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Risk Factors for Chronic Complications in Type 2 Diabetes Mellitus Patients in Makassar City: A Case-Control Study

Faktor Risiko Komplikasi Kronik pada Pasien Diabetes Mellitus Tipe 2 di Kota Makassar: Studi Kasus Kontrol

Andi Selvi Yusnitasari[1*], Ridwan Amiruddin[1], Andi Nur Afifah Wahyuni[1], Andi Tis'a Ramadhani[1], Ghea Fricillia Sambe[2]

[1]Department of Epidemiology, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

[2]Nutrition Study Program, Faculty of Nursing and Midwifery, Megarezky University, Makassar, Indonesia

***Correspondence:**
E-Mail/ Phone Number: selvi.yusnitasari@unhas.ac.id./ +62 852-4068-6878
Address: Jl. Perintis Kemerdekaan, Makassar, South Sulawesi, Indonesia

ABSTRACT

The prevalence of type 2 diabetes mellitus continues to increase globally and has become a significant economic burden on health, making the identification of risk factors for chronic complications important in order to prevent long-term effects. This study aims to analyze risk factors for chronic complications in patients with type 2 DM at five community health centers in Makassar: Sudiang, Ballaparang, Kassi-kassi, Antara, and Paccerakkang. The study design used an analytical observational approach with a case-control approach. The total sample consisted of 100 respondents (50 cases and 50 controls) selected using purposive sampling. Data were collected through interviews and medical records, then analyzed univariately and bivariately (Odds Ratio/OR). The results of statistical analysis showed that age (OR = 2.524; 95% CI = 0.723-8.818), blood pressure (OR = 1.379; 95% CI = 0.628–3.029), GDP (OR = 3.802; 95% CI = 1.482–9.750), duration of DM (OR = 18.614; 95% CI = 6.782–51.087), treatment adherence (OR = 2.263; 95% CI = 1.013–5.052), stress (OR = 1.084; 95% CI = 0.494–2.377), and self-care for DM (OR = 2.495; 95% CI = 1.105–5.629). Based on these findings, patients with type 2 DM are advised to monitor their blood sugar levels regularly, improve adherence to therapy, and implement good self-care practices such as diet management, regular physical activity, and periodic health checkups to prevent chronic complications.

Keywords: Risk factors, T2DM, chronic complications

ABSTRAK

Prevalensi Diabetes Melitus tipe 2 terus meningkat secara global dan menjadi beban ekonomi kesehatan yang signifikan, sehingga identifikasi faktor risiko komplikasi kronik menjadi penting untuk mencegah dampak jangka Panjang. Penelitian ini bertujuan menganalisis faktor risiko komplikasi kronik pada pasien DM tipe 2 di lima puskesmas Kota Makassar: Puskesmas Sudiang, Ballaparang, Kassi-kassi, Antara, dan Paccerakkang. Desain penelitian menggunakan observasional analitik dengan pendekatan case control. Total sampel berjumlah 100 responden (50 kasus dan 50 kontrol) yang dipilih menggunakan teknik purposive sampling. Data dikumpulkan melalui wawancara dan rekam medis, kemudian dianalisis secara univariat dan bivariat *(Odds Ratio/OR)*. Hasil analisis statistik menunjukkan, umur (OR = 2,524; 95% CI = 0.723-8.818), tekanan darah (OR = 1,379; 95% CI = 0,628–3,029), GDP (OR = 3,802; 95% CI = 1,482–9,750), lama DM (OR = 18,614; 95% CI = 6,782–51,087), kepatuhan pengobatan (OR = 2,263; 95% CI = 1,013-5,052), stres (OR = 1,084; 95% CI = 0,494-2,377), perawatan diri DM (OR 2,495; 95% CI = 1,105-5,629). Berdasarkan temuan ini, pasien DM tipe 2 disarankan melakukan pemantauan kadar gula darah secara rutin, meningkatkan kepatuhan terhadap terapi, serta menerapkan perawatan diri yang baik seperti pengaturan pola makan, aktivitas fisik teratur, dan pemeriksaan kesehatan berkala untuk mencegah komplikasi kronik

Kata Kunci: Faktor risiko, DMT2, komplikasi kronik

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INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia and is one of the leading noncommunicable diseases with a steadily increasing global prevalence.[1] The economic burden of DM is estimated to reach USD 1.015 trillion by 2024. According to the 11th Edition of the Diabetes Atlas 2025, there are 589 million people with DM worldwide with 3.4 million deaths in 2024, and this number is projected to increase by 45% to around 852 million by 2050. Southeast Asia ranks second globally in terms of the number of DM cases with 107 million cases and a projected increase of up to 73% by 2050. 81% of people with DM come from low- and middle-income countries.[2]

Indonesia is one of the countries with the highest burden of DM in the world and ranks first in Southeast Asia.[3] The prevalence of DM in people aged ≥15 years increased from 2.0% in 2018 to 2.2% in 2023, including in South Sulawesi Province, which increased from 1.8% to 2.0%.[4] The city of Makassar recorded a DM prevalence of 2.4%,[5] and approximately 90–95% of cases were type 2 DM.[6]

Type 2 DM is mainly caused by insulin resistance and carries a risk of acute and chronic complications. Chronic complications include microvascular complications such as retinopathy, neuropathy, and nephropathy, as well as macrovascular complications such as heart disease, stroke, and peripheral vascular disorders.[7,8] Complications in the heart and kidneys are the leading causes of death in people with DM, accounting for 65% of deaths, with the risk of heart disease being two to four times higher than in individuals without DM.[9]

Various studies show that the incidence of type 2 DM complications is influenced by age, duration of DM, treatment adherence, blood glucose control, blood pressure, stress levels, and self-care behaviors. [10–13] However, most studies have been conducted in referral facilities or hospitals, while evidence at the primary health care level, especially in eastern Indonesia, is still limited.

Although the prevalence of DM in Makassar City is relatively high, comprehensive studies analyzing risk factors for type 2 DM complications at the primary care level are still very limited. Furthermore, there are no studies that simultaneously assess the role of Blood Glucose Control (BGC), duration of DM, treatment adherence, blood pressure, stress levels, and self-care behaviors on the occurrence of complications in type 2 DM patients at community health centers.

Type 2 DM complications have a significant impact on the physical, psychological, and economic conditions of patients. Organ damage reduces functional ability, while long-term treatment costs place a financial burden on patients, families, and the health system.[14] The low level of understanding among DM patients about the disease and the risk of complications leads to delays in treatment, so that patients often come to health facilities in a state of uncontrolled hyperglycemia and with complications.[15]

Given the high prevalence of type 2 DM and the limited empirical evidence at the primary health care level, particularly in Makassar City, this study aims to analyze the risk factors for complications in type 2 DM patients at community health centers in

Makassar City. Specifically, this study analyzes the relationship between age, duration of DM, fasting blood sugar (FBS) control, treatment adherence, blood pressure, stress levels, and self-care behavior with the occurrence of complications.

MATERIALS AND METHODS

This study was a quantitative study with an analytical observational approach, using a case-control study design. The study was conducted in five community health centers in Makassar City, namely Sudiang, Ballaparang, Kassi-kassi, Antara, and Paccerakkang Community Health Centers. The study population consisted of all type 2 diabetes mellitus (DM) patients recorded in the health center medical records. The sample consisted of 100 respondents, comprising 50 type 2 DM patients with complications (cases) and 50 type 2 DM patients without complications (controls), selected using purposive sampling.

The inclusion criteria included type 2 DM patients who were actively recorded as undergoing treatment at the health center. The case group consisted of type 2 DM patients with complications, while the control group consisted of type 2 DM patients without complications based on medical records. The exclusion criteria included incomplete medical records, communication or cognitive disorders, severe acute illness, and unwillingness to be a respondent.

The research data consisted of primary and secondary data. Primary data were obtained through interviews using structured questionnaires, namely the Morisky Medication Adherence Scale-8 (MMAS-8) to measure medication adherence, the Diabetes Distress Scale (DDS) to assess diabetes distress, and a self-care questionnaire. Secondary data were obtained from medical records, including diagnoses of DM complications, Fasting Blood Glucose (FBG) test results, and blood pressure.

The dependent variable was the occurrence of type 2 DM complications. Independent variables included age, duration of DM, FBG control, blood pressure, medication adherence, diabetes distress, and self-care behavior. FPG control was categorized as uncontrolled if ≥126 mg/dL, blood pressure as high if ≥140/90 mmHg, and duration of DM as ≥5 years. Data analysis was performed univariately and bivariately using odds ratio (OR) tests with 95% confidence intervals (CI).

RESULTS

Based on Table 1, most respondents were aged ≥50 years (87.0%) and female (70.0%). The highest level of education among respondents was high school/vocational school, followed by college/university. The majority of respondents were unemployed (61.0%) and married (75.0%). This description shows that type 2 DM patients at the Makassar City Community Health Center are predominantly elderly with middle socioeconomic characteristics.

The distribution of chronic complications in type 2 DM patients (Table 2) shows that diabetic neuropathy is the most common complication (28.0%), followed by diabetic retinopathy (24.0%) and heart disease and peripheral artery disease (16.0% each). Stroke is the complication with the lowest proportion (4.0%). These findings indicate

that microvascular complications are more dominant than macrovascular complications.

Table 1. Distribution of Respondents Based on Characteristics in 5 Makassar City Health Centers

Respondent Characteristics	n=100	%
Age		
<50 years old	13	13,0
≥50 years old	87	87,0
Gender		
Male	30	30,0
Women	70	70,0
Education		
No school	7	7,0
Not finished elementary school	1	1,0
Finishing Elementary School	20	20,0
Junior High School/Junior High School Graduation	16	16,0
High School/High School Graduation	33	33,0
College Graduation	23	23,0
Jobs		
PNS/ABRI/TNI	7	7,0
Self-employed	9	9,0
Not Working	61	61,0
Private Employees	1	1,0
Labor	4	4,0
Farmer	1	1,0
Retirees	17	17,0
Marital Status		
Married	75	75,0
Divorce Life	5	5,0
Divorce Dead	20	20,0

Source: Primary Data 2025

Table 2 . Distribution of Respondents by Type of Chronic Complications in 5 Makassar City Health Centers

Types of Complications	n	%
Peripheral artery	8	16,0
Jantung	8	16,0
Diabetic Nephropathies	6	12,0
Neuropati Diabetic	14	28,0
Retinopati Diabetic	12	24,0
Stroke	2	4,0
Quantity	50	100,0

Source: Primary Data,2025

Based on Table 3, most respondents underwent DM therapy using oral hypoglycemic drugs (73.0%), while insulin use was only 21.0%. Non-pharmacological therapy was the least common choice (6.0%), indicating that DM management at the community health center level was carried out using a pharmacological approach.

Table 3. Distribution of Respondents by Type of DM Treatment in 5 Makassar City Health Centers

Types of DM Treatment	n	%
Oral Hypoglycemic Medication	73	73,0
Insulin	21	21,0
Non-pharmacology	6	6,0
Quantity	100	100,0

Source: Primary Data 2025

The results of the analysis in Table 4 show that individuals aged ≥50 years have a 2.524 times greater risk of experiencing complications compared to those aged <50 years, but this is not statistically significant because the confidence interval includes the number 1 (OR = 2.524; 95% CI = 0.723–8.818). Respondents with abnormal blood pressure have a 1.379 times higher risk of complications.

The results of the analysis also show that non-compliance with treatment increases the risk of complications by 2.263 times compared to patients who comply with treatment (OR = 2.263; 95% CI = 1.013-5.052). High stress can increase the risk of complications by 1.084 times compared to low stress, but this is not statistically significant because the confidence interval includes the number 1 (OR = 1.084; 95% CI = 0.494-2.377). In addition, DM self-care also affects the incidence of DM complications, where poor self-care has a 2.495 times higher risk than good self-care (OR 2.495; 95% CI = 1.105-5.629). Thus, the variables of GDP, duration of DM, treatment adherence, and DM self-care have a significant relationship with the occurrence of chronic complications in type 2

DM patients.

Table 4. Risk Factors for Chronic Complications in Type 2 DM Patients at 5 Makassar City Health Centers

Category	Case		Control		OR 95% CI
	n	%	n	%	
Age					
High Risk (≥50 years)	46	92.0	41	82.0	2,524 (0,723-8,818)
Low Risk (<50 years)	4	8.0	9	18.0	
Blood Pressure					
High Risk (Abnormal)	26	52.0	22	44.0	1,379 (0,628-3,029)
Low Risk (Normal)	24	48.0	28	56.0	
Fasting Blood Sugar (GDP)					
High Risk (Uncontrolled)	42	84.0	29	58.0	3,802 (1,482-9,750)
Low Risk (Controlled)	8	16.0	21	42.0	
Long DM					
High Risk (≥5 years)	39	78.0	8	16.0	18,614 (6,782-51,087)
Low Risk (<5 years)	11	22.0	42	84.0	
Medication Compliance					
High Risk (Non-Compliance)	27	54.0	18	36.0	2,263 (1,013-5,052)
Low Risk (Compliant)	23	46.0	32	64.0	
Stress					
High Risk (High Stress)	27	54.0	26	52.0	1,084 (0,494-2,377)
Low Risk (Low Stress)	23	46.0	24	48.0	
DM Self-Care					
High Risk (No)	31	62.0	23	46.0	2,495 (1,105-5,629)
Low Risk (Yes)	19	38.0	27	54.0	

Source: Primary Data, 2025

DISCUSSION

Age is often associated with an increased risk of type 2 DM complications due to decreased physiological function and accumulated exposure to hyperglycemia. In this study, respondents aged ≥50 years did have a higher risk of complications compared to those aged <50 years, but the relationship was not statistically significant. These findings indicate that age is not the sole predictor of complications, but rather plays a role alongside other more dominant clinical and behavioral factors, such as glycemic control, duration of DM, treatment adherence, and self-care. These results are consistent with the study by Fortuna et al. (2023), which showed that controlling other risk factors can mitigate the impact of age on type 2 DM complications.[16]

Abnormal blood pressure also showed a tendency to increase the risk of complications, but the relationship was not statistically significant. This condition is likely due to the success of some respondents in controlling their blood pressure through therapy and lifestyle changes. These findings are in line with the research by Erdaliza et al. (2024) and the ACC/AHA guidelines, which emphasize the importance of blood pressure control in reducing the risk of cardiovascular complications in DM patients.[15] However, achieving optimal blood pressure targets remains a challenge, as reported that only a small proportion of patients achieve blood pressure <130/80 mmHg.[11] Therefore, blood pressure still needs to be considered as a supporting factor in preventing complications.

Unlike age and blood pressure, GDP levels show a significant association with the occurrence

of complications. Respondents with uncontrolled GDP had a much higher risk of complications compared to respondents with controlled GDP. This confirms the role of chronic hyperglycemia in increasing inflammation, oxidative stress, and endothelial dysfunction, which contribute to the occurrence of microvascular and macrovascular complications.[17] These findings are in line with the study by Suryanegara et al. (2021), which showed that poor glycemic control plays an important role in the occurrence of cardiovascular and cerebrovascular complications in patients with type 2 DM.[18] Thus, GDP can be used as a practical indicator in primary care to identify high-risk patients.

Patients with a diabetes duration of ≥5 years have a significantly higher risk of complications compared to those with a duration of <5 years. These findings reinforce the evidence that long-term exposure to hyperglycemia accelerates damage to blood vessels and organs, especially when glycemic control is not optimal.19 These results are in line with the study by Anugrah et al. (2022), which showed that the longer a person has DM, the greater the risk of chronic complications.[20]

Behavioral factors also play an important role in the occurrence of complications. Non-adherence to treatment is associated with an increased risk of complications, reflecting the importance of adherence in maintaining stable blood glucose levels.[21] These findings are consistent with the study by Laksono et al. (2022), which showed that good treatment adherence contributes to a reduced risk of microvascular and macrovascular complications.[22,23] Thus, the success of DM management is not only determined by the type of therapy but also by the patient's active involvement in undergoing treatment.

The relationship between stress and DM complications in the study shows that high stress is associated with an increased risk of complications, but this relationship is not statistically significant. This is in line with the findings of Buckert et al. (2024) and Park et al. (2024), which show that stress is not always directly related to DM complications after considering other clinical factors.[24,25] Stress is more likely to play an indirect role through its influence on treatment adherence and self-care.

DM self-care has been shown to be significantly associated with the occurrence of complications. Patients with poor self-care have a higher risk of complications compared to patients with good self-care. These findings emphasize the importance of patients' ability and confidence in managing their disease independently, including diet management, physical activity, and blood glucose monitoring. [26] Education-based interventions and patient empowerment are key to preventing long-term complications.

This study has several limitations. The case-control study design has the potential for recall bias, particularly in the measurement of behavioral variables such as compliance and self-care. In addition, this study did not use HbA1c as an indicator of long-term glycemic control, so the evaluation of blood sugar control was based only on GDP.

Nevertheless, this study makes an important contribution by presenting empirical evidence

regarding risk factors for type 2 DM complications at the primary health care level in Makassar City. The practical implication is that community health centers need to prioritize screening patients with long-term DM and uncontrolled GDP, as well as strengthening education on treatment compliance and self-care in chronic disease management programs in order to reduce the burden of type 2 DM complications.

CONCLUSION AND SUGGESTIONS

The results of this study conclude that the risk factors significantly associated with the occurrence of chronic complications in type 2 DM patients at community health centers in Makassar City are uncontrolled GDP levels, duration of DM ≥5 years, non-compliance with medication, and poor DM self-care. Age, blood pressure, and stress levels did not show a significant relationship. These findings confirm that type 2 DM complications at the primary care level are more influenced by modifiable clinical and behavioral factors.

Community health centers are advised to strengthen DM management education, improve medication adherence, and develop self-management programs for type 2 DM patients, accompanied by more comprehensive glycemic control monitoring. Further research should use a longitudinal design with a larger sample size and more comprehensive clinical indicators to strengthen the evidence of the relationship between risk factors and type 2 DM complications.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest that could affect the results or interpretation of this study.

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