

Uncovering the Multifaceted Influences on Type-2 Diabetes Mellitus Incidence in Public Health Centre, Indonesia

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ABSTRACT

Background: Type-2 diabetes mellitus (T2DM) is an emergency disease that often occurs. Lack of knowledge, poor management of self-care, and stress are different factors that promote an increase in blood sugar levels. The objective of this study is to determine the contributing factors between self-care, knowledge, and stress related to the incidence of T2DM in the Public Health Center, Indonesia.

Methods: This research used a correlational design with a cross-sectional approach during the period of July 3rd–August 3rd, 2023. Samples were chosen from 92 respondents with G Power correlation test. The research was conducted at the Public Health Center in Kediri City, Indonesia. The technique used in sample selection was purposive sampling based on inclusion criteria, namely T2DM patients aged 36–65 years, able to read and write, and willing to be the respondents in this study. The instruments used are three factorials developed by researchers, which include self-care, knowledge, and stress. The content validity index of the research instrument was validated and assessed by five experts. Bivariate analysis of the Spearman statistical test. **Results:** The statistical test shows a significant value for all of the variables, with P -value = 0.000 and $Rho = 0.631$ for self-care management, P -value 0.012 and $Rho = 0.305$ for knowledge, and P -value 0.023 and $Rho = 0.187$ for stress factor. **Conclusion:** The results of this study showed that self-care management, knowledge, and stress have significantly affected the incidence of T2DM.

Keywords: Hypoglycemia; Multifaceted Influences; Type-2 Diabetes Mellitus

INTRODUCTION

T2DM is an emergency disease that affects blood sugar regulation in the body. The cause of sudden death in T2DM is complications such as hypoglycemia, kidney disease, stroke, neurological disorders, and myocardial infarction. The elderly and adults are groups that are vulnerable to diabetes mellitus (Alkethiri *et al.*, 2021).

According to the International Diabetes Federation (IDF), in 2021, China will have contributed to the highest number of people living with diabetes mellitus (DM), which accounts for 140.87 million patients. In the same year, Indonesia placed in the fifth position in terms of DM incidence, with a total of 19.47 million sufferers. With a population of 179.72 million in Indonesia, the prevalence of diabetes in Indonesia is indicated at 10.6% (Cho & Williams, 2019). Kediri city has the most cases of DM, with 19 out of 38 cities in the province of East Java, Indonesia. The province of East Java ranked fifth for DM patients in Indonesia, with reported cases of 867,257 in 2021 (Chircop, Sheffield, & Kotera, 2021).

The number of deaths among diabetes mellitus patients is very high due to a lack of knowledge about diabetes mellitus and poor management of self-care among the patients, such as irregular blood glucose monitoring, obesity, unhealthy lifestyles, poor physical exercise, and high glucose intake (Alodhayani *et al.*, 2021). It is estimated that approximately 50% to 80% of diabetes mellitus patients have less knowledge and skills in self-care (Chen *et al.*, 2020; Sirait, Said, & Mohamad, 2024).

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Stress is another factor associated with diabetes mellitus. Stress due to obesity, social relationship problems, and decreased physical activity can cause psychological impacts and increase blood sugar, causing diabetes mellitus (Halim & Halim, 2019). Stress causes an increase in the production of the cortisol hormone, which interferes with the blood sugar level in patients with diabetes mellitus because the cortisol hormone is an enemy of insulin, making it difficult for blood sugar to enter cells and causing an increase in blood glucose levels (Ingrosso *et al.*, 2023). Thyroid dysfunction can cause T2DM. Both hypothyroidism and hyperthyroidism have been investigated to be associated with DM (Hadgu, Worede, & Ambachew, 2024). Adopting a healthy lifestyle, practicing good self-care, and managing stress are preventive measures that can be taken to reduce the risk of T2DM. Knowledge of T2DM management can be gained by controlling blood sugar levels. Blood sugar levels can be controlled by using pharmacological therapy, maintaining a healthy diet, a healthy lifestyle, and regular physical activity. Stress causes an overproduction of cortisol, a hormone that counteracts the effects of insulin and causes high blood sugar level (Putri & Rustam, 2021; Sarli, 2019).

Objectives

The objectives of this study are to determine the contributing factors between self-care, knowledge, and stress related to the incidence of T2DM in the Public Health Center, Indonesia.

METHODOLOGY

This research used a correlational design with a cross-sectional approach during the period of July 3rd–August 3rd, 2023. The study population was T2DM patients at the Public Health Center in Kediri City, Indonesia. According to Memon *et al.* (2020), measurement of the correlation test sample with G Power can use correlation and regression-correlation: a bivariate normal model with correlation p H1, α err prob 0.05, and power (0.80), resulting in a minimum total sample of 84 respondents. To avoid type 2 errors, the sample size needs to be increased by 10%. Thus, the total sample in this study was increased to 92 respondents. The sample selection technique was purposive sampling based on the inclusion criteria, namely T2DM patients aged 36–65 years, able to read and write, and willing to be the respondents in this research.

Data Collection

The instruments used are three factorials developed by researchers, which include self-care, knowledge, and stress. The questionnaire consists of 55 assessment questions consisting of 10 self-care-based assessments, 24 knowledge-based assessments, and 21 stress assessments.

The Summary of Diabetes Self-Care Activities (SDSCA) questionnaire, consisting of 10 questions regarding self-care in patients with T2DM, namely diet patterns, physical activity, smoking, and monitoring blood sugar, was used to measure for the last 7 days with a score of 0–7. Categories based on a cut-point score \geq mean indicate good self-care behavior, and a score $<$ mean indicates bad self-care behavior. The mean value is 62.48 (Sh *et al.*, 2019).

The Diabetes Knowledge Questionnaire is a questionnaire related to the knowledge of diabetes mellitus patients, consisting of 24 items. The measurement for level of knowledge is performed by summing up all the correct questions, numbers 1 to 24, and multiplying by 100%. Results with scores $<$ 55% display poor knowledge, 56–75% indicate sufficient knowledge, and 76–100% indicate good knowledge among the patients (Zakiudin *et al.*, 2022).

The Depression Anxiety Stress Scale (DASS) 21 is a set of subjective scales designed to measure the negative emotional states of depression, anxiety, and stress. This questionnaire consists of 21 question items with answer choices such as never (0), sometimes (1), often (2), and almost all the time (3). The score obtained is then multiplied by 2 to calculate the final score. The results of the assessment were: Normal: 0–14; mild: 15–18; moderate: 19–25; severe: 26–33; and very severe: $>$ 34 (Basha & Kaya, 2016).

Validity and Reliability

The content validity index of the research instrument was validated and assessed by five experts, such as a doctor, nutritionist, pharmacist, medical-surgical nurse, and psychologist. Based on the validation of the self-care, knowledge, and stress instruments, the content validity is calculated at 1.00. According to Saiful and Yusoff (2019), if the content validity index scale is greater than 0.80, it indicates that the instrument is valid.

In addition, reliability analysis was conducted with the results of Cronbach's alpha = 0.885 > 0.70 (self-care), Cronbach's alpha = 0.868 > 0.70 (knowledge), and Cronbach's alpha = 0.923 > 0.70 (stress). According to Taber (2016), if the Cronbach alpha coefficient is greater than 0.70, the instrument can be used reliably in research.

Data Analysis

Bivariate analysis was used to determine the relationship between self-care, knowledge, and stress variables and the occurrence of T2DM. The Spearman statistical test is used as an inferial statistical test to detect the relationship between independent variables and the occurrence of T2DM.

Ethical Consideration

This research was approved by Health Research Ethics Committee of Institut Ilmu Kesehatan, Indonesia of the with reference number 000354/EC/KEPK/I/08/2023 on 21st August, 2023.

RESULTS

Characteristic of the Respondents

The number of respondents used in this study was 92 T2DM patients. As shown in Table 1, the characteristics of the respondents in the study include age, gender, education levels, long-suffering from T2DM, income per month (rupiah), and marital status.

Table 1: Characteristics of the Respondents (n = 92)

Characteristics	Frequency	Percentage (%)
Age		
36 – 45 years	23	25.0
46 – 55 years	31	33.7
56 – 65 years	38	41.3
Gender		
Male	40	43.5
Female	52	56.5
Education Levels		
No Formal Education	9	9.8
Elementary	12	13.1
Junior High School	17	18.5
Senior High School	34	36.9
Higher Education / Academy	20	21.7
Duration of Suffering from T2DM since First Diagnosis		
< 1 years	39	42.4
1-5 years	31	33.7
>5 years	22	23.9
Income Per Month (Rupiah)		
≤ 2.300.000	50	54.3
>2.300.000	42	45.7
Marital Status		
Married	51	55.4
Single / Divorced	41	44.6

Based on the results obtained, most of the T2DM patients (41.3%) were aged between 56 and 65 years. Female patients are higher than males, with 56.5% of respondents in terms of education level; most of the patients graduated from senior high schools (36.9%). The duration of suffering from T2DM since the first diagnosis was mostly < 1 year, or 42.4%. The income per month (rupiah) for more than half of the patients is 54.3%, with $\leq 2,300,000$. Also, 55.4% of the patients are married. The details of the characteristics of the respondents are presented in Table 1.

Contributing Factors Related to the Incidents of T2DM in Indonesia

The results of research on identifying the contributing factors related to the incidence of T2DM in Public Health Center Kediri City, Indonesia, with a total of 92 respondents are presented in Table 2. The results show that more than half of the patients (68.5%) have poorly managed their self-care assessments. The statistical test of the level of self-care shows that there is a significant relationship between the good and poor level variables (P -value 0.000 and $Rho = 0.631$).

Table 2: The Relationship between Self-Care, Knowledge, and Stress T2DM Patients ($n = 92$)

Variables	T2DM		P -Value	Rho
	Frequency	%		
Level of Self-Care				
Good	29	31.5	0.000	0.631
Poor	63	68.5		
Level of Knowledge				
Excellent	27	29.3	0.012	0.305
Moderate	30	32.6		
Poor	35	38.1		
Level of Stress				
Normal	13	14.1	0.023	0.187
Mild	8	8.7		
Moderate	14	15.2		
Severe	26	28.3		
Very Severe	31	33.7		

The level of knowledge in T2DM patients was mostly poor, with 38.1%, followed by moderate (30%) and excellent (27%). The level of knowledge statistical variable test also showed a significant relationship between the variables P -value 0.012 and $Rho = 0.305$.

The stress levels of T2DM patients were mostly very severe (33.7%) and severe (26%). Only 14.1% of the patients were identified as having a normal stress level. The statistical test for stress levels shows a significant relationship between the variables P -value 0.023 and $Rho = 0.187$. The information on the relationship between self-care, knowledge, and stress in T2DM patients is presented in Table 2.

DISCUSSION

Relationship between Self-Care and Occurrence of T2DM

The results showed that there is a significant relationship between the level of self-care and the occurrence of T2DM. More than half of the patient's level of self-care is poor. Similar findings were reported in previous research, which suggests that poor self-care management is contributed by the habits of consuming foods containing excessive sugar that cause damage to pancreatic cells responsible for insulin production. Excessive fat consumption will disrupt fat metabolism in the body. Excessive fat consumption can increase body weight, which can cause T2DM (Bays, 2023). A regular low-sugar and fat diet program and physical activity 3–7 times a week can influence weight loss in T2DM patients (Tang *et al.*, 2020).

Physical activity can help increase insulin sensitivity so that the body can utilize insulin properly. Lack of physical activity such as exercise and walking can cause insulin resistance, which results in T2DM (Alhaik *et al.*, 2019). During physical activity, the muscles take more glucose from the blood as a source of energy. When

a person does not control and monitor their blood sugar regularly, it can cause high blood sugar levels. If this condition is not treated immediately, there will be damage to the pancreatic cells that produce insulin, making it difficult for the body to control blood sugar levels, which causes T2DM (Sigal *et al.*, 2018). Cigarettes contain chemicals that can damage the body's nervous system and cause chronic inflammation, which disrupts glucose metabolism and causes T2DM. Cigarettes also cause weight gain, especially in the stomach area. Being overweight causes insulin resistance and T2DM (Ngueta, Ruddy, & Ndjaboue, 2022).

Numerous studies have shown that most of the T2DM patients are people aged 56–65 years. Elderly people with T2DM experience physical limitations in carrying out proper self-care, such as maintaining personal hygiene, and they also experience a decreased capability to perform any physical activity, as well as their health concerns. The results showed that more than half of the patient's income is $\leq 2,300,000$ per month rupiah. This low-income status can affect the T2DM patients' self-care management in terms of expense allocation for purchasing blood sugar monitoring devices, medicines, and diet planning (Shrivastva *et al.*, 2020).

Maintaining personal and environmental cleanliness is an important part of good self-care. This action can provide some positive benefits for a person's physical and mental well-being and keep the immune system stable. The incidence of T2DM can be reduced by improving self-care management, such as preventing the consumption of high sugar and fat, increasing physical activity, exercising regularly, checking blood sugar regularly, and avoiding smoking. Low income and old age can influence individual self-care behaviors.

Relationship between Knowledge and Occurrence of T2DM

The results of this study indicate that there is a significant relationship between the level of knowledge and the occurrence of T2DM. Most of the patient's level of knowledge is poor. Similar findings in research by Maina, Pienaar, and Reid (2023) showed that lack of knowledge about a healthy lifestyle, such as understanding the types of low-sugar and carbohydrate foods, lack of regular exercise, maintaining an ideal body weight, and not knowing the signs and symptoms of T2DM, can all lead to an increased risk of T2DM. Lack of knowledge and information on a family history of diabetes mellitus makes a person unaware of their risk-probability of suffering from T2DM (Tamiru *et al.*, 2023). Even though diabetes mellitus is genetically inherited, it can still be prevented with proper management of self-care and diet, provided that the risk is known at an earlier stage. In this study, the education level of T2DM patients is mostly from senior high schools, and patients age between 56 and 65 years. This is supported by the research of Shrivastva *et al.* (2020), which found that elderly patients who have low education have limited access to information on websites, literature, medical advice, difficulties in understanding medical instructions, and relevant information about diabetes mellitus.

The elderly patients with T2DM often experience memory loss, which can make it difficult for them to receive information on the treatment of their disease provided by health workers (Jannoo & Mamode Khan, 2019). Most of the respondents have been suffering from T2DM for less than a year. Previous research from Lewing *et al.* (2022) has reported that patients with short-term diabetes mellitus will have poor knowledge and experience regarding the understanding of diet, drug use, self-care, and measuring blood glucose levels as compared to patients with long-term diabetes mellitus. Obtaining the right information on T2DM is important in order to prevent and reduce the risk of the disease. Information that should be considered for the management and prevention of the disease includes a healthy lifestyle, sugar intake, physical activity, signs and symptoms of diabetes mellitus, as well as the family background of the disease.

Relationship between Stress and the Occurrence of T2DM

The research results show that there is a significant relationship between the level of stress and the occurrence of T2DM. Most of the levels of stress are very severe. A significant relationship between stress level and T2DM was also found in this study. Most of the patients experienced severe or very severe stress levels. The body releases adrenaline and cortisol in response to stress, among other hormones. The body naturally reacts to stressful conditions with this condition. Insulin resistance, a condition in which insulin is less effective at regulating blood sugar levels, can be exacerbated by an increase in the hormone's cortisol and adrenaline. This hormone may disrupt the body's ability to regulate blood sugar, which may lead to T2DM

(Lee *et al.*, 2018). In addition to affecting immunity, stress can lead to long-term inflammation. T2DM may arise from this inflammation-induced insulin resistance (Sharma *et al.*, 2022). For some people, when they are under stress, it will increase their appetite (Tunsuchart *et al.*, 2020). Some of the foods they consumed might contain high sugar and fat, and this will result to overweight. In addition, stress can demotivate people to exercise, which is an important factor in controlling the blood sugar level and body weight regulation in the prevention of T2DM.

The current study showed that female T2DM patients are higher than males. In this new era and modern society, a woman's role is very important. Being a wife, mother, and co-worker makes women more stressed with their responsibilities and sometimes becomes a burden to them. This condition causes an imbalance in the estrogen and progesterone hormone regulations in women that can result in insulin resistance and an increased an increased blood sugar level (Zhang *et al.*, 2020). In addition, the hormonal changes that occur in women after menopause can have an impact on blood sugar balance and metabolism (Mewes *et al.*, 2023). Because men have larger muscles than women, this may have an impact on how their bodies metabolize blood sugar. Estrogen and testosterone are examples of sex hormones that may be involved in blood sugar management. Insulin sensitivity in men impacted by hormonal abnormalities (Ingrosso *et al.*, 2023). People with a family history of T2DM are at higher risk, but healthy lifestyle changes can help reduce the risk (Mehta *et al.*, 2023). Patients may suffer stress and lifestyle modifications such as bad eating habits and limited access to nutrient-dense food that could be detrimental to their health when faced with challenging financial circumstances. This may contribute to elevated blood glucose levels (Merabet *et al.*, 2022).

The responders were mostly between the ages of 56 and 65. The body reacts more sensitively to stress in the elderly, and blood sugar swings can affect them more. Diabetes mellitus in the elderly is associated with increased emotions that are hard to manage, which can exacerbate the illness and cause stress (Jafar *et al.*, 2023). Elderly people face more pressure from various sources, such as disease complications, loss of a life partner, and financial problems, which can cause stress and thus increase blood sugar levels (Banjarnahor, Siregar, & Asfiryati, 2023).

The importance of managing stress is that avoiding its causative factors can help prevent the incidence of T2DM. Managing stress in T2DM sufferers is very important because stress can affect blood sugar levels. Managing stress can be done in several ways, such as by using deep breathing techniques, consulting a doctor, using humor, doing fun activities, and avoiding information that triggers stress.

Limitations

The present study prevents establishing causality between self-care, knowledge, stress, and the incidence of T2DM. Additionally, further studies are needed to examine the reliance on self-reported data, which may introduce bias since respondents might have overestimated or underestimated their self-care, knowledge, and stress levels.

CONCLUSION

In conclusion, the results of this study showed the importance of comprehensive self-care management, enhanced knowledge, and effective stress management in reducing the incidence of T2DM. By improving these factors, healthcare providers can help patients better manage their condition, potentially lowering the overall prevalence of T2DM. These insights underscore the need for targeted educational and stress-reduction interventions to support T2DM patients in their self-care practices and overall disease management.

Conflict of Interest

The author states that there is no conflict of interest related to the publication of this research article.

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