

Article

The Health-Related Quality of Life in Patients with Diabetic Foot Ulcers in Türkiye: Challenges in Diagnosis and Treatment

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Abstract

Background: Diabetes mellitus (DM) is a metabolic disease with an increasing global prevalence. It is characterized by chronic and systemic complications. Due to these complications, DM significantly impacts patients' health-related quality of life (HRQoL). One of the most critical complications of DM is diabetic foot ulcers (DFUs), which have serious consequences for patients and healthcare systems. **Objective:** This study aimed to investigate variables potentially associated with HRQoL in patients with DFUs presenting to our wound care unit. **Methods:** This prospective cross-sectional study was conducted from February to May of 2023 at the Wound Care Unit of the General Surgery Department at Eskişehir City Hospital. A total of 209 patients who agreed to participate were included in the study. Data were collected via a structured questionnaire developed based on the literature, which included the Diabetic Foot Ulcer Scale–Short Form (DFS-SF). We used the Kolmogorov–Smirnov test, univariate analyses (Mann–Whitney U and Kruskal–Wallis tests), and multiple linear regression. **Results:** In the multivariate analysis, receipt of foot care education ($p < 0.001$), frequency of hospital applications due to DFU ($p = 0.008$), and Wagner classification ($p = 0.012$) were found to be predictors of HRQoL for DFUs (Adjusted $R^2 = 0.206$, $F = 4.365$, $p < 0.001$). **Conclusions:** To maintain a high HRQoL among DFU patients, they should immediately apply to specialized Wound Care Units, receive education, especially regarding early diagnosis and treatment, and receive multidisciplinary management for DFU.

Keywords: diabetic foot ulcer; DFU; quality of life; QoL; DFS-SF; health-related quality of life; HRQoL



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1. Introduction

Diabetes mellitus (DM) is a metabolic disease with an increasing global prevalence. The condition is distinguished by its persistent, systemic complications. According to the predictions made by the World Health Organization (WHO), by the year 2030, it is expected to become the seventh leading cause of death worldwide [1]. As of 2021, the International Diabetes Federation (IDF) reported that 537 million adults across the globe were living with DM. In Turkey, the number exceeds 9 million [2]. Due to the complications associated with DM, it has a significant impact on patients' health-related quality of life (HRQoL). One of

the most critical complications associated with DM is diabetic foot ulcers (DFUs). A 2017 meta-analysis reported that the global prevalence of DFUs was approximately 6.3% [3].

DFUs have been shown to have significant ramifications for patients and healthcare systems alike. Individuals with DM have a 35% lifetime risk of developing a foot ulcer. The occurrence of ulceration has been documented in approximately 50% of patients following treatment. A significant proportion of amputations in individuals with DM are attributed to foot ulcers, with a five-year mortality rate following lower extremity amputation reaching 77%. Therefore, the identification of risk factors for DFUs and the close monitoring of high-risk patients are imperative [4,5]. The objective of this study was to investigate variables that may be associated with HRQoL in patients with DFU who presented at our wound care unit.

2. Materials and Methods

This prospective, cross-sectional study was conducted from February to May of 2023 in the Wound Care Unit of the General Surgery Department at Eskişehir City Hospital. Ethical approval was obtained from Eskişehir City Hospital's Non-Interventional Clinical Research Ethics Committee (date: 15 February 2023; decision no.: ESH/GOEK 2022/20), and administrative permission was granted by the hospital administration.

Given that 450 patients applied to the Wound Care Unit between February and May of 2022, the known population sample size method was used to calculate the required sample size for the study. The Epi Info™ version 5.5.18 (Centers for Disease Control and Prevention [CDC], Atlanta, GA, USA) program was utilized, and the following parameters were input: a frequency of 50%, a confidence interval of 95%, and a margin of error of 5%. The minimum sample size was calculated to be 207 patients. Patients aged ≥ 18 years with type 2 diabetes and an active diabetic foot ulcers (DFUs) were eligible for inclusion. Active DFU was defined as a pre-existing, open, and non-healed localized full-thickness ulceration due to diabetic neuropathy and/or peripheral arterial disease. Patients were excluded if they had recurrent ulcers, previous amputations, cognitive impairment, or communication difficulties that prevented completion of the questionnaire. Consecutive eligible patients admitted to the Wound Care Unit who agreed to participate were recruited until the calculated sample size was achieved during the study period. The study group consisted of 209 patients. Each patient was included in the study only once. No missing data were identified among the included participants.

For data collection purposes, a questionnaire was prepared based on information from the literature [6–10]. Patients completed the questionnaire through face-to-face interviews under the supervision of researchers. It included questions about sociodemographic characteristics (e.g., age, gender, and educational status), variables thought to be related to DFUs, and items from the Diabetic Foot Ulcer Scale–Short Form (DFS-SF).

In this study, health-related quality of life (HRQoL) of patients with DFUs was evaluated using the DFS-SF. The DFS-SF was developed by Bann et al. in 2003 [11]. It is a shortened version of the 64-item Diabetic Foot Ulcer Scale, which was developed in 2002. Toygar et al. established its validity and reliability in Turkish in 2020 [12]. The Diabetic Foot Ulcer Scale-Short Form (DFS-SF) contains 29 items. All items were reverse coded (new value = 6 – original value), and total scores were converted to a standardized 0–100 scale with the following formula: $\text{Score} = [(\text{sum} - \text{minimum possible score}) / \text{range}] \times 100$. The higher the score, the better the health-related quality of life. In the current study, the Cronbach's alpha coefficient of the DFS-SF was 0.956.

Patients' family income status was assessed as "poor," "moderate," or "good" based on their perceptions. Those who smoked at least one cigarette per day were considered

smokers, and those who consumed alcohol at least once a week were considered alcohol consumers [13–15].

We used the Wagner classification system to grade the severity of DFUs, which categorizes them into one of five grades. Grade 1: superficial wound. Grade 2: A deep wound that penetrates the tendon or joint capsule, but not the bone. Grade 3: A lesion involving deep tissues, abscess, or osteomyelitis. Grade 4: Localized gangrene. Grade 5: Generalized gangrene [16].

The data were analyzed using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, NY, USA). The Kolmogorov–Smirnov test and visual inspection were used to evaluate the normality of the DFS-SF scores. Mann–Whitney U and Kruskal–Wallis tests were used for group comparisons. A multiple linear regression model was constructed using significant variables from the univariate analyses (e.g., gender, income-generating work status, chronic disease status other than DM, psychiatric disease status, regular exercise status, health insurance status, DM diagnosis duration, initial DM diagnosis reason, foot care education receiving status, DFU duration, DFU hospital application frequency, DFU surgery status, and Wagner Classification). Nominal variables with more than two categories were dummy-coded in the regression model. Employment status and reason for initial DM diagnosis were dummy-coded with “retired” and “examination for other reason” as the reference categories, respectively. Tolerance and variance inflation factor (VIF) values were used to assess multicollinearity. Residual normality and homoscedasticity were assessed with residual histograms, normal P-P plots, and plots of standardized residuals against standardized predicted values. A *p*-value of ≤ 0.05 was considered statistically significant.

3. Results

The patient population comprised 66 (31.6%) female patients, 185 (88.5%) patients aged ≥ 50 years, and 114 (54.5%) patients with a primary education. The age range of the patients was from 30 to 81 years old, with a mean age of 62.5 years and a standard deviation of 11.0 years. The Diabetic Foot Ulcer Scale–Short Form (DFS-SF) scores ranged from 0 to 100, with a mean of 64.7 ± 24.0 and a median of 65.9. The study revealed that 103 (49.3%) of the patients had DFS-SF scores below the mean. The distribution of the scores of the study group from the DFS-SF according to some sociodemographic characteristics is given in Table 1.

Table 1. The distribution of the scores of the study group from the Diabetic Foot Ulcer Scale–Short Form according to some sociodemographic characteristics.

Sociodemographic Characteristics	<i>n</i> (%)	Diabetic Foot Ulcer Scale-Short Form Score Median (Min–Max)	<i>z</i> / <i>kW</i> ; <i>p</i> Value
Age Group			3.122; 0.211
30–49	24 (11.5)	73.7 (31.9–100.0)	
50–69	130 (62.2)	66.0 (0.0–100.0)	
≥70	55 (26.3)	60.7 (11.5–100.0)	
Gender			2.480; 0.013
Female	66 (31.6)	54.0 (0.0–100.0)	
Male	143 (68.4)	70.1 (21.3–100.0)	

Table 1. Cont.

Sociodemographic Characteristics	<i>n</i> (%)	Diabetic Foot Ulcer Scale-Short Form Score Median (Min–Max)	<i>z</i> /kW; <i>p</i> Value
Educational Status			
Literate	15 (7.2)	52.2 (0.0–96.4)	1.659; 0.436
Primary School	114 (54.5)	64.8 (11.5–100.0)	
Middle School and above	80 (38.3)	67.2 (20.8–100.0)	
Status Of Income-Generating Work			
Employed ^{a,b}	28 (13.4)	68.0 (22.7–100.0)	11.247; 0.010
Retired ^a	128 (61.2)	70.6 (20.8–100.0)	
Housewife ^b	42 (20.1)	50.0 (0.0–100.0)	
Unemployed ^{a,b}	11 (5.3)	55.2 (20.9–90.8)	
Status Of Family Income			
Poor	93 (44.5)	64.3 (11.5–100.0)	0.249; 0.883
Moderate	106 (50.7)	66.7 (0.0–100.0)	
Good	10 (4.8)	67.0 (22.7–100.0)	
Place of Residence			
City	165 (78.9)	66.7 (0.0–100.0)	0.003; 0.999
District	25 (12.0)	65.9 (20.9–97.3)	
Village	19 (9.1)	60.7 (21.3–100.0)	
Body Mass Index			
Normal	65 (31.1)	60.7 (20.8–100.0)	0.413; 0.814
Overweight	84 (40.2)	65.5 (21.1–100.0)	
Obese	60 (28.7)	72.9 (0.0–100.0)	
Chronic Diseases Other Than DM			
No	61 (29.2)	78.8 (20.8–100.0)	2.281; 0.023
Yes	148 (70.8)	61.3 (0.0–100.0)	
Psychiatric Diseases			
No	178 (85.2)	66.7 (20.9–100.0)	2.102; 0.036
Yes	31 (14.8)	57.1 (0.0–100.0)	
Smoking			
No	156 (74.6)	64.3 (0.0–100.0)	0.843; 0.399
Yes	53 (25.4)	67.5 (20.8–100.0)	
Alcohol Use			
No	199 (95.2)	64.3 (0.0–100.0)	1.099; 0.272
Yes	10 (4.8)	76.8 (34.2–100.0)	
Regular Exercise			
No	157 (75.1)	62.2 (0.0–100.0)	2.302; 0.021
Yes	52 (24.9)	75.0 (20.8–100.0)	

Table 1. Cont.

Sociodemographic Characteristics	<i>n</i> (%)	Diabetic Foot Ulcer Scale-Short Form Score Median (Min–Max)	<i>z</i> /kW; <i>p</i> Value
Health Insurance			
None	15 (7.2)	39.6 (0.0–90.8)	2.121; 0.034
Available	194 (92.8)	66.7 (20.8–100.0)	
Total	209 (100)	65.9 (0.0–100.0)	

DM: diabetes mellitus; a,b; Groups without the same superscript letter differ significantly in Bonferroni-adjusted pairwise comparisons ($p \leq 0.05$).

A total of 148 patients (70.8%) reported having chronic diseases other than DM. The health-related quality of life (HRQoL) for diabetic foot ulcers (DFUs) was found to be statistically lower among patients with additional chronic diseases, as indicated by a *p*-value of 0.023. The prevalence of chronic diseases among the patient population was as follows: hypertension (42.2%), cardiovascular disease (36.4%), kidney disease (16%), other (4.8%), chronic obstructive pulmonary disease (4.4%), eye disease (2.9%), and asthma (1.5%).

Forty-seven patients (22.5%) had a duration of DM > 20 years, and 54 (25.8%) were diagnosed incidentally. The majority of patients (63.6%) had a foot ulcer for less than one year, and only 87 (41.6%) reported receiving foot care education. The HRQoL for DFUs was found to be lower in patients with a duration of DM for more than two decades when compared to patients with a duration of DM for less than ten years. Furthermore, the HRQoL for DFUs was found to be lower in patients with a duration of DFUs for more than ten years when compared to patients with a duration of DFUs for less than one year. The distribution of scores obtained from the DFS-SF by the study group, according to various factors thought to be associated with DFU, is given in Table 2.

Table 2. The distribution of scores obtained from the Diabetic Foot Ulcer Scale–Short Form by the study group, according to various factors thought to be associated with diabetic foot ulcer.

Associated Factors	<i>n</i> (%)	Diabetic Foot Ulcer Scale-Short Form Score Median (Min–Max)	<i>z</i> / <i>kW</i> ; <i>p</i> Value
Duration of DM Diagnosis (years)			
<10	46 (22.0)	75.4 (20.9–100.0)	6.840; 0.033
10–20	116 (55.5)	66.7 (0.0–100.0)	
>20	47 (22.5)	55.8 (20.8–100.0)	
Reason for Initial DM Diagnosis			
Examination for another reason ^a	103 (49.3)	62.5 (0.0–100.0)	8.241; 0.016
Incidentally blood glucose measurement ^b	54 (25.8)	79.0 (25.0–100.0)	
Symptom-related examination ^a	52 (24.9)	58.2 (11.5–98.3)	
Frequency of DM Control			
≥3 per month	99 (47.4)	65.9 (0.0–100.0)	0.977; 0.614
≤6 per month	35 (16.7)	64.4 (20.8–100.0)	
No regular check-ups	75 (35.9)	66.7 (20.9–100.0)	
DM Treatment			
None	18 (8.6)	56.4 (21.3–95.8)	2.709; 0.439
Insulin	69 (33.0)	70.8 (20.8–100.0)	

Table 2. Cont.

Associated Factors	<i>n</i> (%)	Diabetic Foot Ulcer Scale-Short Form Score Median (Min–Max)	<i>z</i> / <i>kW</i> ; <i>p</i> Value
DM Treatment			
Oral antidiabetic	47 (22.5)	67.2 (20.8–100.0)	2.709; 0.439
Insulin + Oral antidiabetic	75 (35.9)	65.9 (0.0–100.0)	
Complications Related to DM			
No	188 (90.0)	65.6 (0.0–100.0)	0.426; 0.670
Yes	21 (10.0)	69.4 (21.9–100.0)	
Status of Receiving Foot Care Education			
No	122 (58.4)	64.8 (0.0–97.3)	2.151; 0.031
Yes	87 (41.6)	66.7 (32.8–100.0)	
Duration of DFU (years)			
<1 ^a	133 (63.6)	70.8 (20.8–100.0)	8.686; 0.013
1–10 ^{a,b}	66 (31.6)	61.5 (0.0–100.0)	
>10 ^b	10 (4.8)	51.9 (11.5–66.8)	
Frequency of Hospital Application Due to DFU			
0 ^a	102 (48.8)	75.3 (20.8–100.0)	18.612; <0.001
1–2 ^a	55 (26.3)	61.0 (29.1–100.0)	
≥3 ^b	52 (24.9)	52.8 (0.0–100.0)	
Surgery Due to DFU			
No	167 (79.9)	67.5 (0.0–100.0)	2.013; 0.044
Yes	42 (20.1)	56.0 (11.5–100.0)	
Wagner Classification			
1.2.3	176 (84.2)	67.0 (0.0–100.0)	2.187; 0.029
4.5	33 (15.8)	55.8 (20.8–100.0)	
Total	209 (100)	65.9 (0.0–100.0)	

DM: diabetes mellitus; DFU: diabetic foot ulcer; a,b; Groups without the same superscript letter differ significantly in Bonferroni-adjusted pairwise comparisons ($p \leq 0.05$).

A significant proportion of the patient population, specifically 48.8%, had not received any treatment for DFU. Among the treated population, 24.9% had three or more hospital applications. According to the study group, patients with DFUs who frequently have three or more hospital applications have a lower quality of life (QoL) ($p < 0.001$). The departments providing care were as follows: orthopedics (27.5%), plastic surgery (21.9%), general surgery (11.9%), internal medicine (10.6%), infectious diseases (10%), cardiovascular surgery (6.8%), dermatology (4.4%), family medicine (3.1%), hyperbaric medicine (1.9%), and other (1.9%).

A multiple linear regression analysis was conducted to ascertain the variables associated with HRQoL for DFUs. The study found that the following variables were significant predictors of HRQoL for DFUs in univariate analysis: gender, status of income-generating work, status of chronic disease other than DM, status of psychiatric disease, status of regular exercise, status of health insurance, duration of DM diagnosis, reason for initial DM diagnosis, status of receiving foot care education, duration of DFU, frequency of hospital applications due to DFU, status of surgery due to DFU, and Wagner Classification. The study also found that receipt of foot care education ($p < 0.001$), frequency of hospital

applications due to DFU ($p = 0.008$), and Wagner classification ($p = 0.012$) were significant predictors of HRQoL for DFUs (Adjusted $R^2 = 0.206$, $F = 4.365$). The findings of the multiple linear regression analysis, which was developed using the variables that were found to be associated with HRQoL for DFUs, are presented in Table 3.

Table 3. The findings of the multiple linear regression analysis, which was developed using the variables that were found to be associated with health-related quality of life for diabetic foot ulcers.

Variables	Standardize Beta	Unstandardize Beta	%95 CI	<i>p</i> Value
Gender	0.071	3.662	−6.050–13.374	0.458
Status of Income-Generating Work				
Employed	0.017	1.228	−7.830–10.286	0.789
Housewife	−0.063	−3.756	−15.477–7.965	0.528
Unemployed	−0.039	−4.198	−20.300–11.904	0.608
Status of Chronic Disease Other Than DM	−0.097	−5.086	−12.271–2.098	0.164
Status of Psychiatric Disease	−0.124	−8.373	−17.131–0.386	0.061
Status of Regular Exercise	0.073	4.068	−3.024–11.159	0.259
Status of Health Insurance	0.122	11.357	−2.546–25.259	0.109
Duration of DM Diagnosis	−0.041	−1.195	−4.970–2.581	0.533
Reason for Initial DM Diagnosis				
Incidentally blood glucose measurement	0.119	6.487	−0.930–13.905	0.086
Symptom-related examination	−0.041	−2.282	−9.852–5.288	0.553
Status of Receiving Foot Care Education	0.238	11.557	5.156–17.959	<0.001
Duration of DFU	−0.033	−1.365	−7.529–4.798	0.663
Frequency of Hospital Applications Due to DFU	−0.219	−6.373	−11.071–(−1.676)	0.008
Status of Surgery Due to DFU	−0.054	−3.199	−11.626–5.229	0.455
Wagner Classification	−0.169	−11.091	−19.722–(−2.460)	0.012
Adjusted R^2		0.206		<0.001
F		4.365		

DM: diabetes mellitus; DFU: diabetic foot ulcer; CI: 95% confidence interval for the unstandardized regression coefficient (B); Adjusted R^2 : adjusted coefficient of determination; F: Test value; Reference categories: retired (status of income-generating work) and examination for another reason (reason for initial DM diagnosis).

4. Discussion

Diabetic foot ulcers (DFUs) represent the most severe and disabling complication of DM, exerting a detrimental impact on patients' physical, psychological, and social well-being. The financial implications of these ulcers are significant, given the associated risks of infection, amputation, and mortality. Accordingly, current National Institute for Health and Care Excellence (NICE) guidelines and the recommendations of the International Working Group on Diabetic Foot (IWGDF) emphasize regular foot assessment, risk stratification, patient education, and multidisciplinary management as key components for the prevention and management of diabetic foot complications [17,18]. The findings of this study are consistent with those of previous research, which indicates that DFUs have a substantial impact on quality of life (QoL).

It is well-known that patients with DFU are hospitalized much more frequently than patients with non-diabetic conditions. Therefore, DFUs account for a significant portion of healthcare expenses. Most of these expenses are incurred for infected DFUs, which can be prevented [19]. Earlier wound management is crucial to reducing this economic burden, preventing disability, and improving QoL by preventing DFUs from progressing to more advanced stages and resulting in amputation. Therefore, these patients should receive prompt treatment in specialized wound care units. The present study found that the frequency of hospital applications due to DFUs significantly impacts health-related quality of life (HRQoL). A study by Nemcova et al. reported that patients with a lower frequency of diabetic ulceration had a higher QoL [20]. A deterioration in QoL has been reported in patients with recurrent DFUs [21]. Studies examining the frequency of hospital applications due to DFUs and HRQoL are very limited in the literature. Further studies on this topic could emphasize the importance of patients immediately consulting wound care units, which are the most relevant units for this condition. This could prevent DFUs from progressing to infection, amputation, and disability, thus improving patients' HRQoL.

Foot care education for patients with DFUs is known to prevent recurrence and reduce amputation rates [22]. Therefore, it is an important factor in improving QoL in the management of DFUs. In our study, we found that foot care education positively impacted HRQoL in patients with DFUs. Several studies have also reported an increase in HRQoL among DFU patients who received foot care education [20,23,24]. The similar results obtained in these studies suggest that health education, a preventive health service, should be integrated into DFU management.

The severity of DFUs is determined by the Wagner classification, which takes into account ulcer depth, the presence of osteomyelitis, or the development of gangrene [25]. According to the Wagner classification, as ulcer severity increases, the risk of infection, amputation, and disability escalates, resulting in a diminished QoL in patients with higher-grade DFUs. The present study found that ulcer severity, according to the Wagner classification, is a significant determinant of HRQoL for DFUs. A similar observation was reported in a study by Mairgani et al., which found that the severity of ulcerations according to the Wagner classification can influence the HRQoL of patients with DFUs [26]. In the study by Nemcova et al., patients with DFUs classified as higher Wagner categories reported lower physical, psychological, and environmental QoL according to the WHOQOL-BREF [20]. Several studies, evaluated using the SF-36 Health Questionnaire, have also reported that the Wagner classification affects the HRQoL of patients with diabetic foot ulcers [27–29]. Despite the utilization of disparate HRQoL scales in the aforementioned studies, the attainment of analogous results suggests the feasibility of employing these scales as a standard instrument in DFU management.

4.1. Implications for Clinical Practice

The present study identified several implications. A multidisciplinary approach should be adopted for diabetic foot ulcer (DFU) management. Health inequalities in DFU management can be prevented through social security coverage and community-based wound care services. Foot care education should be routinely included in DFU management. Patients should seek care at Wound Care Units first in DFU management. Routine use of (health-related quality of life) HRQoL scales, such as the Diabetic Foot Ulcer Scale–Short Form (DFS-SF), in DFU management can guide patient treatment.

4.2. Strengths and Limitations

The strengths of our study include the use of a disease-specific health-related quality of life (HRQoL) scale (Diabetic Foot Ulcer Scale–Short Form) for diabetic foot ulcers (DFUs)

and the examination of HRQoL-related variables in DFU patients, which are very limited in the literature. However, because this is a prospective cross-sectional study, it is limited in its ability to establish causality between the two variables, as the temporal sequence of the observed associations cannot be determined. Additionally, the study's limitations include its focus on a single hospital's Wound Care Unit and the reliance on patient self-report for psychiatric assessment and foot care education status.

5. Conclusions

This study clearly demonstrated that the health-related quality of life (HRQoL) of patients with diabetic foot ulcers (DFUs) is influenced by numerous factors. Multivariate analysis receipt of foot care education, frequency of hospital applications due to DFU, and Wagner classification were predictors of HRQoL for DFUs. These findings further support the current National Institute for Health and Care Excellence (NICE) and International Working Group on Diabetic Foot (IWGDF) recommendations and highlight the importance of comprehensive diabetic foot management and patient-centered care in improving outcomes in people with DFUs. This study concluded that, to maintain a high HRQoL, patients with DFUs should seek care at wound care units specializing in this disease without delay. Education should be provided, particularly regarding early diagnosis and treatment, and a multidisciplinary approach should be adopted in DFU management.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Noninterventional Clinical Research Ethics Committee of Eskişehir City Hospital (Protocol code: ESH/GOEK 2022/2, dated 23 February 2023).

Informed Consent Statement: Informed consent was obtained from all individual participants included in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions concerning participant confidentiality.

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Conflicts of Interest: The authors have declared that they have no conflicts of interest.

Abbreviations

DM	Diabetes mellitus
DFU	Diabetic foot ulcer
QoL	Quality of life
DFS-SF	Diabetic Foot Ulcer Scale–Short Form
HRQoL	Health-related quality of life

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