of dietary regulation is not related to the patient's blood glucose levels. According to this research, the results are inversely proportional to previous research due to the lack of sample size obtained, which affects the significance value.²⁹

This research shows that there is a significant relationship between sports activities and blood sugar control in adult diabetes patients. Research by Syarifah A., et al.²⁵ concluded that exercise activity has a significant relationship with blood glucose levels in diabetes mellitus sufferers. Exercise is the most important part of treating DM sufferers because it can increase the effectiveness of insulin work and the sensitivity of insulin receptors. Regular exercise, for example, 3 to 4 times a week with a duration of approximately 10 minutes which follows the CRIFE principle

(continuous, rhythmic, interval, progressive, endurance) helps insulin work better thereby reducing the risk of increasing blood sugar. The benefits of proper exercise for diabetes sufferers will improve blood circulation, strengthen the heart, reduce weight, reduce blood fat levels, control blood sugar, and reduce stress. The possibility of complications due to chronic DM can be prevented by controlling the blood glucose levels of DM patients.²⁵

The same thing was also revealed by research by Zahira H et al. which concluded that exercise activity was related to blood glucose levels. This research states that the risk of uncontrolled blood glucose levels in DM patients can be reduced by doing physical exercise, taking into account the total duration and intensity of the exercise. Reducing glucose levels in the blood can be achieved through increasing glucose metabolism and insulin sensitivity, this is obtained from sports activities because this activity requires sufficient energy.³⁰ Research conducted by Karamoy AB, et al reported that subjects who regularly exercised had lower blood glucose levels. tends to be lower than those who do not exercise regularly. Exercise done regularly with appropriate intensity can reduce glucose levels in the blood and this is one of the pillars in controlling blood glucose.³¹

Research conducted by Ariyanto A, et al. obtained the opposite result, namely that there was no significant change in blood sugar levels before and after doing leg exercises in elderly people with type 2 DM. This study reported that the decrease in the subjects' blood sugar levels was only around 3-4 points and these results did not show changes as expected. This is probably because the leg exercises that the elderly do are not perfect so they do not affect blood sugar levels.³²

An unbalanced lifestyle is a risk factor for diabetes mellitus, such as irregular eating patterns and lack of exercise. The clinical implication of this research is that people understand the importance of maintaining a regular diet and doing appropriate exercise because this is the most important part of treating diabetes. Making appropriate eating arrangements and sports activities will increase the effectiveness of insulin work and the sensitivity of its receptors so that the body becomes healthier and this also affects mental health.

This study has several limitations, including not being able to rule out the DM treatment variables that the subjects are currently undergoing, which may affect their blood sugar control. Temporary blood sugar measurements are only carried out once and fasting blood sugar measurements are not carried out. The range for determining eating arrangements is only based on gender, not taking into account the age, weight, and height of each subject. Data on the number of calories consumed by the subject is based on memory. This research only focuses on related variables and does not explore the factors that cause DM in subjects such as genetic factors. Filling out the questionnaire to be analyzed depends entirely on the honesty of the subject. To support better management of DM in the future, it is recommended that further research add Hemoglobin A1c (HbA1c) measurements to assess long-term blood sugar in DM sufferers, including factors that influence blood sugar levels in DM sufferers.

CONCLUSION

Subjects of diabetes patients aged 31 to 60 years at the Grogol Petamburan Community Health Center with inappropriate eating arrangements were 63.5% and 50.8% were active in sports. Eating arrangements and exercise activities are related to blood sugar control in adult diabetes patients.

To improve the health of diabetes patients, it is necessary to provide education regarding appropriate eating and exercise management to slow the occurrence of complications. DM patients are advised to pay attention to the glycemic index of the food they consume and calculate their calorie and nutritional needs according to their nutritional status. Apart from that, diabetes patients need to carry out regular exercise activities to help increase the sensitivity of their insulin receptors.

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AUTHORS CONTRIBUTION

SHR has the role of preparing research designs, collecting data in the field, analyzing and interpreting data, and preparing draft papers. K played a role in developing research concepts, interpreting statistical results, and revising papers for publication.

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CONFLICT OF INTEREST

he authors had no conflicts of interest when preparing this article.

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