



Contents lists available at [ScienceDirect](#)

## Primary Care Diabetes

journal homepage: <http://www.elsevier.com/locate/pcd>



### Original research

# Foot care behaviors among adults with type 2 diabetes



Melba Sheila D'Souza<sup>a,\*</sup>, Susan D. Ruppert<sup>b</sup>, Kader Parahoo<sup>c</sup>,  
Subrahmanya Nairy Karkada<sup>d</sup>, Anandhi Amirtharaj<sup>a</sup>, Devakirubai Jacob<sup>a</sup>,  
Shreedevi Balachandran<sup>e</sup>, Nasser Majid Dhabbi Al Salmi<sup>a</sup>

<sup>a</sup> Adult Health and Critical Care, College of Nursing, Sultan Qaboos University, Muscat, Oman

<sup>b</sup> Adult/Gerontology Primary Care Nurse Practitioner Program, Department of Acute & Continuing Care, The University of Texas Health Science, Oman

<sup>c</sup> Nursing and Health Research, School of Nursing University of Ulster – Coleraine Campus, Londonderry, United Kingdom

<sup>d</sup> Department of Business Studies, Higher College of Technology, Al Khuwair, Oman

<sup>e</sup> Fundamentals of Nursing, College of Nursing, Sultan Qaboos University, Muscat, Oman

#### ARTICLE INFO

##### Article history:

Received 21 December 2015

Received in revised form

22 April 2016

Accepted 25 April 2016

Available online 6 June 2016

##### Keywords:

Foot care behaviors

Foot care

Foot problems

Foot preventive strategies

Type 2 diabetes

Nurse

#### ABSTRACT

**Aim:** The aim of the study was to determine factors influencing foot care behaviors among adults with type 2 diabetes.

**Methods:** A correlational descriptive study was conducted with a random sample of 160 adults with type 2 diabetes from the public hospital between April and July 2014.

**Results:** Just over 15% of the sample had a history of foot ulcers and almost 42% had numbness/tingling and pain in their feet. Positive foot care behaviors were correlated with higher income, higher educational attainment, lower body weight, positive attitude and higher awareness of diabetes and its management.

**Conclusion:** Targeting type 2 diabetes people with low level of education, low income and overweight may help to enhance their foot care and reduce foot complications in similar populations, Implications. Those most at risk of foot problems should be targeted for education to increase their awareness of ways to prevent and to manage foot problems.

© 2016 Primary Care Diabetes Europe. Published by Elsevier Ltd. All rights reserved.

\* Corresponding author. Tel.: +968 98137770; fax: +968 24145421.

E-mail addresses: [melba123@rediffmail.com](mailto:melba123@rediffmail.com) (M.S. D'Souza), [Susan.D.Ruppert@uth.tmc.edu](mailto:Susan.D.Ruppert@uth.tmc.edu), [S.Ruppert@msn.com](mailto:S.Ruppert@msn.com) (S.D. Ruppert), [ak.parahoo@ulster.ac.uk](mailto:ak.parahoo@ulster.ac.uk) (K. Parahoo), [ksnairy@gmail.com](mailto:ksnairy@gmail.com) (S.N. Karkada), [anuamir@squ.edu.om](mailto:anuamir@squ.edu.om) (A. Amirtharaj), [djacob@squ.edu.om](mailto:djacob@squ.edu.om) (D. Jacob), [shreedev@squ.edu.om](mailto:shreedev@squ.edu.om) (S. Balachandran), [nasser87@squ.edu.om](mailto:nasser87@squ.edu.om) (N.M.D. Al Salmi).  
<http://dx.doi.org/10.1016/j.pcd.2016.04.002>

1751-9918/© 2016 Primary Care Diabetes Europe. Published by Elsevier Ltd. All rights reserved.

## 1. Introduction

Type 2 diabetes mellitus (T2DM) increases the burden on the health care system and has been called an “economical tsunami” [1,2]. Nearly 80% of the world’s population with T2DM live in developing countries [3] and this prevalence is increasing in the Middle East region [4,5,6]. The prevalence of T2DM was 22% in 2014 in the Sultanate of Oman [4,7]. A 190% increase in the number of adults with T2DM has been projected from 75,000 cases in 2000 to 217,000 cases in 2025 in Oman [8,9]. By 2030, the prevalence of T2DM is expected to rise in Oman and this increase in prevalence may be attributed to sedentary lifestyle, urbanization, high calorie diet and low physical activity [10]. Some Omani adults lack knowledge and information on foot preventive measures [11].

## 2. Background

Foot ulcers are a major complication, occurring in 15% of adults with T2DM [12–14]. Inappropriate footwear and improper toenail trimming can increase the risk of developing foot problems. Foot syndromes like neuropathy, ischemia and infection can result in morbidity and possible amputation [3,6]. An estimated 15–25% of adults with T2DM develop foot ulcers during their lifetime, and up to 70% of all non-traumatic amputations in the world are considered a complication of diabetes [15]. Amputation can lead to severe adverse effects including high financial burden, physical disability and high morbidity. Quality of life (QOL) among adults with foot syndrome is significantly affected, with increased dependence on medical care, worsening pain and discomfort, limited physical functional status, and poor work capacity [16]. Improving foot care behavior is an effective strategy in minimizing subsequent foot complications [17,18]. Understanding the demographic and clinical characteristics influencing foot care behaviors (FCB) among adults with T2DM are helpful to reduce foot problems.

## 3. Theory

Self-efficacy regulates how people feel, think, motivate themselves, and practice self-care behaviors; a key factor of confidence to perform a given behavior [19,20]. This confidence is the end result of cognitive processes that people use when acquiring knowledge, the factors that affect it [21,22], influence of self-care behaviors on foot care [16,23]. In this study, understanding factors related to foot care behaviors among the Arab adults is important to design foot care behavioral interventions (Fig. 1). The self-efficacy model in this study describes the adult person as a whole in terms of demographic and clinical characteristics. Behavior refers to the actual actions related to foot care behaviors. Outcome expectations include physical like foot problems, body mass index (BMI), fasting blood glucose (FBS), and glycosylated haemoglobin (HbA1c). There are no reported studies on foot care behaviors among adults with T2DM in Oman; therefore, this study is useful to plan strategies to prevent foot problems among adults with T2DM. In this study, the factors related to

foot care behaviors among adults with T2DM in Oman were specifically examined.

## 4. Aim

The aim of the study was to examine the demographic and clinical characteristics influencing foot care behaviors among Omani adults with T2DM.

## 5. Material and methods

### 5.1. Design

A descriptive cross-sectional design was used for the study.

### 5.2. Population and setting

Adults with T2DM attending the diabetes clinics in a selected public hospital in Oman were included in the sampling framework. These adults had been assessed for their eligibility for inclusion in the study in the year 2014.

### 5.3. Sample size and sampling criteria

A total of 160 adults with T2DM were necessary to realize 80% power to identify a medium effect size ( $f=0.25$ ), at the 5% level of significance ( $\alpha$ ) with a standard deviation of 1% using multiple regression [24]. One hundred sixty adults were selected by systematic random sampling. Inclusion criteria included adults aged 18–80 years with T2DM for at least two years, ability to provide self-care; and ability to understand and communicate in Arabic or English language. Adults newly diagnosed with T2DM or type 1 diabetes with a cognitive/speech impairment, attention deficit, mental or physical challenges or disability, and inability to mobilize were excluded from the study.

## 6. Measurements

Based on the conceptual framework and aims of the study, the following measurements were used in the self-efficacy model (Fig. 1).

Person was measured as demographic and clinical characteristic. Demographic characteristics included age, gender, formal education, and income. Clinical characteristics included duration of diabetes, diabetes patient education, medications, prevention of activities of daily living (ADL), understanding of diabetes and management and attitude toward DM (ability to fit diabetes into life in a positive manner). Diabetes Knowledge Test (DKT) was developed and validated by the Michigan Diabetes Research and Training Centre [25]. DKT has 23 multiple choice questions with 4–5 options on diet, blood glucose testing, physical activity, medical treatment, complications, foot care, manifestations, sick days, and medication. The correct answers were scored 1 for each item and the total score was summed up. The total DKT scores were classified into poor (0–11) and excellent (12–23). Higher scores

of an individual indicate greater knowledge about diabetes than those individuals who score lower on the instrument.

Efficacy expectations was measured as perception of foot care behaviors (FCB). The Diabetes Foot Care Questionnaire (DFQ) was used to measure the foot care behaviors [26] DFQ consist of a 33-items checklist ('yes' and 'no' responses) with 7 subsections like history of foot problems (3 items), current foot/leg problems (5 items), foot care (7 items), foot safety and prevention (10 items), foot wear (3 items), foot care education (4 items), and current physical activity (1 item). The negative items (e.g. history/current foot problems, heating pad, smoking, legs crossed, bare feet, shoes without socks, no exercise) were scored '0' and positive statements were given scored '1'. The total DFQ scores were summed and classified into poor (<15) and good (16-33) foot care behaviors (FCB). A higher score indicate higher foot care behaviors among adults with T2DM. In this study, the reliability of the DFQ tool was 0.76.

Outcome expectations were measured as BMI, FBS, HbA1c, duration of diagnosis, diabetes patient education, glycosylated hemoglobin (HbA1c), prevention of activities of daily living, understanding DM and management and attitude toward DM. The treatment goal for HbA1c is less than 6.5% for 'healthy/normal', <7% as 'good to excellent', and <8% for 'less healthy/fair' for most adults with T2DM [3].

### 7. Data collection procedure

Participants were diagnosed with T2DM by the physician and were potentially eligible for the study. These participants were provided study information and informed consent. Adults with T2DM who fulfilled the eligibility criteria and signed the informed consent. Participants arrived at the point-of-data collection prior fasting for 6 h for completion of blood investigations. Data was collected between April and July 2014.

### 8. Ethical considerations

An ethical approval was obtained from the institution ethics and research committee and the hospital board. An informed

written consent was obtained from each participant. A letter was provided purposes of the study, human and ethical guidelines, and risks and benefits of participation. Participation and withdrawal from the study was voluntary at any time. Confidentiality was maintained by assigning code numbers, and data were maintained in files secured and locked in the office.

### 9. Data analysis

The Statistical Packages for Social Sciences (SPSS) version 20 [27] was used for data entry, cleaning, analysis, and auditing for accuracy. Collinearity checks were done using a correlation matrix and examining Pearson coefficients. Descriptive summaries of means, standard deviations, frequencies and percentages were used. All variables significantly associated with foot care behaviors ( $p < 0.05$  level) with ANOVA was entered into a multiple linear regression model to determine the factors influencing foot care behaviors.

### 10. Results

A response rate of 87.50% ( $N = 140$ ) was found among the selected adults who participated in the study. Five adults with T2DM had incomplete survey, five adults discontinued from the study, 5 adults were acutely ill and 5 adults moved out of the catchment area.

#### 10.1. Demographic and clinical characteristics

Majority of the participants were men (65%). 48.6% of the adults were between 50 and 59 years (Table 1). The duration of T2DM was 5-10 years (44.3%). Majority of the participants were on oral hypoglycemic medications (72.9%) and less than half percentage of the participants had a BMI above 25 kg/m<sup>2</sup> (41.4%). Most of the participants had a fasting blood glucose (FBS) >7.2 mmol/L (90.7%), had a poor HbA1c of >8% (65%), and poor knowledge of diabetes (73%).

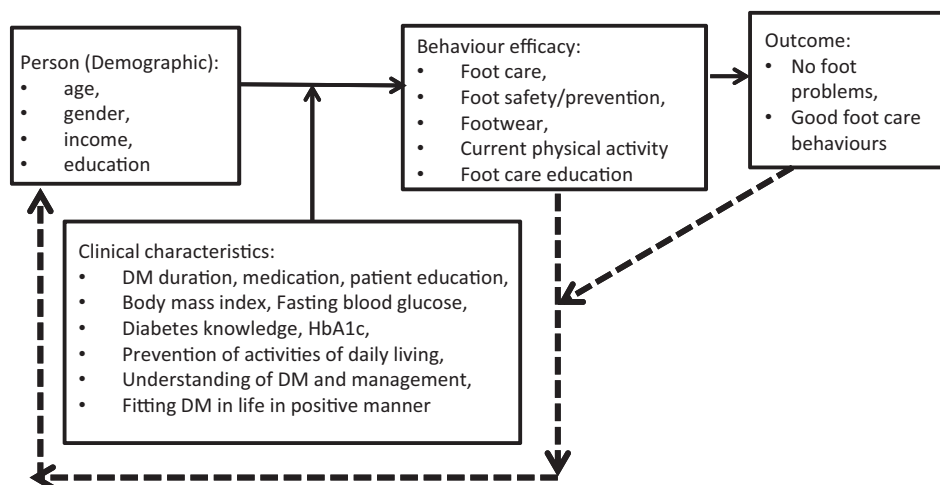


Fig. 1 – Factors influencing foot care behaviors among adults with type 2 diabetes mellitus (DM). → Measured in study. Modified Bandura [52] and Shorridge-Baggett and van der Bijl [53].

**Table 1 – Description of demographic and clinical characteristics among adults with T2DM (N = 140).**

	Variables	Categories	Frequency	Percent
Demographic	Gender	Male	91	65.0
		Female	49	35.0
	Age (years)	30–39 years	11	7.9
		40–49 years	37	26.4
		50–59 years	68	48.6
		>60 years	24	17.1
		<500 OR	60	42.9
	Income (Omani riyals/OR)	501–1000 OR	73	52.1
		1001–1500 OR	5	3.6
		1501–2000 OR	2	1.4
No schooling		13	9.3	
Education	Primary/High school	63	45.0	
	Bachelors/Master degree	64	45.7	
	<4 years	52	37.1	
Duration of diabetes (years)	5–10 years	62	44.3	
	10–15 years	18	12.9	
	>15 years	8	5.7	
	No	81	57.9	
Diabetes education	Yes	59	42.1	
	Insulin and oral hypoglycemic agents	38	27.1	
Medication	Oral hypoglycemics	102	72.9	
	<18.5 kg/m <sup>2</sup>	1	0.7	
Body mass index (kg/m <sup>2</sup> )	18.5–24.9 kg/m <sup>2</sup>	50	35.7	
	>25 kg/m <sup>2</sup>	58	41.4	
	>30 kg/m <sup>2</sup>	31	22.1	
Fasting blood glucose (mmol/L)	<7.2 mmol/L	13	9.3	
	>7.2 mmol/L	127	90.7	
	<6.99%	3	2.1	
	7–7.99%	46	32.9	
HbA1c (%)	>8%	91	65.0	
	Poor knowledge	102	73.0	
Diabetes knowledge	Excellent knowledge	38	27.0	
	Mildly prevents	13	9.3	
Prevention of activities of living	Moderately prevents	120	85.7	
	Highly prevents	7	5.0	
	Low understanding	9	6.4	
Understanding diabetes and its management	Moderate understanding	125	89.3	
	High understanding	6	4.3	
	Poor attitude	5	3.6	
Attitude toward DM	Adequate attitude	127	90.7	
	Good attitude	8	5.7	

DM – diabetes mellitus.

### 10.2. Foot care behaviors

Nearly 15.71% of the participants had a history of foot ulcers, and 41.43% had numbness/tingling and pain/heaviness in the feet. Majority of the adults with T2DM washed their feet every day (87.86%), while 32.86% had family members who trimmed their toenails (Table 2). Approximately 53.57% of the participants walked bare feet, and 24.29% of them used medication on warts, corns, or callus. Nearly 33.57% of the participants wore special foot wear and shoes, and 25% wore socks. Many of the participants were physically active (73.57%) and 37.86% had foot care education.

### 10.3. Relationship between demographic characteristics and foot care behaviors

History of foot problems was significantly associated with income (Table 3). Physical activity was associated with gender

(female), younger age (30–39 and 40–49 years), and education (Bachelor/Master). Foot care education was associated with income and education. Footwear and Total foot care behaviors were associated with education.

### 10.4. Relationship between clinical characteristics and foot care behaviors

Current foot problems were associated with duration of diabetes (10–15 years), FBS, HbA1c (<6.99%), prevention of activities of daily living, understanding DM and management and attitude toward DM (Table 4). History of foot problems was associated with duration of DM and medication. Foot care was associated with duration of DM, medication, diabetes knowledge, and attitude toward DM. Foot wear was associated with prevention of activities of daily living, diabetes patient education and attitude toward DM. Foot safety and prevention and physical activity were associated with body mass index

**Table 2 – Foot care behaviors among adults with T2DM using descriptive (N = 140).**

Foot care behaviors		Frequency	Percent	
History of foot problems	Amputation of a toe, foot or leg	11	7.86	
	Foot ulcer	22	15.71	
	Sore or cut on foot or leg that took > 2 weeks to heal	16	11.43	
	History foot problems subscale [mean (M), standard deviation (SD)]		2.65 (0.78)	
Current foot problems	Ulcer, sore, or blister on foot	51	36.43	
	Blood or discharge on socks	22	15.71	
	Callus build-up on feet	28	20.00	
	Numbness, or tingling in feet	58	41.43	
	Pain, cramping, heaviness in feet/legs	58	41.43	
	Current foot problems (M, SD)		3.45 (1.44)	
Foot care	Reach and see the bottoms of feet	116	82.86	
	Examine feet daily	110	78.57	
	Wash feet every day	123	87.86	
	Thoroughly dry between the toes	98	70.00	
	Moisturize feet and between toes daily	62	44.29	
	Cut own toenails	85	60.71	
	Another person (family member, care giver, nurse) cut toenails and trim toenails	46	32.86	
	Foot care subscale (mean, standard deviation)		4.57 (1.36)	
	Foot safety and prevention	Soak feet	57	40.71
		Always test the water temperature before putting foot in bath	56	40.00
Use medicated foot products for warts, corns or calluses		34	24.29	
Wear shoes at all times, indoors and out		66	47.14	
Inspect shoes for foreign objects or torn linings		69	49.29	
Use of hot water bottle or heating pad on feet		35	25.00	
Smoking		45	32.14	
Sit with legs crossed		74	52.86	
Walk around in bare feet		75	53.57	
Wear shoes without wearing socks		62	44.29	
Foot safety and prevention subscale (M,SD)		5.12 (1.97)		
Footwear	Wear special shoes and/or protective inserts	47	33.57	
	Kind of shoes worn	47	33.57	
	Kind of socks worn	35	25.00	
	Footwear subscale (M,SD)		0.84 (0.93)	
Physical activity	Current Physical Activity/exercise 0.74 (0.44)	103	73.57	
	Exercise subscale (M,SD)		0.73 (0.44)	
Foot care education	Attended foot care class in the past	53	37.86	
	Footcare education (M,SD)	2.05	1.46	
Total foot care behaviors	Poor foot care behaviors	25	18.00	
	Good foot care behaviors	115	82.00	
	Foot care behaviors subscale (M,SD)		18.58 (3.78)	

(<18.5 kg/m<sup>2</sup>) and prevention of activities of daily living. Physical activity was associated with diabetes patient education. Total foot care behaviors were associated with prevention of activities of daily living, understanding DM and management, and attitude toward DM.

### 10.5. Factors influencing foot care behaviors

In the multivariate analysis, education level (Bachelor/Master), prevention of activities of daily living and understanding DM and management significantly predicted good foot care behaviors ( $p < 0.05$ ) (Table 5). Higher the education and understanding of DM and lower the prevention of activities of daily living, better the foot care behaviors.

## 11. Discussion

This study demonstrated moderate to good foot care behaviors among adults with T2DM attributed to free access to health care, ablution (washing) before prayers, spending more time indoor than outdoor and adapting to extreme heat. It was observed that longer duration of diabetes (10–15 years), low FBS, HbA1c (<6.99%), low prevention of activities of daily living, increased understanding DM and management and attitude toward DM were associated with current foot problems among adults with T2DM.

In this study duration of DM, medication, diabetes knowledge, and attitude toward DM foot care was associated with foot care among adults with T2DM. Other studies show that adults had low knowledge foot care scores and were unaware



**Table 3 – Association between demographic characteristics and foot care behaviors (N = 140).**

	ANOVA	Gender		Age		Income		Education	
		F	Sig.	F	Sig.	F	Sig.	F	Sig.
Current foot problems	Between Groups Within Groups Total	0.537	0.465	0.416	0.741	1.780	0.154	0.460	0.632
History foot problems	Between Groups Within Groups Total	0.421	0.518	0.753	0.523	2.775	0.044*	0.907	0.406
Foot care	Between Groups Within Groups Total	0.151	0.698	1.662	0.178	0.322	0.809	0.495	0.611
Footwear	Between Groups Within Groups Total	0.104	0.748	1.313	0.273	0.365	0.778	3.000	0.050*
Foot safety and prevention	Between Groups Within Groups Total	2.340	0.128	0.176	0.913	0.430	0.732	0.528	0.591
Physical activity/Exercise	Between Groups Within Groups Total	0.608	0.043*	2.148	0.050*	0.964	0.412	5.026	0.008*
Foot care education	Between Groups Within Groups Total	2.318	0.130	0.570	0.636	2.297	0.050*	3.666	0.028*
Total Footcare behaviors	Between Groups Within Groups Total	1.197	0.276	0.693	0.558	0.332	0.802	3.628	0.029*

\*  $p < 0.05$ .  
Sig – significance.

of inspecting footwear [28–30]. In addition, prevention of activities of daily living, diabetes patient education and attitude toward DM was associated with foot wear. Adults who had positively fit foot care in their daily life [31,32] and those who had good knowledge had lower HbA1c level [23]. Normal body mass index ( $<18.5 \text{ kg/m}^2$ ) and prevention of activities of daily living was associated with foot safety and prevention among adults with T2DM. Low body mass index, blood glucose, moderate physical activity and dietary intake influenced self-care behaviors [33].

It is apparent women, middle age (30–49 years), higher education (Bachelor/Master), diabetes patient education, normal body mass index ( $<18.5 \text{ kg/m}^2$ ) and prevention of activities of daily living was associated with physical activity. Aging led to changes in the vascular, neurological, and musculoskeletal systems causing high risk of peripheral vascular disease and neuropathy. Younger age, females, higher education, shorter duration of diabetes, and positive attitude to diabetes was significantly associated with foot care [34] and foot care and controlled HbA1c accounted for 78%, and 51% variances respectively [31,32]. Men have been found to be at a higher risk for foot ulcers than women [35]. Women, older adults ( $>75$  years), and occurrence of foot ulcers correlated with poor QOL domain scores [23]. Higher proportion of women and those educated had higher FCB like checking, washing and drying feet was better than inspecting interior of shoe [36].

In this study income and education were associated with foot care education. Education, knowledge and foot care practices [37] are risk factors of foot self-care behaviors. Adherence to self-care and formal education had higher knowledge

[18,38]. Low education and foot care knowledge, not washing or inspecting feet and foot wear and non-use of foot wear were at risk of foot ulcers [39]. In this study income, duration of DM and medication was associated with history of foot problems. Poor education, knowledge and low socioeconomic status impact low foot care knowledge [23,40–42].

In this study education, prevention of activities of daily living, understanding DM and management, and attitude toward DM were significantly associated with total foot care behaviors. Women with higher education and ability to manage diabetes positively; while higher age, prevention of ADL, and knowledge/management of diabetes were significant with health state among women [43,44] and foot care beliefs in Iran [41]. Drying between toes, cutting nails along the toe tip and appropriate foot wear reduced foot ulcers [45].

In this study education, prevention of activities of daily, and understanding DM and management predicted good foot care behaviors in the self-efficacy model. Poor education status, diabetes awareness and care was associated with poor foot care while blood glucose monitoring and compliance to diet improved foot care [46]. This finding is consistent with studies showing moderate level of activities of daily living, ability to manage diabetes, average knowledge of diabetes [47], and lack of knowledge increased the risk of foot ulcers [23,48]. Frequency of self-monitoring of blood glucose decreased and inconsistent timing of dietary existed with poor knowledge [30]. Level of knowledge was influenced by education, duration of DM and advice on foot care [49]. Low level of education have less access to health care, inappropriate foot wear lead to plantar pressure and foot injuries [50,51]. Hence adults with T2DM have to adapt to daily foot care behaviors which depends on

**Table 4 – Association between clinical characteristics and foot care behaviors (N = 140).**

		Duration of DM	Medication	Body mass index	Fasting blood glucose	HbA1c	Diabetes knowledge	Prevention of ADL	Diabetes patient education	Understanding DM and management	Attitude toward DM
		Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
Current foot problems	Between Groups	0.049 <sup>*</sup>	0.608	0.687	0.013 <sup>*</sup>	0.033 <sup>*</sup>	0.361	0.041 <sup>*</sup>	0.372	0.038 <sup>*</sup>	0.028 <sup>*</sup>
	Within Groups										
	Total										
History foot problems	Between Groups	0.004 <sup>*</sup>	0.001 <sup>*</sup>	0.424	0.837	0.320	0.465	0.394	0.678	0.452	0.424
	Within Groups										
	Total										
Foot care	Between Groups	0.021 <sup>*</sup>	0.033 <sup>*</sup>	0.438	0.106	0.590	0.046 <sup>*</sup>	0.113	0.596	0.550	0.046 <sup>*</sup>
	Within Groups										
	Total										
Footwear	Between Groups	0.379	0.156	0.124	0.115	0.323	0.150	0.000 <sup>*</sup>	0.035 <sup>*</sup>	0.264	0.050 <sup>*</sup>
	Within Groups										
	Total										
Foot safety and prevention	Between Groups	0.400	0.789	0.050 <sup>*</sup>	0.432	0.796	0.109	0.050 <sup>*</sup>	0.166	0.351	0.636
	Within Groups										
	Total										
Physical activity/Exercise	Between Groups	0.786	0.403	0.000 <sup>*</sup>	0.109	0.566	0.281	0.955	0.003 <sup>*</sup>	0.307	0.533
	Within Groups										
	Total										
Foot care education	Between Groups	0.307	0.706	0.385	0.467	0.444	0.436	0.987	0.364	0.268	0.222
	Within Groups										
	Total										
Total Footcare behaviors	Between Groups	0.346	0.617	0.574	0.134	0.739	0.771	0.001 <sup>*</sup>	0.163	0.021 <sup>*</sup>	0.041 <sup>*</sup>
	Within Groups										
	Total										

\* p &lt; 0.05.

Sig – significance; ADL – activities of daily living.

**Table 5 – Multiple linear regression (MLR) model among adults with T2DM (N = 140).**

Model	Coefficients <sup>a</sup>				t	Significance
	Unstandardized coefficients		Standardized coefficients			
	B	Std. error	Beta			
(Constant)	19.155	2.156			8.886	0.000
Prevention of activities of daily living	-2.985	0.803	-0.297		-3.718	0.000*
Education	1.174	0.463	0.201		2.536	0.012*
Understanding DM and its management	0.632	0.305	0.166		2.070	0.040*

METHOD = Forward gender + age + duration of DM + income + prevention of activities of daily living + diabetes patient education + Understanding DM and management + Education + Medication + BMI + Attitude + FBS + HbA1c.

<sup>a</sup> Dependent variable: total score Footcare.

\*  $p < 0.05$ .

education, understanding DM and management and attitude toward DM.

### 11.1. Limitations

Measures of foot self-care behaviors were obtained from self-reported questionnaires with the possibility of response and recall bias. Prospective studies with larger sample sizes may be needed to explore the sources of efficacy expectations, socio-cultural factors, and outcome expectations that affect foot care behaviors.

## 12. Conclusion

Good foot care behaviors were observed among 82% of the adults with T2DM. Foot problems are influenced by duration of DM, medications, BMI, FBS and HbA1c, knowledge and patient education. Age, income, education and foot care education self-efficacy in foot care, foot wear, foot safety and prevention and physical activity. Among these FCB, three major predictors education, understanding DM and management and attitude toward DM directly influenced better FCB. This study emphasizes that these predictors influence FCB which are inevitable to low-risk adults with T2DM. Factors influencing poor foot care behaviors were non-adherence to medications, high BMI, HbA1c, poor diabetes knowledge and diabetes patient education. Education, prevention of ADL and understanding of DM are a key component of good FCB proactively, thus reducing the likelihood of foot complications and prevention of foot injuries. The study recommends reinforcing foot care education on foot care, foot safety and prevention, foot wear and exercise.

## 13. Implications

This study recommends desirable foot care behaviors like understanding of management, improved activities of living, and self-efficacy based on socio-cultural, family and individual preferences. Continuous foot care education can be integrated to improve foot care behaviors, safety and prevention with a focus on cognitive and behavioral skill change. Nurses in ambulatory foot clinics should assess willingness among adults to adopt best foot care approaches and adherence to foot self-care behaviors. Interprofessional

collaborative practice with a nurse educator, a podiatrist, a physical therapist, an occupational therapist, a physician, a dietician, a pharmacist, and a social worker is recommended for designing appropriate foot care interventions among adults with T2DM.

## Authors contributions

MSD, SR, KP, KSN, AA, DJ, SB, and NS have substantial contributions on conception and design, acquisition of data, and analysis and interpretation of data. MSD, SR, KP, and KSN have drafted the article and revised it critically for important intellectual content. All authors have agreed on the final version of the paper to be published. Melba Sheila D'Souza (MSD), Susan Rupert (SR), Kader Parahoo (KP), Subrahmanya Nairy Karkada (KSN), Anandhi Amirtharaj (AA), Devaikirubai Jacob (DJ), Shreedevi Balachandran (SB), and Nasser Al Salmi (NS).

## Funding statement

This research received a grant (IG/CN/AHCC/14/02) from the institution fund. The sponsors played no role in the design, execution, analysis, data interpretation, writing reports or decision to submit the paper for publication.

## Ethical approval

Ethical approval (IG/CN/AHCC/14/02) was given by the College of Nursing research and ethics committee, Sultan Qaboos University hospital board and the Sultan Qaboos University institutional review board. WMA Declaration of Helsinki and ICMJE recommendations of conduct, reporting, editing and publishing of scholarly work is confirmed.

## Conflict of interest

The authors state that they have no conflict of interest.

## Acknowledgements

This study was supported by College of Nursing, Sultan Qaboos University grant (IG/CN/AHCC/14/2). The views expressed in



this study do not necessarily represent the views of the CON, SQU. We are grateful to the consultant, content validators, research assistants, bi-linguistics and language editors.

## REFERENCES

- [1] Canadian Diabetes Association, Diabetes Care Program of Nova Scotia. Foot Risk Assessment Form: September, 2009.
- [2] R. Somerville, An Economic Tsunami: The Cost of Diabetes in Canada, Canadian Diabetes Association, Ottawa, ON, 2009.
- [3] American Diabetes Association, American Diabetes Association Diagnosis and classification of diabetes mellitus, *Diabetes Care* 37 (Suppl. 1) (2014) S81-S90.
- [4] International Diabetes Federation, About Diabetes, 2013, Retrieved January, 16, 2014 from <http://www.idf.org/about-diabetes>.
- [5] D.R. Whiting, L. Guariguata, C. Weil, J. Shaw, IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030, *Diabetes Res. Clin. Pract.* 94 (3) (2011) 311-321.
- [6] World Health Organization, Global Health Estimates: Deaths by Cause, Age, Sex and Country 2000-2012, WHO, Geneva, 2014.
- [7] Ministry of Health, World Health Survey: Oman, D. G. o. P. Department of Research, Ministry of Health Publications, 2014.
- [8] Z.S. Al Bimani, S.A. Khan, P. David, Evaluation of T2DM related knowledge and practices of Omani patients, *Saudi Pharm. J.* (2013).
- [9] World Health Organization, Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020, 2013.
- [10] D.W. Lam, D. LeRoith, The worldwide diabetes epidemic, *Curr. Opin. Endocrinol. Diabetes Obes.* 19 (2) (2012) 93-96.
- [11] M.A. Al Shafae, S. Al-Shukaili, S.G. Rizvi, Y. Al Farsi, M.A. Khan, S.S. Ganguly, . . . S. Al Adawi, Knowledge and perceptions of diabetes in a semi-urban Omani population, *BMC Public Health* 8 (1) (2008) 249.
- [12] I.S. Al-Busaidi, Quality of Diabetic Foot Care in Oman, University of Otago, 2014.
- [13] J.A. Al-Lawati, R. Mabry, A.J. Mohammed, Addressing the threat of chronic diseases in Oman, *Prev. Chronic Dis.* 5 (3) (2008) A99.
- [14] A. Al-Shookri, G.L. Khor, Y.M. Chan, S.C. Loke, M. Al-Maskari, Type 2 diabetes in the sultanate of Oman, *Malays. J. Nutr.* 17 (1) (2011) 129-141.
- [15] International Diabetes Federation, IDF Diabetes Atlas, 6th ed., International Diabetes Federation, Brussels, Belgium, 2013.
- [16] R. Zeleníková, R. Bužgová, E. Janíková, D. Jarošová, Evaluation of Quality of Life of Patients with Diabetic Foot Syndrome in Selected Health Care Facilities of Moravian Silesian Region, 2014.
- [17] T. Kurniawan, W. Sae-Sia, K. Maneewat, W. Petpichetchian, The effect of a self-management support program on the achievement of goals in diabetic foot care behaviors in Indonesian Diabetic Patients, *Nurse Media J. Nurs.* 1 (2) (2011) 195-210.
- [18] B.M. Perrin, H. Swerissen, C. Payne, The association between foot-care self efficacy beliefs and actual foot-care behaviour in people with peripheral neuropathy: a cross-sectional study, *J. Foot Ankle Res.* 2 (3) (2009) 1-8.
- [19] A. Bandura, Self-efficacy mechanism in human agency, *Am. Psychol.* 37 (2) (1982) 122.
- [20] K. Bussey, A. Bandura, Social cognitive theory of gender development and differentiation, *Psychol. Rev.* 106 (4) (1999) 676.
- [21] Y. Liu, M. Maier, Y. Hao, Y. Chen, Y. Qin, R. Huo, Factors related to quality of life for patients with type 2 diabetes with or without depressive symptoms - results from a community-based study in China, *J. Clin. Nurs.* 22 (1/2) (2013) 80-88, <http://dx.doi.org/10.1111/jocn.12010>.
- [22] H. Yoo, C.J. Kim, Y. Jang, M.A. You, Self-efficacy associated with self-management behaviours and health status of South Koreans with chronic diseases, *Int. J. Nurs. Pract.* 17 (6) (2011) 599-606.
- [23] O. Desalu, F. Salawu, A. Jimoh, A. Adekoya, O. Busari, A. Olokoba, Diabetic foot care: self reported knowledge and practice among patients attending three tertiary hospital in Nigeria, *Ghana Med. J.* 45 (2) (2011).
- [24] S. Amsberg, T. Anderbro, R. Wredling, J. Lisspers, P.-E. Lins, U. Adamson, U.-B. Johansson, A cognitive behavior therapy-based intervention among poorly controlled adult type 1 diabetes patients - a randomized controlled trial, *Patient Educ. Couns.* 77 (1) (2009) 72-80.
- [25] J.T. Fitzgerald, M.M. Funnell, G.E. Hess, P.A. Barr, R.M. Anderson, R.G. Hiss, W.K. Davis, The reliability and validity of a brief diabetes knowledge test, *Diabetes Care* 21 (5) (1998) 706-710.
- [26] C. Abbott, A. Carrington, H. Ashe, S. Bath, L. Every, J. Griffiths, . . . K. Johnson, The North-West Diabetes Foot Care Study: incidence of, and risk factors for, new diabetic foot ulceration in a community-based patient cohort, *Diabet. Med.* 19 (5) (2002) 377-384.
- [27] IBM, IBM SPSS Statistics for Windows Version 20.0, IBM Corp Armonk, NY, 2011.
- [28] C.V.M. Jinadasa, M. Jeewantha, SP5-14 A study to determine the knowledge and practice of foot care in patients with chronic diabetic ulcers, *J. Epidemiol. Community Health* 65 (Suppl. 1) (2011) A449.
- [29] R.M. Rocha, M.L. Zanetti, M.A.D. Santos, Behavior and knowledge: basis for prevention of diabetic foot, *Acta Paul. Enferm.* 22 (1) (2009) 17-23.
- [30] F. Saleh, S.J. Mumu, F. Ara, H.A. Begum, L. Ali, Knowledge and self-care practices regarding diabetes among newly diagnosed type 2 diabetics in Bangladesh: a cross-sectional study, *BMC Public Health* 12 (1) (2012) 1112.
- [31] M.S. D'Souza, S.N. Karkada, N.P. Hanrahan, R. Venkatesaperumal, A. Amirtharaj, Do perceptions of empowerment affect glycemic control and self-care among adults with type 2 diabetes? *Glob. J. Health Sci.* 7 (5) (2015) 80.
- [32] M.S. D'Souza, S.N. Karkada, N.P. Hanrahan, R. Venkatesaperumal, A. Amirtharaj, Do perceptions of empowerment affect glycemic control and self-care among adults with type 2 diabetes? *Glob. J. Health Sci.* 7 (5) (2015) 80.
- [33] M.S. D'Souza, A. Amirtharaj, R. Venkatesaperumal, C. Isac, S. Maroof, Risk-assessment score for screening diabetes mellitus among Omani adults, *SAGE Open Med.* 1 (2013), 2050312113508390.
- [34] M.S. D'Souza, S.N. Karkada, R. Venkatesaperumal, J. Natarajan, Self-care behaviours and glycemic control among adults with type 2 diabetes, *J. Nurs. Health Care* 2 (1) (2015).
- [35] H.A. Elshenawie, W. Ahmed Shalan, E. Aziza, Effect of ozone olive oil ointment dressing technique on the healing of superficial and deep diabetic foot ulcers, *J. Am. Sci.* 9 (2013) 235-250.
- [36] M. Chourdakis, V. Kontogiannis, K. Malachas, T. Pliakas, A. Kritis, Self-care behaviors of adults with type 2 diabetes mellitus in Greece, *J. Community Health* 39 (5) (2014) 972-979.
- [37] M.C. Gholap, V.R. Mohite, To assess the knowledge and practice regarding foot care among diabetes patients at

- Krishna Hospital, Karad, Indian J. Sci. Res. 4 (2) (2013) 69–75.
- [38] S. Hasnain, N.H. Sheikh, Knowledge and practices regarding foot care in diabetic patients visiting diabetic clinic in Jinnah Hospital, Lahore, J. Pak. Med. Assoc. 59 (10) (2009) 687.
- [39] M.E. Khamseh, N. Vatankhah, H.R. Baradaran, Knowledge and practice of foot care in Iranian people with type 2 diabetes, Int. Wound J. 4 (4) (2007) 298–302.
- [40] P. Bartolo, S. Mizzi, C. Formosa, An evaluation of foot care behaviours in individuals with type 2 diabetes living in Malta, J. Diabetes Nurs. 17 (2) (2013).
- [41] M.S. Hamedan, M.S. Hamedan, Z. Torki, Relationship between Foot-Care Self-Efficacy Beliefs and Self Care Behaviors in Diabetic Patients in Iran (2011), J. Diabetes Metab. 3 (220) (2012) 2.
- [42] P. Kafaie, M.T. Noorbala, S. Soheilikhah, M. Rashidi, Evaluation of patients' education on foot self-care status in diabetic patients, Iran. Red Crescent Med. J. 14 (12) (2012) 829.
- [43] M.S. D'Souza, K.S. Nairy, Health promoting behaviours and quality of life among adults with diabetes mellitus: improved after nurse directed intervention, Nightingale Nurs. Times 3 (12) (2008) 17–20.
- [44] M.S. D'Souza, R. Venkatesaperumal, S.D. Ruppert, S.N. Karkada, D. Jacob, Health related quality of life among Omani men and women with type 2 diabetes, J. Diabetes Res. 501 (2015) 154834.
- [45] D.H. Iunes, C.B. Rocha, N.C. Borges, C.O. Marcon, V.M. Pereira, L.C. Carvalho, Self-care associated with home exercises in patients with type 2 diabetes mellitus, PLOS ONE 9 (12) (2014) e114151.
- [46] S. Saurabh, S. Sarkar, K. Selvaraj, S.S. Kar, S.G. Kumar, G. Roy, Effectiveness of foot care education among people with type 2 diabetes in rural Puducherry, India, Indian J. Endocrinol. Metab. 18 (1) (2014) 106.
- [47] M.S. D'Souza, R. Venkatesaperumal, K.S. Nairy, A. Amirtharaj, Determinants of glycosylated haemoglobin among adults with Type 2 diabetes mellitus in Muscat, J. Diabetes Metab. 4 (5) (2013).
- [48] D.G. Armstrong, K. Holtz-Neiderer, C. Wendel, M.J. Mohler, H.R. Kimbriel, L.A. Lavery, Skin temperature monitoring reduces the risk for diabetic foot ulceration in high-risk patients, Am. J. Med. 120 (12) (2007) 1042–1046.
- [49] F.S. Chiwanga, M.A. Njelekela, 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. 8 (1) (2015) 20.
- [50] International Working Group on the Diabetic Foot, International Consensus on the Diabetic Foot, International Working Group on the Diabetic Foot, 2007.
- [51] F.N. Smanioto, M.D.C.F.L. Haddad, M.A. Rossaneis, Self-care into the risk factors in diabetic foot ulceration: cross-sectional study, Online Braz. J. Nurs. 13 (3) (2014) 343–352.
- [52] A. Bandura, Self-efficacy: toward a unifying theory of behavioral change, Psychol. Rev. 84 (2) (1977) 191–215.
- [53] L.M. Shortridge-Baggett, J.J. van der Bijl, International collaborative research on management self-efficacy in diabetes mellitus, J. N. Y. State Nurses Assoc. 27 (3) (1996) 9–14.