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Risk factors for type 2 diabetes mellitus in rural communities in South Sumatra, Indonesia

Yoki Arum Sari*, Najmah

Fakultas Kesehatan Masyarakat Universitas Sriwijaya
Corresponding author: *E-mail: yokiarum@gmail.com

Abstract

Background: Diabetes mellitus (DM) is a chronic metabolic disorder characterized by elevated blood sugar levels caused by insulin resistance or impaired insulin secretion. The prevalence of type 2 diabetes mellitus continues to increase, especially in rural areas due to low public awareness and limited access to non-communicable disease control.
Method: To case-control design involving patients undergoing outpatient treatment at the Indralaya Community Health Center. The study sample consisted of 143 cases and 143 controls. Sampling in the control group was performed using a “non-matching” technique. Data were collected through questionnaires and medical record analysis.
Results: Data analysis used the Chi Square test with a 95% confidence level. Of the 143 respondents, 143 were found to have diabetes mellitus. The results of the analysis showed a significant relationship between gender, income, family history of DM, diet, physical activity, and blood pressure on the incidence of type 2 DM in the Indralaya Community Health Center area after controlling for the IMT variable. Meanwhile, age, occupation, education, and smoking were confounding variables and did not have a significant relationship with the incidence of type 2 DM. The dominant variables associated with the incidence of type 2 DM were income and family history of DM.
Conclusion: Income and family history of DM are the most dominant determinants causing type 2 DM in rural areas. Gender, diet, physical activity, and blood pressure are also associated with the incidence of type 2 DM in the Indralaya Community Health Center area after controlling for the BMI variable. The dissemination of information and education is very important for health workers to provide to high-risk communities in order to prevent this disease.

Keywords: Diabates Mellitus; Risk Factors; Rural Communities.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease characterized by hyperglycemia due to impaired insulin secretion, insulin resistance, or both (Jadon, Kaushik, Anitha, Bhatt, Bhadauriya, & Sharma, 2024). Uncontrolled hyperglycemia can cause serious damage to vital organs such as the heart, blood vessels, kidneys, eyes, and nerves, thereby increasing the risk of disability and even premature death. Diabetes mellitus has become a complex global challenge, affecting both developed and developing countries, and placing a significant burden on individuals, communities, and healthcare systems (Khunti, Chudasama, Gregg, Kamkuemah, Misra, Suls, & Valabhji, 2023). The economic burden of DM includes direct costs, such as the treatment and management of complications, as well as indirect costs due to reduced productivity resulting from illness and premature death.

Globally, the prevalence of diabetes is increasing significantly every year. The International Diabetes Federation (IDF) reports that the number of people with diabetes is projected to nearly triple by 2030, with the highest number of cases occurring in low- and middle-income countries (Sun, Saeedi, Karuranga,

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Pinkepank, Ogurtsova, Duncan, & Magliano, 2022). In Indonesia, the IDF recorded 19.5 million cases of DM in 2022, placing Indonesia fifth in the world after China, India, Pakistan, and the United States. This number is estimated to increase to 28.5 million people by 2045. In addition, the IDF reports that 44% of people with diabetes remain undiagnosed, potentially increasing the risk of complications due to delayed disease management.

Diabetes is also one of the leading causes of death worldwide. In 2021, there were 236,711 deaths in Indonesia caused by diabetes, an increase of 58% compared to 2011. The majority of deaths occurred in the productive age group of 45–54 years, with a higher prevalence in urban than rural populations. Data from the South Sumatra Health Office shows an upward trend in DM cases each year. In 2023, there were 434,296 cases in this province, with Ogan Ilir Regency being one of the areas with the highest number of cases, increasing from 17,975 cases in 2021 to 27,746 cases in 2023. The Indralaya Community Health Center itself reported 2,095 cases of DM in 2023.

The increase in the prevalence of type 2 DM in rural areas is influenced by low public awareness of health management and limited access to health services. In addition, urbanization and modernization have changed the lifestyle of rural communities towards unhealthy habits, such as high-calorie diets, low physical activity, and increased smoking. Type 2 diabetes is caused by a combination of modifiable and non-modifiable risk factors. Non- modifiable factors include age, gender, and family history, while modifiable factors include obesity, diet, physical activity, hypertension, and dyslipidemia.

Previous studies have shown that risk factors for type 2 diabetes vary (Holman, Knighton, Kar, O'Keefe, Curley, Weaver, & Valabhji, 2020). Found that obesity, consumption of caffeinated beverages, and low physical activity play a significant role in increasing the risk of type 2 diabetes in Bangladesh. The main factors directly related to type 2 diabetes are age, obesity, and an inactive lifestyle. The city found a significant relationship between age, family history, body mass index (BMI), high- sugar diet, and physical activity with the incidence of type 2 diabetes (Silveira, de Souza Rosa, de Carvalho Santos, de Souza Cardoso, & Noll, 2020). That stress is also an important risk factor (van der Molen, Nieuwenhuijsen, Frings-Dresen, & de Groene, 2020).

However, most previous studies have focused on urban areas. Studies examining risk factors for type 2 diabetes in rural areas are still limited, even though rural areas have unique characteristics, including different levels of health awareness and access to services compared to urban areas. This is important considering that non-communicable disease prevention and control programs are mostly concentrated in urban areas (Fazeli Dehkordi, Khatami, & Ranjbar, 2022). The Ogan Ilir District Health Office has implemented various programs such as healthy exercises, counseling, health screening, and the establishment of the Chronic Disease Management Program (PROLANIS) and Posbindu PTM at the community health center level. However, the increase in type 2 diabetes cases indicates that existing programs are not yet optimal, particularly in minimizing risk factors in rural areas.

Based on these conditions, this study aims to analyze the relationship between socio- demographic factors, family history, lifestyle, BMI, and blood pressure with the incidence of type 2 DM in the working area of the Indralaya Community Health Center. The results of this study are expected to form the basis for the development of more effective DM prevention and control strategies, particularly in rural areas. Thus, this study makes an important contribution to identifying specific risk factors relevant to rural populations and providing evidence-based recommendations for reducing the prevalence and complications of type 2 DM in Ogan Ilir District.

RESEARCH METHOD

This study used a quantitative approach with an unmatched case-control design, which aimed to identify factors associated with the incidence of type 2 diabetes mellitus in the working area of the Indralaya Community Health Center, Ogan Ilir District. The case-control design was chosen because it is able to evaluate various risk factors that may influence the occurrence of diabetes mellitus efficiently in a relatively short time. This study involved two groups, namely the case group (patients diagnosed with type 2 diabetes mellitus) and the control group (patients who did not have type 2 diabetes mellitus), then an analysis was carried out to compare the exposure to risk factors between the two groups.

Yoki Arum Sari*, Najmah

Fakultas Kesehatan Masyarakat Universitas Sriwijaya
Corresponding author: *E-mail: yokiarum@gmail.com

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RESEARCH RESULTS

Table Respondent Characteristics

Variable	Sample Group		OR	95%CI	p-value
	Intervention (n=143)	Control (n=143)			
Age (n/%)					
18-24	1/0.7	6/4.2			
25-40	33/23.1	32/22.4			
41-59	76/53.1	70/48.9			
≥60	33/23.1	35/24.5	1.47	0.68 - 3.15	0.325
Gender (n/%)					
Male	55/38.5	31/21.7			
Female	88/61.5	112/78.3	0.27	0.097 – 0.73	0.010
Education (n/%)					
Elementary-Secondary	41/28.7	37/25.9			
Junior High School	42/29.4	27/18.9			
Senior High School	50/34.9	56/39.2			
Diploma/University	10/7.0	23/16.0	1.78	0.96 – 3.26	0.069
Employment Status (n/%)					
Employed	59/41.3	80/55.9			
Unemployed	84/58.7	63/44.1	1.85	0.81 – 4.22	0.143
Family Income (IDR) (n/%)					
<(3.600.000)	140/97.9	122/85.3			
≥(3.600.000)	3/2.1	21/14.7	10.75	2.26 – 51.12	0.003
Family History of Diabetes Mellitus (n/%)					
Yes	83/58.1	25/17.5			
No	60/41.9	118/82.5	8.74	4.42 – 17.25	0.001
Unhealthy Dietary Habits (n/%)					
No	137/95.8	121/84.6			
Yes	6/4.2	22/15.4			
			3.41	1.11 – 10.39	0.031
Daily Physical Activity (n/%)					
Inadequate	115/80.4	93/65.1			
Adequate	28/19.6	50/34.9	3.67	1.46 – 9.19	0.006
Smoking Status (n/%)					
Current Smoker	34/23.8	12/8.4			
Non-Smoker	109/76.2	131/91.6	2.87	0.84 – 9.82	0.093
Body Mass Index (BMI) (n/%)					
<25 kg/m^2	94/65.7	91/63.6			
≥25 kg/m^2	49/34.3	52/36.4			
Blood Pressure (n/%)					
Normal	69/48.3	95/66.4			
Hypertension	74/51.7	48/33.6	2.10	1.13 – 3.92	0.019

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Based on Table, the characteristics of the respondents show that in the case group, most diabetes mellitus (DM) patients were in the 41–59 age range (53.1%), predominantly female (61.5%), with a highest level of education of high school (34.9%), and the majority were unemployed (58.7%). Most had incomes below the minimum wage (97.9%), a family history of DM (58.1%), as well as risky eating patterns (95.8%) and inactive physical activity (80.4%). The majority had a BMI <25 kg/m² (65.7%) and hypertension (51.7%). In the control group, most were aged 41–59 years (48.9%), predominantly female (78.3%), educated to high school level (39.2%), and the majority were employed (55.94%). Most had no family history of DM (82.52%), but still had risky eating patterns (84.62%) and low physical activity (65.1%). The majority did not smoke (91.6%), had a BMI <25 kg/m² (63.7%), and normal blood pressure (66.4%). It was found that gender (p-value=0.010, OR=0.27), income (p- value=0.003, OR=10.75), family history of diabetes mellitus (p-value=0.001, OR=8.74), diet (p-value=0.031, OR=3.41), physical activity (p-value=0.006, OR=3.67), and blood pressure (p-value=0.019, OR=2.10) are significantly associated with the incidence of type 2 diabetes in the Indralaya Community Health Center area after controlling for the BMI variable. Meanwhile, the variables of age (p-value=0.325, OR=1.47), occupation (p-value=0.143 OR=1.85), smoking (p-value=0.093, OR=2.87), education (p-value=0.069, OR=1.78) were not significantly associated with the occurrence of type 2 diabetes and were confounding variables.

DISCUSSION

The results of multivariate analysis in this study indicate that there are six factors that are significantly associated with the incidence of Type 2 DM in the working area of the Indralaya Community Health Center, namely gender, income, family history of DM, diet, physical activity, and blood pressure. These findings illustrate that the incidence of Type 2 DM is influenced by a combination of biological, behavioral, and socioeconomic factors (Beulens, Pinho, Abreu, den Braver, Lam, Huss, & Vermeulen, 2022).

The gender variable had a p-value of 0.010 with an OR of 0.27, indicating that women had a lower risk of developing Type 2 DM than men after controlling for other variables. In other words, men had a risk approximately 3.7 times higher than women of developing Type 2 DM. This differs from the classical theory that states that women are at higher risk of developing DM due to hormonal factors such as menopause and pregnancy (Lambrinoudaki, Paschou, Armeni, & Goulis, 2022). However, the results of this study show a protective effect in women, which is likely influenced by behavioral and biological factors, such as women's involvement in Posbindu PTM activities and routine health checkups, as well as estrogen hormones that still play a role before menopause in increasing insulin sensitivity (Mauvais-Jarvis, 2018). In addition, women in this population are also more involved in healthy lifestyles, such as regular food consumption and disease prevention activities, so their risk of Type 2 DM is relatively lower.

Income was the most dominant factor with a p-value of 0.003 and an OR of 10.75. This means that individuals with incomes below the minimum wage are 10.7 times more likely to suffer from type 2 diabetes than those with higher incomes. This finding is in line with the concept of Social Determinants of Health (World Health Organization, 2022), which states that socioeconomic conditions influence health behavior. Low income often hinders access to nutritious food, routine health checkups, and adequate physical activity (Ziso, Chun, & Puglisi, 2022). In this region, the majority of the population works in the informal sector as farmers and laborers with irregular incomes. Based on field observations, individuals with low incomes tend to consume cheap but high-calorie and low-nutrient foods such as fried foods, excessive rice, and sweetened beverages. This diet increases the risk of insulin resistance and body fat accumulation, which leads to Type 2 DM (Lei, Intrator, Conwell, Fortinsky, & Cai, 2021).

The family history of DM variable has a p-value = 0.001 and OR = 8.74, which means that individuals with a family history of DM have an 8.7 times greater risk of developing Type 2 DM. Genetic factors and family lifestyle habits have a strong influence on the development of Type 2 DM. Individuals who inherit certain genes, such as TCLFL2 and PPARG, are more susceptible to insulin resistance and pancreatic β-cell dysfunction (Ismail et al., 2021). In addition to genetic factors, similar family lifestyles, such as a diet high in carbohydrates and low in fiber, increase the risk of developing DM. This study is in line with the study by (Zmysłowska, Jakiel, Gadzalska, Majos, Płoszaj, Ben-Skowronek, & Borowiec, 2022), which states that if

Yoki Arum Sari*, Najmah

Fakultas Kesehatan Masyarakat Universitas Sriwijaya
Corresponding author: *E-mail: yokiarum@gmail.com

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both parents have DM, their children have a 75% risk of developing DM.

A risky diet is significantly associated with the incidence of type 2 diabetes (p-value = 0.031, OR = 3.41). Individuals with a risky diet are 3.4 times more likely to develop diabetes than those with a healthy diet. In the study area, the majority of the population has a habit of consuming large amounts of rice, salted fish, fried foods, and low consumption of vegetables and fruits. This dietary pattern increases the daily glycemic index, causing spikes in blood sugar levels and triggering insulin resistance (Dimova, Chakarova, Del Prato, & Tankova, 2023). That high consumption of sugar and saturated fat are the main factors triggering Type 2 DM (Veit, van Asten, Olie, & Prinz, 2022).

Low physical activity was also a significant factor with a p-value of 0.006 and an OR of 3.67, indicating that respondents with low physical activity had a 3.6 times higher risk of developing Type 2 DM. Lack of physical activity causes glucose entering the body to not be used by muscles as energy, but instead stored as fat. This condition accelerates insulin resistance and increases blood glucose levels. That increased physical activity can lower HbA1c levels and improve glycemic control in people with DM (Shah, Karam, Zeb, Ullah, Shah, Haq, & Chen, 2021). Lifestyle interventions in the form of at least 150 minutes of physical activity per week are recommended to prevent diabetes in at-risk populations (Colberg, Sigal, Yardley, Riddell, Dunstan, Dempsey, & Tate, 2016).

Blood pressure has a significant association with the incidence of type 2 diabetes (p- value = 0.019, OR = 2.10). Respondents with hypertension have a 2.1 times greater risk of developing diabetes compared to individuals with normal blood pressure. Hypertension causes damage to blood vessels, disrupting blood flow to the pancreas, which results in a decrease in the function of pancreatic β-cells in producing insulin (Weir & Bonner-Weir, 2023). In addition, chronic hypertension triggers oxidative stress and inflammation, which increases insulin resistance in muscle and liver tissue (DeFronzo, Ferrannini, Groop, Henry, Herman, Holst, & Weiss, 2015). This condition shows that hypertension and type 2 diabetes mutually influence and exacerbate each other's conditions. Therefore, early detection and management of hypertension are important strategies in the prevention of diabetes.

CONCLUSION

Statistical analysis shows a significant relationship between several risk factors and the incidence of type 2 diabetes. The dominant influencing factor is income, where respondents with incomes below the minimum wage have a 10.7 times greater risk of developing type 2 diabetes after controlling for BMI variables. In addition, a family history of DM also has a significant effect, with an 8.7 times greater risk in individuals with a family history of DM.

Risky eating patterns and low physical activity increase the risk of type 2 DM by 3.4 times and 3.6 times, respectively. Blood pressure also has an effect, with hypertensive patients having a 2.1 times higher risk than individuals with normal blood pressure. These findings emphasize the importance of controlling modifiable risk factors, such as diet and physical activity, as well as early detection through routine screening. Efforts to prevent and control type 2 DM need to focus on low socioeconomic groups and those with a family history of DM to reduce the incidence of this disease.

SUGGESTION

The Health Office and Community Health Centers are expected to strengthen type 2 DM prevention programs by increasing routine screening activities, educating the public about healthy lifestyles, and optimizing the role of Posbindu PTM. The public is advised to have their blood sugar checked regularly and adopt a healthy lifestyle to prevent complications.

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Yoki Arum Sari*, Najmah

Fakultas Kesehatan Masyarakat Universitas Sriwijaya
Corresponding author: *E-mail: yokiarum@gmail.com

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