Original article

Factors associated with foot self-care behaviors among patients with type 2 diabetes mellitus at Son Tra Regional Medical Center

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Abstract

Background: Foot ulcers are a serious complication among patients with type 2 diabetes mellitus, while foot self-care practices in primary healthcare settings remain suboptimal. In addition, factors associated with foot self-care behaviors have not yet been fully elucidated.

Objectives: To identify factors associated with foot self-care behaviors among patients with type 2 diabetes mellitus receiving outpatient care at Son Tra Regional Medical Center.

Materials and methods: A cross-sectional descriptive study was conducted among 248 outpatients with type 2 diabetes mellitus receiving treatment at Son Tra Regional Medical Center from April to August 2024. Data were collected using the Diabetes Foot Knowledge Questionnaire (DFKQ), Diabetes Foot Care Self-Efficacy Scale (DFCSES), Diabetes Self-Management Questionnaire (DSMQ), and Foot Self-Care Behavior Scale (DFSBS).

Results: The mean age of the 248 study participants was 63.92 ± 9.97 years. For routine daily foot self-care behaviors (DFSBS-1), significant independent associated factors included longer duration of diabetes ($p = 0.031$), higher body mass index (BMI) ($p = 0.021$), and higher self-efficacy (DFCSES, $p < 0.001$). For specific preventive behaviors (DFSBS-2), independent associated factors included better foot-care knowledge (DFKQ, $p = 0.011$), higher self-efficacy (DFCSES, $p < 0.001$), and routine daily foot self-care behaviors (DFSBS-1, $p < 0.001$). Overall self-management (DSMQ) was not independently significantly associated with either dimension of foot self-care behaviors ($p = 0.284$).

Conclusion: Health education and interventions to enhance self-efficacy should be strengthened to improve foot self-care behaviors among patients with type 2 diabetes mellitus.

Keywords: *Type 2 diabetes mellitus; foot self-care behaviors; self-efficacy; self-management.*

1. INTRODUCTION

Diabetes mellitus (DM) is rapidly increasing worldwide, placing a substantial burden on healthcare systems and causing serious complications such as blindness, renal failure, and, particularly, diabetic foot ulcers (DFUs), which may ultimately lead to limb amputation [1]. Diabetic foot ulcers are defined as ulcers occurring on the foot, including areas below the ankle such as the dorsum, plantar surface, heel, and toes, in individuals with diabetes mellitus [2]. According to the International Diabetes Federation, approximately 9.1 – 26.1 million people with diabetes develop diabetic foot ulcers annually [2]. In 2023, approximately 7 million people in Vietnam were living with diabetes. Notably, more than 55% of these individuals had developed complications, including cardiovascular complications (34%), ocular and neurological complications (39.5%), and renal complications (24%). Diabetes-related complications not only increase healthcare costs but also adversely affect patients' quality of life [3]. National statistics on diabetic foot ulcers in Vietnam are currently unavailable; however, several studies have reported that the prevalence of foot ulcers among hospitalized patients with diabetes is approximately 20% [2]. Evidence-based foot self-care practices have been demonstrated to be the most cost-effective primary prevention strategy for reducing the burden of diabetic foot ulcers [4]. However, previous studies have mainly focused on assessing general knowledge or overall glycemic control. The role of cognitive-behavioral factors, particularly self-efficacy and self-management, in foot self-care behaviors remains inconsistent across studies, with some authors reporting no significant association [5]. In addition, empirical evidence from primary healthcare settings remains limited. The simultaneous assessment of knowledge (DFKQ), overall self-management (DSMQ), and self-efficacy (DFCSES) is clinically important. Overall diabetes self-management (DSMQ) represents systematic adherence to whole-body diabetes treatment, such as medication

adherence, dietary practices, and blood glucose monitoring [6]. In contrast, foot self-care requires specific, localized physical practices. A patient may adhere well to overall diabetes treatment but still neglect foot care if they lack specific knowledge or self-efficacy. According to Bandura's Social Cognitive Theory, self-efficacy is a core cognitive association of the initiation and maintenance of behavior [7]. This study also clearly distinguishes between two dimensions of foot self-care behaviors: DFSBS-1 (routine daily foot self-care, measured by the number of days per week; score range, 0 – 28) and DFSBS-2 (specific preventive behaviors, measured using a 5-point Likert scale; score range, 0 – 15) [8]. This distinction is essential from both methodological and clinical perspectives. Because the two scales use different units of measurement, combining them would obscure the specific characteristics of the behaviors assessed. Clinically, establishing routine daily foot self-care (DFSBS-1) provides a behavioral foundation for adopting specific preventive practices (DFSBS-2). Therefore, this study was conducted to: (1) Describe the demographic characteristics and associated factors, including knowledge, self-management, and self-efficacy related to foot self-care behaviors. (2) Identify factors associated with foot self-care behaviors among outpatients with type 2 diabetes mellitus receiving treatment at Son Tra Regional Medical Center.

2. MATERIALS AND METHODS

2.1. Study participants

The study included 248 patients diagnosed with type 2 diabetes mellitus (T2DM). Eligible participants were aged ≥18 years, receiving outpatient treatment at Son Tra Regional Medical Center, able to hear, see, understand, read, and communicate in Vietnamese, able to use a mobile phone for communication, capable of answering the study questionnaire, without a history of limb amputation, and willing to voluntarily participate in the study.

Participants aged 18 years and older were selected to ensure they had the legal capacity to provide written informed consent and possessed the cognitive and physical abilities required to independently comprehend the questionnaire and perform lower-limb self-care behaviors. At the time of the interview, participants cooperated in the measurement of body mass index (BMI), including height and body weight.

2.2. Study design

A descriptive cross-sectional study design was employed.

2.3. Sample size and sampling method

The minimum sample size was calculated using the formula for estimating a proportion in a descriptive study, resulting in n = 246. Accounting for a 10% attrition rate, the study approached 273 patients and obtained 248 valid questionnaires (a response rate of 90.8%). This sample size also met Green's criterion (n ≥ 50 + 8m) for multivariate regression analysis. Study participants were selected using a convenience sampling method.

2.4. Research instruments and study variables

Demographic characteristics: Age, gender, BMI, duration of illness, marital status, education level.

Knowledge (DFKQ): Knowledge of foot self-care was assessed using the Diabetes Foot Knowledge Questionnaire (DFKQ; 5 items), derived from the DKQ-24 and developed by Garcia et al. [9]. The response options for the DFKQ were: (1) True, (2) False, and (3) I don't know. The scale demonstrated a Cronbach's alpha coefficient of 0.58. While a reliability coefficient of 0.58 is relatively low compared to Likert-scale psychological instruments, it is widely considered acceptable in clinical literature for short cognitive or knowledge-based scales (comprising only 5 dichotomous items) that measure heterogeneous domains of knowledge rather than a single homogenous psychological construct.

Self-efficacy (DFCSES): The Diabetes Foot Care Self-Efficacy Scale (DFCSES), consisting of 9 items, was developed by Quarles. Self-efficacy was assessed using a scale ranging from 0 to 10, with 0 indicating the lowest perceived ability and 10 indicating the highest perceived ability. The Turkish version of this instrument demonstrated high internal consistency, with a Cronbach's alpha coefficient of 0.86, as reported by Emine et al. [8]. In the present study, the translated Vietnamese version of the DFCSES demonstrated consistency, with a Cronbach's alpha coefficient of 0.870.

Self-management (DSMQ): The questionnaire was developed at the Research Institute of the Diabetes Center Mergentheim. The Diabetes Self-Management Questionnaire (DSMQ) consists of 16 items structured into four subscales/domains: "Glucose Management" (5 items: 1, 4, 6, 10, and 12), "Dietary Control" (4 items: 2, 5, 9, and 13), "Physical Activity" (3 items: 8, 11, and 15), and "Health-Care Use" (3 items: 3, 7, and 14). In addition, one item (item 16) assesses overall self-care and is combined with the other 15 items to calculate the total score ("Sum Scale"). The items are rated on a 4-point Likert scale ranging from 0 ("does not apply to me") to 3 ("very much applies to me"). Negatively worded items are reverse-scored. Item

scores are summed and transformed to a 0–10 scale, with higher scores indicating better self-management behaviors. In the original validation study by Schmitt et al., reliability (Cronbach's alpha) was 0.84 for the Sum Scale and ranged from 0.60 to 0.77 across the four subscales [6].

Foot self-care behaviors (DFSBS): The Diabetes Foot Self-Care Behavior Scale (DFSBS) consists of 7 items divided into two sections (DFSBS-1, measured by the number of days; and DFSBS-2, measured by frequency). Developed by Chin and Huang, the scale assesses seven foot self-care behaviors. A five-point Likert scale is used to assess the frequency with which participants perform foot self-care behaviors. The DFSBS demonstrated a two-week test–retest reliability of 0.95. In the present study, the scale demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.73 [10]. The DFSBS consists of 7 items divided into two separate sections due to their different scoring systems and clinical focuses. DFSBS-1 (4 items) measures the frequency of basic daily routine foot care behaviors (such as washing and inspecting feet) based on the number of days per week (ranging from 0 to 7 days, total score 0 – 28). In contrast, DFSBS-2 (3 items) measures more specific preventive and response behaviors (such as applying moisturizer or inspecting the inside of shoes) using a 5-point Likert scale (total score 0 – 15). Because of these distinct measurement metrics, scoring systems, and clinical implications, the two subscales cannot be aggregated into a single total score and must be analyzed as two separate dependent variables representing different dimensions of foot self-care.

The questionnaires used in this study were translated from the original English versions into Vietnamese following the WHO forward–backward translation procedure. The Vietnamese versions were reviewed and assessed for semantic clarity and cultural appropriateness by a panel of three experts, comprising one clinician and two clinical nurses. Feedback from the expert panel was incorporated to revise and refine the relevant professional terminology before the questionnaires were administered for field data collection.

2.5. Data analysis

Data were analyzed using SPSS version 20.0, employing the t-test, one-way ANOVA, Pearson correlation, and multivariable linear regression. To identify factors associated with the two distinct dimensions of foot self-care, two separate multivariable linear regression models were constructed. Model 1 used DFSBS-1 as the dependent variable to examine factors associated with basic routine daily foot self-care. Model 2 used DFSBS-2 as the dependent variable to examine factors associated with specific preventive behaviors. In Model 2, DFSBS-1 was included as an independent variable based on clinical considerations. Before performing multivariable linear regression, all statistical assumptions were thoroughly assessed to ensure model validity. Multicollinearity among the independent variables was assessed using the variance inflation factor (VIF); a VIF threshold of < 5 (and Tolerance > 0.2) was considered indicative of no substantial multicollinearity.

2.6. Ethical considerations

The study was approved by the Biomedical Research Ethics Committee of Son Tra Regional Medical Center, Da Nang, under approval No. 2024.25.14 in April 2024.

3. RESULTS

3.1. Demographic characteristics of the study participants.

Table 1. Demographic characteristics of the study participants (n = 248)

Characteristics		N	Percentage	Mean ±SD
Duration of type 2 diabetes mellitus				7.06 (± 6.02)
Gender	1. Male	76	30.6%	
	2. Female	172	69.4%	
BMI	1. Underweight	2	0.8%	
	2. Normal weight	128	51.6%	
	3. Overweight	64	25.8%	
	4. Obesity (Class 1)	48	19.4%	
	5. Obesity (Class 2)	6	2.4%	

Age group	1. 18 – 35 years	1	0.4%
	2. 36 – 59 years	79	31.9%
	3. 60 years and older	168	67.7%
Educational level	1. Primary school	18	7.3%
	2. Lower secondary school	48	19.4%
	3. Upper secondary school	157	63.3%
	4. Vocational school/College	23	9.3%
	5. University/Postgraduate	2	0.8%
Marital status	1. Never married	3	1.2%
	2. Married	244	98.4%
	3. Divorced	1	0.4%
Ethnicity	1. Kinh	248	100%
	2. Other	0	0%
Occupation	1. Government/Public employee	55	22.2%
	2. Worker	56	22.6%
	3. Business/Self-employed	40	16.1%
	4. Homemaker	42	16.9%
	5. Other	55	22.2%

The mean age of the participants was 63.92 years (SD = 9.967); females accounted for the majority (69.4%). The mean duration of diabetes was 7.06 years. A total of 51.6% of participants had a normal BMI. Regarding educational level, 157 participants (63.3%) had completed high school.

3.2. Associations and correlations between demographic and clinical characteristics and foot self-care behavioral factors.

3.2.1. Comparison of knowledge, self-management, self-efficacy, and foot self-care behaviors by gender.

Table 2. Comparison of mean scores for knowledge, self-management, self-efficacy, and foot self-care behaviors by gender (n = 248)

Measurement Scale	Male (n = 76) Mean ± SD	Female (n = 172) Mean ± SD	t	df	p
DFKQ	2.24 ± 1.09	2.20 ± 0.88	0.276*	119.35	0.783
DSMQ	29.54 ± 4.69	30.15 ± 4.96	-0.911	246.00	0.363
DFCSES	55.34 ± 12.03	57.12 ± 10.47	-1.174	246.00	0.241
DFSBS-1	17.49 ± 7.16	18.78 ± 5.88	-1.388*	121.65	0.168
DFSBS-2	9.93 ± 2.07	9.94 ± 1.69	-0.028*	121.09	0.977

The results showed no statistically significant differences between males and females in terms of knowledge (p = 0.783), self-management (p = 0.363), self-efficacy (p = 0.241), or either dimension of foot self-care behaviors, as measured by DFSBS-1 (p = 0.168) and DFSBS-2 (p = 0.977).

3.2.2. Differences in mean scores for knowledge, self-management, self-efficacy, and foot self-care behaviors by educational level, occupation, and marital status.

Table 3. Comparison of mean scores for knowledge, self-management, self-efficacy, and foot self-care behaviors by educational level, occupation, and marital status (n = 248)

Characteristics		DFKQ			DSMQ			DFCSES		
		Mean ± SD	F	p	Mean ± SD	F	p	Mean ± SD	F	p
Educational level	1. Primary school	2.28 ± 0.90	0.410	0.801	27.94 ± 5.15	1.030	0.392	58.22 ± 9.23	1.156	0.331
	2. Lower secondary school	2.21 ± 0.99			29.94 ± 4.75			54.96 ± 9.26		
	3. Upper secondary school	2.20 ± 0.89			30.05 ± 4.93			56.27 ± 11.13		
	4. Vocational school/ College	2.13 ± 1.25			30.96 ± 4.51			60.35 ± 14.14		
	5. University/ Postgraduate	3.00 ± 1.41			30.50 ± 4.95			61.00 ± 1.41		
Marital status	1. Never married	2.00 ± 0.00	2.862	0.059	32.67 ± 1.16	0.465	0.629	54.33 ± 2.31	0.723	0.486
	2. Married	2.22 ± 0.94			29.93 ± 4.91			56.65 ± 11.03		
	3. Divorced	0.00 ± 0.00			30.00 ± 0.00			44.00 ± 0.00		
Occupation	1. Government/ Public employee	2.38 ± 0.97	1.798	0.130	30.69 ± 4.71	1.235	0.297	57.58 ± 10.70	2.000	0.095
	2. Worker	2.27 ± 0.90			30.61 ± 4.96			54.91 ± 11.10		
	3. Business/ Self-employed	1.88 ± 0.94			29.85 ± 5.05			56.23 ± 12.54		
	4. Homemaker	2.19 ± 0.94			28.83 ± 4.82			60.19 ± 8.15		
	5. Other	2.24 ± 0.94			29.53 ± 4.82			54.75 ± 11.39		

The results showed no statistically significant differences in knowledge, self-management, self-efficacy scores across educational levels, marital status, and occupational groups ($p > 0.05$).

3.2.3. Correlation between age, diabetes duration, BMI and knowledge, self-management, self-efficacy, and foot self-care behaviors.

Table 4. Correlation coefficients between age, diabetes duration, BMI, knowledge, self-management, self-efficacy, and foot self-care behaviors (n=248)

Variable	1	2	3	4	5	6	7	8
1. Age	1							
2. Diabetes duration	0.300**	1						
3. BMI	-0.115	-0.122	1					
4. DFKQ	0.070	0.236**	-0.085	1				
5. DSMQ	-0.237**	-0.118	-0.058	-0.021	1			
6. DFCSES	0.020	0.126*	0.177**	-0.009	-0.300**	1		

7. DFSBS-1	0.125*	0.197**	0.188**	-0.045	-0.143*	0.545**	1	
8. DFSBS-2	-0.033	0.195**	0.002	0.128*	-0.070	0.543**	0.518**	1

***. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).*

Foot self-care behavior 1 (DFSBS-1) was positively correlated with self-efficacy (DFCSES: r = 0.545; p < 0.001), as well as with diabetes duration (r = 0.197; p = 0.002), BMI (r = 0.188; p = 0.003), and age (r = 0.125; p = 0.049). In contrast, overall diabetes self-management (DSMQ) showed a weak negative correlation with DFSBS-1 (r = −0.143; p = 0.024). For foot self-care behavior 2 (DFSBS-2), positive correlations were observed with self-efficacy (DFCSES: r = 0.543; p < 0.001) and daily self-care practices (DFSBS-1: r = 0.518; p < 0.001). In addition, DFSBS-2 was positively correlated with diabetes duration (r = 0.195; p = 0.002) and foot care knowledge (DFKQ: r = 0.128; p = 0.044).

3.3. Factors associated with foot self-care behaviors among patients with diabetes mellitus

3.3.1. Factors associated with routine daily foot self-care behaviors (DFSBS-1)

Table 5. Factors associated with routine daily foot self-care behaviors (DFSBS-1) (n=248)

Variables	B	SE	β	95% CI	VIF	p
Age	0.068	0.036	0.107	(-0.003; 0.139)	1.168	0.060
Duration of DM	0.127	0.058	0.121	(0.013; 0.241)	1.133	0.031
BMI	0.303	0.130	0.126	(0.048; 0.558)	1.064	0.021
Self-management (DSMQ)	0.079	0.073	0.061	(-0.064; 0.222)	1.169	0.284
DFCSES (Self-efficacy)	0.301	0.032	0.524	(0.238; 0.364)	1.152	< 0.001

Regression model: $R^2 = 0.338$; Adjusted $R^2 = 0.324$; $F = 24.672$; $p < 0.001$.

The model was statistically significant (F = 24.672, p < 0.001) and explained 32.4% of the variance in foot self-care behaviors (adjusted $R^2 = 0.324$). Three factors were independently and significantly associated with foot self-care behaviors: diabetes duration (p = 0.031), BMI (p = 0.021), and self-efficacy in foot care (DFCSES) (p < 0.001). Age and diabetes self-management (DSMQ) were not significantly associated with foot self-care behaviors in this model. No multicollinearity was detected, with all VIF values well below the threshold of 5.

3.3.2. Factors associated with specific preventive foot self-care behaviors (DFSBS-2)

Table 6. Factors associated with diabetes foot self-care behaviors (DFSBS-2) (n = 248)

Variables	B	SE	β	95% CI	VIF	p
Duration of DM	0.017	0.016	0.057	(-0.014; 0.048)	1.110	0.285
Knowledge (DFKQ)	0.253	0.099	0.132	(0.059; 0.447)	1.069	0.011
DFCSES (Self-efficacy)	0.060	0.010	0.367	(0.040; 0.080)	1.424	< 0.001
DFSBS-1 (Behaviors-1)	0.090	0.017	0.313	(0.057; 0.123)	1.469	< 0.001

Regression model: $R^2 = 0.389$; Adjusted $R^2 = 0.379$; $F = 38.738$; $p < 0.001$.

The model was statistically significant (F = 38.738, p < 0.001) and explained 37.9% of the variance in the dependent variable (adjusted $R^2 = 0.379$). Foot care knowledge (p = 0.011), self-efficacy (DFCSES) (p < 0.001), and foot self-care behaviors measured by DFSBS-1 (p < 0.001) were positively and significantly associated with DFSBS-2 behaviors. Diabetes duration was not significantly associated with DFSBS-2 in this model (p = 0.285). The VIF values for all independent variables ranged from 1.064 to 1.169, indicating no evidence of multicollinearity.

4. DISCUSSION

4.1. Correlations between demographic characteristics and related factors among the study participants

Correlation analysis showed that demographic characteristics, including sex, occupation, and marital status, were not significantly associated with scores for foot care knowledge (DFKQ), diabetes self-management (DSMQ), self-efficacy (DFCSES), or either dimension of foot self-care behaviors (DFSBS-1 and DFSBS-2) (p > 0.05). These findings were fully consistent with those reported in a study conducted at Da Nang Hospital by Sen et al. [14] and with the systematic review by Woo et al. [16].

Regarding educational attainment, the present study found no statistically significant differences in foot self-care practice scores across educational groups. Specifically, for foot self-care behaviors assessed using DFSBS-1, mean scores ranged from 14.00 ± 11.31 to 19.04 ± 6.81 across educational groups, with no statistically significant difference between groups (p = 0.429). Similarly, for DFSBS-2, mean scores ranged from 9.54 ± 1.71 to 11.00 ± 1.41, and the differences across educational groups were not statistically significant (p = 0.470). These findings were not entirely consistent with some previous studies, in which higher educational attainment was associated with better levels of foot care knowledge or practice. Specifically, a study conducted at Cho Ray Hospital reported that patients with an upper secondary education or higher were 2.1 times more likely to have good knowledge (OR = 2.1; 95% CI: 1.2–2.7; p = 0.01) and 2.6 times more likely to demonstrate good foot care practices (OR = 2.6; 95% CI: 1.5–4.6; p = 0.01) than those with lower educational attainment [11]. Similarly, a study conducted at the University Medical Center Ho Chi Minh City found that the mean preventive practice score among participants with an upper secondary education or higher was 3.6 ± 1.4, which was significantly higher than that among those with less than an upper secondary education (3.0 ± 1.4; p < 0.001) [13]. Differences across studies may be attributable to variations in population characteristics, the distribution and sample size of educational groups, healthcare settings, as well as the instruments and methods used to assess foot self-care behaviors. In addition, foot self-care is a multifactorial health behavior that may be related not only to educational attainment but also to diabetes duration, the presence of complications, a history of foot lesions, and exposure to health education, mobility, family support, and access to healthcare services.

Regarding age and diabetes duration, Pearson correlation analysis showed that age had a weak positive correlation with routine daily foot self-care behaviors (DFSBS-1) (r = 0.125; p = 0.049) and a negative correlation with overall diabetes self-management (DSMQ) (r = −0.237; p < 0.01). This pattern may reflect differences in daily responsibilities and health-related perceptions across age groups. Younger patients may have greater work and family responsibilities and may perceive themselves as being at lower immediate health risk, potentially resulting in less consistent attention to detailed self-care practices. A study by Zhu et al. (2024) published in BMJ Open [17] similarly reported that younger patients had a higher risk of potentially harmful foot-related behaviors. Conversely, although older adults may pay greater attention to chronic disease management, their overall diabetes self-management (DSMQ) may be constrained by memory and physical limitations. Boz et al. (2026) reported that older age was negatively correlated with self-care and self-efficacy scores, potentially reflecting sensory and visual limitations [18].

In contrast, diabetes duration was significantly and positively correlated with DFKQ (r = 0.236; p < 0.01), DFCSES (r = 0.126; p < 0.05), DFSBS-1 (r = 0.197; p = 0.002), and DFSBS-2 (r = 0.195; p = 0.002). In the multivariable regression analysis, diabetes duration remained independently and positively associated with DFSBS-1 (B = 0.127; p = 0.031). This finding was consistent with studies by Phan Huu Hen (2025) at Cho Ray Hospital [11], Alsaleh et al. (2021) in Kuwait [19], Amro et al. (2026) in Palestine (B = +1.02 per 5-year increase in diabetes duration; p = 0.035) [20], and the review by Woo et al. (2023) [16]. From a clinical perspective, patients who have lived with diabetes for a longer period may have had more opportunities to accumulate disease-related experience, receive repeated clinical counseling, and encounter or experience warnings regarding the risk of complications. These experiences may be reflected in greater awareness and more regular foot-monitoring practices. In addition, BMI was positively correlated with DFCSES (r = 0.177; p < 0.01) and DFSBS-1 (r = 0.188; p = 0.003), and it remained an independent predictor of DFSBS-1 in the multivariable regression model (B = 0.303; p = 0.021). Patients with higher BMI may experience greater physical limitations or increased mechanical loading on the feet, which may be accompanied by greater attention to hygiene and lower-extremity care. The management of diabetes-related foot complications is challenging and requires considerable time and financial resources, while also adversely affecting the quality of life of people with diabetes [21]. These complications may recur frequently and are susceptible to infection when appropriate foot care and timely treatment are not provided.

4.2. Factors associated with foot self-care behaviors among the study participants

Diabetes duration was positively associated with routine foot self-care practices (B = 0.127; p = 0.031), suggesting that patients with a longer duration of diabetes may have developed more established self-care routines over time through accumulated

experience from previous clinical counseling. In addition, higher BMI was statistically associated with better routine foot self-care behaviors (B = 0.303; p = 0.021). Because physical mobility, joint flexibility, and perceived clinical severity were not directly assessed in the present study, one possible explanation is that patients with higher BMI may receive closer medical monitoring, greater clinical attention, or more frequent health counseling regarding obesity-related complications, which may be accompanied by greater attention to routine daily foot care. Conversely, this association may also be influenced by unmeasured confounding factors, such as socioeconomic conditions or other clinical characteristics. Longitudinal studies incorporating objective measures of physical function are therefore warranted to further clarify the mechanisms underlying this association.

Multivariable regression analysis showed that foot self-care knowledge (DFKQ) was independently and significantly associated with specific preventive foot self-care behaviors (DFSBS-2) (B = 0.253; β = 0.132; p = 0.011), but was not independently associated with routine daily behaviors (DFSBS-1). This finding may reflect differences in the cognitive and behavioral demands of the two dimensions. Knowledge may be particularly relevant to more complex preventive decisions represented by DFSBS-2, such as inspecting the inside of footwear, applying moisturizer while avoiding the interdigital spaces, and avoiding soaking the feet in hot water. These behaviors require patients to understand the mechanisms underlying neuropathic and vascular complications and the potential risks of burns and ulcers. Higher DFKQ scores may therefore be accompanied by greater understanding of the rationale for these preventive measures and greater likelihood of incorporating them into decision-making. In contrast, knowledge alone may not necessarily translate into routine daily habits (DFSBS-1), as behaviors such as washing and inspecting the feet each day may be more closely related to intrinsic motivation, self-efficacy (DFCSES), and consistency in daily routines. Previous studies conducted in Vietnamese hospitals have also demonstrated a substantial gap between knowledge and practice. At Thanh Nhan Hospital, although 68.6% of patients had good knowledge, only 11.1% performed daily foot inspection and 14.4% demonstrated good foot care practices [12]. At Ha Dong General Hospital, although 100% of patients reported adherence to general treatment recommendations, only 34.7% inspected their feet daily and 14.7% cut their toenails correctly [15]. At Cho Ray Hospital, 43.8% of patients had poor foot care practices despite a counseling rate of 58.7% [11]. These findings may support the relevance of the Knowledge–Attitude–Practice (KAP) framework, in which knowledge may serve as an important prerequisite for guiding specific preventive behaviors but may not be sufficient on its own to sustain daily routines in the absence of reinforced self-efficacy and repeated practical skills training.

Foot care self-efficacy (DFCSES) emerged as the strongest independent factor associated with routine daily foot self-care behaviors (B = 0.301, β = 0.524, p < 0.001). This finding is consistent with Bandura's Social Cognitive Theory, which proposes that an individual's belief in their ability to successfully perform a specific behavior represents a core cognitive association of behavioral change [7]. Our findings are also broadly consistent with cross-sectional and prospective studies conducted internationally. For example, studies by Wendling and Beadle [5] in the United States and Biçer and Enç [8] in Turkey reported that higher self-efficacy was associated with more consistent foot inspection and daily foot hygiene practices. In Vietnam, this finding is further supported by the study of Sen et al. [14] in Da Nang, which identified self-efficacy as an important factor associated with foot care behaviors, as well as by Phan Huu Hen's study at Cho Ray Hospital [11], which emphasized that patients with higher self-efficacy may demonstrate greater cognitive persistence in managing practical barriers, maintaining motivation, and consistently performing foot care tasks.

An important finding was that overall diabetes self-management (DSMQ) was not significantly associated with routine foot self-care behaviors in the multivariable model (p = 0.284) and showed only a very weak correlation in the univariable analysis (r = −0.143, p < 0.05). This finding highlights an important conceptual and clinical distinction between the two constructs. Overall diabetes self-management represents systematic, cognitive, and therapeutic self-management behaviors, such as medication adherence, insulin administration, and blood glucose monitoring, aimed at overall glycemic control [6]. In contrast, foot self-care represents a localized, practical preventive regimen that requires specific physical actions, such as inspecting the interdigital spaces and applying moisturizer to dry skin [10]. Clinically, patients may adhere well to medication and dietary recommendations, as reflected by higher DSMQ scores, while paying less attention to lower-extremity care because of limited foot-specific

awareness or lower foot care self-efficacy. The statistical independence between these constructs highlights that general diabetes self-management may not automatically translate into foot self-care behaviors, suggesting the need for separate, foot-specific behavioral interventions. Our findings are consistent with the structural analyses reported by Schmitt et al. (2016), which compared the DSMQ and SDSCA [21]. The authors indicated that the capacity for overall diabetes self-management did not necessarily translate into preventive foot care behaviors in the absence of targeted behavioral training addressing lower-extremity care.

The second regression model focused on specific preventive behaviors, including checking the inside of footwear before wearing it, applying moisturizer while avoiding the interdigital spaces, and cutting toenails appropriately (DFSBS-2). The model was statistically significant ($F = 38.738$, $p < 0.001$) and explained 37.9% of the variance in specific preventive behaviors (adjusted $R^2 = 0.379$). Knowledge (DFKQ), self-efficacy (DFCSES), and routine daily foot self-care behaviors (DFSBS-1) were independently and significantly associated with these specific preventive behaviors, whereas diabetes duration was no longer statistically significant in the model ($p = 0.285$). A notable finding was the positive association between DFSBS-1 (routine daily foot self-care) and DFSBS-2 (specific preventive behaviors) ($B = 0.090$, $\beta = 0.313$, $p < 0.001$). This finding suggests that consistent performance of basic daily foot care behaviors may represent an important behavioral foundation. As reported in the prospective study by Chin et al. [22] and the meta-analysis by Yildirim Ayaz et al. [23], when patients successfully integrate foot washing and foot inspection into their daily routines (DFSBS-1), they may develop greater awareness of lower-extremity health and establish more structured behavioral patterns. Such behavioral patterns, together with strengthened foot-specific self-efficacy, may be associated with greater adoption of more complex preventive practices (DFSBS-2), such as inspecting the inside of footwear and applying moisturizer.

4.3. Limitations of the study

Although this study provides valuable clinical insights, several limitations should be acknowledged. First, the cross-sectional design limits the ability to establish temporal relationships or causal associations among diabetes-related knowledge, self-efficacy, diabetes self-management, and foot self-care behaviors. Second, the study was conducted at a single primary healthcare facility (Son Tra Regional Medical Center), and the use of convenience sampling limits the generalizability of the findings. The study sample consisted predominantly of older adults (67.7% were aged ≥60 years) and women (69.4%); therefore, the applicability of the findings to younger patients, men, or patients receiving care at tertiary hospitals and private healthcare facilities may be limited. Third, foot self-care behaviors, diabetes self-management, and self-efficacy were assessed exclusively using self-reported questionnaires and may therefore be subject to information bias, particularly recall bias and social desirability bias. Fourth, the 5-item DFKQ demonstrated relatively low internal consistency (Cronbach's alpha = 0.58). Although this level may be acceptable for a brief instrument assessing clinical knowledge, future studies should consider using more comprehensive, multidimensional instruments with a larger number of items to improve measurement reliability. Finally, the content and semantic validity of the translated Vietnamese questionnaires were assessed based on consensus among a panel of three clinical professionals; however, quantitative content validity indices (I-CVI and S-CVI) were not calculated using a larger panel of experts.

5. CONCLUSION

The study found that foot self-care practices among outpatients with type 2 diabetes mellitus (T2DM) receiving care at the primary healthcare level remained suboptimal. Factors associated with foot self-care differed between routine daily care and specific preventive behaviors, indicating that foot self-care is a multidimensional behavior associated with various cognitive, behavioral, and clinical factors. Foot care self-efficacy was significantly associated with both dimensions of foot self-care behaviors, whereas foot care knowledge was associated with specific preventive behaviors. These findings suggest that the assessment and support of patients should consider knowledge, self-efficacy, and other characteristics related to diabetes care concurrently.

6. IMPLICATIONS

Clinical nursing interventions at the primary healthcare level should transition from traditional, passive lecture-based instruction toward interactive, skill-oriented counseling strategies. Enhancing patients' self-efficacy, establishing daily routine care habits, and providing targeted practical training are essential clinical priorities to improve overall foot self-care compliance and reduce lower-limb complications in patients with type 2 diabetes.

Conflict of interest statement

The authors declare no conflict of interest regarding the research, authorship, and publication of this article.

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