

https://dspace.org/

Knowledge and Practices in Diabetic Foot Ulcer Prevention Among Patients with Diabetes Mellitus in Gauteng, South Africa

T Mukheli; T Mokoena; Shingirai Kagodora; Thifhelimbilu Luvhengo

https://hdl.handle.net/10539/48223
WOS

Downloaded from a DSpace repository. https://dspace.org/

diabetology

MDPI

Article

Knowledge and Practices in Diabetic Foot Ulcer Prevention Among Patients with Diabetes Mellitus in Gauteng, South Africa

Tshifhiwa Mukheli [1], Tshepo P. Mokoena [2], Shingirai B. Kagodora [3] and Thifhelimbilu E. Luvhengo [4,*]

[1] Oral Health and Therapeutic Services, Gauteng Department of Health, Johannesburg 2001, South Africa; tshifhiwa.mukheli@gauteng.gov.za
[2] Department of Podiatry, Charlotte Maxeke Johannesburg Academic Hospital, Johannesburg 2193, South Africa; polly.mokoena@gauteng.gov.za
[3] Department of Nuclear Medicine, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg 2193, South Africa; brenda.kagodora@wits.ac.za
[4] Department of Surgery, Charlotte Maxeke Johannesburg Academic Hospital, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg 2193, South Africa
* Correspondence: thifhelimbilu.luvhengo@wits.ac.za; Tel.: +27-839952552

Abstract

Background: Patients with diabetes mellitus are at increased risk of foot ulcerations. Prevention and timeous treatment of diabetic foot ulcer requires a multidisciplinary team, including patients and healthcare workers. The study investigated levels of knowledge regarding foot care and prevention of diabetic foot ulcer in patients with diabetes mellitus. Methods: We conducted a cross-sectional descriptive study using structured face-to-face interviews of patients seen at the outpatient department. Interviews covered socio-demographic and clinical characteristics, and foot care practices. Statistical analysis was performed using STATA 15. Results: The study involved 245 participants with a mean age of participants was 53.7 (SD) years, and 69% were female. The majority, 77.6%, had Type 2 diabetic mellitus (DM). Mean score of appropriate knowledge on diabetic foot ulcer (DFU) was 73.5%, lower scores were 44.9% and 45.7% for moisturizing between toes and wearing slippers outdoors, respectively. Knowledge of foot care was significantly influenced by age ($p = 0.0033$), duration of DM ($p = 0.047$), treatment type ($p = 0.002$), prior education on foot care ($p < 0.0001$), and existence of foot complications ($p = 0.030$). Conclusions: Younger patients and those with Type 1 diabetes mellitus had less knowledge of appropriate foot care and prevention of DFU. We recommend the implementation of structured and targeted educational interventions.

Keywords: diabetes mellitus; diabetic foot ulcer; foot care practice; knowledge levels; prevention

check for updates

Academic Editor: Aikaterini Andreadi

Received: 25 August 2025
Revised: 6 October 2025
Accepted: 22 October 2025
Published: 1 November 2025

Citation: Mukheli, T.; Mokoena, T.P.; Kagodora, S.B.; Luvhengo, T.E. Knowledge and Practices in Diabetic Foot Ulcer Prevention Among Patients with Diabetes Mellitus in Gauteng, South Africa. *Diabetology* **2025**, *6*, 125. https://doi.org/10.3390/diabetology6110125

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

A diabetic foot ulcer (DFU) is a major complication of diabetes mellitus (DM) [1,2]. Patients with DFU are at risk of foot infection (DFI), which, if not timeously and effectively treated, may lead to major amputation and/or death [3–6]. The International Diabetes Federation (IDF) estimates that the number of individuals living with diabetes will reach 853 million by 2050, with the number in South Africa reaching 3.9 million [7–9]. Diabetic foot disease remains the leading cause of non-traumatic amputations and associated mortality in various countries, including South Africa [4–6,9,10]. The likelihood of developing DFU is higher in patients with longstanding or poorly controlled DM, older age, low socio-economic status, lack of family support, occupations predisposing to foot trauma, smoking,

sedentary lifestyle, high body mass index (BMI), peripheral neuropathy and peripheral artery disease [11–15].

Diabetic foot ulcer is preventable, but barriers that remain include limited knowledge of appropriate foot care among healthcare practitioners and patients [16,17]. Effective prevention and treatment of DFU requires a multidisciplinary approach, which must include active participation of patients and their families [3,18]. Often, individuals with DM do not perceive the urgency of foot-related symptoms due to neuropathy or a lack of awareness about the risks, leading to a delay in presentation to healthcare facilities for treatment. Delayed presentation of DFU with or without DFI increases the likelihood of amputation and mortality [1,3,19].

Although the International Working Group on the Diabetic Foot(IWGDF) [20] advocates for a structured patient education and early detection strategies to reduce the burden of diabetic foot disease, gaps in the knowledge and foot care practices among patients with DM persist, especially in low- and middle-income countries [20–28]. Furthermore, despite knowing the importance of foot care, some of the patients do not apply it, emphasizing the need for ongoing education and integration of foot care into routine management [29–31]. Aljaouni et al. (2024) found that only 35% of patients in Saudi Arabia had good knowledge of foot care, and only 27% practiced it adequately [32]. Similarly, Pourkazemi et al. (2020) reported that 84.8% of patients with DM had poor knowledge on appropriate foot care and only 8.8% demonstrated acceptable practice [21].

Improving access to healthcare services and embedding foot care practices and education into routine management of DM are critical strategies for reducing the incidence of DFU [33,34]. Essential practices include regular foot inspection, proper foot hygiene, appropriate footwear, maintaining good glycemic control, and continuous support by families and healthcare providers [34–36]. This study evaluated levels of knowledge of foot care and prevention of DFU in patients with DM. It specifically evaluated patients' awareness of DFU risk factors and daily foot care practices. Our study further examined whether patients had received foot care education from healthcare workers as part of their routine diabetes management. Additionally, it explored associations between knowledge levels and demographic or clinical factors such as age, type of DM, duration of diabetes, and education level.

2. Materials and Methods

2.1. Study Design and Setting

This cross-sectional descriptive study was conducted at 14 hospitals and health district services. The study took place from September 2023 to July 2024.

2.2. Sample

Adults ($\geq$18 years) with Type 1 or Type 2 diabetes mellitus attending outpatient clinics, polyclinics, primary healthcare clinics, or community health centers in Gauteng were eligible. Individuals with cognitive impairments or under caregiver supervision were excluded due to limitations in obtaining reliable self-reported data during structured interviews. The calculated sample size was 196 participants. Table 1 below presents the calculated sample sizes for various confidence levels based on a population of 1,000,000, a hypothesized outcome frequency of 15%, and a margin of error of $\pm$5%. The sample size corresponding to a 95% confidence level was 196, which served as the benchmark for this study. The actual sample size achieved was 245.

Table 1. Sample size for frequency in a population.

Population size (for finite population correction factor or fpc) (N):	1,000,000
Hypothesized % frequency of outcome factor in the population (p):	15% +/− 5
Confidence limits as % of 100(absolute +/− %) (d):	5%
Design effect (for cluster surveys-DEFF):	1
Sample Size (n) for Various Confidence Levels	
Confidence Level (%)	Sample Size
95%	196
80%	84
90%	138
97%	241
99%	339
99.9%	552
99.99%	772

Equation

$$\text{Sample size n} = [\text{DEFF} \times \text{Np}(1 - \text{p})]/[(\text{d2}/\text{Z21} - \alpha/2 \times (\text{N} - 1) + \text{p} \times (1 - \text{p})]$$

DEFF = design effect

2.3. Instrument

The study used a questionnaire adapted from previously validated tools to assess diabetic foot care knowledge and practices [21–23,30,31]. The questionnaire included three sections. The first section had six questions addressing socio-demographic information (6 questions). Clinical characteristics were covered by 10 questions in the second section. The last section of the questionnaires had 19 questions assessing levels of knowledge of foot care and prevention of DFU.

The questionnaire was administered to participants through face-to-face interviews conducted by healthcare professionals during routine follow-up visits. The interviews were conducted in the participants' preferred language. Participants either had to agree or disagree with the statement posed. Appropriate responses of either agree or disagree were labeled Yes for an appropriate response and No for an inappropriate answer.

A response was deemed evidence of appropriate knowledge if a participant agreed, i.e., marked Yes to daily examination of feet, daily washing of feet, checking of temperature of the water before washing the feet, drying of feet after washing, application of moisturizer or lotion to feet, checking shoes before wearing them, immediate visit to a clinic upon noticing a wound on the foot, cleaning a wound with an antiseptic solution or salt water and presenting to a clinic if there is non-healing wound. Participants with good knowledge of foot care were expected to disagree, i.e., mark no to application of moisturizer or lotion in-between toes, using hot water bottle to warm feet, using heater or fire to warm the feet, wearing shoes without socks, walking barefoot, wearing slippers outdoors, opening foot blisters, cutting calluses oneself and using corn plasters or removers. The level of knowledge for each question was derived from the percentage of participants who provided appropriate response for each of the 19 questions. Finally, a composite score was calculated.

2.4. Pilot Study

The questionnaire was administered to 15 nurses before the study to assess the clarity of the questions. Based on their feedback, minor corrections were made, and the final version of the questionnaire was developed. This pretesting step helped ensure the questionnaire's validity and reliability.

2.5. Ethical Consideration

Ethical approval to conduct the study was received from the Human Research Ethics Committee (Medical) of University of the Witwatersrand (M19/05/62-19/09/2019) and the study followed the guidelines contained in the 2024 revised Declaration of Helsinki of the World Medical Association. All participants were informed about the nature and purpose of the research and signed informed consent before completing the questionnaires.

2.6. Statistical Analyses

Data were entered into MS Excel and analyzed using STATA version 15. The chi-square test was used to determine if the sex, age, marital status and level of formal education of participants influenced their knowledge of foot care. We also analyzed relationships between the type of DM, duration, current pharmacological treatment, prior education on foot care and presenting foot problem, and appropriate knowledge of foot care. A p-value of <0.05 was considered statistically significant.

Adherence to foot care practices was assessed by calculating the proportion of participants reporting each recommended behavior. Scores ranged from 45% to 98%, with an overall adherence score of 53%, classified as moderate. Adherence levels were defined as follows: low adherence: <50%; moderate adherence: 50–74% and high adherence: ≥75%.

3. Results

Two hundred and forty-five (245) patients with DM participated in the study. The majority (69%: 168/245) were female, and two participants did not declare their sex. The mean age of the participants was 53.7 years (SD 17.7). Moreover, 41.2% (101/245) were married and 45.3% (111/245) were single. Overall, 61% (149/245) had primary education. One hundred and thirteen (46%: 113/245) of the participants were at tertiary level healthcare facilities. Most, 77.6% (190/245) participants had Type 2 DM, and 52.7% (129/245) were diagnosed within the last 10 years. Ninety-two (37.6%: 92/245) participants were on combination treatment of oral medications and insulin. Majority of participants, 87.3% (214/245), were non-smokers. The foot problems participants had included parasthesia in 38.8% (95/245), nail pathologies in 14.7% (37/245), callosities in 14.7% (36/245) and prior amputation in 3.3% (8/245) (Table 2).

The mean score (SD) of good knowledge of foot care among all participants was 73.5% (±9.21). The most commonly agreed-upon practices included drying feet after washing (94%: 230/245), using lotion or moisturizer on feet (88.2%: 216/245), washing feet daily (98%: 240/245), checking temperature of water before washing the feet (81%: 198/245) and routinely checking shoes before wearing them (80.8%: 198/245) but only 59.2% (145/245) agreed to daily foot examination. For the care of cuts or open wounds, (34%: 84/245) agreed to using salt water, and (32.7%: 80/245) an antiseptic. When a wound is not healing (84.1%: 206/245) of participants agreed to seek professional care at a clinic. Worrying, only 45.7%, 53.5% and 71% will avoid wearing slippers outdoor, would go to clinic immediately on noticing a wound and avoid walking barefoot, respectively (Table 3).

In univariate analysis, Type I diabetes was associated with lower odds of good knowledge compared to Type II (UOR = 0.43, 95% CI: 0.23–0.79, p = 0.0008). Duration of diabetes between 21 and 30 years significantly increased the odds of good knowledge compared to other durations of diabetes (UOR = 3.2, 95% CI: 1.34–7.69, p = 0.009). Patients on insulin therapy had lower odds of good knowledge compared to those on both insulin and oral treatment of DM (UOR = 0.38, 95% CI: 0.19–0.72, p = 0.003). Those who received education from healthcare providers were almost three times more likely to have good knowledge than those who did not receive education (UOR = 2.93, 95% CI: 1.73–4.94, $p < 0.00001$). Presence of nail pathologies increased the odds of good knowledge compared to parasthe-

sia (UOR = 2.41, 95% CI: 1.09–5.36, $p = 0.03$). Increasing age was associated with slightly higher odds per year of good knowledge (UOR = 1.02, 95% CI: 1.007–1.04, $p = 0.004$). After adjustment in multivariate analysis, significant independent predictors included duration of diabetes between 21 and 30 years (AOR = 2.78, 95% CI: 1.01–7.68, $p = 0.049$), insulin treatment (AOR = 0.4, 95% CI: 0.17–0.94, $p = 0.035$), and receiving education from healthcare providers (AOR = 2.78, 95% CI: 1.55–4.98, $p = 0.001$). Nail pathologies, type of diabetes, gender, level of care, and marital status were not statistically significant in the adjusted model. The findings suggest that education from healthcare providers strongly improves knowledge and practices in diabetic foot ulcer prevention, while longer disease duration and certain treatments influence patient behavior and awareness (Table 4).

Table 2. Sociodemographic and clinical characteristics of the participants (N = 245).

Variable	Result
Sex	
Male	74 (30.2%)
Female	169 (69%)
Not specified	2 (0.8%)
Level of Education	
Primary	149 (60.8%)
Graduate	67 (27.3%)
Postgraduate	18 (7.3%)
Uneducated	11 (4.5%)
Level of Care of Facility	
Primary	92 (37.6%)
Secondary	40 (16.3%)
Tertiary	113 (46.1%)
Marital Status	
Divorced	21 (8.6%)
Married	101 (41.2%)
Single	111 (45.3%)
Widowed	12 (4.9%)
Type of DM	
Type 1	55 (22.4%)
Type 2	190 (77.6%)
Duration of DM	
<10 years	129 (52.7%)
10–20 years	73 (29.8%)
21–30 years	31 (12.7%)
>30 years	12 (4.9%)
Treatment of DM	
Insulin	70 (28.6%)
Oral and insulin	92 (37.6%)
Oral	83 (33.9%)
Education received from healthcare workers	
No	136 (55.5%)
Yes	109 (44.5%)
Current foot problems	
Amputation	8 (3.3%)
Callosities	36 (14.7%)

Table 2. *Cont.*

Variable	Result
Circulation problems	28 (11.4%)
Nail pathologies	36 (14.7%)
Parasthesia	95 (38.8%)
Ulcer	8 (3.3%)
Multiple	33 (14%)
Smoker	
No	214 (87.3%)
Yes	31 (12.7%)

Table 3. Percentage distribution of participants who correctly agreed or disagreed with statements regarding appropriate foot care and prevention of DFU.

Variable	Results
Participants who correctly agreed	
Daily washing of feet	98%
Always drying the feet after washing	94%
Application of lotion or moisturizer on the feet after washing	88%
Exercising is good for the feet	88%
Going to a clinic if experiencing non-healing	84%
Checking water temperature first before washing the feet	81%
Routinely checking the shoes before putting them on	81%
Treatment of an open wound with saline or an antiseptic	67%
Perform daily foot examination	59%
Going to a clinic immediately upon noticing a wound	59%
Participants who correctly disagreed	
Utilization of corn plasters or removers	86%
Using a heater or fire to warm the feet	79%
Immediately opening foot blister(s) upon noticing	78%
Warming the feet with hot water bottle in winter	72%
Walking barefoot	71%
Cutting calluses self	65%
Wearing shoes without socks	61%
Wearing slippers outdoor	46%
Putting lotion or moisturizer between toes to keep the area moist	45%

Table 4. Sociodemographic and clinical characteristics that influenced level of knowledge of diabetic foot care and prevention of DFU (N = 245).

Variable	UOR	*p*-Value	AOR	*p*-Value
Sex				
Male	1.25 (0.72–2.16)	0.4270		
Female	1 (base)			

Table 4. *Cont.*

Variable	UOR	*p*-Value	AOR	*p*-Value
Education				
Primary	1.23 (0.69–2.19)	0.084	1.16 (0.58–2.33)	0.151
Graduate	1 (base)		1 (base)	
Postgraduate	1.72 (0.59–4.97)		2.67 (0.78–9.09)	
Uneducated	0.24 (0.05–1.21)		0.26 (0.04–1.63)	
Level of care				
Primary	0.74 (0.43–1.29)	0.4737		
Secondary	1.08 (0.52–2.23)			
Tertiary	1 (base)			
Marital status				
Divorced	1.34 (0.53–3.42)	0.3525		
Married	1.46 (0.84–2.51)			
Single	1 (base)			
Widowed	2.44 (0.69–8.58)			
Type of DM				
I	0.43 (0.23–0.79)	0.0008	0.8 (0.32–2.01)	0.637
II	1 (base)		1 (base)	
Duration of DM				
<10	1 (base)	0.009	1 (base)	0.049
10–20	0.97 (0.55–1.73)		0.95 (0.47–1.93)	
21–30	3.2 (1.34–7.69)		2.78 (1.01–7.68)	
>30	1.11 (0.34–3.64)		1.74 (0.41–7.36)	
Treatment of DM				
Insulin	0.38 (0.19–0.72)	0.003	0.4 (0.17–0.94)	0.035
Oral and insulin	1 (base)		1 (base)	
Oral	1.11 (0.61–2.02)		1.08 (0.53–2.21)	
Education in healthcare				
No	1 (base)	<0.00001	1 (base)	0.001
Yes	2.93 (1.73–4.94)		2.78 (1.55–4.98)	
Present foot problems				
Amputation	0.17 (0.02–1.40)	0.03	0.2 (0.02–1.85)	0.433
Callosities	1.30 (0.60–2.79)		0.93 (0.38–2.24)	
Circulation problems	0.75 (0.32–1.77)		0.62 (0.23–1.64)	
Nail pathologies	2.41 (1.09–5.36)		1.43 (0.59–3.50)	
Parasthesia	1 (base)		1 (base)	
Ulcer	0.70 (0.16–3.08)		0.58 (0.12–2.92)	
Multiple	2.03 (0.89–4.59)		1.05 (0.41–2.69)	
Age	1.02 (1.007–1.04)	0.004	1.0006 (0.98–1.02)	0.958

Toenail Cutting Practices: Participant Preferences

The most preferred method for cutting nails was "Straight Across and Not Too Short," preferred by 33.1% (81/245) of participants. Additionally, 29% (71/245) of participants rely on family members for assistance in cutting their toenails. About 18.4% (45/245) cut their toenails very short and at the corners. Approximately 11.8% (29/245) preferred their toenails to be cut by healthcare professionals, and 7.8% (19/245) did not specify the methods they used to cut their toenails.

4. Discussion

Our study assessed the knowledge and practices related to DFU prevention among patients with DM attending public healthcare facilities. Our findings revealed that while participants demonstrated moderate adherence to recommended foot care practices, such as daily foot washing, moisturizing, and checking water temperature, only 59% reported performing daily foot inspections, a critical component of DFU prevention. Although a majority (84.1%) would seek professional care for a non-healing wound on a foot, 67% agreed to try home remedies such as salt water or antiseptics for initial wound care. Importantly, several factors were significantly associated with higher levels of knowledge of foot care, among them older age, longer duration of DM, use of combined oral and insulin therapy, prior education on foot care, and the presence of current foot problems. In contrast, sex, marital status, education level, and level of healthcare facility were not significantly association with knowledge levels. These results underscore the need for targeted educational interventions and routine foot care reinforcement, particularly for younger patients and those newly diagnosed with DM.

Our study demonstrated that 73.5% of participants possessed adequate knowledge of diabetic foot care, a proportion substantially higher than that reported in comparable studies conducted in Iran (84.8% with poor knowledge) [21], Gambia (52.5% with poor knowledge) [23], Saudi Arabia (35% with good knowledge) [32], Ethiopia (52.5% with adequate knowledge) [37], and Ghana (63% with good knowledge) [22]. Despite this relatively high level of knowledge, our findings revealed that adherence to specific foot care behaviors remained suboptimal. For instance, only 46% of participants avoided wearing slippers outdoors, 45% refrained from applying moisturizer between the toes, 59% performed daily foot inspections, and 61% consistently wore shoes without socks. Similar gaps have been documented elsewhere, with practice rates ranging from 20.2% in Ethiopia to 49% in Ghana and 31.3% in The Gambia, while Iran reported 50.4% despite poor knowledge [21–23,37].

This knowledge-practice discrepancy reflects a broader challenge in diabetes care: behavioral adherence. Despite widespread recognition of the importance of daily foot inspection, only slightly more than half of the participants reported engaging in this critical preventive behavior. Hynes et al. [38] identified several psychosocial and systemic barriers to self-care among young adults with Type 1 diabetes, including emotional distress, perceived stigma, limited autonomy, and suboptimal patient–provider communication. These barriers may similarly affect foot care adherence, particularly among younger individuals and those with Type 1 diabetes, who in our study exhibited significantly lower knowledge levels.

Recent literature further highlights the importance of psychological and behavioral determinants in promoting effective self-management. Sadeghi et al. [39] demonstrated that self-efficacy plays a pivotal role in foot care adherence among patients with Type 1 diabetes, with higher self-efficacy associated with improved engagement in preventive behaviors. Sukartini et al. [40] proposed a behavioral model for diabetic ulcer prevention, emphasizing the influence of knowledge, attitudes, and behavioral intentions on foot care practices. These findings align with our study's observation that knowledge alone does not guarantee behavioral compliance, particularly in populations facing psychosocial and motivational challenges.

Our findings highlight the need for integrated interventions that address both educational and behavioral aspects of diabetic foot care. Behavioral adherence is shaped by a complex interplay of individual-level factors—such as motivation, self-efficacy, health literacy, and perceived risk—and systemic influences, including access to care and the quality of patient–provider interactions [40]. To improve adherence and clinical outcomes,

strategies such as the D1 Now type 1 diabetes intervention, which emphasizes tailored, youth-centered support for self-management [41], and the behavioral model proposed by Sukartini et al., which incorporates predisposing, enabling, and reinforcing factors [40], should be considered effective approaches for enhancing diabetic foot care practices. Within the context of our study, integrating foot care education into routine clinical encounters and adapting interventions to the psychosocial needs of younger patients may strengthen both knowledge retention and behavioral compliance.

Understanding the factors that influence patients' knowledge of diabetic foot care is essential for designing effective educational strategies. In our study, age emerged as a statistically significant determinant, with older participants exhibiting higher levels of awareness, which may be attributed to longer disease duration and greater engagement with self-care practices over time. Our findings support previous findings that older individuals tend to possess more comprehensive knowledge and demonstrate good foot care behavior due to prolonged exposure to diabetes-related complications [23,26,42]. However, other studies reported lower knowledge scores among older adults compared to younger counterparts, highlighting inconsistencies in the literature [21,24,28]. These discrepancies underscore the need for age-sensitive educational interventions. Based on our findings, we recommend implementing age-specific strategies, providing advanced, complication-focused education for older patients, while equipping younger individuals with foundational knowledge to establish effective self-care routines early in their disease progression.

The type of DM can significantly influence patients' exposure to education and engagement in self-care practices, particularly foot care. In our study, a statistically significant association was observed between type of DM and knowledge of diabetic foot care. Participants diagnosed with Type II DM demonstrated substantially higher levels of good knowledge (85%) compared to those with Type I (15%). These findings are consistent with previous studies conducted in Ethiopia [37] and Ghana [22], which reported good knowledge levels of 52.5% and 63% among Type II DM patients, respectively. However, in the Ghanaian study, only 49% of participants effectively translated this knowledge into practice, highlighting a gap between awareness and behavioral adherence.

Unlike these studies, which focused exclusively on Type II DM populations, our study included both Type I and Type II patients, with 77% diagnosed with Type II. This broader inclusion may explain the higher overall knowledge levels observed and underscores the need for tailored educational interventions. The comparatively lower knowledge among Type I DM patients, who are often younger and may have had less exposure to chronic disease education, may contribute to disparities in foot care awareness and self-care practices. These findings support the development of diabetes type-specific education strategies, ensuring that patients with Type I DM receive targeted support to build foundational knowledge and preventive behaviors early in their disease course.

The current study found a statistically significant association between the DM duration and patients' knowledge and practices related to diabetic foot care, with longer DM duration linked to improved outcomes. This improvement appears to be influenced by several key factors, such as patients with long-standing diabetes are more likely to have experienced foot-related complications, which often prompt preventive behaviors; repeated exposure to educational interventions enhancing knowledge retention and application; and sustained engagement with healthcare professionals reinforcing best practices. These cumulative experiences contribute meaningfully to improved awareness and adherence to foot care practices. Our findings are consistent with previous research, which reported greater foot care knowledge among patients with longer disease duration [26,27,32]. However, despite these encouraging trends, overall knowledge levels remain suboptimal in many populations [24,42], highlighting the need for targeted, accessible, and culturally

sensitive educational strategies, particularly for newly diagnosed individuals. We advocate for early and continuous education as a cornerstone of effective diabetes care.

The complexity of diabetes treatment regimens can influence patients' understanding and engagement with self-care practices, including foot care. Our study demonstrated a significant association between treatment type and diabetic foot care knowledge, with patients on combined oral and insulin therapies exhibiting greater understanding. This may be attributed to the complexity of managing dual therapies, which often involves more comprehensive care plans, frequent education, and regular interaction with healthcare providers. Additionally, many participants were older adults with long-standing Type II diabetes and existing foot complications, which likely contributed to their heightened awareness. Despite this encouraging level of knowledge, it does not necessarily translate into improved self-care practices. Previous studies have reported mixed findings [25,43]. A study conducted in Kuwait [43] found that patients on Oral Hypoglycemic Agents (OHAs) alone had lower odds of practicing good foot care, while those on diet plus OHAs showed better adherence. Interestingly, the same study reported that patients on combined OHAs and insulin were at greater risk of developing diabetic peripheral neuropathy (DPN), suggesting that treatment complexity may reflect disease severity rather than improved self-care. Similarly, Mekonen and Demssie observed that patients on both injections and pills were more likely to demonstrate poor foot self-care compared to those on injections alone [25]. Although we sought to identify studies that directly aligned with our findings, no such research was found. This highlights the novelty and relevance of our contribution. By exploring the relationship between treatment complexity and patient knowledge, our findings add to the existing literature and underscore the need for tailored educational interventions and more research in this area. Healthcare providers should consider the treatment regimen as a potential indicator of educational needs and priorities and patient-centered education to improve both knowledge and self-care practices.

Prior education on diabetic foot care was strongly and significantly associated with improved knowledge among participants, reinforcing the pivotal role of educational interventions in diabetes management. This association may be partially explained by demographic characteristics in our sample, including older age, longer diabetes duration, and a high prevalence of Type II DM—factors commonly linked to more intensive care, ongoing education, and regular engagement with healthcare providers. Notably, although 55.5% of participants reported not receiving foot care education from healthcare professionals, those who had received such education exhibited significantly higher knowledge levels. These findings are consistent with previous studies, which collectively highlight the positive impact of structured foot care education on patient knowledge and self-care behaviors [22–24,26,27,42]. Based on our results, we advocate for the integration of foot care education into routine diabetes care as a strategic approach to reducing foot-related complications and enhancing clinical outcomes. This recommendation is further supported by the International Working Group on the Diabetic Foot (IWGDF), which emphasizes the importance of educating at-risk individuals to promote effective foot self-care and prevent ulceration [20].

Diabetic foot complications represent a significant challenge in diabetes management, contributing substantially to patient morbidity and the overall burden on healthcare systems [6]. These complications, such as ulcers, infections, and amputations, are associated with prolonged hospitalizations, increased medical costs, and a marked decline in patients' quality of life. A key finding in our study was the significant association between the presence of visible foot problems and higher levels of diabetic foot care knowledge. Participants presenting with conditions such as amputations, callosities, nail pathologies, ulcers, or multiple visible issues demonstrated greater awareness compared to those with

non-visible complications, including circulation problems and parasthesia. This difference may be attributed to more frequent interactions with healthcare providers, longer disease duration, and increased exposure to foot care education as part of complication management. These findings are consistent with previous studies conducted in Iran [21], Ghana [22], Nigeria [23], the United Arab Emirates [27], Pakistan [24], Saudi Arabia [32,42], and Ethiopia [37], which similarly reported that individuals with diabetic foot complications tend to exhibit improved knowledge and self-care practices. However, this trend also highlights a critical gap in preventive care: individuals without visible foot problems may not receive adequate education or support until complications arise. This reactive approach delays early intervention and increases the risk of severe outcomes. As healthcare professionals, we have a responsibility to ensure that all individuals with diabetes, regardless of symptom presentation, receive comprehensive and proactive foot care education. Emphasizing early education, routine screening, and culturally appropriate interventions is essential to promote effective self-management and prevent the development of diabetic foot complications.

This study draws on a diverse sample from public healthcare facilities in Gauteng, enhancing contextual relevance. A structured, validated questionnaire supported methodological consistency. While key associations were identified, the statistical analysis was descriptive and constrained by the cross-sectional design. Additionally, the study addresses a critical public health issue in a resource-limited setting and offers actionable recommendations for integrating foot care education into routine diabetes management. Several limitations should be noted. The cross-sectional design limits causal inference, and the absence of a control group or longitudinal follow-up restricts assessment of temporal changes and intervention effects. Convenience sampling and reliance on self-reported data introduce potential selection, recall, and social desirability biases. Findings may not be generalizable beyond the public healthcare context in Gauteng. Additionally, income and geographic data were not collected, limiting sub-analyses based on socioeconomic or regional differences. Future studies should address these gaps using prospective, controlled designs with longitudinal follow-up.

5. Conclusions

This study highlights that while moderate adherence to diabetic foot care practices exists among patients in Gauteng Province, critical gaps remain, particularly in daily foot inspections and early preventive education. Factors such as age, type and duration of diabetes, treatment complexity, prior education, and the presence of foot complications significantly influence knowledge levels. However, demographic variables such as sex, marital status, and education level showed no significant impact. To address these gaps, it is essential to integrate structured foot care education into routine diabetes management, targeting younger and newly diagnosed patients, and tailoring interventions based on diabetes type and treatment regimen. Additionally, community engagement should be promoted by involving caregivers and community health workers in outreach efforts, thereby extending the reach of foot care awareness beyond clinical settings and fostering a more inclusive, preventive approach to diabetic foot care.

Author Contributions: T.M., T.P.M., S.B.K. and T.E.L., Conceptualization; T.M., T.P.M., S.B.K. and T.E.L., Methodology; T.M., T.P.M. and T.E.L., Validation; S.B.K., Formal Analysis; T.M., T.P.M. and S.B.K.; Investigation; T.M., T.P.M., S.B.K. and T.E.L., Resources; T.M., T.P.M. and S.B.K., Data Curation; T.M., T.P.M. and S.B.K., Writing—Original Draft Preparation; T.M., T.P.M., S.B.K. and T.E.L., Writing—Review and Editing; T.M., T.P.M. and T.E.L., Supervision; T.E.L., Project Administration; T.M. and T.P.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (M19/05/62, 19 September 2019).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be made available on request following receipt of authorization from our local ethics committee.

Acknowledgments: We sincerely appreciate the cooperation of participants and staff across all facilities that participated.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

DFI	Diabetic foot infection
DFU	Diabetic foot ulcer
DM	Diabetes mellitus
IDF	International Diabetes Federation
IWGDF	International Working Group on Diabetic Foot

References

1. Zhang, P.; Lu, J.; Jing, Y.; Zhu, D.; Bi, Y. Global epidemiology of diabetic foot ulceration: A systematic review and meta-analysis. *Ann. Med.* **2017**, *49*, 106–116. [CrossRef]
2. McDermott, K.; Fang, M.; Boulton, A.J.M.; Selvin, E.; Hicks, C.W. Etiology, epidemiology, and disparities in the burden of diabetic foot ulcers. *Diabetes Care* **2023**, *46*, 209–221. [CrossRef] [PubMed]
3. Hatem, M.A.; Kamal, D.M.; Yusuf, K.A. Diabetic foot limb-threatening infections: Case series and management review. *Int. J. Surg. Open* **2022**, *48*, 100568. [CrossRef]
4. Vuorlaakso, M.; Kiiski, J.; Salonen, T. Major amputation profoundly increases mortality in patients with diabetic foot infection. *Front. Surg.* **2021**, *8*, 655902. [CrossRef] [PubMed]
5. Chaudhary, N.; Huda, F.; Roshan, R. Lower limb amputation rates in patients with diabetes and an infected foot ulcer: A prospective observational study. *Wound Manag. Prev.* **2021**, *67*, 22–30. [CrossRef]
6. Rathnayake, A.; Saboo, A.; Malabu, U.H.; Falhammar, H. Lower extremity amputations and long-term outcomes in diabetic foot ulcers: A systematic review. *World J. Diabetes* **2020**, *11*, 391–399. [CrossRef] [PubMed]
7. International Diabetes Federation. *IDF Diabetes Atlas*, 11th ed.; International Diabetes Federation: Brussels, Belgium, 2025; Available online: https://diabetesatlas.org (accessed on 10 June 2025).
8. Garg, R.K. The alarming rise of lifestyle diseases and their impact on public health: A comprehensive overview and strategies for overcoming the epidemic. *J. Res. Med. Sci.* **2025**, *30*, 1. [CrossRef]
9. Chen, L.; Sun, S.; Gao, Y.; Ran, X. Global mortality of diabetic foot ulcer: A systematic review and meta-analysis of observational studies. *Diabetes Obes. Metab.* **2023**, *25*, 36–45. [CrossRef]
10. Khan, M.Z.; Smith, M.T.; Bruce, J.L.; Kong, V.Y.; Clarke, D.L. Evolving indications for lower limb amputations in South Africa offer opportunities for health system improvement. *World J. Surg.* **2020**, *44*, 1436–1443. [CrossRef]
11. Lane, K.L.; Abusamaan, M.S.; Voss, B.F.; Thurber, E.G.; Al-Hajri, N.; Gopakumar, S.; Le, J.T.; Gill, S.; Blanck, J.; Prichett, L.; et al. Glycemic control and diabetic foot ulcer outcomes: A systematic review and meta-analysis of observational studies. *J. Diabetes Complicat.* **2020**, *34*, 107638. [CrossRef]
12. Al-Rubeaan, K.; Al Derwish, M.; Ouizi, S.; Youssef, A.M.; Subhani, S.N.; Ibrahim, H.M. Diabetic foot complications and their risk factors from a large retrospective cohort study. *PLoS ONE* **2015**, *10*, e0124446. [CrossRef] [PubMed]
13. Wu, Y.; Ding, Y.; Tanaka, Y.; Zhang, W. Risk factors contributing to type 2 diabetes and recent advances in the treatment and prevention. *Int. J. Med. Sci.* **2014**, *11*, 1185–1200. [CrossRef]
14. Fan, Z.; Liu, Y.; Xie, H.; Yang, Q.; Zhang, G.; Zhang, P.; Ding, H. Analysis of risk factors for foot ulcers in diabetes patients with neurovascular complications. *BMC Public Health* **2025**, *25*, 792. [CrossRef]
15. Sachin, I.D.; Manasa, M.R.; Subhashree, P. Study of socio-demographic, behavioural and clinical risk factors of diabetic foot in a tertiary care centre. *Int. Surg. J.* **2021**, *8*, 2059. [CrossRef]

16. van Netten, J.J.; Sacco, I.C.N.; Lavery, L.A.; Monteiro-Soares, M.; Rasmussen, A.; Raspovic, A.; Bus, S.A. Treatment of modifiable risk factors for foot ulceration in persons with diabetes: A systematic review. *Diabetes Metab. Res. Rev.* **2020**, *36* (Suppl. S1), e3271. [CrossRef] [PubMed]
17. Mullan, L.; Driscoll, A.; Wynter, K.; Rasmussen, B. Barriers and enablers to delivering preventative and early intervention footcare to people with diabetes: A scoping review of healthcare professionals' perceptions. *Aust. J. Prim. Health* **2019**, *25*, 517–525. [CrossRef]
18. Somayaji, R.; Elliott, J.A.; Persaud, R.; Lim, M.; Goodman, L.; Sibbald, R.G. The impact of team-based interprofessional comprehensive assessments on the diagnosis and management of diabetic foot ulcers: A retrospective cohort study. *BMC Public Health* **2025**, *25*, 792. [CrossRef]
19. Turner, M.J.; Van Vuuren, S.; Leigh-de Rapper, S. Analysing patient factors and treatment impact on diabetic foot ulcers in South Africa. *South Afr. J. Sci.* **2024**, *120*. [CrossRef]
20. Bus, S.A.; Sacco, I.C.; Monteiro-Soares, M.; Raspovic, A.; Paton, J.; Rasmussen, A.; Lavery, L.A.; van Netten, J.J. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2023 update). *Diabetes Metab. Res. Rev.* **2020**, *40*, e3651. [CrossRef] [PubMed]
21. Pourkazemi, A.; Ghanbari, A.; Khojamli, M.; Balo, H.; Hemmati, H.; Jafaryparvar, Z.; Motamed, B. Diabetic foot care: Knowledge and practice. *BMC Endocr. Disord.* **2020**, *20*, 40. [CrossRef]
22. Tuglo, L.S. Knowledge and practice of diabetic foot care among patients in selected hospitals in the Volta Region, Ghana. *J. Diabetes Res.* **2021**, *19*, 601–614. [CrossRef]
23. Omotosho, T.O.; Sanyang, Y.; Senghore, T.; Jallow, M.; Bah, A.; Ceesay, S. Diabetic foot self-care knowledge and practice among patients with diabetes attending diabetic clinic in the Gambia. *Int. Wound J.* **2024**, *21*, e14963. [CrossRef] [PubMed]
24. Khuhro, B.A. Diabetic foot care: Knowledge and practices regarding foot care among diabetic patients in tertiary care hospital Nawabshah, Pakistan—A cross-sectional study. *Indo Am. J. Pharm. Sci.* **2019**, *6*, 11857–11864. [CrossRef]
25. Mekonen, T.; Demssie, G. Preventive foot self-care practices among diabetic patients in Northwest Ethiopia. *BMC Endocr. Disorders.* **2022**, *22*, 124. [CrossRef]
26. Chiwanga, F.S.; Njelekela, M.; Mwakalebela, M.; Mushi, D.; Mlay, G.; Mboya, T. Diabetic foot: Prevalence, knowledge, and foot self-care practices among diabetic patients in Dar es Salaam, Tanzania—A cross-sectional study. *J. Foot Ankle Res.* **2015**, *8*, 20. [CrossRef]
27. AlOwais, M.; Shido, O. Knowledge and practice of foot care in patients with diabetes mellitus attending primary care center at Security Forces Hospital, Riyadh, Saudi Arabia: A cross-sectional study. *J. Fam. Med. Prim. Care* **2020**, *9*, 5954–5960. [CrossRef]
28. Bekele, F.; Berhanu, D.; Alemu, G.; Tadesse, H.; Abebe, M.; Tesfaye, S. Knowledge and attitude on diabetic foot ulcer care and associated factors among diabetic mellitus patients on chronic care follow-up of Southwestern Ethiopian hospitals: A multicenter cross-sectional study. *Ann. Med. Surg.* **2021**, *72*, 103140. [CrossRef]
29. Hirpha, N.; Tatiparthi, R.; Mulugeta, T. Diabetic foot self-care practices among adult diabetic patients: A descriptive cross-sectional study. *Diabetes Metab. Syndr. Obes.* **2020**, *13*, 4779–4786. [CrossRef]
30. Dikeukwu, R.A.; Omole, O.B. Awareness and practices of foot self-care in patients with diabetes at Dr Yusuf Dadoo District Hospital, Johannesburg. *J. Endocrinol. Metab. Diabetes South Afr.* **2013**, *18*, 112–118. [CrossRef]
31. Goie, T.T.; Naidoo, M. Awareness of diabetic foot disease amongst patients with type 2 diabetes mellitus attending the chronic outpatients department at a regional hospital in Durban, South Africa. *Afr. J. Prim. Health Care Fam. Med.* **2016**, *8*, e1–e8. [CrossRef]
32. Aljaouni, M.; Alqahtani, F.; Alsharif, A.; Alzahrani, M.; Alghamdi, S.; Alharbi, M. Knowledge and practices regarding foot care among patients with type II diabetes. *J. Diabetes Res.* **2024**, *12*, 1244. [CrossRef]
33. Mullan, L.; Wynter, K.; Driscoll, A.; Rasmussen, B. Preventative and early intervention diabetes-related foot care practices in primary care. *Aust. J. Prim. Health* **2020**, *26*, 161–172. [CrossRef]
34. Song, K.; Chambers, A.R. Diabetic Foot Care. In *StatPearls*; StatPearls Publishing: Tampa, FL, USA, 2025. Available online: https://www.ncbi.nlm.nih.gov/books/NBK553110/ (accessed on 20 July 2025).
35. Lopes, G.S.G.; Landeiro, M.J.L.; Maciel, T.; Sousa, M.R.M.G.C. Clinical practice guidelines of foot care practice for patients with type 2 diabetes: A scoping review using self-care model. *Contemp. Nurse* **2024**, *60*, 516–536. [CrossRef] [PubMed]
36. Mullan, L.; Driscoll, A.; Wynter, K.; Rasmussen, B. Prioritisation of diabetes-related foot care amongst primary care healthcare professionals. *J. Clin. Nurs.* **2020**, *29*, 4653–4673. [CrossRef]
37. Letta, S.; Tadesse, H.; Abebe, M.; Tesfaye, S.; Alemu, G.; Bekele, F. Foot care practices and knowledge among type II diabetes patients attending a chronic ambulatory care unit in Eastern Ethiopia. *BMC Open* **2023**, *13*, e070023. [CrossRef]
38. Hynes, L.; Byrne, M.; Casey, D.; Dinneen, S.F. Barriers and facilitators associated with attendance at clinic appointments in adults with Type 1 diabetes. *J. Health Psychol.* **2016**, *21*, 1981–1991.
39. Sadeghi, M.A.; Raiesifar, A.; Aazami, S. Beyond Compliance: The Role of Self-Efficacy in Foot Care and Self-Management Among Patients With Type 1 Diabetes. *Sci. World J.* **2025**, *2025*, 8848211.

40. Sukartini, T.; Theresia Dee, T.M.; Probowati, R.; Arifin, H. Behaviour model for diabetic ulcer prevention. *J. Diabetes Metab. Disord.* **2020**, *19*, 135–143. [CrossRef]
41. Morrissey, E.C.; Casey, B.; Hynes, L.; Dinneen, S.F.; Byrne, M. Supporting self-management and clinic attendance in young adults with type 1 diabetes: Development of the D1 Now intervention. *Pilot Feasibility Stud.* **2021**, *7*, 186. [CrossRef]
42. Alharbi, M.O.; Sulaiman, A.A.; Alqahtani, F.; Alzahrani, M.; Alshahrani, A.; Alghamdi, S. Foot care knowledge, attitude and practices of diabetic patients: A survey in diabetes health care facility. *J. Fam. Med. Prim. Care* **2022**, *11*, 3816–3823. [CrossRef]
43. Alsaleh, F.M.; AlBassam, K.S.; Alsairaf, Z.K.; Naser, A.Y. Knowledge and practice of foot self-care among patients with diabetes attending primary healthcare centers in Kuwait: A cross-sectional study. *Saudi Pharm. J.* **2021**, *29*, 506–515. [CrossRef] [PubMed]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.