

Prevalence of diabetic comorbidities and knowledge and practices of foot care among diabetic patients: a cross-sectional study

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Background: Diabetes mellitus with comorbid complications constitute a major public health problem worldwide. The aim of this study was to evaluate the risk of comorbid complications with glycosylated hemoglobin levels and diabetes duration. Also assessed were patients' diabetic foot-care knowledge and practices.

Patients and methods: This was a quasiexperimental study. A total of 360 type 2 diabetes mellitus patients were interviewed at a government health care center in Riyadh, Saudi Arabia. Diabetic complications and HbA_{1c}-level data were collected from hospital records. A standard questionnaire was used to assess their diabetic foot-care knowledge and practice.

Results: Of the type 2 diabetes mellitus patients, 32.5% had highly uncontrolled glycosylated hemoglobin (HbA_{1c}) levels ($\geq 8.6\%$) and 62.8% had had diabetes >10 years. The patients had comorbid complications, such as hypertension (61.4%), dyslipidemia (58.6%), retinopathy (23.3%), heart disease (14.4%), and severe foot complications (3.9%). The majority of highly uncontrolled HbA_{1c}-level patients had retinopathy (OR 8.90, $P=0.0001$), foot complications (OR 8.09, $P=0.0001$), dyslipidemia (OR 2.81, $P=0.010$), and hypertension (OR 2.0, $P=0.028$) compared to the controlled HbA_{1c}-level ($<7\%$) group. Patients with diabetes >10 years also had higher prevalence of foot complications (OR 2.92, $P=0.0001$), retinopathy (OR 2.17, $P=0.011$), and hypertension (OR 1.67, $P=0.033$). From patient responses, physicians examined only 34.2% of patient feet and 36.7% of patients received physicians advice for foot care. About 70% of patients had knowledge of diabetic foot care; however, only 41.7% of patients always examined their feet, 41.4% washed feet with warm water, 31.4% carefully dried between the toes, and 33.1% were using foot-moisturizing substances.

Conclusion: The prevalence of comorbid complications was higher in the Saudi population compared to other international studies. Also, foot-care practice was not satisfactory. Therefore, there is need of improvement and increased awareness among physicians and patients to check regularly for proper care of the diabetic foot to avoid diabetic foot-related complications.

Keywords: diabetic mellitus, comorbid complication, foot care, Saudi Arabia

Introduction

Diabetes mellitus (DM) is a progressive metabolic disorder characterized by hyperglycemia, mainly due to resistance or deficiency of insulin hormone. The prevalence of DM is gradually rising worldwide, and it is predicted to increase from 171 million in the year 2000 to 366 million during 2030.¹ In a report of the World Health Organization, DM will be the seventh-leading cause of death worldwide in 2030.² About two-thirds of patients who attend primary health care centers have diabetic complications.^{3,4} The International Diabetes Federation Atlas recently reported that about 17.7% of the Saudi Arabia adult population suffered from DM.⁵ Saudi Arabia has become the first country

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with high diabetes prevalence in the Middle East.⁵ DM also enhances health complications manyfold, such as hypertension, heart disease, retinopathy, and foot complications in the long term.^{6,7} Therefore, physicians' primary aim in DM management is to maintain blood-glucose levels around the normal range and thus prevent or delay the onset of related complications.⁸

The diabetic foot is a common complication of diabetes patients associated with an increase in age and diabetic duration.^{9,10} Diabetic foot complications are caused by many factors, such as peripheral neuropathy that leads to loss of sensation in the feet and peripheral vascular diseases that decrease blood supply to tissue and may cause infection and gangrene, increasing the risk of amputation.⁷ Diabetic foot complications are the major cause of hospitalization among diabetic patients,¹¹ and impose major economic burdens on the community and patients.¹² A Saudi National Diabetes Registry data-based study reported foot complications among 3.3% of diabetes patients, of whom 2.05% had a foot ulcer, 0.19% had gangrene, and 1.06% had had an amputation.^{10,13} Poor foot care and foot-care-knowledge deficiency are important risk factors for foot problems.¹⁴ In many studies, awareness of diabetic foot care has been correlated with a decrease in foot ulcers and amputation.^{15,16} However, to our knowledge, there has been no study to assess the knowledge and practice of diabetic patients with regard to diabetic foot care in Saudi Arabia. In the present study, we investigated the prevalence of comorbidities and assessed the knowledge and practice of diabetic foot care among Saudi diabetic patients.

Patients and methods

Data collection

This was a cross-sectional descriptive study comprising 360 Saudi diabetic patients who attended two primary health care centers at King Khalid University Hospital and King Abdulaziz University Hospital, affiliated with King Saud University, Riyadh, Saudi Arabia, during December 2015 to September 2016. A systematic random-sampling technique was used to select every fourth patient in each clinic among those visiting for a routine diabetic checkup. Patients participation was entirely voluntary, and whoever agreed to participate in this study signed a consent form. All participants in this study were interviewed individually by research-team members.

Instrument

A standard bilingual (Arabic and English) questionnaire was prepared based on previous studies and guidelines after

an extensive literature review.^{17–20} The questionnaire was reviewed by expert physicians and piloted on ten diabetic patients. Some suggested changes were incorporated. The questionnaire comprised four parts: the first consisted of sociodemographic information, presence or absence of comorbidities, presence or absence of foot complications, types of medication used, and DM-control level in the form of glycosylated hemoglobin (HbA_{1c}); the second consisted of seven questions assessing physician roles in diabetic patients' foot-care; the third assessed patients' knowledge about their foot care; and the fourth asked about the foot-care practices of the patients. Second-part answers were collected as yes/no, third-part answers as true/false, and fourth-part answers were collected on a 4-point Likert scale (always [3], sometimes [2], rarely [1], and never [0]). Patients' HbA_{1c} level was collected from their hospital-database records and categorized into three levels (controlled [$<7.0\%$], uncontrolled [$7.0\%–8.5\%$], and highly uncontrolled [$\geq 8.6\%$]). The criterion for good knowledge of foot care was a median score or above on the knowledge questions, while that for poor knowledge of foot care was a score below the median on the knowledge questions.

Statistical analysis

Data were entered into Microsoft Excel software and analyzed using SPSS version 21.0 (IBM, Armonk, NY, USA). The χ^2 test was used to measure associations among the different categorical variables. $P < 0.05$ was considered statistically significant.

Ethical approval

All participants were informed of the objectives of the study, and the items in the questionnaire were explained. The research ethics committee of the Faculty of Medicine at King Saud University approved the study.

Results

Table 1 shows the demographic information of the type 2 DM (T2DM) patients. A total of 360 patients were interviewed, of which 37.2% were males and 62.8% females. The majority of the patients (62.8%) had had T2DM >10 years. Patient ages were 18–75 years, and most female patients were younger than the male patients ($P=0.001$). Most patients were married. Of these, the percentage of females married and divorced/widowed was high ($P=0.0001$). About 26% of patients had uncontrolled HbA_{1c} levels, whereas 32.5% patients had highly uncontrolled (HbA_{1c} $\geq 8.6\%$) levels. Medications used for the treatment of DM were

Table 1 Demographic information of diabetic patients (n=360)

		Patients (360), n (%)	Male (134), n (%)	Female (226), n (%)	χ^2 (P)
Age group, years	18–30	21 (5.8)	8 (6.0)	13 (5.8)	16.35 (0.001)
	31–45	44 (12.2)	13 (9.7)	31 (13.7)	
	46–60	177 (49.2)	52 (38.8)	125 (55.3)	
	61–75	118 (32.8)	61 (45.5)	57 (25.2)	
Marital status	Married	299 (83.1)	124 (92.5)	175 (77.4)	22.24 (0.0001)
	Single	18 (5.0)	8 (6.0)	10 (4.4)	
	Divorced/widowed	42 (11.7)	2 (1.5)	40 (17.7)	
Duration of diabetes	>10 years	226 (62.8)	89 (66.4)	137 (60.6)	1.21 (0.27)
	≤10 years	134 (37.2)	45 (33.6)	89 (39.4)	
HbA_{1c}^a	Controlled	149 (41.4)	57 (42.5)	92 (40.7)	0.256 (0.880)
	Uncontrolled	94 (26.1)	33 (24.6)	61 (27.0)	
	Highly uncontrolled	117 (32.5)	44 (32.8)	73 (32.3)	
Diabetes treatment	Diet/oral agent	209 (58.3)	68 (50.7)	142 (62.8)	6.48 (0.039)
	Insulin	67 (18.6)	33 (24.6)	34 (15.0)	
	Insulin oral agent	83 (23.1)	33 (24.6)	50 (22.1)	
Foot complication	Numbness	9 (2.5)	8 (6.0)	6 (2.7)	2.630 (0.269)
	History of healed ulcer	4 (1.12)	31 (23.1)	50 (22.1)	
	One toe amputation	1 (0.27)			
	None	346 (96.12)	95 (70.9)	170 (75.2)	
Hypertension	Yes	221 (61.4)	77 (57.5)	144 (63.7)	1.39 (0.239)
	No	139 (38.6)	57 (42.5)	82 (36.3)	
Heart disease	Yes	52 (14.4)	26 (19.4)	26 (11.5)	4.247 (0.039)
	No	308 (85.6)	108 (80.6)	200 (88.5)	
Dyslipidemia	Yes	209 (58.1)	53 (39.6)	156 (69.0)	30.01 (0.0001)
	No	151 (41.9)	81 (60.4)	70 (31.0)	
Retinopathy	Yes	84 (23.3)	27 (20.1)	57 (25.2)	1.21 (0.271)
	No	276 (76.7)	107 (79.9)	169 (74.8)	

Notes: ^aHbA_{1c} categories: control level (<7.0%), uncontrolled level (7.0%–8.5%), and highly uncontrolled level (≥8.6%).

Abbreviation: HbA_{1c}, glycosylated hemoglobin.

oral hypoglycemic agents (OHAs) with controlled diet (58.3%), insulin and OHAs (23.1%), and insulin injections alone (18.6%). Compared to male patients, a high percentage of female patients were taking OHAs with diet control ($P=0.04$). Diabetic patients also had many diabetes-related comorbidities. About 3.9% of diabetic patients had foot complications. Of these, male patients had more foot complications than females; however, the difference was not significant. More than 58% patients had dyslipidemia, and the percentage of female patients was significantly higher than the male patients ($P=0.0001$).

Table 2 shows a multivariate analysis of HbA_{1c} levels and diabetic duration with associated comorbid diseases. The history of foot complication was significantly higher in both uncontrolled HbA_{1c} (OR 2.76, $P=0.008$) and highly uncontrolled HbA_{1c} patients (OR 8.09, $P=0.0001$) compared to the controlled HbA_{1c} group. Also, dyslipidemia significantly increased with increased HbA_{1c} levels (uncontrolled HbA_{1c} OR 2.14, $P=0.01$; highly uncontrolled HbA_{1c} OR 2.81, $P=0.0001$). Hypertension prevailed among 61.4% of

patients, and the percentage was significantly high in the case of highly uncontrolled HbA_{1c} (OR 2.00, $P=0.028$). The frequency of retinopathy was only 23.3% of the patients, but ORs were significantly high in both uncontrolled HbA_{1c} (OR 8.89, $P=0.0001$) and highly uncontrolled HbA_{1c} (OR 8.90, $P=0.0001$) compared to controlled HbA_{1c} patients. Patients with diabetes >10 years also had more complications in the feet (OR 2.92, $P=0.0001$), retinopathy (OR 2.17, $P=0.011$), and hypertension (OR 1.67, $P=0.033$).

Table 3 showed diabetic patients' foot-care practices. Only 41.7% always examined their feet regularly, 41.4% always washed their feet with warm water, 31.4% always carefully dried between the toes after washing, 33.1% always moisturized their feet, and 65.8% regularly cut their toenails. On the negative side, 2.8% always walked barefoot outside the house. Of these, male patients' foot-care management was significantly low compared to female patients, because the majority of them were always walking outside barefoot (4.5%, $P=0.0001$). However, a high percentage of male patients always inspected their feet (50.0%), checked their

Table 2 Multiple-variable analysis of diabetes-associated comorbid diseases

Problems	HbA _{1c} (uncontrolled) ^a			HbA _{1c} (highly uncontrolled) ^a			DM duration > 10 years ^b		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Foot problems ^c	2.76	1.30–5.84	0.008	8.09	4.01–16.32	0.0001	2.92	1.63–5.23	0.0001
Hypertension	1.17	0.65–2.09	0.603	2.00	1.08–3.70	0.028	1.67	1.04–2.67	0.033
Heart disease	2.16	0.86–5.38	0.100	2.35	0.94–5.85	0.066	1.75	0.83–3.67	0.140
Dyslipidemia	2.14	1.20–3.84	0.010	2.81	1.53–5.15	0.001	1.11	0.69–1.78	0.663
Retinopathy	8.89	3.81–20.78	0.0001	8.90	3.75–21.15	0.0001	2.17	1.20–3.94	0.011

Notes: ^aReference controlled HbA_{1c} level; ^breference diabetic duration <10 years; ^cboth severe and mild.

Abbreviations: HbA_{1c}, glycosylated hemoglobin; DM, diabetes mellitus.

shoes before wear (45.5%), and used cotton socks (38.8%, $P < 0.050$). Regarding patients' compliance with foot examination, the majority of patients self-examined or inspected their feet regularly, and their percentage was significantly higher than the no-foot-problem patients ($P = 0.05$). For the query related to the physician's role in diabetic patients' foot care, only 34.2% of patients agreed that the physician examined their feet, whereas only 36.7% of patients agreed that they got foot-care advice from their physicians during routine checkups.

Table 4 presents the effect of physician advice and patients knowledge of foot-care practices. About 70% of patients had good knowledge scores: equal to or more than the median score. Table S1 shows patients' knowledge of individual items related to diabetic foot care. The results inferred that foot-care practice was high among the group of patients who got advice from their physicians. Their foot-care practice was significantly high for "carefully dry between toes after washing feet" ($P = 0.0001$) and "moisturizing feet daily" ($P = 0.013$) compared to the no-advice group. Similarly, patients' with good foot-care knowledge showed a positive effect on foot-care practices compared to the poor-knowledge group.

Discussion

This is one of the few studies in Saudi Arabia to address DM-associated comorbidity and awareness of diabetic foot-care practice. In this study, about a third of patients had highly uncontrolled T2DM and about 63% had had it for >10 years. The prevalence of diabetes was higher in the female and younger age group than the male participants of the similar age group, and this fact has also been reported in other international and local studies.^{1,4} A sedentary lifestyle or physical inactivity might be one of the associated factors of uncontrolled HbA_{1c} levels in the Saudi population. One local study found that >50% of those in younger age-groups were physically inactive, with the most common obstacles preventing physical activity hot

weather during most of the year, lack of appropriate social culture, and affordable physical activity facilities and outdoor spaces for activities, particularly for women.²¹

Defects in insulin action simultaneously increase blood-glucose levels, consequently leading to a higher amount of lipoprotein synthesis.²² Therefore, the prevalence of dyslipidemia among the study population was higher than the nondiabetic Saudi population,²³ as the majority (~58%) of the patients had dyslipidemia. The prevalence of dyslipidemia among the DM patients has varied in different studies, and its frequency is up to 88% of diabetes population.^{24,25} As with another study, the prevalence of dyslipidemia was higher for uncontrolled HbA_{1c} patients.²⁶ Also, the frequency of dyslipidemia is constantly increasing in Saudi diabetic patients. In 1995, al-Nuaim et al²⁷ reported only 14% of diabetic patients with hypercholesterolemia, whereas in 1998 al-Ghamdi and Rehman²⁸ reported 26% of the diabetic population had hypercholesterolemia.

Uncontrolled hyperglycemia with dyslipidemia causes many health complications, including dysfunction of multiple organs.²⁹ As per previous research, the frequency of hypertension was high among the patients and higher among those who had an uncontrolled HbA_{1c} level.^{26,30,31} The prevalence of retinopathy and heart diseases as comorbidities among our DM patients was less than the previous local study.³² However, a higher frequency of DM patients with dyslipidemia reported cardiovascular complications. More than a quarter of diabetic retinopathy patients were hypertensive and had dyslipidemia. Similarly to our study, other studies have also reported that hypertension and dyslipidemia were associated with substantially increased cardiovascular disease and retinopathy.^{33,34} In the present study, female patients had more dyslipidemia and suffered from more hypertension and retinopathy complications than male patients. These results were consistent with previous local and international findings.^{3,35}

Table 3 Diabetic patients' self-practice of foot care

Items	Categories		Never, n (%)	Sometimes, n (%)	Always, n(%)	χ^2 (P)
Do you examine/inspect your feet on a regular basis, daily?	Sex	Male	20 (14.9)	47 (35.1)	67 (50.0)	6.27 (0.043)
		Female	47 (20.8)	96 (42.5)	83 (36.7)	
	Foot complications	Yes	19 (20.0)	28 (29.5)	48 (50.5)	5.98 (0.050)
		No	48 (18.1)	115 (43.4)	102 (38.5)	
		Total	67 (18.6)	143 (39.7)	150 (41.7)	
Do you check your shoes before you put them on?	Sex	Male	32 (23.9)	41 (30.6)	61 (45.5)	8.46 (0.015)
		Female	87 (38.5)	61 (27.0)	78 (34.5)	
	Foot complications	Yes	33 (34.7)	25 (26.3)	37 (38.9)	0.30 (0.861)
		No	86 (32.5)	77 (29.1)	102 (38.5)	
		Total	119 (33.1)	102 (28.3)	139 (38.6)	
Do you walk outside barefoot?	Sex	Male	102 (76.1)	26 (29.4)	6 (4.5)	17.90 (0.0001)
		Female	208 (92.0)	14 (6.2)	4 (1.8)	
	Foot complications	Yes	79 (83.2)	13 (13.7)	3 (3.2)	0.97 (0.617)
		No	231 (87.2)	27 (10.2)	7 (2.6)	
		Total	310 (86.1)	40 (11.1)	10 (2.8)	
Do you wash your feet with warm water daily?	Sex	Male	14 (10.4)	66 (49.3)	54 (40.3)	4.07 (0.130)
		Female	11 (4.9)	120 (53.1)	95 (42.0)	
	Foot complications	Yes	7 (7.4)	43 (45.3)	45 (47.3)	2.17 (0.337)
		No	18 (6.8)	143 (54.0)	104 (39.2)	
		Total	25 (6.9)	186 (51.7)	149 (41.4)	
Do you carefully dry between toes after washing your feet?	Sex	Male	50 (37.3)	36 (29.9)	48 (35.8)	1.97 (0.374)
		Female	92 (40.7)	69 (30.5)	65 (28.8)	
	Foot complications	Yes	36 (37.9)	27 (28.4)	32 (33.7)	0.320 (0.852)
		No	106 (40.0)	78 (29.4)	81 (30.6)	
		Total	142 (39.4)	105 (29.2)	113 (31.4)	
Do you moisturize your feet (put cream on) daily?	Sex	Male	40 (29.9)	56 (41.8)	38 (28.4)	16.75 (0.0001)
		Female	28 (12.4)	117 (51.8)	81 (35.8)	
	Foot complications	Yes	16 (16.8)	42 (44.2)	37 (38.9)	2.04 (0.361)
		No	52 (19.6)	131 (49.4)	82 (30.9)	
		Total	68 (18.9)	173 (48.1)	119 (33.1)	
Do you continuously wear cotton socks?	Sex	Male	9 (6.7)	73 (54.5)	52 (38.8)	22.09 (0.0001)
		Female	61 (27.0)	95 (42.0)	70 (31.0)	
	Foot complications	Yes	13 (13.7)	50 (52.6)	32 (33.7)	3.18 (0.203)
		No	57 (21.5)	118 (44.5)	90 (34.0)	
		Total	70 (19.4)	168 (46.7)	122 (33.9)	
Do you cut your toenails every 2 weeks?	Sex	Male	2 (1.5)	40 (29.9)	92 (68.7)	0.83 (0.569)
		Female	3 (1.3)	78 (34.5)	145 (64.2)	
	Foot complications	Yes	2 (2.1)	30 (31.6)	63 (66.3)	0.54 (0.764)
		No	3 (1.1)	88 (33.2)	174 (65.7)	
		Total	5 (1.4)	118 (32.8)	273 (65.8)	

Our study results also confirm the prevalence of DM-associated comorbidities was higher among patients who had had diabetes >10 years, similarly to other studies.^{26,36,37} The overall cumulative effect of dyslipidemia, hypertension, retinopathy, and diabetic duration leads to occlusive arterial disease that results in ischemia in the lower extremity and an increased risk of foot ulcers, gangrene, and amputation.^{38,39} However, in the present study, major foot complications among the patients were fewer and almost similar to a previous cohort study, in which 3.5% of diabetic patients had foot ulcers and gangrene.¹⁰ Conversely, an international study

found that about 15%–25% of diabetic patients were at risk of developing foot ulcers during their lifetime,¹⁵ though the incidence of foot ulceration in Western countries is around 2% annually.⁴⁰

Many diabetes-care organizations and researchers recommend serious timely intervention in the form of diabetic foot-care awareness, dietary instructions, and physical exercises. A majority of diabetic foot complications can be prevented by patient foot-care practices on a regular basis.^{41,42} Contrary to this recommendation, in the present study, only 41.7% of diabetic patients' self-examined their

Table 4 Effect of physician advice and patient knowledge on foot-care practices

Item	Response	Physician advice			Foot-care knowledge		
		Yes (132), n (%)	No (228), n (%)	χ^2 (P)	Good (251), n (%)	Poor (109), n (%)	χ^2 (P)
Do you examine/inspect your feet on a regular basis, daily?	Yes	113 (85.6)	180 (78.9)	2.45 (0.118)	208 (82.9)	85 (78.0)	1.19 (0.274)
	No	19 (14.4)	48 (21.1)		43 (17.1)	24 (22.0)	
Do you check your shoes before you put them on?	Yes	87 (65.9)	154 (67.5)	0.10 (0.751)	179 (71.3)	62 (56.9)	7.15 (0.007)
	No	45 (34.1)	74 (32.5)		72 (28.7)	47 (43.1)	
Do you check your shoes when you take them off?	Yes	80 (60.6)	143 (62.7)	0.16 (0.691)	163 (64.9)	60 (55.0)	3.15 (0.076)
	No	52 (39.4)	85 (37.7)		88 (35.1)	49 (45.0)	
Do you walk outside barefoot?	Yes	5 (3.8)	5 (2.2)	0.79 (0.375)	6 (2.4)	4 (3.7)	0.46 (0.497)
	No	127 (96.2)	223 (97.8)		245 (97.6)	105 (96.3)	
Do you wash your feet with warm water daily?	Yes	124 (93.9)	211 (92.5)	0.25 (0.616)	231 (92.0)	104 (95.4)	1.34 (0.246)
	No	8 (6.1)	17 (7.5)		20 (8.0)	5 (4.6)	
Do you carefully dry between the toes after washing your feet?	Yes	98 (74.2)	120 (52.6)	16.35 (0.0001)	155 (61.8)	63 (57.8)	0.50 (0.481)
	No	34 (25.8)	108 (47.4)		96 (38.2)	46 (42.2)	
Do you moisturize your feet (put cream on) daily?	Yes	116 (87.9)	176 (77.2)	623 (0.013)	205 (81.7)	87 (79.8)	0.17 (0.679)
	No	16 (12.1)	52 (22.8)		46 (18.3)	22 (20.2)	
Do you continuously wear cotton socks?	Yes	110 (83.3)	180 (78.9)	1.02 (0.311)	210 (83.7)	80 (73.4)	5.11 (0.024)
	No	22 (16.7)	48 (21.1)		41 (16.3)	29 (26.6)	
Do you cut your toenails every 2 weeks?	Yes	132 (100)	223 (97.8)	2.93 (0.087)	248 (98.8)	107 (98.2)	0.22 (0.634)
	No	0	5 (2.2)		3 (1.2)	2 (1.8)	

feet. Almost the same figure was reported in a previous local study.⁴³ Also, only a third of patients had their feet examined by a physician or received advice from their physicians about foot care. These data were also almost similar to previous local studies.^{43,44} Patients' foot examination and advice regarding foot care from attending physicians will increase patients' confidence in managing their foot-care practices.^{20,41}

Furthermore, in this study, the majority of patients had good knowledge of diabetic foot care, more so than other studies.^{19,20} Also, foot-care practice was high among patients who had good foot-care knowledge and got advice from their physicians. However, the results did not show significant differences from the poor-knowledge and not-advised groups. Here, the results should be interpreted with caution, because Muslims wash their feet and toes at least five times a day for their prayers. In this study, few patients had indoor and outdoor barefoot-walking habits, though these patients were much fewer compared to other studies reported elsewhere.^{45,46} Of these patients, the majority had poor knowledge and did not get advice from their physicians. Physicians should advise not walking barefoot inside home and that walking outside the home can be disastrous. Patients from rural areas, of low economic and poor educational status, and other sociodemographic factors could lead to such practice, which in turn can result in ulcer development or even toe or lower-extremity amputations.

It is well known that good knowledge will lead to healthy behavior, but some people may still engage in unhealthy behavior despite knowledge of their risk.⁴⁷ Therefore, this study suggests an improvement in or increased awareness and practice of diabetic foot care by patients as well as health care providers. Physicians are an important source of information, and have a leading role to play in increasing awareness among patients regarding foot self-care. Therefore, our study recommends that physicians taking care of diabetic patients check their patients' feet routinely and improve patients' knowledge about foot self-care.

This study also recommends that hospital management organizes frequent training programs for primary health care physicians involved in diabetes management. This could be an effective way to increase knowledge of diabetic foot management and complications, as well as awareness among diabetic patients, as reported by another study.⁴⁸

Conclusion

We found that about a third of participants suffered from highly uncontrolled DM and half had other comorbidities. Despite this, only a third of patients reported their feet had been examined at clinics or receiving advice on foot care from their physician. On the other hand, the majority of patients had knowledge of diabetic foot care, but few actually practiced proper foot care. Therefore, there is an urgent need for additional efforts for diabetic patients and their physicians for

regular checkups of patients' feet and promoting appropriate foot care among patients.

Limitations

A few limitations of our study should be kept in mind. First, all information regarding the patients was based on interviews and their hospital records. Second, this study was conducted only among patients living in Saudi Arabia.

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Disclosure

The authors report no conflicts of interest in this work.

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Supplementary material

Table S1 Diabetic foot-care knowledge among patients

Item	Response	Participants, n (%)	Male, n (%)	Female, n (%)	χ^2 (P)
Look after their feet because they may not feel a minor injury to their feet	True	308 (85.6)	124 (92.5)	184 (81.4)	8.42 (0.004)
	Do not know	52 (14.4)	10 (7.5)	42 (18.6)	
Look after their feet because wounds and infection may not heal quickly	True	343 (95.3)	131 (97.8)	212 (93.8)	2.93 (0.087)
	Do not know	17 (4.7)	3 (2.2)	14 (6.2)	
Look after their feet because they may get a foot ulcer	True	342 (95.0)	129 (96.3)	213 (94.2)	0.72 (0.395)
	Do not know	18 (5.0)	5 (3.7)	13 (5.8)	
Do not smoke because smoking causes poor circulation and affects the feet	True	326 (90.6)	127 (94.8)	199 (88.1)	4.45 (0.035)
	Do not know	34 (9.4)	7 (5.2)	27 (11.9)	
Look after their feet because they are more prone to flat foot	True	319 (88.6)	121 (90.3)	198 (87.6)	0.602 (0.438)
	Do not know	41 (11.4)	13 (9.7)	28 (12.4)	
Take medication regularly because they are liable to get DM complication	True	355 (98.6)	132 (98.5)	223 (98.7)	0.017 (0.897)
	Do not know	5 (1.4)	2 (1.5)	3 (1.3)	
How often do you think you should inspect the inside of your footwear for objects or torn lining?	True	328 (91.1)	123 (91.8)	205 (90.7)	0.64 (0.725)
	Do not know	31 (8.6)	11 (8.2)	20 (8.8)	
How often do you think you should need to wash your feet daily?	True	343 (95.3)	126 (94.0)	217 (96.0)	0.739 (0.390)
	Do not know	17 (4.7)	8 (6.0)	9 (4.0)	
What water temperature of do you think you should wash your feet in?	True	277 (79.9)	104 (77.6)	173 (76.5)	0.054 (0.817)
	Do not know	83 (23.1)	30 (22.4)	53 (23.5)	
How often do you think you should wear shoes and socks?	True	247 (68.6)	91 (67.9)	156 (69.0)	0.049 (0.825)
	Do not know	113 (31.4)	43 (32.1)	70 (31.0)	

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