

Factors Associated with Random Blood Glucose Status among Type 2 Diabetes Patients: A Cross-Sectional Study at Alianyang Health Center, Pontianak***Faktor-Faktor yang Berhubungan dengan Status Gula Darah Sewaktu pada Pasien Diabetes Melitus Tipe 2: Studi Potong Lintang di Puskesmas Alianyang, Pontianak***Novia Surya Ningsih^{1*}, Marlenywati², Iskandar Arfan³^{1,2,3} Universitas Muhammadiyah Pontianak, Pontianak, West Kalimantan, 78123, Indonesia**ARTICLE INFO****Received:**

October 20, 2025

Accepted:

December 04, 2025

Published online:

December 31, 2025

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Doi:<https://doi.org/10.5463/0/ijahr.v2i2.137>**Keyword:**

Type 2 diabetes mellitus; random blood glucose level; body mass index; family history; physical activity.

Kata Kunci:

Diabetes melitus tipe 2; kadar glukosa darah sewaktu; indeks massa tubuh; riwayat keluarga; aktivitas fisik.

ABSTRACT

Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia due to insulin resistance and impaired insulin secretion. Prevention and management of type 2 diabetes require health education, dietary regulation, regular physical activity, and adherence to medication. This study aimed to identify factors associated with random blood glucose levels in patients with type 2 diabetes mellitus in Pontianak City. This quantitative study employed a cross-sectional design. The sample consisted of 93 patients with diabetes mellitus who visited Alianyang Health Center in Pontianak City. Data were analyzed using the Chi-Square test. The results showed a significant relationship between body mass index ($p = 0.006$), family history ($p = 0.001$), and exercise or physical activity ($p = 0.003$) with random blood glucose levels among patients at Alianyang Health Center. These findings indicate that both biological and lifestyle factors play an important role in blood glucose control. Patients are encouraged to maintain an ideal body mass index, engage in regular physical activity, and adopt healthy lifestyle behaviors. In addition, individuals with a family history of diabetes require early screening and continuous monitoring to prevent complications and improve glycemic control.

ABSTRAK

Diabetes melitus merupakan penyakit metabolik kronis yang ditandai oleh hiperglikemia akibat resistensi insulin dan gangguan sekresi insulin. Pencegahan dan pengelolaan diabetes melitus tipe 2 memerlukan edukasi kesehatan, pengaturan pola makan, aktivitas fisik yang teratur, serta kepatuhan terhadap pengobatan. Penelitian ini bertujuan untuk mengidentifikasi faktor-faktor yang berhubungan dengan kadar glukosa darah sewaktu pada pasien diabetes melitus tipe 2 di Kota Pontianak. Penelitian ini merupakan penelitian kuantitatif dengan desain cross-sectional. Sampel penelitian berjumlah 93 pasien diabetes melitus yang berkunjung ke Puskesmas Alianyang Kota Pontianak. Data dianalisis menggunakan uji Chi-Square. Hasil penelitian menunjukkan adanya hubungan yang signifikan antara indeks massa tubuh ($p = 0,006$), riwayat keluarga ($p = 0,001$), dan aktivitas fisik atau olahraga ($p = 0,003$) dengan kadar glukosa darah sewaktu pada pasien di Puskesmas Alianyang. Temuan ini menunjukkan bahwa faktor biologis dan gaya hidup memiliki peran penting dalam pengendalian kadar glukosa darah. Pasien dianjurkan untuk menjaga indeks massa tubuh yang ideal, melakukan aktivitas fisik secara teratur, serta menerapkan pola hidup sehat. Selain itu, individu dengan riwayat keluarga diabetes perlu melakukan skrining dini dan pemantauan berkala untuk mencegah komplikasi serta meningkatkan pengendalian glikemik.



1. INTRODUCTION

Blood glucose levels are closely related to diabetes mellitus (DM). An increase in random blood glucose levels ≥ 200 mg/dL, accompanied by symptoms such as polyuria, polydipsia, polyphagia, and unexplained weight loss, is sufficient to diagnose Type 1 DM¹. Countries in the Arab-North Africa region and the Western Pacific rank first and second with the highest diabetes prevalence among the 7 regions globally, with rates of 12.2% and 11.4%, respectively. Southeast Asia, where Indonesia is located, ranks third with a prevalence of 11.3%. The International Diabetes Federation (IDF) projects the number of diabetes patients in the top 10 countries with the highest numbers, including China (116.4 million), India (77.0 million), the United States (31.0 million), Pakistan (19.4 million), Brazil (16.8 million), Mexico (12.8 million), Indonesia (10.7 million), Germany (9.5 million), Egypt (8.9 million), and Bangladesh (8.4 million)².

Indonesia is the only Southeast Asian country in the top 10 countries with the highest number of diabetes cases, ranking 7th with 10.7 million diabetes patients. The prevalence of diabetes in Indonesia reached 6.2% in 2020, meaning more than 10.8 million people have diabetes. The 2018 Riskesdas (National Health Survey) data showed that the prevalence of diabetes in women was higher than in men, with a ratio of 1.78% for women compared to 1.21% for men. In the 2013 Riskesdas, the prevalence for women was 1.7% compared to 1.4% for men. Over the past five years, the prevalence in women has shown a slight increase, while the prevalence in men has decreased³.

The prevalence of diabetes mellitus in West Kalimantan in 2018 was 1.6%⁴. According to data from the Alianyang Health Center in Pontianak City, there were 121 cases of diabetes mellitus. Diabetes mellitus (DM) has become a serious threat to human health in the 21st century, with 422 million people suffering from it worldwide in 2014. The majority of these cases are in developing countries. As a developing country, Indonesia has a relatively high number of diabetes patients. Diabetes caused 1.5 million deaths in 2012, and elevated blood glucose levels beyond the maximum threshold contributed to an additional 2.2 million deaths, increasing the risk of cardiovascular diseases and other complications. Forty-three percent (43%) of these 3.7 million deaths occurred before the age of 70, particularly in low- and middle-income countries compared to high-income countries⁵.

According to the Ministry of Health of the Republic of Indonesia, in West Kalimantan, there were 4,208 cases of diabetes mellitus in the age group 35–44 years, 3,171 cases in the age group 45–54 years, and 2,031 cases in the age group 55–64 years⁶. Data from the Pontianak City Health Office shows that as of December 2020, there were 121 Type 2 Diabetes Mellitus patients at the Alianyang Health Center.

The primary causes of diabetes mellitus in this era of globalization include lifestyle changes, such as an imbalanced diet and lack of physical activity, which ultimately lead to obesity. Other factors suspected to be risk factors for DM include stress, as high stress levels can affect blood glucose levels and insulin metabolism, potentially triggering diabetes. Psychologically, stress can lead to lifestyle changes, such as eating sugary snacks. Stress can also arise from work-related issues or family problems. Stress not only impacts an individual's psychological state, but prolonged stress can also trigger elevated blood glucose levels, as stress stimulates the release of stress hormones⁷.

Therefore, this study aims to identify the factors associated with random blood glucose levels in patients with controlled Type 2 DM, including physical activity, carbohydrate intake, body mass index, waist circumference, and medication adherence

during the Chronic Disease Management Program, a healthcare system designed to maintain the health of individuals with chronic diseases, including Type 2 DM. This study aims to identify the dominant factors influencing Type 2 DM patients in this program ⁸.

Physical activity and exercise habits can affect blood glucose levels. Activities that diabetes patients should avoid include a sedentary lifestyle, such as watching TV, sitting, and relaxing. Therefore, patients are advised to increase their physical activity, such as brisk walking, cycling, and muscle exercises. Diabetes patients can perform regular aerobic exercises to improve insulin sensitivity and reduce cardiovascular risks. Some examples of aerobic exercises that patients can do are walking, cycling, jogging, and swimming. It is recommended to exercise at least 3-4 times a week. Regular physical exercise can lower HbA1c levels ⁹.

2. METHODS

This study is a quantitative research with a cross-sectional approach. The research was conducted from July to August 2021. The study population consisted of patients with Type 2 diabetes mellitus who visited the Alianyang Health Center in Pontianak City in July 2021. The sample size in this study was 93 participants, selected using the Accidental Sampling (Convenience Sampling) technique. After data collection, the data were processed and analyzed using the Chi-square test for the variables of Body Mass Index, family history, and exercise history.

3. RESULTS

Table 1. Respondent Characteristics

Characteristics	n = (93)	%
Body Mass Index (BMI)		
Underweight	7	7,4
Normal	44	47,3
Overweight	28	30,1
Obesity	14	15,1
Blood Pressure		
Normal	26	28,0
High	67	72,0
Family History		
Biological Mother	39	41,9
Biological Sister	6	6,5
Biological Father	8	8,6
Biological Brother	2	2,2
Grandparents	8	8,6
No Family History	30	32,3
Random Blood Glucose		
Decreased	55	59,1
Increased	38	40,9

Source: Primary Data, 2021

Table 1 shows that the highest body mass index (BMI) category among the respondents was "Normal," with 44 individuals (47.3%). In terms of blood pressure, 67 respondents (62.0%) had high blood pressure. Regarding family history of Type 2

Diabetes Mellitus, the most common relative with a history of diabetes was the biological mother, with 39 respondents (41.9%). Additionally, 55 respondents (59.1%) had decreased random blood glucose levels.

Table 2. Bivariate Analysis Using Chi-Square Test

Variable	Random Blood Glucose				<i>p-value</i>	PR Value (95%CI)
	Decreased		Increased			
	n	%	n	%		
Body Mass Index (BMI)						1.701
Not Normal	36	38.7	13	14.0	0.006	(1.165 – 2.484)
Normal	19	20.4	25	26.9		
Family History						2,143
Yes	45	48.4	18	19.4	0.001	(1.262 – 3.639)
No	10	18.2	20	21.5		
Exercise History						1.905
Adequate	44	47.3	19	20.4	0.003	(1.158 – 3.133)
Inadequate	11	11.8	19	20.4		

Source: Primary Data, 2021

Table 2 indicates that there is a significant relationship between body mass index (BMI) (p -value = 0.006, PR 1.701, CI 1.165-2.484), family history (p -value = 0.001, PR 2.143, CI 1.262-3.639), and exercise (p -value = 0.003, PR 1.905, CI 1.158-3.133) with the decrease in random blood glucose levels in patients at the Aliyang Health Center in Pontianak City.

3. DISCUSSION

a. The Relationship Between Body Mass Index (BMI) and Decrease in Random Blood Glucose Levels

The results of this study indicate a significant relationship between body mass index (BMI) and the decrease in random blood glucose levels. The Chi-Square test analysis produced a p -value of $0.029 < 0.05$, which suggests a meaningful relationship between BMI and the decrease in random blood glucose levels in patients with Type 2 Diabetes Mellitus in the working area of the Aliyang Health Center in Pontianak City. This study aligns with previous research, which has shown a significant relationship between BMI and blood glucose levels. For instance, a study by Ibnu Sina et al. (2022) found a significant relationship between excess BMI and blood glucose levels. An increased BMI is considered a risk factor for higher blood glucose levels in people with Type 2 diabetes¹⁰. Other studies have also reported that BMI is associated with blood glucose levels in working-age individuals¹¹.

The findings show that patients with Type 2 Diabetes Mellitus and abnormal BMI are 1.480 times more likely to experience diabetes and have decreased random blood glucose levels. The study found that 28 respondents (30.1%) were categorized as overweight, while 14 respondents (15.1%) were classified as obese. Excess body weight is a major risk factor for Type 2 diabetes. The more body fat a person has, the more resistant the cells become to insulin. However, one does not necessarily need to be overweight to develop Type 2 diabetes. Weight affects health in various ways. Excess weight can prevent the body from producing and utilizing insulin correctly, which can

also lead to high blood pressure. Losing weight and increasing physical activity reduces the risk of developing Type 2 diabetes.

Clinically, if a person is overweight, the leptin levels in the body will increase. Leptin is a hormone related to obesity genes. Increased leptin levels in plasma can lead to weight gain. Leptin acts on both the peripheral and central nervous systems. Leptin inhibits glucose uptake, which may lead to higher blood glucose levels¹²⁻¹⁴.

b. The Relationship Between Family History and Decrease in Random Blood Glucose Levels

The results of this study indicate a significant relationship between family history and the decrease in random blood glucose levels. The Chi-Square test analysis produced a p-value of $0.015 < 0.05$, suggesting that there is a meaningful relationship between family history and the decrease in random blood glucose levels in patients with Type 2 Diabetes Mellitus in the working area of the Alianyang Health Center in Pontianak City. This finding is supported by previous research, which indicates that having a family history of Type 2 diabetes increases the risk of changes in glucose levels by six times for the first-generation offspring¹⁵.

If a person has parents or siblings with Type 2 diabetes, their risk of developing diabetes increases. Genetic inheritance from parents to their offspring is expressed, including some genes that undergo mutations. Mutations in Type 2 diabetes can increase gene expression in the Islets of Langerhans, which affects insulin secretion, reduces plasma insulin levels, impairs insulin secretion in response to glucose stimulation, and decreases insulin sensitivity, thereby increasing the risk of developing Type 2 diabetes¹⁶⁻¹⁸.

Patients serve as references for meeting health needs related to glucose levels, and they also highlight the importance of family support in diabetes care. Family support is essential in maintaining healthy blood glucose levels, so that the patient's blood glucose can remain controlled and prevent further complications.

c. The Relationship Between Exercise History and Decrease in Random Blood Glucose Levels

The results of this study show a significant relationship between exercise and the decrease in random blood glucose levels. The Chi-Square test analysis produced a p-value of $0.033 < 0.05$, indicating that there is a meaningful relationship between exercise and the decrease in random blood glucose levels in patients with Type 2 Diabetes Mellitus in the working area of the Alianyang Health Center in Pontianak City. This finding aligns with previous research that showed a relationship between regular exercise, such as aerobics, and a decrease in random blood glucose levels in diabetes patients¹⁹.

Based on the results of the Dependent T-test, the significance value (2-tailed) was $0.000 < 0.05$, indicating a significant difference between random blood glucose levels before and after the implementation of exercise. This study involved regular exercise sessions, consisting of aerobics, conducted three times a week for 30 to 45 minutes per session. This finding is supported by previous research, which indicates that physical exercise, when done at least three times a week for a minimum of 30 minutes per session, has a positive effect on insulin sensitivity²⁰. Diabetes exercise routines, such as aerobics, are commonly used because they engage all the body's organs, from the brain to the toes, helping counteract the widespread effects of diabetes. The mildest impact of diabetes is tingling feet, while the most severe consequence can be a stroke. The varied movements during exercise stimulate the brain to help improve memory²¹.

Physical exercise directly increases insulin sensitivity. The effects of this increase occur in the short term, such as reducing body fat, and in the long term, by lowering blood glucose levels and improving cardiovascular function. Combining aerobic exercise with strength training provides additional benefits to fitness, body composition, quality of life, and cognitive function, making it an ideal component of a comprehensive management plan for Type 2 Diabetes Mellitus ²¹⁻²⁵.

4. CONCLUSION

The conclusion of this study is that there is a significant relationship between body mass index (BMI) (p-value = 0.006), family history (p-value = 0.001), and exercise (p-value = 0.003) with the decrease in random blood glucose levels in patients at the Alianyang Health Center in Pontianak City. Based on the findings of this study, it is recommended that efforts to manage Type 2 diabetes should focus on controlling body mass index, promoting physical activity, and addressing family history. Healthcare providers, especially at community health centers like Alianyang, should prioritize educational programs aimed at increasing awareness about the importance of a balanced diet, regular physical exercise, and consistent medication adherence. Furthermore, patients with Type 2 diabetes should be encouraged to actively seek information on blood glucose management and adopt healthy lifestyle changes to prevent further complications. Regular screening for those with a family history of diabetes could also be beneficial in early intervention and prevention strategies.

5. ACKNOWLEDGEMENT

The author would like to express gratitude to all the respondents involved in this study, as well as to the head of the Alianyang Health Center and the Faculty of Health Sciences at Muhammadiyah University of Pontianak for their support in making this research possible.

Contribution of Authors

NSN: conceptualized and designed the study, collected analysed data, wrote and edited the paper; M: designed the methodology; IA: reviewed empirical studies

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