Poor Foot-Care Behavior Significantly Increases Recurrent Diabetic Foot Ulcers Among Patients

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ABSTRACT
Diabetes mellitus is a major non-communicable disease that poses a serious global health threat across socioeconomic and national boundaries. Individuals with diabetes are at high risk of developing chronic complications, including diabetic neuropathy, which may progress to diabetic foot ulcers. Approximately 90% of patients with diabetic foot ulcers face the risk of lower-extremity amputation. Inadequate foot-care behavior among people with diabetes further increases the likelihood of severe complications, including recurrent foot ulcers and amputation. This study aimed to analyze the relationship between foot-care behavior among patients with diabetes mellitus and the occurrence of recurrent diabetic foot ulcers. A quantitative cross-sectional design was employed using accidental sampling. The sample consisted of 51 patients with recurrent diabetic foot ulcers. Descriptive analysis and Spearman's rho correlation test were used to examine the association between foot-care behavior and ulcer recurrence. The findings demonstrated a significant relationship between foot-care behavior and recurrent diabetic foot ulcers, with a p-value of (0.022) and a correlation coefficient of (–0.320). Most patients with recurrent ulcers were male (60.8%), nearly half were aged ≥65 years, and 47.1% had lived with diabetes for 1–5 years. A majority experienced two episodes of recurrent ulcers (78.4%) and exhibited poor foot-care behavior (72.5%). Poor foot-care behavior is significantly associated with recurrent diabetic foot ulcers. The demographic profile of affected patients indicates predominance among older males with a moderate duration of diabetes. Strengthening foot-care practices is essential to reduce recurrence and prevent severe complications.
Keywords: diabetes mellitus; diabetic foot ulcer; complications; foot care

INTRODUCTION
Diabetes mellitus (DM) is recognized as one of the most consequential non-communicable diseases contributing substantially to global mortality. As a chronic metabolic disorder, DM is characterized by impaired insulin production or complete failure of insulin secretion, resulting in persistent hyperglycemia and progressive multisystem complications [1]. According to the International Diabetes Federation (IDF), an estimated 463 million individuals worldwide were living with DM in 2019, and the global prevalence among adults aged 20–79 years reached 425 million cases, reflecting a continuing upward trend in disease burden [2]. Indonesia ranks seventh among the ten countries with the highest number of people with diabetes, contributing approximately 10.7 million cases to the global total [3].

In the context of Kalimantan Barat, the prevalence of DM diagnosed by physicians reached 1.15% across all age groups. Provincial data from 2018 indicate that the highest prevalence among individuals aged ≥15 years occurred in Singkawang (3.55%), followed by Pontianak (2.70%) and Sambas (2.00%). Meanwhile, Sekadau reported the lowest prevalence at 0.71% [4]. These epidemiological patterns underscore the growing public health challenge posed by DM in the region.

One of the most common and debilitating complications of DM is peripheral neuropathy, affecting approximately 10%–60% of individuals with diabetes. Peripheral neuropathy significantly increases the risk of diabetic foot ulcers (DFU), a condition associated with high morbidity, recurrent ulceration, and potential limb loss [5]. Preventive strategies, particularly routine and appropriate foot-care practices, play a critical role in reducing the incidence of ulceration. Consistent foot-care behavior enables early detection of foot abnormalities and effectively lowers the risk of ulcer formation [6]. However, many individuals with DM fail to perform adequate foot care, thereby increasing the likelihood of ulcer development and severe complications such as lower-extremity amputation [7].

A preliminary study conducted by the researcher at Klinik PKU Muhammadiyah Kitamura Pontianak between 5–12 December 2022 revealed a notable increase in DFU cases, rising from 865 cases in 2020 to 1026 cases in 2021. Interviews with eight patients experiencing recurrent diabetic foot ulcers further illustrated gaps in foot-care behavior. Five patients reported washing and drying their feet daily but did not adequately dry the interdigital spaces. Only three patients routinely inspected their feet after bathing to identify abnormalities. In terms of footwear management, six patients did not check their sandals or shoes before or after use and rarely wore protective closed footwear. Nail-care practices were also suboptimal, with only four patients trimming their toenails weekly, and none filing their nails afterward. Regarding injury prevention, only four patients performed diabetic foot exercises, while three sought routine foot examinations from healthcare providers. For injury management, five patients reported visiting health facilities when wounds appeared.

Given the increasing epidemiology of diabetic foot complications, nurses play a pivotal role in preventing recurrent DFU through patient education, risk identification, and reinforcement of proper foot-care behavior. Based on the observed phenomena and the empirical gaps identified, therefore, this study aims to analyze the relationship between foot-care behavior among patients with diabetes mellitus and the occurrence of recurrent diabetic foot ulcers at Klinik Utama PKU Muhammadiyah Kitamura Pontianak.

METHODS
This study was carried out at Klinik Utama PKU Muhammadiyah Kitamura Pontianak, using patient records collected over a six-month period from June to November 2022. During this timeframe, the clinic documented 352 cases of diabetic foot ulcers, with an average of approximately 59 cases per month. These epidemiological data served as the foundation for determining the study population and contextualizing the burden of recurrent diabetic foot ulcers in the region.

The research adopted a correlational analytic design with an observational cross-sectional approach. This design allowed the researcher to examine the relationship between behavioral patterns of foot care and the recurrence of diabetic foot ulcers at a single point in time, without manipulating any conditions or intervening in patient behavior. By observing naturally occurring variations in foot-care practices and ulcer recurrence, the study sought to capture the real-world dynamics of diabetic foot management among patients.

The study subjects consisted of individuals diagnosed with recurrent diabetic foot ulcers who sought treatment at the clinic and met the predetermined inclusion criteria. Using the standard formula for cross-sectional sampling, the researcher obtained a sample of 51 participants. Recruitment followed a non-probability accidental sampling technique, in which eligible patients presenting during the study period were approached consecutively and invited to participate.

The variables were conceptualized narratively rather than as discrete categories. The central phenomenon explored was how patients' everyday foot-care behavior shaped the likelihood of experiencing recurrent diabetic foot ulcers. Foot-care behavior was understood as a constellation of routine actions, such as washing and drying the feet properly, inspecting the feet for abnormalities, managing footwear, trimming toenails, preventing injuries, and responding appropriately when wounds appeared. These behaviors were treated as expressions of patients' functional self-care capacity, reflecting both their knowledge and their habitual practices. Meanwhile, the recurrence of diabetic foot ulcers was viewed as the clinical manifestation of inadequate foot protection, neuropathic vulnerability, and environmental risks. Thus, the relationship between the two variables was framed as an interaction between daily self-care practices and the physiological consequences experienced by patients.

To measure the behavioral dimension of foot care, the study employed the Nottingham Assessment of Functional Footcare (NAFF) questionnaire. Originally developed by Lincoln et al. (2007) and later modified by Windasari (2014), the instrument consists of 29 items capturing multiple aspects of functional foot-care behavior. Reliability testing demonstrated acceptable psychometric properties, with a Cronbach's Alpha of 0.53 and a reliability coefficient of 0.83 (r > r-table 0.532), indicating that the instrument was sufficiently robust for assessing foot-care behavior among individuals with diabetes.

Data analysis was conducted using both descriptive and analytic techniques. Descriptive analysis was used to portray the demographic characteristics of the participants, the frequency of recurrent ulcer episodes, and the distribution of foot-care behaviors. Analytic testing employed Spearman's rho correlation to determine the strength and direction of the association between foot-care behavior and recurrent diabetic foot ulcers. This non-parametric test was appropriate given the ordinal nature of the NAFF scores and the clinical categorization of ulcer recurrence.

RESULTS

Table 1 presents the distribution of patient characteristics at Klinik Utama PKU Muhammadiyah Kitamura Pontianak. A total of 51 respondents participated, consistent with the sample size. Nearly half of the respondents were older adults, with the largest proportion falling within the ≥65-year age group (35.3%), indicating that recurrent diabetic foot ulcers predominantly affect elderly individuals. The majority of respondents were male (60.8%), suggesting a gender-related pattern in ulcer recurrence. Regarding disease duration, almost half of the respondents had been living with diabetes for 1–5 years (47.1%), reflecting a substantial proportion of patients who developed recurrent ulcers relatively early in the course of their disease.

Table 2 describes the distribution of the main study variables. The majority of respondents experienced two episodes of recurrent diabetic foot ulcers (78.4%), indicating that recurrence is a common clinical pattern among patients treated at the clinic. Furthermore, most respondents demonstrated poor foot-care behavior (72.5%), suggesting that inadequate self-care practices may contribute to repeated ulceration. These findings highlight the importance of strengthening foot-care education and behavioral interventions for diabetic patients.

Table 3 examines the relationship between foot-care behavior and the frequency of recurrent diabetic foot ulcers. The distribution shows that respondents with poor foot-care behavior were more likely to experience multiple ulcer recurrences, including higher frequencies such as three, four, or five episodes. In contrast, respondents with good foot-care behavior were found only in the group experiencing two episodes, and none were present in higher recurrence categories.

The Spearman's rho test yielded a p-value of 0.022, indicating a statistically significant relationship between foot-care behavior and ulcer recurrence. The correlation coefficient r = –0.320 suggests a negative correlation, meaning that better foot-care behavior is associated with fewer ulcer recurrences. Although the correlation is modest, it is clinically meaningful, reinforcing the importance of consistent and proper foot-care practices among individuals with diabetes mellitus.

Table 1. Distribution of demographic characteristics of patients

Demographic variable	Frequency	Percentage
Age		
26–35 years	0	0.0
36–45 years	4	7.8
46–55 years	13	25.5
56–65 years	16	31.4
≥65 years	18	35.3
Sex		
Male	31	60.8
Female	20	39.2
Duration of diabetes		
1–5 years	24	47.1
6–10 years	10	19.6
≥10 years	17	33.3

Table 2. Distribution of recurrent diabetic foot ulcers and foot-care behavior

Variable	Frequency	Percentage
Recurrent diabetic foot ulcers		
2 episodes	40	78.4
3 episodes	6	11.8
4 episodes	3	5.9
≥5 episodes	2	3.9
Foot-care behavior		
Poor	37	72.5
Good	14	27.5

Table 3. Relationship between household sanitation and diarrhea incidence

Foot-care behavior	Recurrent diabetic foot ulcers (episodes): f (%)				r	p
	2	3	4	≥5		
Poor	26 (70.27)	6 (16.22)	3 (8.11)	2 (5.41)	-0.320	0.022
Good	14 9100)	0 (0)	0 (0)	0 (0)		

DISCUSSION

The findings of this study indicate that a substantial proportion of respondents were aged 65 years and above, suggesting that recurrent diabetic foot ulcers are more prevalent among older adults. This result aligns with previous research [8], which reported that 55.70% of individuals experiencing recurrent diabetic foot ulcers were older than 65 years. Advancing age is known to increase the likelihood of developing diabetes due to declining physiological function, particularly reduced pancreatic insulin production, which disrupts glucose regulation. Impaired glucose control contributes to the development of atherosclerosis, subsequently compromising blood circulation in the lower extremities and increasing

susceptibility to ulcer formation [5]. Beyond vascular changes, individuals aged over 65 years also experience a 35% reduction in mitochondrial activity within muscle cells, accompanied by a 30% increase in intramuscular fat, both of which contribute to insulin resistance. This insulin resistance further elevates the risk of recurrent diabetic foot ulcers [9].

The study also found that most respondents were male, a pattern consistent with earlier findings indicating that men are more likely to experience recurrent ulcers due to generally poorer health-seeking behavior compared to women [10]. Men often engage in more physically demanding activities, which may exacerbate foot trauma and increase the risk of ulcer recurrence among individuals with diabetes mellitus [11]. Women, on the other hand, tend to exhibit greater concern for their health and are more likely to seek medical attention when abnormalities arise. Effective management of recurrent diabetic foot ulcers requires consistent wound care and foot-care practices, which women are more likely to adhere to [18].

Regarding disease duration, nearly half of the respondents had been living with diabetes for 1–5 years (47.1%). This finding is consistent with previous research [12], which noted that individuals with diabetes for less than five years often have limited experience and have not yet fully adapted to the lifestyle changes required to manage the disease, thereby increasing the risk of complications. Patients within the 1–5-year duration range may also experience peripheral arterial disease (PAD), characterized by diminished pulsation in the lower extremities [13]. As diabetes progresses, chronic hyperglycemia increases the likelihood of complications such as retinopathy, nephropathy, coronary artery disease, and diabetic foot ulcers [14]. The researcher assumes that patients newly diagnosed with diabetes are at higher risk of developing diabetic foot ulcers due to limited knowledge and experience in managing the disease. Many newly diagnosed patients in this study tended to ignore early signs of foot abnormalities, allowing minor issues to progress into more severe ulcerations.

The results further show that 72.5% of respondents demonstrated poor foot-care behavior. Previous studies [15] have indicated that foot-care behavior among individuals with diabetes is influenced by age, sex, and disease duration. Older adults often exhibit poorer foot-care practices due to reduced motivation and declining physical function, which limit their ability to perform routine self-care activities.

The study also revealed that nearly half of the respondents experienced two episodes of recurrent diabetic foot ulcers, particularly among those with diabetes for 1–5 years. This finding is consistent with research [16], which reported that 49.1% of respondents experienced recurrent ulcers twice. Individuals who have previously experienced diabetic foot ulcers are at high risk of recurrence, with recurrence rates of 40% within one year, 60% within three years, and 65% within five years after initial healing [17]. These statistics highlight the chronic and recurrent nature of diabetic foot ulcers, emphasizing the need for sustained preventive strategies.

Importantly, this study found a significant relationship between foot-care behavior and recurrent diabetic foot ulcers. Supporting evidence from previous research [18] indicates that patients with diabetic foot ulcers are 12.799 times more likely to exhibit poor foot-care behavior compared to diabetic patients without ulcers. Individuals with diabetes often experience sensory deficits such as loss of pain perception, diminished pressure sensation, and dry, cracked skin, all of which increase vulnerability to foot injuries. Proper foot-care practices facilitate early detection of abnormalities, thereby reducing the likelihood of ulcer formation and recurrence [19-21].

During the study, patients with diabetic foot ulcers routinely underwent wound care and blood glucose monitoring. However, analysis of questionnaire responses revealed low scores in the domains of footwear maintenance and injury prevention. Many respondents wore open footwear such as flip-flops without socks, increasing exposure to trauma. Additionally, most respondents did not perform diabetic foot exercises. Even among respondents who practiced good foot care, recurrence still occurred, likely due to other contributing factors such as peripheral neuropathy, poor circulation, previous ulcer history, obesity, or inadequate glycemic control.

CONCLUSION

The study concludes that recurrent diabetic foot ulcers predominantly affect older adults, especially men, and are more common among individuals who have lived with diabetes for 1–5 years. Most respondents demonstrated poor foot-care behavior, which showed a significant negative association with ulcer recurrence. These findings highlight the critical role of consistent and proper foot-care practices in preventing repeated ulceration among patients with diabetes mellitus.

Ethical consideration, competing interest and source of funding

-Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Tanjungpura. The ethical review ensured that participants' rights, safety, and well-being were protected throughout the research process. The committee issued Ethical Clearance Certificate No. 1681/UN22.9/PG/2023, confirming that the study met all ethical standards and could proceed without ethical concerns. With this approval, the research was formally authorized and recognized as compliant with established ethical principles for human subject research.
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REFERENCES

1. Frisca S, Redjeki GS, Supardi S. Efektivitas edukasi terhadap perilaku perawatan kaki pasien diabetes mellitus. Carolus Journal of Nursing. 2019;1(2):125–37.
2. Ningrum TP, AlFatih H, Yuliyanti NT. Hubungan tingkat pengetahuan dengan perilaku perawatan kaki pada pasien diabetes melitus tipe II. Jurnal Keperawatan BSI. 2021;9(2):166–77.
3. Kemenkes RI. Tetap produktif, cegah, dan atasi diabetes melitus 2020. Infodatin. 2020;20(1):22-8.
4. Kemenkes RI. Laporan RISKESDAS tahun 2018. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018.
5. Pratama DA, Sukarni, Nurfianti A. Analisis faktor-faktor terjadinya luka kaki berulang pada pasien diabetes melitus di Klinik Kitamura dan RSUD Dr. Soedarso Pontianak. JM Keperawatan Untan. 2018;2(1):1–12.
6. Hudiyawati D, Rizki S. Pengetahuan berpengaruh terhadap kepatuhan dalam perawatan kaki pada klien diabetes melitus tipe II. Jurnal Keperawatan Global. 2018;3(2):66–74.
7. Manungkalit M. Hubungan lama menderita ulkus diabetik dengan kualitas hidup pada penderita ulkus diabetikum. Adi Husada Nursing Journal. 2020;6(1):32-8.
8. Cheng Y, Zu P, Zhao J, Shi L, Shi H, Zhang M, et al. Differences in initial versus recurrent diabetic foot ulcers at a specialized tertiary diabetic foot care center in China. J Int Med Res. 2021;49(1):212-8.

9. Imelda S. Faktor-faktor yang mempengaruhi terjadinya diabetes melitus di Puskesmas Harapan Jaya tahun 2018. Scientia Journal. 2019;8(1):28–39.
10. Mildawati, Diani N, Wahid A. Hubungan usia, jenis kelamin dan lama menderita diabetes dengan kejadian neuropati perifer diabetik. 2019;3(2):31–7.
11. Jannaim, Dharmajaya R, Asrizal. Pengaruh Buerger Allen exercise terhadap sirkulasi ekstremitas bawah pada pasien luka kaki diabetik. Jurnal Keperawatan Indonesia. 2018;21(2):101–8.
12. Laili F. Hubungan faktor lama menderita DM dan tingkat pengetahuan dengan distres diabetes pada penderita diabetes mellitus tipe 2 tahun 2017 (Studi di Wilayah Kerja Puskesmas Rowosari, Kota Semarang). Media Kesehatan Masyarakat Indonesia. 2019;18(2):35–8.
13. Lintang AA, Mutiara H, Sari MI, Muhartono, Falamy R. Hubungan antara lama menderita diabetes melitus tipe 2 dengan kejadian peripheral arterial disease pada pasien diabetes melitus tipe 2 di Puskesmas Kedaton Kota Bandar Lampung. Jurnal Medula. 2020;9(2):379–84.
14. Suryati I, Primal D, Pordiati D. Hubungan tingkat pengetahuan dan lama menderita diabetes mellitus (DM) dengan kejadian ulkus diabetikum pada pasien DM tipe 2. Jurnal Kesehatan Perintis. 2019;6(1):1–8.
15. Ningrum H, Imamah I. Pengetahuan dan perilaku perawatan kaki pada penderita diabetes melitus tipe 2 di Puskesmas Gondang Sragen. Journal Keperawatan. 2022;1(2):59–66.
16. Marissa N, Ramadhan N. Kejadian ulkus berulang pada pasien diabetes mellitus. Sel Jurnal Penelitian Kesehatan. 2017;4(2):91–9.
17. Hicks C, Canner J, Mathioudakis N, Lippincott C, Sherman R, Abularrage C. Incidence and risk factors associated with ulcer recurrence among patients with diabetic foot ulcers treated in a multidisciplinary setting. J Surg Res. 2019;246:243–50.
18. Lubis SPS. Analisis pengaruh perawatan kaki dan penggunaan alas kaki dengan ulkus kaki diabetik pada penderita DM. Jurnal Prosiding SINTAKS. 2019;1(1):870–6.
19. Astuti A, Merdekawati D, Aminah S. Faktor risiko kaki diabetik pada diabetes mellitus tipe 2. Riset Informasi Kesehatan. 2020;9(1):72-8.
20. Swaminathan N, Awuah WA, Bharadwaj HR, Roy S, Ferreira T, Adebusoye FT, Ismail IF, Azeem S, Abdul-Rahman T, Papadakis M. Early intervention and care for diabetic foot ulcers in low and middle income countries: Addressing challenges and exploring future strategies: A narrative review. Health Science Reports. 2024 May;7(5):e2075.
21. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA, IWGDF Editorial Board. Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). Diabetes/Metabolism Research and Reviews. 2020 Mar;36:e3266.