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Factors influencing self-awareness with blood glucose level among patients with type 2 diabetes

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Abstract

Background: Type 2 diabetes mellitus is a global health problem with increasing prevalence, especially in urban areas. Management of the disease requires patient self-awareness of factors such as physical activity, balanced diet, stress control, and medication adherence.

Purpose: To analyze the influence of physical activity, balanced diet, stress control, and medication adherence on patients' self-awareness behavior in controlling blood sugar levels in urban communities of Riau Province.

Method: Quantitative research with a cross-sectional design involved 105 respondents aged 40-65 years who were registered as type 2 DM patients at a health center in an urban area of Riau Province. Data were collected using a questionnaire and analyzed using the chi-square test and odds ratio.

Results: Insufficient physical activity increased the risk of low patient self-awareness by 2.8 times ($p=0.016$). Unbalanced diet increased the risk by 3.5 times ($p=0.004$). Poor stress control increased the risk by 4.5 times ($p=0.0001$). Meanwhile, lack of medication adherence increased the risk by 3.2 times ($p=0.007$).

Conclusion: Physical activity, balanced diet, stress control, and medication adherence significantly influenced patients' self-awareness in diabetes management. Community-based interventions are needed to improve the management of this disease.

Keywords: Balanced Diet; Physical Activity; Self-awareness; Stress Control; Type 2 Diabetes Mellitus.

INTRODUCTION

Diabetes mellitus (DM) is a degenerative disease whose prevalence continues to increase. Changes in people's lifestyles along with increasing income are one of the triggering factors. The increasing prevalence of DM can be caused by ineffective self-management in DM patients. Diabetes mellitus is a chronic metabolic disease characterized by insufficient insulin production or the body's inability to use insulin effectively, leading to excess glucose in the blood. The disease is often triggered by unhealthy habits, such as overeating, lack of physical activity, and stress. Patients with diabetes mellitus often face difficulties in managing their diet (American Diabetes Association, 2020).

Uncontrolled diet, lack of exercise, and stress are the main contributing factors to Diabetes Mellitus. The principle of dietary regulation is based on the nutritional status of diabetic patients by modifying the diet that takes into account lifestyle and eating habits. Non-compliance with dietary rules is one of the obstacles in achieving treatment goals (Yuswatiningsih & Ningsih, 2023). Based on data from the International Diabetes Federation (IDF), the number of diabetes patients continues to increase every year. By 2030, an estimated 552 million people in the world will suffer from diabetes. In Indonesia, according to WHO predictions, the number of people with diabetes will increase from 8.4 million in 2000 to

around 21.3 million in 2030. Meanwhile, the IDF predicts an increase from 7.0 million in 2009 to 12.0 million in 2030 (Anwar, An-Naf, Lathiifah, Tiana, Hardianti, Puspitasari, Maharani, Fadillah, Tibbiya, Najmah, Kartika, Apriadi, Astuti, Alicia, Mahmudah, & Editia, 2022; Harna, Efriyanurika, Novianti, Sa'pang, & Irawan, 2022). The prevalence of Diabetes Mellitus in urban Indonesia reached 6.2% in 2020. Other studies note that the main risk factors contributing to the prevalence of DM in Indonesia include obesity, hypertension, and physical inactivity. DKI Jakarta was recorded to have the highest prevalence at 3.4%, while other provinces, including Riau, also showed an increasing trend in prevalence in the last decade (Pranatasari & Laksono, 2021).

Diabetes mellitus is caused by a deficiency of the hormone insulin as well as insufficient insulin production by the pancreas. Consumption of sugary foods and sugar-sweetened beverages can lead to high blood sugar levels. If uncontrolled, diabetes mellitus can lead to various complications such as heart disease, kidney disease, eye disorders, stroke, atherosclerosis, and limb amputation. However, if patients have the self-awareness to adhere to the recommended diet pattern, diabetes mellitus can be well controlled. The success of treatment is greatly influenced by the quality of service, the attitude and skills of health workers, the lifestyle of patients and their families, and patient compliance with the treatment program. The patient's glycemic index can be controlled if the patient adheres to dietary recommendations, including the type and amount of food consumed. Patient non-adherence to the diet program is one of the obstacles to achieving treatment goals and can cause patients to require additional examinations or treatment that should not be needed. Therefore, serious attention and optimal handling from health workers are needed to reduce the incidence of DM through adherence to a predetermined diet program (Laili, Dewi, & Wahyuni, 2019).

Patient self-awareness in managing type 2 DM is one of the key components for successful blood sugar control. Research shows that low levels of self-awareness can be caused by a lack of education, lack of family support, and challenges in implementing lifestyle changes consistently. Factors such as physical activity, a balanced diet, stress control, and medication adherence greatly influence the

successful management of DM (Andriyanto, Rekawati, & Rahmadiyah, 2019; Yasmin, Ilyas, Mir, Tauseef, & Shuaib, 2022). Previous studies have highlighted the importance of factors such as physical activity, dietary patterns, stress control, and medication adherence in the management of type 2 DM. Increasing dietary fiber intake to 35 grams per day can significantly reduce HbA1c levels (Reynolds, Akerman, & Mann, 2020). Consumption of bioactive nutritional fiber can improve insulin sensitivity and support better management of blood sugar levels (Nie, Hu, Gao, Li, Sun, Chen, Zuo, Fang, Huang, Yin, & Nie, 2021). Urban studies reveal that DM management in urban settings is influenced by unhealthy lifestyles, limited access to healthy food, and disease management costs. This study recommends urban policies to support self-management of patients with type 2 DM through community-based interventions (Banasiak, Hux, Lavergne, Luk, Sohal, & Paty, 2020; Kamynina & Chernus, 2021).

Although previous studies have explored the challenges of urbanization in the management of type 2 DM, few have specifically highlighted the relationship between the factors of physical activity, diet, stress control, and medication adherence with patients' self-awareness behaviors in urban areas. This study seeks to fill this gap by providing an in-depth analysis in the context of urban communities in Riau Province. The results are expected to serve as a basis for the development of interventions tailored to local needs, such as health education campaigns, increased access to healthy food, and stress management programs. In addition, the findings can enrich public health policies at the local level to reduce the incidence of DM. So, the purpose of this study is to analyze the factors that influence self-awareness behavior in controlling blood sugar levels of type 2 diabetes mellitus patients in urban communities in Riau Province.

RESEARCH METHOD

This study is a quantitative study with a cross-sectional design. This design was used to analyze the relationship between physical activity, balanced nutritional diet, stress control, and medication compliance with self-awareness behavior in controlling blood sugar levels in patients with type 2 diabetes. The study was conducted in an urban area

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of Riau Province by involving patients who were registered as type 2 DM patients at the Community Health Center.

The study population was all patients with type 2 DM in the working area of the specified health facility. The sampling technique used a stratified random sampling method with a total sample size of 105 respondents. Inclusion criteria included type 2 DM patients aged 40-65 years, able to communicate well, and willing to participate in the study. Exclusion criteria were patients with severe medical conditions that could interfere with participation in the study.

Data were collected using a structured questionnaire that included questions about respondents' characteristics (age, gender, education, occupation), as well as questions related to physical activity, dietary patterns, stress control, medication adherence, and self-awareness behaviors. Data were statistically analyzed using the chi-square test to test the relationship between variables with a significance level of 5%. Further analysis with odds ratio (OR) was used to determine the odds of each variable influencing self-awareness behavior.

The dependent variable in this study is self-awareness in blood glucose level, which is categorized into good and poor. A good level of self-awareness is shown when respondents consistently demonstrate awareness and appropriate behavior in managing their blood sugar, such as monitoring their levels, adhering to healthy lifestyle choices, and recognizing early symptoms of abnormal sugar levels. In contrast, a poor level is indicated when respondents show a lack of awareness or inconsistent efforts in controlling their blood sugar.

The independent variables consist of four main aspects: physical activity, balanced nutrition, stress control, and medication adherence. Physical activity is categorized as less if the respondent engages in light physical activity for less than 30 minutes per day on fewer than 3 days per week, or performs sports activities for less than 30 minutes a day or under 150 minutes per week. It is considered sufficient if the respondent engages in moderate to vigorous physical activity for at least 30 minutes per day on 3 or more days per week, or reaches a total of 150 minutes or more per week. Balanced nutrition is categorized as not balanced if the respondent consumes carbohydrate and protein sources less than once per day, fat sources less than 1–3 times per week or more than once per day, and fiber sources less than once per day. It is categorized as balanced if carbohydrate and protein sources are consumed more than once per day, fat sources are consumed 1–3 times per week or once per day, and fiber sources are consumed more than once per day. Stress control is considered insufficient if the respondent is unable to manage or control stress, and good if the respondent is able to control stress effectively. Lastly, medication adherence is categorized as insufficient if the respondent does not consistently take prescribed medication, and good if they regularly and correctly adhere to their medication regimen.

Research ethics were obtained from the STIKES Tengku Maharatu Health Research Ethics Commission with the number: 097/STIKes-T.MHRT/KEPK/X/2024.

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RESEARCH RESULTS

Table 1. Characteristics of Respondents (N=105)

Variables	Results	p-value	OR (95% CI)
Age (Mean±SD)(Range)(Year)	(55.99±8.432) (40-65)		
Gender (n/%)			
Male	37/35.24		
Female	68/64.76		
Education (n/%)			
Elementary School	13/13.38		
Junior High School	32/30.48		
Senior High School	45/42.86		
University	15/14.29		
Employment Status (n/%)			
Employed	45/42.86		
Unemployed	60/57.14		
Self-awareness in Blood Glucose Level (n/%)			
Poor	50/47.6		
Good	55/52.4		
Physical Activity (n/%)			
Poor	49/46.7	0.016	2.842 (1.286-6.282)
Moderate	56/53.3		
Balanced Nutrition Diet (n/%)			
Unbalanced	59/56.2	0.004	3.578 (1.580-8.102)
Balanced	46/43.8		
Stress Control (n/%)			
Poor	56/53.3	0.0001	4.500 (1.969-10.283)
Good	49/46.7		
Medication Adherence (n/%)			
Poor	58/55.2	0.007	3.246 (1.447-7.283)
Good	47/44.8		

Table 1 shows that the average age of respondents in this study was 55.99 with a standard deviation of 8.432. The lowest age was 40 years, and the highest age was 65 years. A small proportion of respondents (35.24%) were male. The most education in the respondents of this study is high school (42.86%). A small proportion of respondents in this study were employed (42.86%).

Less than half of the respondents had poor self-awareness behavior in controlling blood sugar levels (47.6%), poor physical activity (46.7%), most respondents had an unbalanced diet (56.2%), more than half of the respondents had poor stress management (53.3%), and most respondents were poor compliant in taking medication (55.2%).

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Based on table, it can be seen that respondents who lack physical activity and score self-awareness behavior in controlling blood sugar levels are poor than 61.2%, while those who score self-awareness behavior in controlling blood sugar levels are good at 38.8%. The results of statistical tests using the chi-square test obtained a p-value of 0.016, then H_0 is rejected, which means there is a significant influence between physical activity and self-awareness behavior in controlling blood sugar levels of patients with type 2 diabetes mellitus. The odds test obtained an OR value of 2.8, which means that people who do poor physical activity have a 2.8 times greater chance of self-awareness behavior in controlling blood sugar levels poor.

Respondents who have an unbalanced diet and score self-awareness behavior in controlling blood sugar levels poor than 64.2%, while those who score self-awareness behavior in controlling blood sugar levels is good is 39.0%, The results of statistical tests using the chi-square test obtained a p-value of 0.004, then H_0 is rejected, which means there is a significant influence between a balanced nutritional diet and self-awareness behavior in controlling blood sugar levels of patients with type 2 diabetes mellitus. The odds test obtained an OR value of 3.5, which means that people whose diets are not balanced have a 3.5 times greater chance of self-awareness behavior in controlling blood sugar levels.

Respondents who are lacking in stress control and score self-awareness behavior in controlling blood sugar levels poor is 64.3%, while those who scored self-awareness behavior in controlling blood sugar levels good is 35.7%, the results of statistical tests using a chi-square test obtained a p-value is 0.0001, then H_0 is rejected which means there is a significant influence between stress control with self-awareness behavior in controlling blood sugar levels of patients with type 2 diabetes mellitus. The odds test obtained an OR value of 4.5, which means that people who are lacking in stress control have a 4.5 times greater chance of self-awareness behavior in controlling blood sugar levels.

Respondents who were poor compliant in taking medication and scored self-awareness behavior in controlling blood sugar levels poor is 60.3%, while those who scored self-awareness behavior in controlling blood sugar levels were good is 39.7%, The results of statistical tests using the chi-square test

obtained a p-value of 0.007, then H_0 is rejected, which means there is a significant influence between compliance with taking medication with self-awareness behavior in controlling blood sugar levels of patients with type 2 diabetes mellitus. The odds test obtained an OR value of 3.2 which means that people who are poor compliant in taking medication have a 3.2 times greater chance of behaving self-consciously in controlling blood sugar levels poor.

DISCUSSION

The results showed that there was a significant influence between physical activity and self-awareness behavior in controlling blood sugar levels in patients with type 2 diabetes mellitus. Respondents who lack physical activity have a 2.8 times greater chance of having low self-awareness behavior in controlling blood sugar levels. Research supports that physical activity contributes significantly to controlling blood sugar levels. Patients with type 2 DM who regularly engage in physical activity have better glycemic control than those who are inactive (Wang, Dzubur, James, Fakhouri, Brunning, Painter, Madan, & Shah, 2022). Physical inactivity can worsen blood sugar control and increase the risk of diabetic complications (Hossain, Hassan, Shabnam, Jabeen, Biswas, & Akter, 2024). In addition, moderate to vigorous physical activity can reduce HbA1c levels and improve the quality of life of diabetic patients (Shah, Karam, Zeb, Ullah, Sha, Haq, Ali, Darain, & Chen, 2021).

In the context of urban communities in Riau Province, low physical activity can be attributed to sedentary lifestyles, busy daily lives, and lack of access to sports facilities. Regular physical activity, including aerobic and strength training, can significantly increase insulin sensitivity, improve glucose metabolism, and support better blood sugar control (Harrington & Henson, 2021). Other studies have shown that moderate to vigorous physical activity, such as walking or aerobic exercise, can significantly reduce insulin resistance and improve glycemic control in patients with type 2 diabetes (Bassin & Srinath, 2025). In addition, the reduction of prolonged sitting time and the introduction of light to moderate physical activity in the daily routine also provide additional benefits to the cardiovascular health and blood sugar control of patients with type 2 diabetes (Kanaley, Colberg, Corcoran, Malin,

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Rodriguez, Crespo, Kirwan, & Zierath, 2022). This reinforces the importance of integrating physical activity into the daily routine of patients with type 2 DM to increase self-awareness in the management of their disease. Promotion of an active lifestyle through community-based health programs, such as exercise campaigns or the provision of easily accessible exercise facilities, may help overcome these barriers and support more effective DM management.

The results of this study indicate a significant influence between a balanced nutritional diet and self-awareness behavior in controlling blood sugar levels in patients with type 2 diabetes. Respondents with an unbalanced diet had a 3.5 times greater chance of having low self-awareness behavior. Previous research supports that a nutritionally balanced diet that includes complex carbohydrates, low-fat protein, and adequate fiber intake, plays an important role in controlling blood sugar levels. A balanced dietary approach significantly reduced HbA1c levels by 2% in patients with type 2 DM (Yeh, Yen, & Hwu, 2023). A culture-based diet program increased patient adherence to a balanced nutritional diet and improved blood sugar control (Has, Aulia, Kusumaningrum, & Efendi, 2019). In addition, a low-glycemic index diet helped maintain stable blood glucose levels in patients with type 2 DM Al-Adwi, Al-Haswsa, Alhmmadi, Eissa, Hamdan, Bawadi, & Tayyem, 2023).

In the context of urban communities in Riau Province, poor diet quality can be attributed to a lack of knowledge about nutrition, limited access to healthy foods, and a preference for fast food. A balanced diet supports stable blood sugar levels by improving insulin sensitivity, reducing insulin resistance, and lowering the risk of complications. Previous studies have shown that food education-based interventions in community programs can improve the diets of patients with type 2 diabetes, with increased vegetable consumption and decreased body fat levels (Vasconcelos, Cabral, Ramos, & Mendes, 2021). In addition, hands-on balanced diet training can also improve patients' skills and knowledge in planning a suitable diet for their diabetes management (Nusantara, Salam, & Addiarto, 2022). Community-based programs involving dietary education are also effective in improving glycemic control and increasing patient awareness of the importance of healthy lifestyle changes (Shirvani, JavadiVala, Azimi,

Shaghaghi, Fathifar, Devender Bhalla, Abdekhoda, & Nadrian, 2021). Health education on the importance of a balanced diet needs to continue, especially through community-based programs. This approach should include training in healthy food preparation, access to nutritious food, and promotion of healthy lifestyles to increase patients' self-awareness in diabetes control.

The results showed a significant influence between stress control ability and self-awareness behavior in controlling blood sugar levels in patients with type 2 diabetes. Respondents who are poor able to control stress have a 4.5 times greater chance of low self-awareness behavior. Previous research supports this finding. A social cognitive theory-based stress management intervention significantly reduced stress levels and improved blood glucose control by strengthening self-efficacy and social support (Zamani-Alavijeh, Araban, Koohestani, & Karimy, 2018). High levels of stress correlated with increased blood sugar levels in patients with type 2 diabetes, underscoring the importance of stress management in diabetes care (Sari, Nurhayati, & Rustini, 2020). A stress-based mindfulness program helped improve mental well-being and glycemic control in patients with type 2 diabetes (Nikkhah Ravari, Mousavi, & Babak, 2020).

In the context of urban communities in Riau Province, high levels of stress can be attributed to work pressures, busy lives, and lack of access to stress management services. Uncontrolled stress increases cortisol levels, triggers insulin resistance, and hinders effective glycemic control. A nursing-based mindfulness approach significantly reduces diabetes-related distress and improves self-management in patients with type 2 diabetes (Guo, Wang, Ge, Valimaki, Wiley, & Whittemore, 2022). A combination of cognitive-behavioral therapy-based stress management with self-care training improves medication adherence and quality of life in patients with type 2 DM (Jalali, Pourhosein, Alipour, & Afrooz, 2024). Stress management through community-based approaches, such as mindfulness programs, psychological counseling, and relaxation exercises, can be a solution to increase self-awareness and better diabetes management. Integration of multidisciplinary approaches in this program is needed to support type 2 diabetes patients in urban areas, especially in maintaining stable blood sugar levels.

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The results showed that there was a significant influence between medication adherence and self-awareness behavior in controlling blood sugar levels in patients with type 2 diabetes mellitus. Respondents who are poor compliant in taking medication have a 3.2 times greater chance of having low self-awareness behavior in controlling blood sugar levels. Diabetic patients who attended medication-related counseling had higher levels of adherence, which was directly related to better glycemic control (Shakya, Shrestha, Karmacharya, Morisky, & Kulseng, 2023). Low medication adherence contributes to poor blood sugar control, especially in patients with comorbidities (Sendekie, Netere, Kasahun, & Belachew, 2022). Adherence to oral antidiabetic therapy is significantly associated with better glycemic control and reduced risk of complications (Piragine, Petri, Martelli, Calderone, & Lucenteforte, 2023).

In the context of urban communities in Riau Province, lack of medication adherence may be attributed to lack of education regarding the importance of therapy, complexity of drug regimens, and patient perceptions of treatment. Medication adherence plays an important role in blood sugar control through mechanisms that improve insulin sensitivity and decrease glucose production in the liver. Health education and the provision of information on the importance of medication are effective in improving patient adherence rates, especially in urban areas (Nair & Ahmed, 2024). In addition, socioeconomic factors, such as limited access to medicines due to high costs, also contribute to low adherence rates. To improve adherence, community-based approaches such as digital reminders, intensive counseling, and health worker involvement in patient education have shown positive results (Kaur, Gomra, Girdhar, Sharma, & Chaudhary, 2023).

CONCLUSION

This study shows that physical activity, nutritionally balanced diet, stress control, and medication adherence have a significant influence on self-awareness behavior in controlling blood sugar levels in patients with type 2 diabetes mellitus in urban areas of Riau Province. Insufficient physical activity, an unbalanced diet, high-stress levels, and low medication adherence each increase the risk of low self-awareness in controlling blood sugar levels. A

community-based health education program that includes physical activity training, counseling on the importance of a balanced diet, stress management counseling, and strengthening medication adherence is needed. This program should involve collaboration between health workers, patients' families, and local government to improve access and effectiveness of health interventions in urban communities.

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