Original Article

Foot Care Practices as Determinants of Diabetic Foot Ulcer Risk in Rural Populations

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Abstract

Background: Diabetic foot ulcers (DFUs) represent a major chronic complication of diabetes mellitus and are associated with infection, extended hospital stays, and an increased likelihood of lower-limb amputation. Individuals with diabetes remain at lifelong risk of DFUs, with recurrence frequently reported. Consistent and appropriate foot self-care is therefore considered a key preventive measure, particularly in community settings with limited access to specialized care.

Objective: This study aimed to examine the relationship between foot self-care behaviour (FSCB) and the risk of developing diabetic foot ulcers among adults with type II diabetes living in rural communities.

Methods: A cross-sectional study was conducted involving 100 adult outpatients with type II diabetes attending the Sukawati II Primary Health Care Centre, Gianyar, Bali. Participants were recruited using consecutive sampling. Data were collected through structured questionnaires that included demographic characteristics and foot self-care behaviour assessed using the Nottingham Assessment of Functional Foot Care (NAFF). The risk of diabetic foot ulcers was evaluated using Inlow's 60-second diabetic foot screening tool, incorporating a 10 g monofilament test. Data analysis employed the Gamma correlation test to determine the association between variables.

Results: The findings showed that 62% of participants demonstrated poor foot self-care behaviour. Additionally, 50% of respondents were identified as being at risk of developing DFUs. Statistical analysis revealed a strong and significant inverse relationship between foot self-care behaviour and DFU risk ($p = 0.001$; $r = -0.613$).

Conclusion: Poor foot self-care behaviour is strongly associated with an increased risk of diabetic foot ulcers among individuals with type II diabetes in rural settings. These findings highlight the importance of strengthening foot care education and preventive interventions at the primary health care level.

Keywords: Depression, Diabetic foot ulcer; Foot self-care behaviour; Type 2 diabetes mellitus; Rural health; Primary health care; Foot care practices; Ulcer risk assessment

INTRODUCTION

Diabetes continues to pose a major challenge to global public health. Data reported by the International Diabetes Federation indicate that in 2021, an estimated 537 million adults aged 20–79 years were affected by diabetes worldwide. This figure is expected to increase substantially,

reaching approximately 643 million individuals by 2030 and nearly 783 million by 2045. The burden of diabetes is disproportionately concentrated in low- and middle-income countries, where the majority of affected individuals reside. Indonesia is among the countries experiencing a high prevalence, reflecting the broader trend that nearly three-quarters of adults living with diabetes are found in these settings (1).

Diabetes mellitus is classified as a chronic non-communicable condition that is associated with a wide range of short-term and long-term complications. These complications may affect large blood vessels, leading to cardiovascular and cerebrovascular disorders, as well as small vessels, resulting in conditions such as diabetic nephropathy, retinopathy, and peripheral neuropathy. One of the most debilitating outcomes of diabetes is the occurrence of diabetic ulcers, which substantially increase the disease burden and negatively influence morbidity among individuals living with diabetes (2).

Out of the estimated 537 million people living with diabetes around the world, about 19% to 34% will develop a diabetic foot ulcer (DFU) in their lifetime. Of those who do, around 1 in 5 will require some form of lower-limb amputation, whether a minor one below the ankle, a major one above the ankle, or sometimes both. Moreover, about 10% of patients die within just one year after being diagnosed with their first DFU(3). The five-year mortality risk for diabetic patients with DFU is reported to be 2.5 times higher than those who without DFU. Furthermore, an estimated 74% of these patients are at risk of requiring renal replacement therapy within two years. The elevated mortality risk observed in this patient population is closely associated with the presence of coexisting comorbidities, particularly cardiovascular and cerebrovascular diseases (3).

DFU complication is largely preventable, as it commonly originates from minor trauma or repetitive pressure. The primary approach of diabetic foot intervention is prevention. Preventive strategies, including patient education, regular foot examinations for peripheral vascular diseases and neuropathy, as well as risk stratification, serve as the foundation for the management of diabetic foot disease (3). These measures are essential in identifying at-risk individuals and preventing the development of complications, ultimately improving patient outcomes.

Preventive strategies which are essential in reducing the incidence and severity of DFU involves early detection and prompt management of such cutaneous injuries as it is critical in preventing progression to more severe outcomes (2) Early detection of patients who at high risk for DFUs is a priority to prevent the burden of diabetic foot complications. The risk of developing diabetic foot ulcers can be assessed using a risk assessment tool. This instrument helps screen for diabetic foot conditions, allowing for early intervention to prevent ulcer formation.

Recent studies have emphasized the effectiveness of foot self-care in reducing the risk of DFUs. Essential foot care practices such as daily foot inspection, proper hygiene, nail care, and the use of appropriate footwear have been shown to significantly lower the incidence of DFUs and improve long-term outcomes in patients with type 2 diabetes (4,5) Furthermore, integrating foot care education into routine diabetes management has been recognized as a simple, feasible, and highly effective strategy to prevent foot complications (6,7) However, much of the current evidence comes from studies conducted in hospital settings or developed countries, while data from community health Centres, especially in Indonesia, remains limited.

This study seeks to address the existing research gap by examining the association between foot care practices and the risk of diabetic foot ulcers among individuals with type 2 diabetes receiving care at the Sukawati II Primary Health Care Centre, a first-level health facility located in Gianyar, Bali. The investigation is designed to generate evidence that is specific to a rural primary care context, where access to specialized services may be limited. It emphasizes the assessment of patients' foot care behaviours as they occur within routine community-based health services and aims to translate the findings into practical strategies to strengthen preventive care at the local level. By analysing this relationship within a localized setting, the study enhances understanding of how diabetic patients in rural Indonesian communities manage foot care as part of daily self-management. Furthermore, the results provide empirically grounded insights that can support health professionals, particularly nurses and primary care providers, as well as policymakers, in designing and implementing targeted

educational initiatives and preventive interventions to reduce the risk of diabetic foot ulcers

METHODS

Study Design

This is a Descriptive Correlational Study conducted Primary Health Care Centre II Sukawati Gianyar Bali. This study employed a correlational research design to examine the relationship between foot self-care behaviour and the risk of diabetic foot ulcers (DFU) among individuals with diabetes. A cross-sectional approach was used, in which data were collected at a single point in time. This design allows for the identification and analysis of the relationship between the variables without manipulating any conditions. The cross-sectional correlational design is suitable for understanding the strength and direction of associations between variables within a specific population at one specific period (8).

Participants

Sample for this study consists of 100 patients diagnosed with Type 2 Diabetes Mellitus (DM) at Sukawati II Primary Health Care Centre, recruited using consecutive sampling technique (9). The inclusion and exclusion criteria are adult patient aged older than 40 years old who can communicate properly and willing to be participant in this study. Patient who has other complication of diabetic, with obesity and uncontrol hypertension were excluded from this study

Instrument

This study utilized two instruments. The first instrument is the Nottingham Assessment of Functional Footcare (NAFF), which is designed to measure foot care in patients with Type 2 Diabetes Mellitus. The questionnaire consists of 29 items which has internal consistency of the questionnaire is 0.53, and good test–retest reliability. Reliability test using Cronbach's Alpha obtain result of 0.87 (10). Patients responded to the items using a Likert scale, with the frequency of behaviours ranging from 0 to 3. A higher total score reflects better foot care behaviour (11), while a score of 50 indicates the need for further evaluation, which in this study is categorized as poor foot care.

The second instrument is Inlow's 60-Second Diabetic Foot Screen Tool which was used to identify the risk of ulcer development. This tool evaluates 12 parameters of the lower extremity through visual inspection and physical examination, allowing nurses to identify early signs of complications within approximately one minute. The assessment includes observation of the skin condition, nails, deformities, callus formation, fissures, pitting edema, temperature, range of motion, sensation, pedal pulses, history of ulcer or amputation, and footwear condition. Each item is scored from 0 to 2, with a higher total score indicating a greater risk for ulcer development. Protective sensation was assessed using a 10-gram Semmes-Weinstein monofilament, applied to standard plantar sites to detect loss of sensation indicative of peripheral neuropathy. The total score ranges from 0 to 24, and the risk categories are interpreted as no risk for scores of 0–6 (11) and at risk for scores greater than 6. Patients categorized as "at risk" were referred for further podiatric or medical evaluation.

The validity test of this instrument was conducted by Murphy et al. on 69 patients, divided into two groups: 26 patients from an acute care setting (dialysis) and 43 patients from a long-term care (LTC) setting. The results showed intrarater reliability in LTC is 0.96 (0.93–0.98) for right foot, and 0.97 (0.95–0.98) for left foot; in dialysis setting obtain 1.00 in right and 1.00 in left foot. Interrater reliability obtained in LTC 0.92 (0.86–0.96) in right foot, 0.93 (0.87–0.96) in left foot; meanwhile in dialysis setting is 0.83 (0.65–0.92) for both feet. This demonstrated that the Inlow's 60-second diabetic foot screening tool is valid for predicting the risk of future foot ulcers. The occurrence of foot ulcers and amputations was confirmed 1 to 5 months later (12).

Data Collection procedure

Data collection was carried out from December 20, 2022, to February 20, 2023. A total of 100 respondents, all diagnosed with Type 2 Diabetes Mellitus (DM), participated in the study when visiting the Sukawati Primary Health Care Centre. The researchers recruited participants during their visits to the health Centre (9) After conducting a brief interview to assess the suitability of the sample criteria (13), the researchers asked the patients to sign an informed consent form. Subsequently, the researchers performed an assessment to evaluate the risk of foot ulcers and provided the participants with a questionnaire to complete.

Once the participants finished filling out the questionnaire, the researchers gave them a souvenir in the form of a leaflet on foot care, which adhered to the standards set by the Indonesian Endocrinology Association (14).

Data Analysis
The data obtained was analyzed using the Gamma correlation test (15) to examine the strength and direction of the association between foot self-care practices and the risk of diabetic foot ulcers. The Gamma test was chosen because both variables were measured on ordinal scales. A negative Gamma value indicated that higher foot self-care was associated with lower DFU risk, and vice versa. Statistical significance was set at $p < 0.05$ with a 95% confidence level.

Ethical Considerations:
The study was conducted following ethical research principles and approved by the institutional review board with ethical clearance number 03.0608/KEPITEKES-BALI/XI/2022, dated November 24, 2022. Prior to participation, all respondents were provided with detailed information regarding the study's objectives, procedures, and their rights as participants.

Written informed consent was obtained from each respondent before they were included as research participants. Confidentiality and anonymity of all data were strictly maintained throughout the research process.

RESULTS

The results of this study are presented in Table 1, Table 2, and Figure 1. Table 1 outlines the demographic and clinical characteristics of the participants, including age, gender, education level, and duration of diabetes. Table 2 displays the cross-tabulation between foot care behaviour and the risk of diabetic foot ulcers (DFUs), along with the results of the Gamma correlation test. Figure 1 illustrates the distribution of foot care behaviour in relation to DFU risk among the study population.

Table 1 present most respondents were aged 60–74 years (49%), and the majority were female (55%). In terms of education, 33% had completed elementary school, while 17% had not completed elementary education. Regarding the duration of diabetes, more than half (58%) had been living with the condition for over five years.

Table 1. Characteristic and Demography (n=100)

Characteristic	Frequency	Percentage (%)
Age		
45 – 59 years	35	35%
60 – 74 years	49	49%
75 – 90 years	16	16%
Total	100	100%
Gender		
Male	45	45%
Female	55	55%
Total	100	100%
Educational Level		
Did not complete elementary school	17	17%
Elementary School	33	33%
Junior High School	23	23%
Senior High School	16	16%
Higher Education	11	11%
Total	100	100%
Duration of Diabetes Mellitus		
< 5 years	42	42%
> 5 years	58	58%
Total	100	100%

Table 2. Cross-tabulation and Gamma Test Results (n=100)

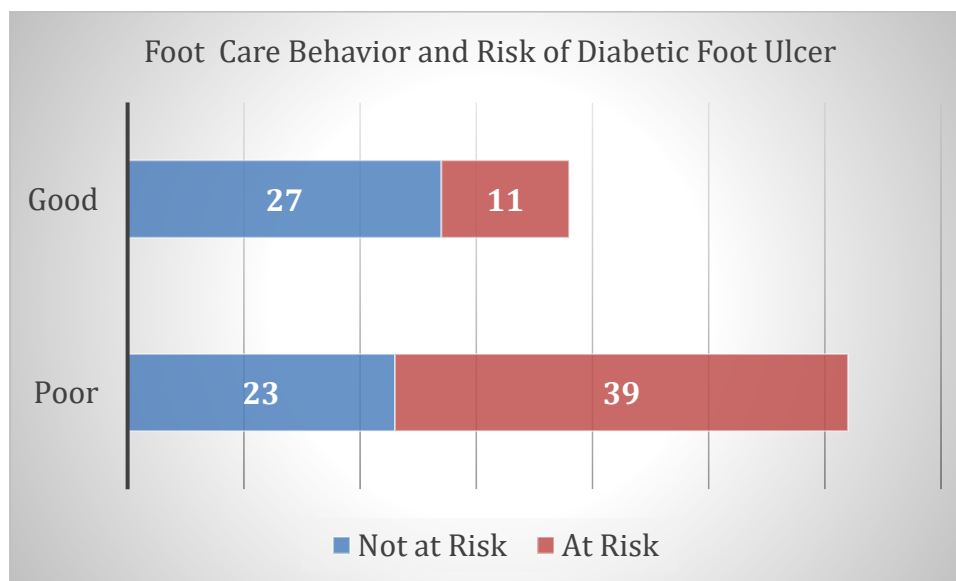| Foot Care Behaviour	Not at Risk	At Risk	Gamma (γ)	*p-value*
Poor	23	39	-0.613	0.0001
Good	27	11		
Total	50	50		

Figure 1. Foot Care Behaviour and Risk of DFUs (n=100)

Table 2 shows the cross-tabulation between foot care behaviour and the risk of diabetic foot ulcers (DFUs). Among participants with poor foot care behaviour, 62% were at risk of DFUs, while only 11% of those with good foot care behaviour were at risk. The Gamma correlation test revealed a significant negative correlation between foot care behaviour and the risk of DFUs (γ = -0.613, p = 0.0001) .

Figure 1 visually supports this finding, illustrating that individuals with poor foot care behaviour are more likely to be categorized as at risk for diabetic foot ulcers compared to those who practice good foot care.

DISCUSSION

This study demonstrated a significant negative correlation between self-foot care behaviour and the risk of diabetic foot ulcers (DFUs) among individuals with type 2 diabetes (r = −0.613, p = 0.001), indicating that better adherence to foot self-care is associated with a lower risk of ulceration. The demographic characteristics of participants provide important context for interpreting this relationship. Almost half of respondents were aged 60–74 years, and more than one-tenth were above 75 years. Increasing age is a recognized risk factor for peripheral neuropathy, vascular insufficiency, and impaired mobility (16), all of which compromise the ability to perform adequate foot care and increase DFU risk.

Most respondents had low educational attainment, with limited exposure to higher education. Education is strongly linked to health literacy, comprehension of self-care recommendations, and overall diabetes management capability (17). Limited knowledge among older adults in rural settings may further contribute to poor foot care practices and increased DFU vulnerability. More than half of the respondents had been diagnosed with diabetes for over five years. Longer disease duration has been strongly associated with the development of

microvascular and macrovascular complications (18), indicating a need for intensified preventive interventions over time.

Notably, 62% of participants demonstrated poor foot care practices. This aligns with reports that individuals living in rural areas often experience barriers such as limited access to healthcare services, inadequate educational resources, and entrenched cultural practices (19,20). Behaviours such as walking barefoot or wearing inappropriate footwear remain common in many rural communities and increase exposure to trauma and infection (21). These gaps highlight the importance of strengthening primary care-based diabetes self-management programs that are adapted to local socioeconomic and cultural conditions.

The findings reinforce the protective value of self-foot care in preventing DFUs. Routine practices—including daily foot inspections, appropriate hygiene, and wearing protective footwear—help prevent skin breakdown and minimize trauma, which are common precursors to ulceration (4) Given challenges such as neuropathy, sensory loss, and reduced healing capacity among diabetic patients (22), consistent preventive behaviour becomes critical.

Beyond individual behaviour, the results of this study highlight the particularly influential role of structural factors. Rural-living patients often lack continuous access to diabetes educators or structured self-care counselling. Similar to prior studies, improvements in knowledge, social support, and motivation are key drivers of better foot care adherence (23) Nurses and primary healthcare providers therefore play an essential role as educators and change agents. By integrating culturally appropriate and practical teaching strategies into routine diabetes services, healthcare systems can more effectively reduce DFU incidence and prevent avoidable amputations. Overall, these findings emphasize the need for a comprehensive approach to DFU prevention that considers demographic vulnerabilities, community context, and health system support.

Limitations

Several limitations should be acknowledged when interpreting the findings of this study. First, the cross-sectional design restricts the ability to draw conclusions about cause-and-effect relationships, as the temporal sequence between foot care behaviour and ulcer risk cannot be determined. Second, data collection was confined to a single rural primary health care facility with a modest number of participants, which may reduce the extent to which the results can be applied to wider populations of individuals with diabetes. Third, reliance on self-reported information introduces the potential for recall error and social desirability bias, possibly resulting in an overrepresentation of favourable self-care behaviours. Future research would benefit from incorporating objective clinical measures, expanding sample sizes, and involving multiple study sites to improve external validity and better reflect regional differences in foot self-care practices.

CONCLUSION

The findings demonstrated a statistically meaningful inverse association of moderate strength between foot self-care behaviour and the likelihood of developing diabetic foot ulcers among people with type 2 diabetes in a rural Indonesian context. Many participants exhibited inadequate foot care practices, highlighting an urgent need to reinforce diabetes education and preventive strategies within primary health care services. Preventive efforts should prioritize populations at greater risk, including older individuals, those with limited educational attainment, and patients with longer disease duration. As key providers in community health settings, nurses play a central role in delivering individualized education and implementing community-based programmes that promote regular foot care, early recognition of foot abnormalities, and timely intervention. Strengthening foot care knowledge and self-management skills in rural communities is vital to minimizing avoidable DFU-related complications and enhancing the overall well-being of individuals living with diabetes.

Author Contributions

All authors contributed substantially to the development of this study. The first author was responsible for the study conception, data collection, analysis, and manuscript drafting. The second author contributed to the study design, data interpretation, critical revision of the manuscript, and final approval of the version to be published. All authors have read and approved the final manuscript.

Conflict of Interest

Authors state no conflict of interest

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and privacy considerations

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