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Factors Influencing Diabetes Self-Management in Rural Indonesia: Lessons from the COVID-19 Pandemic

Factores Determinantes del Autocontrol de la Diabetes en las Áreas Rurales de Indonesia: Lecciones Derivadas de la Pandemia de COVID-19

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SUMMARY

Introduction: *In rural areas, positive and effective self-management not only controls the condition of Diabetes mellitus (DM) on physiological indicators but also improves the patient's quality of life. This study aims to identify factors related to Self-Management of DM during the COVID-19 pandemic in rural areas. This study employed a descriptive correlational design with a cross-sectional approach.*
Methods: *A total of 115 patients with type 2 diabetes mellitus residing in rural areas of Lamongan and Gresik, East Java, Indonesia, were purposively selected from May to July 2022. Data were collected using questionnaires, including demographic information, the Diabetes Self-Management Questionnaire (DSMQ), and the Generalized Anxiety Disorder Scale (GAD-7), along with anthropometric measurements and random plasma glucose measurements. The main variables included self-management behavior, anxiety level, and glycemic status. Data were analyzed using descriptive statistics and ordinal regression analysis with a significance level of $p < 0.05$.*
Results: *The study showed a mean age of 55.3 years and a mean random plasma glucose test result in the hyperglycemia category (258.67 mg/dL). Conditions of hyperglycemia ($p < 0.001$), obesity ($p = 0.003$), and psychological conditions that are at risk of experiencing anxiety ($p = 0.001$) were found as risk factors significantly associated with decreased diabetes self-management during the COVID-19 pandemic.*
Conclusion: *Hyperglycemia, obesity, and anxiety were significantly related to poor diabetes self-management during the COVID-19 pandemic, emphasizing the need for improved self-management education and psychosocial support in rural diabetic populations.*

Keywords: *Self-management; diabetes; COVID-19; health care; rural*

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RESUMEN

Introducción: *En las zonas rurales, un autocontrol positivo y eficaz no solo regula las condiciones fisiológicas de la diabetes mellitus (DM), sino que también mejora la calidad de vida de los pacientes. El objetivo de este estudio fue identificar los factores asociados al autocontrol de la DM durante la pandemia de COVID-19 en áreas rurales. Este estudio empleó*

un diseño correlacional descriptivo con un enfoque transversal.
Métodos: *Se seleccionó un total de 115 pacientes con diabetes mellitus tipo 2 que residían en zonas rurales de Lamongan y Gresik, Java Oriental, Indonesia, mediante un muestreo intencional, entre mayo y julio de 2022. Los datos se recopilaron mediante cuestionarios que incluían información demográfica, el Diabetes Self-Management Questionnaire (DSMQ) y la Generalized Anxiety Disorder Scale (GAD-7), así como mediciones antropométricas y pruebas de glucosa plasmática aleatorias. Las principales variables incluyeron el comportamiento de autocontrol, el nivel de ansiedad y el estado glucémico. Los datos se analizaron mediante estadísticas descriptivas y un análisis de regresión ordinal, con un nivel de significación de $p < 0,05$.*
Resultados: *El estudio mostró una edad media de 55,3 años y una glucosa plasmática aleatoria promedio dentro de la categoría de hiperglucemia, de 258,67 mg/dL. Se identificaron hiperglucemia ($p < 0,001$), obesidad ($p = 0,003$) y factores psicológicos asociados al riesgo de ansiedad ($p = 0,001$) como factores de riesgo significativamente relacionados con una disminución del autocontrol de la diabetes durante la pandemia de COVID-19.*
Conclusión: *La hiperglucemia, la obesidad y la ansiedad se asociaron significativamente con un deficiente autocontrol de la diabetes durante la pandemia de COVID-19, lo que resalta la necesidad de fortalecer la educación sobre autocontrol y el apoyo psicosocial en las poblaciones diabéticas rurales.*

Palabras clave: *Autocontrol, diabetes, COVID-19, atención sanitaria, zona rural.*

INTRODUCTION

The management of patients with comorbid diseases worldwide is being affected by the massive spread of COVID-19 (1,2). Patients with diabetes mellitus (DM) are at higher risk of contracting COVID-19 due to underlying immunosuppression, which may lead to more severe disease outcomes once infected. In Indonesia, the prevalence of diabetes continues to rise, affecting approximately 10.9 % of the adult population in 2023 (3). The burden is particularly concerning in rural areas, where limited access to healthcare services, lower health literacy, and economic barriers contribute to poor glycemic control and delayed diagnosis.

Rural regions show a growing trend of undiagnosed and uncontrolled diabetes, with many individuals unaware of their condition until complications occur. This disparity highlights the urgent need to strengthen diabetes self-management and preventive strategies among rural populations (4,5). Diabetes ranks as the second most common comorbidity among COVID-19 patients after cardiovascular disease (6). In Italy, 36 % of COVID-19 patients who died were related to DM (5). Reports from the Philippine Department of Health (DOH) show that DM and hypertension are the most common comorbidities in the deaths of COVID-19 patients in the Philippines (4). A meta-analysis of studies in China reported that COVID-19 patients with DM had a doubled risk of being admitted to the intensive care unit (ICU) (7), and it makes DM an independent predictor for patients admitted to the ICU or using invasive mechanical ventilation in COVID-19 patients (8,9).

Good self-management behavior plays an important role in the treatment of DM, especially in type 2 DM. From a patient-welfare perspective, encompassing emotional, behavioral, and medical aspects, it requires understanding and adopting long-term, effective self-management behaviors. To improve quality of life and physiological conditions, it must be supported by effective, positive self-management (10). A study in China of T2DM patients who recovered from COVID-19 found that only 22.76 % - 40.09 % had achieved optimal glycemic control (hemoglobin A1c level <7.0 %, 53 mmol/mol) (11,12), and 9.20 % - 16.43 % had shown good self-management behavior (11). This certainly raises the question of how to identify the factors that hinder self-management in DM and how to overcome them.

In self-management found several common barriers in research in several developed countries such as Canada, Singapore, England and the United States, namely lack of family support, poor communication between patients and health care providers, lack of knowledge about disease, limited access to health care facilities, techniques limited treatment, low family economic factors, loss of motivation to comply in self-management and physical and cognitive disorders (13-15), and the emergence of problems such as anxiety, insomnia, and impaired blood sugar control (16-18). People with diabetes tend to have varying levels of negative emotions, including anxiety and depression, which will naturally increase during

an epidemic (19,20). Unhealthy emotions will, in turn, affect glycemic control in DM sufferers in the midst of the COVID-19 pandemic (21-23).

Rural areas may remain vulnerable to COVID-19 even in the absence of confirmed cases (24). Compared to urban areas, rural areas have poor COVID-19 testing (25). Complex, heterogeneous barriers among patients with DM impede self-management. In addition, factors related to the self-management behavior of patients with DM remain uncertain during the COVID-19 pandemic. Several studies related to the treatment and control of blood glucose in COVID-19 patients with DM have been published previously (26,27), but primarily focused on hospitals and physicians' practices. Therefore, this study aims to identify the specific factors influencing self-management of diabetes among individuals with type 2 diabetes mellitus living in rural areas of Indonesia. Specifically, it examines the effects of biological factors (hyperglycemia and obesity) and psychological factors (anxiety) on diabetes self-management behaviors. Although the study was conducted during the COVID-19 pandemic, these factors remain highly relevant in the post-pandemic era, as the long-term effects of disrupted healthcare access, lifestyle changes, and increased psychological distress continue to affect diabetes control and self-care behaviors. Understanding how these biological and psychological determinants interact to influence self-management is essential for developing sustainable interventions that strengthen diabetes care, enhance patient autonomy, and improve health outcomes in rural communities under both normal and crisis conditions.

METHODS

Study Design and Sample

A descriptive correlation design with a cross-sectional approach. A total of 115 people with type 2 diabetes mellitus living in rural areas of Lamongan and Gresik, East Java Province, Indonesia, in May-July 2022. Participants were selected using purposive sampling based on the following inclusion criteria: individuals diagnosed with type 2 diabetes mellitus, residing in the study area (Lamongan or Gresik District) for more than 2 years, aged 30 years or older, and willing to participate by providing informed consent. The sampling process involved coordination with local community health centers to identify eligible participants who met these criteria. The study examined three main independent variables—hyperglycemia, obesity, and anxiety—and their relationship with the dependent variable, diabetes self-management.

Data Collection Procedures

The principal investigator was responsible for obtaining research permits and ethical clearance to conduct the study in the two rural research areas. Researchers coordinated with the local health offices and community health centers (Puskesmas) in both regions to identify potential participants from the diabetes mellitus registry. Eligible individuals who met the inclusion criteria were approached by the health center staff and invited to participate in the study. Those who agreed to join were asked to provide written informed consent and schedule a suitable time for data collection. The data collection procedure consisted of completing demographic data (age, gender, exercise habits, participant and family history), the Diabetes Self-Management Questionnaire (DSMQ), and the Generalized Anxiety Disorder Scale (GAD-7). A physical examination was then performed, including blood sugar testing at the time, and anthropometric measurements were obtained according to the standard protocol. Data collectors are trained researchers with backgrounds in the health sector and experience conducting surveys.

The Generalized Anxiety Disorder Scale (GAD-7) questionnaire was used to assess the level of anxiety among participants. This instrument was included as a parameter because psychological factors, particularly anxiety, play a crucial role in influencing diabetes self-management behaviors (28). During the COVID-19 pandemic, heightened anxiety related to health risks, social restrictions, and economic uncertainty could disrupt patients' motivation and ability to adhere to diet, medication, and physical activity routines. Therefore, measuring anxiety levels using the GAD-7 provided valuable insight into how psychological distress may have

impacted diabetes self-management during and after the pandemic period (29).

Measurements

In the measurement process, participants were also asked about their medical history, specifically the presence of comorbid conditions such as hypertension and hypercholesterolemia. These comorbidities were included because they are commonly associated with diabetes mellitus and can affect patients' overall health status, glycemic control, and ability to manage their condition effectively. Information regarding these conditions was obtained from participant self-reports and, when available, verified through medical records. Researchers collected capillary blood samples from participants using the Easy Touch glucose meter to measure their random blood sugar (RBS). The RBS test can be an appropriate tool for mass screening to detect diabetes and prediabetes, given its acceptable performance (30). In this study, a random/non-fasting plasma glucose value <200 mg/dL was used as the cut-off for hyperglycemia, according to the criteria of the American Diabetes Association (31). Participants' height was measured in centimeters (cm) using a Microtoise stature meter, with an accuracy of 0.1 cm. In contrast, body weight was measured in kilograms (kg) using a one-med digital scale, and the results were used to calculate body mass index (BMI) (32).

Participants completed a demographic questionnaire, the Diabetes Self-Management Questionnaire (DSMQ), and the Generalized Anxiety Disorder Scale (GAD-7). The Diabetes Self-Management Questionnaire (DSMQ), developed by Schmitt et al. (33), comprises 16 items assessing key indicators of diabetes self-care behavior, including glucose management, dietary control, physical activity, and healthcare use. Each item is rated on a four-point Likert scale, with higher scores indicating better self-management performance. The focus of this questionnaire is to assess the behavior of patients with DM in the 2 months preceding completion. Cronbach's alpha reliability coefficient is 0.641 (alpha > 0.374), indicating acceptable reliability. The DSMQ questionnaire uses a Likert scale. The questionnaire comprises 16 items, including indicators of diet control (at numbers 2, 5, 9, 13), physical activity (at numbers 8, 11, 15), health care (at numbers 3, 7, 14, 16), and glucose management (at numbers 1, 4 ,6, 10, 12). The assessment score is very suitable: 3, suitable: 2, almost suitable: 1, not appropriate: 0 (33). The score obtained is then categorized as low (0-16), sufficient (17-23), or good (24-48) (34). The GAD-7 produces a severity score ranging from 0 to 21, with seven items, each scored 0 to 3. A score of 5 indicates mild anxiety, a score of 10 indicates moderate anxiety, and a score of 15 indicates severe anxiety (35).

Statistical Analyses

Descriptive statistics was used to determine frequencies and percentages for categorical variables and means and standard deviations for numerical variables. Statistical analysis was performed using SPSS version 21.0 for Windows. Characteristics of participants related to diabetes self-management were compared between groups using an ordinal regression analysis with 95 % confidence intervals for the dependent variable self-management, with three categories (good, adequate, poor) (36).

Ethical consideration

The Committee on Human Research Ethics has approved the research protocol, which is still explained orally and in writing on the informed consent form given to participants. This research has obtained ethical approval from the Ethics Commission of the Faculty of Nursing, Universitas Airlangga, with ethics number: 2506-KEPK.

RESULTS

115 participants (average age 55.3 years) were categorized as elderly, and their average random plasma glucose test result placed them in the hyperglycemia category (258.67 mg/dL). On average, the participants were female (80 %) and included in the category of higher

education level (having graduated from high school and above) (60.9 %) (Table 1). Most of the participants had a good and sufficient level of self-management (32.2 %), but had a high risk of experiencing anxiety (53.9 %). Most participants were classified as overweight (29.6 %) or obese (24.3 %).

Table 1. Sociodemographic characteristics and clinical variables of DM participants in rural areas (n=115).

Variable	**n (%) or mean (SD) (min-max)**
Age	55.30 ± 8.647 (32-72)
Gender	
Male	23 (20)
Female	92 (8a0)
Education leveal	
High educational level	70 (60.9)
Low educational level	45 (39.1)
History of COVID-19	
Ever experienced	6 (5.2)
Never	109 (94.8)
Exercise	
Routine	64 (55.7)
Not a routine	51 (44.3)
Random plasma glucose (mg/dL)	258.67± 103.313 (73-525)
Family history of diabetes mellitus	
Yes	43 (37.4)
No	72 (62.6)
History of hypertension	
Yes	49 (42.6)
No	66 (57.4)
History of hypercholesterolemia	
Yes	25 (21.7)
No	90 (78.3)
Smoking History	
Yes	15 (13.0)
No	100 (87.0)
Body mass index (kg/m^2)	
Normal (18.5–24.9)	53 (46.1)
Overweight (25–29.9)	34 (29.6)
Obesity (diameter 30)	28 (24.3)
Self-management Diabetes Mellitus (DSMQ)	
Low	37 (32.2)
Moderate	37 (32.2)
High	41 (35.7)
Generalized Anxiety Disorder-7 Questionnaire	
High risk of anxiety (score ≥10)	62 (53.9)
Normal (score<10)	53 (46.1)

Table 1 also shows that most participants regularly engage in sports (55.7 %) and have no history of smoking (87 %). A small proportion of participants had a history of hypertension (42.6 %) and hypercholesterolemia (21.7 %), and there were families with diabetes mellitus (37.4 %).

Table 2. Analysis of Ordinal Regression of sociodemographic characteristics on self-management in diabetes mellitus in rural areas.

Variable	Coefficient (B)	P-value	OR(95 %CI)
Age	-0.022	0.345	0.978 (0.935-1.024)
Male gender	0.519	0.364	1.680 (0.548-5.150)
Low education level	-0.329	0.439	0.719 (0.313-1.656)
History of experiencing COVID-19	0.447	0.587	1.564 (0.311-7.865)
History of hypertension	0.025	0.953	1.025 (0.452-2.324)
History of hypercholesterolemia	-0.281	0.540	0.755 (0.307-1.857)
Family history of DM	-0.128	0.734	0.880 (0.420-1.841)
History of smoking	-1.113	0.078	0.328 (0.095-1.135)
Not exercising regularly	0.636	0.095	1.889 (0.894-3.991)

Based on Table 2, the sociodemographic characteristics of the study participants were not associated with improved DM self-management in rural areas.

Table 3. Analysis of participants' biopsychological ordinal regression on self-management of diabetes mellitus in rural areas

Variable	Coefficient (B)	P-value	OR(95 %CI)
Random plasma glucose (mg/dL)	-0.010	<0.001	0.990 (0.985-0.994)
BMI category: Obesity (above 30)	-1.596	0.003	4.932 (1.693-14.372)
BMI Overweight category (25–29.9)	-0.639	0.250	1.894 (0.638-5.627)
High Risk for Anxiety (GAD-7 score 10)	-1.368	0.001	0.255 (0.110-0.591)

Based on Table 3, an increase in the value of temporary blood glucose (mg/dL) is associated with a decreased chance of DM self-management ability by 0.990 times. The interesting thing from Table 3 is that participants with DM in rural areas who are obese will increase the chance of decreasing self-management by 4,932 times. Most DM participants are also at risk of experiencing increased anxiety due to the COVID-19 pandemic situation, which can affect the decrease in self-management by 0.255 times.

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DISCUSSION

As far as we understand, this study provides an overview of the factors influencing self-management among DM patients during the COVID-19 pandemic in rural Indonesia. One of the factors causing mortality in DM patients during the COVID-19 pandemic is the lack of self-care management (16). The ability to perform self-care management involves managing diet, blood sugar levels, medication, physical activity, and exercise, as well as stress (37). Problems with the lack of self-care for DM patients have an impact on psychosocial issues (35). The DM self-management level in this study had a relatively balanced distribution for low, moderate, and high levels. Several studies conducted before and during the COVID-19 pandemic found that DM patients' self-management was low (38-40).

Among the examined factors, hyperglycemia emerged as the most influential determinant

affecting diabetes self-management during the pandemic. The findings indicated that participants with higher random plasma glucose levels tended to have poorer self-management behaviors. Specifically, an increase in random plasma glucose (mg/dL) was associated with a 0.990-fold lower likelihood of demonstrating effective diabetes self-management. This suggests that poor glycemic control significantly undermines patients' ability to manage their condition independently, highlighting the need for continuous monitoring and education to improve metabolic control in individuals with diabetes. Individuals with DM who have poor glycemic control will have a higher risk of contracting COVID-19 (9 %-15 %) than individuals with DM who are optimally controlled (41). Sudden fluctuations in blood sugar levels in DM will complicate treatment during viral infections (42). Recent research has shown that during the COVID-19 pandemic, DM sufferers consume a lot of carbohydrates and sweet foods, lack physical activity, and neglect to monitor their own blood glucose levels (42-44). Self-monitoring of capillary blood glucose is an acceptable alternative to plasma glucose estimation in this situation. The availability of glucose strips can be a challenge under current conditions (9). Online ordering from pharmacies can be an alternative, but it requires financial support and the availability of these services in rural areas. Routine blood glucose monitoring can serve as a motivator to maintain normal blood glucose levels.

One of the notable findings in this study is the high prevalence of obesity among participants with diabetes mellitus living in rural areas. This condition may be attributed to limited access to health education, reduced physical activity due to occupational patterns such as sedentary farming or household work, and the increased consumption of high-calorie, low-nutrient foods that are more affordable and readily available in rural communities. Cultural eating habits and low awareness of healthy dietary practices may also contribute to the higher rates of obesity observed among rural residents with diabetes. These findings indicate a health risk because central adiposity is associated with secondary metabolic and cardiovascular changes due to obesity, which is more prevalent among individuals with insulin resistance, supporting the development of prediabetes or diabetes in those with abdominal fat accumulation (45). A study in Spain found that rural areas had a higher prevalence of abdominal obesity in women compared to urban areas (p=0.001) (46). Factors that can affect the incidence of obesity include education and work levels, food intake, stress, physical activity, gender, and age (47).

An important finding in this study is that participants with DM in rural areas who are obese are 4.9 times more likely to experience a decrease in self-management abilities by 4.9 times. More specifically, obesity is a major contributor to the type 2 diabetes epidemic, in which nearly 88 % of those with DM are considered overweight or obese. Individuals with metabolic syndrome have a 5-fold increased risk of diabetes. Hyperinsulinemia directly contributes to the accumulation of excess lipids (obesity) in some body tissues (48). Performing empowerment therapy has a positive effect on normalizing BMI, systolic blood pressure, and stress levels (49). In empowerment therapy, patients with DM gain the knowledge needed to influence their behavior and improve their quality of life. This therapy consists of five stages, starting from identifying problems to evaluating implementation (50,51).

The psychological condition of DM participants in rural areas was investigated, and the result was that most participants experienced a high risk of anxiety (53.9 %). This condition may be related to the current COVID-19 pandemic. These findings are not much different from a study conducted in Bangladesh, which found that 59 % of chronic disease patients experienced anxiety due to the COVID-19 pandemic (52). In Brazil, as many as 43.3 % of DM patients experienced anxiety during the COVID-19 pandemic (53). This finding is slightly different from a study conducted in Saudi Arabia, which found that residents of urban areas are more likely to suffer from depression and anxiety (35). In this case, DM patients, either living in cities or in rural areas, are very likely to experience anxiety caused by the COVID-19 pandemic situation.

DM participants in rural areas were also at risk of experiencing increased anxiety due to the COVID-19 pandemic situation, which could affect the decrease in self-management. This finding

is consistent with previous studies (11,35,54). Widespread social restrictions and fear of infection have a significant impact on mental health, but may also be due to other factors such as education level, genetics, and culture. Another factor to consider is the low level of social support and social networks, which can significantly contribute to the development of diabetes distress (55-57). Teleconference consultations with psychiatrists can be used as an alternative in managing psychological problems in these situations (58).

The findings of this study can be interpreted through the lens of health behavior theories such as the Health Belief Model (HBM) and Social Cognitive Theory (59,60). According to these frameworks, individuals' self-management behaviors are influenced by perceived disease susceptibility and severity, perceived benefits and barriers, and self-efficacy in performing diabetes-related care. During the COVID-19 pandemic, many rural residents with diabetes perceived limited control over their health due to restricted mobility, reduced healthcare access, and psychological distress, which weakened their self-efficacy and adherence to diabetes management routines (61). Cultural and environmental factors specific to rural areas also play a significant role. Moreover, reliance on family and community support systems shapes health behaviors that may both positively and negatively influence self-management (62,63). Therefore, interventions to improve diabetes self-management in rural populations should be culturally sensitive, enhance self-efficacy, and incorporate community-based approaches that leverage local social structures and beliefs.

The cross-sectional design of our study did not allow us to establish a causal relationship; therefore, further research is needed to clarify the relationship between these phenomena. Appropriate models for screening DM self-management during pandemics should be developed using cohort studies with adequate sample sizes. Exercise was not investigated in depth in this study; therefore, further studies, perhaps with a larger sample size, are needed to clarify the exact role of our findings.

CONCLUSION

This study highlights the importance of strengthening diabetes self-management among individuals living in rural areas. Comprehensive strategies are needed to enhance self-care capacity through education, lifestyle modification, and psychological support. Collaboration among healthcare providers, patients, and families is crucial to promoting consistent self-management practices. Additionally, integrating telehealth or teleconference-based monitoring systems offers a promising approach to support diabetes management and continuity of care, especially for individuals with limited access to healthcare facilities.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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