

The Impact of Self-Management Practices on the Occurrence of Diabetic Ulcers Among Type 2 Diabetes Mellitus Patients in South Kalimantan – Indonesia

Abstract

Background: Type 2 Diabetes Mellitus (T2DM) is a growing public health issue, particularly in Indonesia, due to its increasing prevalence and serious complications like diabetic ulcers. This study investigated the relationship between self-management behaviors and the incidence of diabetic ulcers in T2DM patients. **Materials and Methods:** A cross-sectional analytical study was conducted from March to December 2024 at Sari Mulia Hospital. From 432 registered T2DM patients, 220 were selected through purposive sampling based on inclusion criteria. Data were collected using the Diabetes Self-Management Questionnaire (DSMQ) and analyzed with Chi-square tests. **Results:** Diabetic ulcers were identified in 34.5% of participants with Type 2 Diabetes Mellitus. Significant associations were found between poor self-management behaviors and ulcer incidence. Patients who did not regularly monitor their blood glucose levels had a 9.5-fold increased risk of developing diabetic ulcers ($\chi^2 (1) = 7.52, p = 0.006$). Non-compliance with dietary recommendations was associated with a 13.93-fold increased risk ($\chi^2 (1) = 9.40, p = 0.002$), while low physical activity was linked to a 14.57-fold increased risk ($\chi^2 (1) = 9.44, p = 0.002$). These findings highlight the critical role of self-management behaviors in preventing diabetic foot ulcers. **Conclusions:** Self-management behaviors strongly influence diabetic ulcer occurrence in T2DM patients. Promoting regular blood glucose monitoring, dietary compliance, and physical activity is essential in ulcer prevention. Future research should assess the long-term impact of educational interventions in broader patient populations to improve diabetes care outcomes.

Keywords: Behavior, foot ulcer, primary prevention, self-management, type 2 diabetes mellitus

Introduction

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder that continues to pose a significant global health challenge. As of 2022, an estimated 150 million people worldwide were living with diabetes, and this number is projected to double by 2025.^[1,2] The condition contributes substantially to the burden of non-communicable diseases due to its long-term complications. In Indonesia, the prevalence of diabetes has increased sharply in recent years. For instance, in South Kalimantan, diagnosed cases rose from 29.9% in 2021 to 44.9% in 2025.^[3,4] This trend reflects broader national concerns influenced by changes in lifestyle, aging populations, and urbanization.

One of the most severe and costly complications of T2DM is diabetic foot ulceration, which typically results

from peripheral neuropathy, impaired circulation, and poor glycemic control.^[5-7] Diabetic ulcers not only increase the risk of infection and lower limb amputation but also significantly reduce quality of life and escalate healthcare costs. Numerous studies have emphasized that effective self-management behaviors—such as regular blood glucose monitoring, adherence to a diabetes-specific diet, consistent physical activity, and proper foot care—can significantly reduce the risk of such complications.^[8,9]

Research utilizing the Diabetes Self-Management Questionnaire (DSMQ)

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has shown that improved self-care practices are strongly associated with better glycemic control and fewer complications.^[10] However, despite this growing body of evidence, limited research has explored the relationship between self-management behaviors and the incidence of diabetic ulcers, particularly among the Indonesian population.

Therefore, this study aims to examine the association between self-management behaviors and the incidence of diabetic ulcers in patients with Type 2 Diabetes Mellitus, thereby contributing to improved strategies for diabetes care and complication prevention in Indonesia. Therefore, this study aims to examine the association between self-management behaviors and the incidence of diabetic foot ulcers in patients with Type 2 Diabetes Mellitus. This study investigated the relationship between self-management behaviors and the incidence of diabetic ulcers in T2DM patients.

Materials and Methods

This study employed a quantitative cross-sectional analytical design and was conducted at Sari Mulia Hospital in South Kalimantan, Indonesia, from January to February 2024. The study population comprised 432 patients with Type 2 Diabetes Mellitus (T2DM) registered at the hospital. Based on predetermined inclusion criteria, 220 participants were selected using a purposive sampling technique. The sample size was calculated using the Lemeshow formula for estimating proportions in cross-sectional studies, ensuring adequate power and precision. Inclusion criteria included: (1) patients clinically diagnosed with T2DM; (2) those who had received diabetes-related education or instructions; (3) individuals with or without diabetic ulcers; and (4) willingness to participate voluntarily. Patients were excluded if they withdrew consent during the data collection process.

Primary data were collected using the Diabetes Self-Management Questionnaire (DSMQ), a validated instrument developed by.^[11-13] and subsequently adapted for the Indonesian population.^[14,15] The DSMQ evaluates four domains of diabetes self-care: glucose management, dietary control, physical activity, and healthcare utilization. It consists of 16 items, scored on a 4-point Likert scale ranging from 0 (does not apply to me) to 3 (applies to me very much), with higher scores indicating better self-management behaviors. Face-to-face structured interviews were conducted by trained enumerators to complete the DSMQ with each participant. The study did not implement any educational or behavioral intervention. Instead, it aimed to observe the existing association between self-management behaviors and the incidence of diabetic ulcers. Data regarding the presence or absence of diabetic foot ulcers were extracted from patient medical records and clinical examination notes. Based on this information, participants were categorized into two groups: those with diabetic foot ulcers and those without.

Data were analyzed using Chi-square tests to examine the association between self-management behaviors and the incidence of diabetic ulcers. The DSMQ's validity and reliability were confirmed in prior studies conducted in Indonesia. Specifically, the instrument demonstrated a Cronbach's alpha of 0.889, indicating high internal consistency, and a p value > 0.05 in construct validity testing, supporting its applicability in the current population.

To enhance internal validity, potential confounders were considered, including age, gender, duration of diabetes, comorbidities, socioeconomic status, and medication adherence. These variables were accounted for during analysis to isolate the true association between self-management behaviors and diabetic ulcer incidence.

Ethical consideration

The process underwent a review and obtained ethical approval (Number: 1211-KEPK) from the Indonesian Health Research Ethics Commission, overseen by the Institutional Review Board (IRB) of Banua Institute, Indonesia, on January 19, 2025.

Results

Table 1 summarizes the demographic and health characteristics of participants diagnosed with type 2 diabetes mellitus. The mean (SD) age of participants was 52.39 (7.39) years, with an age range of 36 to 69 years. The mean (SD) duration of illness was 5.50 (1.98) years, ranging from 3 to 10 years. Most participants (40.45%) had completed junior high school, and males represented 55.45% of the sample. A total of 65% of respondents were engaged in employment. The overall prevalence of diabetic ulcers among the study population was 34.50%.

Table 2 presents the relationship between self-management behaviors, including blood glucose monitoring, diet compliance, and physical activity, and the incidence of diabetic ulcers among patients with type 2 diabetes mellitus. This study identified a significant association between non-routine blood glucose monitoring and the incidence of diabetic ulcers ($OR = 9.50$, $p = 0.06$). Participants who did not regularly monitor their blood sugar levels had a substantially higher risk of developing diabetic ulcers compared to those who consistently performed routine monitoring. Similarly, poor adherence to a diabetes-specific diet was strongly associated with an increased risk of ulceration ($OR = 13.933$, $p = 0.002$). Participants who failed to comply with dietary recommendations exhibited nearly 14 times greater odds of developing diabetic ulcers than those who adhered to prescribed dietary regimens.

Low levels of physical activity were also significantly linked to the occurrence of diabetic ulcers ($OR = 14.57$, $P = 0.02$). Participants categorized as having inadequate physical activity had over 14 times greater odds of

Table 1: Demographic characteristics of respondents
n=220

Demographics	n (%)	M (SD)
Age (years)		52.39 (7.387)
<30	31 (14.10)	
31–45	75 (34.10)	
46–55	83 (37.70)	
>55	31 (14.10)	
Total	220	
Duration of illness (years) (range: 3–10 years)	220	5.50 (1.983)
Gender		
Man	122 (55.45)	
Woman	98 (44.55)	
Education		
Elementary school	56 (25.45)	
Junior high school	89 (40.45)	
Senior high school	71 (32.27)	
College	4 (1.83)	
Work		
Does not work	77 (35)	
Work	143 (65)	
Incidence of diabetic ulcers		
Diabetic ulcers occur	76 (34.5)	
No diabetic ulcers	144 (65.5)	
Monitoring blood sugar levels		
Not a routine	71 (32.3)	
Routine	149 (67.7)	
Diabetes diet compliance		
Not obey	72 (36)	
Obedient	148 (74)	
Physical activity		
Bad	98 (44.5)	
Good	122 (55.5)	

developing ulcers than those who engaged in regular, moderate physical exercise. These findings underscore the importance of three interrelated self-management behaviors—routine blood glucose monitoring, dietary compliance, and physical activity—in mitigating the risk of diabetic foot complications in individuals with T2DM.

Further examination of physical activity levels revealed that among the 98 participants with low physical activity, 42 individuals (21.30%) developed diabetic ulcers, while 56 (23.20%) did not. In contrast, of the 122 participants categorized as having adequate physical activity, 34 (18.10%) had ulcers, and 88 (37.40%) did not. The Chi-square analysis confirmed a statistically significant association ($p = 0.002$), reinforcing that low physical activity levels markedly increase the risk of diabetic ulceration. The corresponding odds ratio ($OR = 14.571$) indicates that participants with low physical activity were over 14 times more likely to develop diabetic ulcers compared to those who maintained adequate activity levels.

Discussion

The present study demonstrated a diabetic ulcer prevalence of 34.5% among individuals with T2DM, underscoring the continued burden of diabetes-related complications in clinical settings. This finding is consistent with existing literature, which indicates that diabetic foot ulcers remain a significant contributor to morbidity and healthcare costs due to their association with peripheral neuropathy, poor glycemic control, and vascular impairment.

The study identified significant associations between key self-management behaviors—blood glucose monitoring, dietary compliance, and physical activity—and the incidence of diabetic ulcers. Specifically, patients who did not routinely monitor their blood glucose levels exhibited a 9.5-fold increased risk of developing diabetic ulcers ($p = 0.006$). This association reinforces existing evidence that regular glycemic monitoring is critical for maintaining metabolic stability and preventing microvascular complications.^[16-18] Routine monitoring enables early detection of abnormal glucose fluctuations, allowing for timely clinical intervention that may mitigate the progression to ulceration.

In addition, non-compliance with dietary recommendations was associated with a 13.9-fold increase in the likelihood of diabetic ulcer development ($p = 0.002$). This finding supports previous research that emphasizes the role of medical nutrition therapy in achieving glycemic targets. Dietary indiscretions—particularly high intake of refined carbohydrates and saturated fats—are well-established contributors to poor glucose control and systemic inflammation, both of which impair wound healing and increase susceptibility to foot ulcers.^[19-21]

Physical inactivity was also strongly associated with the occurrence of diabetic ulcers. Participants with inadequate physical activity levels had 14.6 times higher odds of ulcer development compared to their more active counterparts ($p = 0.002$). This is in alignment with prior studies demonstrating that regular exercise improves insulin sensitivity, enhances peripheral circulation, and reduces the risk of diabetes-related vascular complications.^[22-24] Structured physical activity is known to support glucose uptake by skeletal muscle, reduce lipid accumulation, and improve endothelial function, all of which are protective against foot ulceration.^[25-27]

The interrelated nature of these self-management behaviors suggests that an integrated approach to diabetes care is essential. Patients who consistently monitor their glucose, adhere to dietary guidelines, and engage in physical activity are significantly less likely to develop diabetic ulcers. Conversely, failure in any one of these areas may increase vulnerability, even if other aspects of self-care are maintained.^[28] These findings underscore the necessity of comprehensive Diabetes Self-Management

Table 2: Relationship of variables with the incidence of diabetic ulcers $n=220$

Variables	The incidence of diabetic ulcers				Total	<i>p</i>	OR (95% CI)
	Ulcers occur		No ulcers				
	<i>n</i>	(%)	<i>n</i>	%			
Monitoring blood sugar levels							
Not a routine	27	(10.20)	47	22.1	71 (23.30)	0.006	9,500 (2,075–43,502)
Routine	51	(20.10)	98	47.6	149 (67.70)		
Diabetes diet compliance							
Not obey	24	(13.50)	48	22.5	72 (36)	0.002	13,933 (2,778–69,881)
Obedient	52	(27.70)	96	46.3	148 (74)		
Physical activity							
Bad	42	(21.30)	56	23.2	98 (44.5)	0.002	14,571 (2,566–82,732)
Good	34	(18,10)	88	37.4	122 (55.5)		

Education (DSME) programs that holistically address multiple behavioral domains.

Notably, a subset of participants who were non-compliant with certain aspects of diabetes management but engaged in other positive health behaviors (e.g., regular exercise or foot hygiene) did not develop ulcers. This observation suggests the potential for compensatory effects and highlights the need for individualized care strategies that reinforce patients' strengths while addressing gaps.

Despite the important findings, this study has several limitations. Its cross-sectional design precludes causal inference, and the reliance on self-reported data may introduce recall or social desirability bias. Additionally, while efforts were made to control for potential confounders such as age, gender, and duration of diabetes, residual confounding cannot be entirely excluded.^[29-31] Future research should employ longitudinal designs and include broader sociodemographic and clinical variables to further elucidate the causal pathways linking self-management practices and diabetic ulcer development. In conclusion, this study reinforces the critical role of blood glucose monitoring, dietary adherence, and physical activity in the prevention of diabetic foot ulcers among patients with T2DM. These findings highlight the need for targeted DSME interventions, routine foot assessments, and multidisciplinary care strategies to reduce the burden of diabetic ulcers and improve overall patient outcomes. Limitations This study has several limitations. First, its cross-sectional design restricts the ability to infer causality between self-management behaviors and the incidence of diabetic ulcers. Although associations were identified, longitudinal or interventional studies are required to establish causal relationships. Second, the reliance on self-reported data through structured interviews may introduce recall bias or social desirability bias, potentially affecting the accuracy of participants' responses regarding their self-care behaviors. Third, while several potential confounders were considered during analysis (such as age, gender, duration of illness, and comorbidities), residual confounding due to unmeasured variables (e.g., psychological factors, socioeconomic

status, access to care) may still exist. Additionally, the study was conducted in a single hospital setting in South Kalimantan, limiting the generalizability of the findings to broader or more diverse populations. Lastly, the DSMQ tool, although previously validated, may not fully capture cultural or contextual nuances in diabetes self-management among Indonesian patients. Future studies should consider multicenter or community-based settings, use longitudinal designs, and incorporate mixed methods approaches to deepen understanding and strengthen evidence on the role of self-management in diabetic ulcer prevention.

This study has several limitations that should be acknowledged. First, its cross-sectional design restricts the ability to infer causality between self-management behaviors and the incidence of diabetic ulcers. Although associations were identified, longitudinal or interventional studies are required to establish causal relationships. Second, the reliance on self-reported data through structured interviews may introduce recall bias or social desirability bias, potentially affecting the accuracy of participants' responses. Third, although potential confounders such as age, gender, duration of illness, and comorbidities were considered, residual confounding from unmeasured variables (e.g., psychological stress, socioeconomic status, or access to care) may still be present. Fourth, the study was conducted in a single hospital setting in South Kalimantan, which may limit the generalizability of the findings to other populations in Indonesia or internationally. Lastly, the DSMQ tool, while validated, may not fully capture cultural or contextual nuances in diabetes self-management specific to the Indonesian population. Future research should address these limitations by adopting multicenter or community-based longitudinal designs and incorporating mixed methods to provide deeper insight into the dynamics of diabetes self-care and ulcer prevention.

Conclusion

This study identified significant associations between key self-management behaviors and the incidence of diabetic foot ulcers in individuals with T2DM. Specifically, irregular blood glucose monitoring, non-adherence to dietary

recommendations, and low levels of physical activity were each independently associated with a markedly increased risk of ulcer development. These findings emphasize the critical role of comprehensive self-management practices in the prevention of diabetic complications, particularly foot ulcers, which are among the most serious and costly outcomes of poorly controlled diabetes. The results underscore the importance of integrating structured DSME into routine clinical care. Interventions should prioritize empowering patients with the knowledge and skills required to maintain glycemic control, adhere to nutritional guidelines, engage in regular physical activity, and perform consistent foot care. Additionally, the development of individualized and culturally appropriate education programs may further enhance patient adherence and health outcomes. Future research should explore the longitudinal effects of DSME interventions and investigate the role of additional factors such as health literacy, social support, and healthcare accessibility in influencing self-care behaviors. Multidisciplinary collaboration and community-based strategies may also be beneficial in promoting sustainable behavior change and reducing the long-term burden of diabetic foot ulcers.

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Conflicts of interest

Nothing to declare.

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