

## FOOT ULCER EXPERIENCES OF PATIENTS WITH TYPE 2 DIABETES MELLITUS: A PROFILE FROM DUHOK/KURDISTAN

HAWAR A. MOHAMMEDSADIQ, NAWZAD SULAIMAN MURAD  
and RONAK HASSAN MOHAMMAD BARWARI

Adult Nursing and Fundamental of Nursing Branch, College of Nursing, University of Duhok,  
Kurdistan Region-Iraq.

(Received: December 2, 2019; Accepted for Publication: December 18, 2019)

### ABSTRACT

**Introduction:** Foot ulcers and their complications are important causes of morbidity and mortality in patients with type 2 diabetes mellitus (T2DM) with an annual incidence of 1% to 4%. The present study aimed to assess the physical examinations of feet of patients with T2DM.

**Methods:** In the present cross-sectional study, a total of 210 patients previously diagnosed with T2DM were purposively invited for foot physical examination between the 1<sup>st</sup> of Feb 2018 and 10<sup>th</sup> of Apr 2019. The foot assessment was performed by using 60-second Diabetic Foot Screen.

**Results:** The mean age of the patients was 54.40 (20-79 years old) and had the disease for the past nine years. Most of the patients were females (63.3%) and non-smokers (85.2%). The study revealed that 3.8% of patients had a history of foot ulcers, 1.4% had an amputation, and 3.3% had Charcot. Hypertension was the most common complication (52.4%), followed by nephropathy (46.7%) and retinopathy (41.9%). Most of the patients required yearly screening (**left foot:** 82.4%; **right foot:** 80.5%), followed by every 6 month screening (**left foot:** 16.2%; **right foot:** 19.0%). The patients with complications had a significantly higher level of foot ulcer either in left or right foot except for retinopathy and hypertension. In addition, the patients with a longer duration had a higher level of foot ulcer severity in left ( $r=0.143$ ;  $P=0.039$ ) and right ( $r=0.150$ ;  $P=0.031$ ) foot.

**Conclusions:** The present study suggests that patients with T2DM have a higher level of foot ulcer, and its severity is higher in those with complications either in left or right foot except for retinopathy and hypertension.

**KEYWORDS:** Foot Ulcer, Type 2 Diabetes Mellitus, Complication, Physical deterioration

### INTRODUCTION

Diabetes mellitus (DM) type 2 is a dominant disease, categorized by an asymptomatic phase between the clinical diagnosis and actual onset of diabetic hyperglycemia. Chronic complications development in DM type 2 patients as results of Hyperglycemia, is remain the main problems in diabetic maintenance, increase disability, lack of fitness to work, and premature death.

Universally, roughly a total of 366 million peoples have diabetes. Nearly half of the patients are unaware that they have the disease. Middle East, including Lebanon, Kuwait, Saudi Arabia, Qatar, United Arab Emirates and Bahrain are the highest occurrence of diabetes from the top ten highest prevalence of diabetes mellitus. Nearly about 13.7 million of prediabetes stage or having impaired glucose tolerance and 20.5 million

people with diabetes are living in the 20 Arab countries (Control *et al.*, 2011).

The most significant complications of the diabetes is diabetic foot. Diabetic foot is considered to be the major worldwide medical, social, and economic issue that affect the quality of life of patients. It is estimated that the diabetic patients have close 25% risk of foot ulcer development (Alexiadou *et al.*, 2012) resulting in frequently to disablement and leg amputation. It is estimated that every 30 seconds, a lower limb is amputated somewhere in the world in patients with diabetes (Arifin *et al.*, 2017).

Recently, foot ulcers from diabetic foot ulcers (DFUs) has increased (Boulton *et al.*, 2005). Late stage DFUs Treatment and understanding have improved. However DFUs prognosis still poor (Ghanassia *et al.*, 2008). The DFUs as serious and common complication are linked with substantial mortality (Tabatabaei-Malazy *et al.*, 2010). DM type2 morbidity and mortality of

patients caused by foot ulcers and their complications. Annually, incidence of foot ulcers is about 1- 4% and its prevalence is 5-10% in patients with DM type2 (Reiber, 2001). About 50% of DM type 2 patients have non-traumatic lower-limb amputations, The mortality of these patients are ranged between 39 to 80% (Reiber, 2001). Clinicians who care for these patients facing many challenges with foot problems in DM type2 including impaired life quality, morbidity and mortality (Moulik *et al.*, 2002).

The DM type 2 complications are mostly devastating to the foot. Approximately, 85% of diabetes-related amputations have the appearance of a foot ulcer (Health *et al.*, 2011). Assessing and screening patients with diabetes by clinician are at risk of developing foot ulcers and dealing with diabetic foot ulcers of the patients. To best of our knowledge, this issue has not been addressed yet in this region.

A diabetic foot is a foot that displays somewhat pathology that results directly from any long-term (or "chronic") complication of diabetes mellitus or diabetes mellitus itself (Pascale *et al.*, 2012). The present study aimed to assess the physical examinations of feet of patients with T2DM. In particular, the prevalence of amputation, ulcer, deformity, and its association with clinical factors was examined in the study.

## PATIENTS AND METHODS

### Study design and sampling

In the current cross-sectional study, the patients previously diagnosed with T2DM by a clinician were recruited purposively and were screened for feet health issues for study purposes. The required cases for the present study were obtained from the Duhok Diabetes Center of Azadi hospital in Duhok. The screening was performed for 210 patients with T2DM between 1<sup>st</sup> of Feb 2018 and 10<sup>th</sup> of Apr 2019.

### Eligible criteria

The subjects met eligible criteria for the present study, if they were male or female, diagnosed with T2DM, aged 18 years and older irrespective of their socio-demographic aspects and clinical conditions. The pregnant subjects, those with gestational or type 1 diabetes mellitus (T1DM) or rejected to participate, were not included in the study. In addition, the patients who had complications before T2DM

development, such as cardiovascular diseases, neuropathy, nephropathy, and retinopathy were not included in this study.

### Diagnostic and Measurement Criteria

The socio-demographic aspects of the patients, including age, gender, smoking, and past medical history, were collected through direct interviews with the patients. The medical information that was collected from the patients was previous foot ulcers, amputation, Charcot, vascular surgery, and angioplasty. The patients were asked to report the following complication in a dichotomous way; cardiovascular diseases, nephropathy, neuropathy, retinopathy, and hypertension.

The feet-related ulcer information was collected through the 60-second Diabetic Foot Screen established by the "Canadian Association of Wound Care (Inlow, 2004). This tool has the components for an assessment of skin, nail, deformity, footwear, temperature, and range of motion and includes Sensation – Monofilament Testing, Pedal Pulses, Dependent Rubor and Erythema. The scoring criteria for this tool are measured as follows:

**The following scores were given to the following conditions for both left and right foot through looking:**

**Skin rated as 0** (intact and healthy); 1 (dry with fungus or light callus); 2 (heavy callus build-up); and 3 (open ulceration or history of previous ulcer)

**Nails rated as 0** (well-kept); 1 (unkempt and ragged); and 2 (thick, damaged, or infected)

**Deformity rated as 0** (no deformity); 2 (mild deformity); and 4 (major deformity)

**Footwear rated as 0** (appropriate); 1 (inappropriate); and 2 (causing trauma)

**The following scores were given to the following conditions for both left and right foot through touching:**

**Temperature (cold):** 0 = foot warm; 1 = foot is cold

**Temperature (Hot);** 0 = foot is warm; 1 = foot is hot

**Range of Motion:** 0 = full range to hallux; 1 = hallux limitus; 2 = hallux rigidus; and 3 = hallux amputation

**The following scores were given to the following conditions for both left and right foot through assessment:**

**Sensation – Monofilament Testing:** 0 = 10 sites detected; 2 = 7 to 9 sites detected; and 4 = 0 to 6 sites detected

**Sensation – Ask 4 Questions:** i. Are your feet ever numb; ii. Do they ever tingle; iii. Do they ever burn; and iv. Do they ever feel like insects are crawling on them  
0 = no to all questions; 2 = yes to any of the questions

**Pedal Pulses:** 0 = present; and 1 = absent

**Dependent Rubor:** 0 = no; 1 = yes

**Erythema:** 0 = no; and 1 = yes

Screening for foot ulcers and/or limb-threatening complications. The highest score is used for left or right foot.

Score = 0 to 6 → recommend screening yearly;  
Score = 7 to 12 → recommend screening every 6 months;  
Score = 13 to 19 → recommend screening every 3 months;  
and Score = 20 to 25 → recommend screening every 1 to 3 months.

The monofilament test is a simple, bedside test that can predict the risk of neuropathic ulceration is used in this tool as well.

**Anthropometric measurement**

Waist hip ratio (WHR) is a comparison of measurement of waist to that of hip. It was measured through the following formula:

Waist Hip Ratio= Waist circumference / Hip Circumference

**Statistical analysis**

The descriptive purposes of the study were presented in frequency distribution either mean and standard deviation or frequency and percentage. The prevalence of disease

complications was presented in frequency and percentage. The total scores of the foot ulcer either left or right was added together to obtain the final score and was displayed in mean and standard deviation. The independent t-test was performed to compare the total score of feet in patients with and without complications. The correlation of disease duration with total score of feet was examined in the Pearson correlation. The significant level was determined in a P-value of less than 0.05. The statistical calculations were performed by Statistical Package for Social Sciences version 24:00 (SPSS 24:0; IBM).

**Ethical Considerations:**

The ethical approval of the present study was taken from the local health ethics committee in Duhok city. The present study had not any harm to the patients as no intervention was applied and their personal information was protected in the time of publication.

**RESULTS**

A total of 210 patients who were previously diagnosed with T2DM were included in this study. The mean age of the patients was 54.40 ranged between 20 and 79 years old. The patients had the disease for the past 9.0 years. The mean WHR of the patients was 0.99 (range: 0.63-1.85). Most of the patients were females (63.3% vs. 36.7%), and non-smokers (85.2% vs. 14.8%) and heavy smokers (71.0%), see Table 1.

**Table (1):** General information of type 2 diabetic patients

Patients' characteristics (n=210)	Frequency Distribution	
	Mean	Sta. Deviation
Age; Range: 20-79 years	54.40	9.81
Disease duration; Range: 1-35 years	9.0 (Median)	11.0 (Interquartile Range)
WHR; Range: 0.63-1.85	0.99	0.08
	Frequency	Percentage
<b>Gender</b>		
Male	77	36.7
Female	133	63.3
<b>Smoking</b>		
Yes	31	14.8
No	179	85.2
<b>Smoking types</b>		
Light Smoker	5	16.1
Moderate Smoker	4	12.9

Heavy Smoker	22	71.0
--------------	----	------

Of the total 210 patients who were included in the study; 8 (3.8%) had a history of foot ulcer, 3 (1.4%) had an amputation, 7 (3.3%) were with Charcot, 17 (8.1%) with vascular surgery, and 38 (18.1%) had angioplasty. The study revealed that hypertension was the most common complication (52.4%), followed by nephropathy (46.7%) and retinopathy (41.9%). The lowest common complications were CVD (27.6%) and neuropathy (23.8%), as shown in Table 2.

**Table (2):** History of medical conditions in type 2 diabetic patients

Medical patients' characteristics (n=210)	Frequency	Percentage
<b>Medical History</b>		
Foot Ulcer	8	3.8
Amputation	3	1.4
Charcot	7	3.3
Vascular Surgery	17	8.1
Angioplasty	38	18.1
<b>Complications</b>		
CVD	58	27.6
Nephropathy	98	46.7
Neuropathy	50	23.8
Retinopathy	88	41.9
Hypertension	110	52.4

The mean value of the left foot score was 4.14 ranged between 0 and 20. According to the cut-off of left foot scores, most of them require yearly screening (82.4%), followed by every six-month screening (16.2%). A small percentage of the patients required every three-month screening (1.4%) see Table 3.

Similarly, the mean value of right for the score was 4.00 ranged between 0 and 19.0. Based on the recommended cut-offs, most of the patients required yearly screening of their right feet (80.5%), followed by every six-month screening for 40 patients (19.0%). Only one patient required every three months of screening (0.5%), as presented in Table 3.

**Table (3):** Total score and its categories of left and right foot ulcer in type 2 diabetic patients

Patients' characteristics (n=210)	Frequency Distribution	
	Mean	Sta. Deviation
<b>Left foot score; Range: 0-20</b>	4.14	3.11
<b>Left foot category recommendations</b>		
Score = 0 to 6	173	82.4
Score = 7 to 12	34	16.2
Score = 13 to 19	3	1.4
<b>Right foot score; Range: 0-19.0</b>	4.00	2.90
<b>Right foot category recommendations</b>		
Score = 0 to 6	169	80.5
Score = 7 to 12	40	19.0
Score = 13 to 19	1	0.5

The study showed that the patients with complications had a significantly higher level of foot ulcer either in left or right foot except for

the patients with retinopathy and hypertension (Table 4).

**Table (4):** Comparison of foot ulcer score between patients with and without complications in left and right feet

Complications (n=210)	left Score		Right Score	
	Mean ± SD	P-Value	Mean ± SD	P-Value
CVD		<b>0.019</b>		<b>0.030</b>
Yes	4.95 ± 3.27		4.71 ± 2.79	
No	3.83 ± 2.99		3.74 ± 2.91	
Nephropathy		<b>0.009</b>		<b>0.017</b>
Yes	5.26 ± 3.54		4.86 ± 3.37	
No	3.79 ± 2.88		3.74 ± 2.70	
Neuropathy		<b>0.038</b>		<b>0.002</b>
Yes	4.61 ± 3.04		4.65 ± 2.91	
No	3.72 ± 3.12		3.44 ± 2.78	
Retinopathy		0.077		0.079
Yes	4.60 ± 3.50		4.43 ± 3.19	
No	3.80 ± 2.75		3.70 ± 2.64	
Hypertension		0.271		0.110
Yes	4.36 ± 3.08		4.31 ± 2.95	
No	3.89 ± 3.13		3.67 ± 2.83	

An independent t-test was performed for statistical analyses. The bold number shows a significant difference.

The study showed that the patients with a longer duration of a diabetic had a higher level of foot ulcer severity in left ( $r=0.143$ ;  $P=0.039$ ) and right ( $r=0.150$ ;  $P=0.031$ ) foot. However, the

correlation of WHR with foot ulcer severity was not significant in left ( $r=-0.020$ ;  $P=0.779$ ) and right ( $r=0.021$ ;  $P=0.767$ ) foot (Table 5).

**Table (5):** Correlation of foot ulcer score with disease duration and WHR in patients with type 2 diabetes

	Correlations	left Score	Right Score
Duration DM	Correlation	0.143	0.150
	Significance (2-tailed)	<b>0.039</b>	<b>0.031</b>
WHR	Correlation	-0.020	0.021
	Significance (2-tailed)	0.779	0.767

The correlation was adjusted for age and gender.

The bold number show a significant correlation.

## DISCUSSION

The present study showed that 8 patients (3.8%) had a foot ulcer, in which 3 (1.4%) of them had an amputation, 7 (3.3%) had Charcot, 17 (8.1%) had vascular surgery, and 38 (18.1%) had angioplasty. Importantly, hypertension was the most common complications in the study patients (52.4%), followed by nephropathy (46.7%) and retinopathy (41.9%) and the lowest common complications were CVD (27.6%) and neuropathy (23.8%). Mansour (2009) Conducted a longitudinal descriptive study in

Southern regions of Iraq in Basra between 2003 and 2009. He included 4,926 patients including 51.0% with mean age of  $55.0 \pm 13.1$  years with 5 years disease duration and 67.6% with overweight or obese. The complications which were found in their study were hypertension in 31.0%, peripheral neuropathy in 13.8%, ischemic heart disease in 7.8%, proteinuria in 6.6%, cerebrovascular accident in 4.6%, interdigital fungal infection in 4.3%, heart failure in 3.4%, and erectile dysfunction in 6.0%. He reported that 2.8% of the patents died due to cardiovascular causes, 2.7% of them developed

diabetic foot, 2.4% with non-alcoholic fatty liver. Importantly, 0.7% of the patients had amputation, 0.4% developed ophthalmoplegia, 0.2% had peripheral vascular disease, and 0.04% developed mucormycosis. The patients with T2DM have a higher risk to severe foot ulcer since it's has been show to associate with chronic complications in other parts of the world.

Another cross-sectional population-based study conducted in Iraq included 3176 including 56.8% females reported that the overall prevalence of undiagnosed diabetes was 2.14% (Mansour *et al.*, 2008). In addition, they reported that 5.29% had known diabetes reached a combined prevalence of new and known to 7.43%. The prevalence of impaired fasting plasma glucose (IFG) was 2.02% and 9.45% had abnormal hyperglycemia. The previously undiagnosed diabetics were 28.81% in all diabetics. These studies show that a large number of the population could at risk of further complications, including foot ulcers.

The patients included in this study had a critical situation because 82.4% required yearly screening according to the 60-second Diabetic Foot Screen scale as suggested by Canadian Association of Wound Care. Also, 16.2% and 1.4 % of them need six and three month-screening, respectively. Particularly that the prevalence of the complications is higher in patients, and those with chronic complications have a more severe foot ulcer.

In comparison with the study conducted (Mansour, 2009), the present study showed that the patients with a greater disease duration have a more severe foot ulcer score. Mansour (2009) showed that the patients with more than 5 years with hypertension, peripheral neuropathy, ischemic heart disease, proteinuria, cerebrovascular accident, heart failure, erectile dysfunction, cardiovascular death, diabetic foot, amputation, and peripheral vascular disease. The chronic complications are prevalent in diabetic patients in other parts of the Middle East as well (Zabetian *et al.*, 2013).

Mansour *et al.* (2007) Showed that patients with T2DM have higher anthropometric indices including BMI, WC, WHpR, WHtR. The present study showed that the patients have a higher WHR (0.99 ranged 0.63-1.85). It shows the patients included in this study, whether males or females have a high risk of

cardiovascular diseases. This kind of medical issue must be taken into consideration in the health promotion strategies of the health officers in the region. Mansour *et al.* (2007) Showed in multivariable logistic regression that hypertension (OR 1.66; 95% CI 1.41–1.96;  $p < 0.001$ ) is only predictor for incidence of T2DM. The present study showed that severity of left and right foot ulcers in the patients is independently associated with Neuropathy, Charcot, and Nephropathy (data not shown).

## CONCLUSIONS AND RECOMMENDATIONS

The present study showed that the patients have severe foot ulcer scores either in left or right side. In addition, majority of the patients required one year and six-month screening.

It is recommended to enhance regular foot examination, patient education, simple hygienic practices, and provision of appropriate footwear. The effect of footwear may contribute to the prevention of injuries associated with diabetic foot, and prompt treatment of minor injuries and it can decrease ulcer occurrence by 50% and eliminate the need for major amputation in non-ischemic limbs (Lavery *et al.*, 2005). Health professionals who manage people with diabetes should choose the most appropriate indication for the specific needs of each person and foot based on the international and national guidelines (Jorgetto *et al.*, 2019).

The diabetic nurses or in general nurses can educate the patients to prevent the diabetic foot, prevent patients with foot ulcer from further complications and injuries. In addition, the nurses can have a key role in early detection of abnormal changes in skin and foot sensation, foot care, dressing, and apply novel technology. Importantly, in the field of rehabilitation, the nurses can assist the patients who suffer from diabetic foot ulcer or amputation (Aalaa *et al.*, 2012). It is recommended to enhance foot care knowledge and self-reported patient behavior. It has been shown to associate with positively influenced by education in the short term (JAN *et al.*, 2014).

## REFERENCE

Aalaa, M, Malazy, Ot, Sanjari, M, Peimani, M, & Mohajeri-Tehrani, M. Nurses' Role In

- Diabetic Foot Prevention And Care; A Review. *Journal Of Diabetes & Metabolic Disorders*. 2012; 11(1): 24
- Alexiadou, K, & Doupis, J. Management Of Diabetic Foot Ulcers. *Diabetes Therapy*. 2012; 3(1): 4
- Arifin, N, Hasbollah, Hr, Hanafi, Mh, Ibrahim, Ah, Rahman, Wawa, & Aziz, Rc. Provision Of Prosthetic Services Following Lower Limb Amputation In Malaysia. *The Malaysian Journal Of Medical Sciences: Mjms*. 2017; 24(5): 106
- Boulton, Aj, Vileikyte, L, Ragnarson-Tennvall, G, & Apelqvist, J. The Global Burden Of Diabetic Foot Disease. *The Lancet*. 2005; 366(9498): 1719-1724
- Control, Cfd, & Prevention. National Diabetes Fact Sheet: National Estimates And General Information On Diabetes And Prediabetes In The United States, 2011. Atlanta, Ga: Us Department Of Health And Human Services, Centers For Disease Control And Prevention. 2011; 201(1): 2568-2569
- Ghanassia, E, Villon, L, Dit Dieudonné, J-Ft, Boegner, C, Avignon, A, & Sultan, A. Long-Term Outcome And Disability Of Diabetic Patients Hospitalized For Diabetic Foot Ulcers: A 6.5-Year Follow-Up Study. *Diabetes Care*. 2008; 31(7): 1288-1292
- Health, Udo, & Services, H. (2011). *Healthy People 2010: Understanding And Improving Health*. Washington, Dc: Us Department Of Health And Human Services; 2000.
- Inlow, S. The 60-Second Foot Exam For People With Diabetes. *Wound Care Canada*. 2004; 2(2): 10-11
- Jan, D, Dmw, K, Wjj, A, & Gd., V. Patient Education For Preventing Diabetic Foot Ulceration. *Cochrane Database Of Systematic Reviews*. 2014; (12): 2-15
- Jorgetto, Jv, Gamba, Ma, & Kusahara, Dm. Evaluation Of The Use Of Therapeutic Footwear In People With Diabetes Mellitus—A Scoping Review. *Journal Of Diabetes & Metabolic Disorders*. 2019: 1-12
- Lavery, La, Wunderlich, Rp, & Tredwell, Jl. Disease Management For The Diabetic Foot: Effectiveness Of A Diabetic Foot Prevention Program To Reduce *Amputations And Hospitalizations*. *Diabetes Research And Clinical Practice*. 2005; 70(1): 31-37
- Mansour, Aa. *Chronic Complications Of Diabetes In Iraq: Experience From Southern Iraq*. *Clinical Medicine. Endocrinology And Diabetes*. 2009; 2: Cmed. S3657
- Mansour, Aa, & Al-Jazairi, Mi. Predictors Of Incident Diabetes Mellitus In Basrah, Iraq. *Annals Of Nutrition And Metabolism*. 2007; 51(3): 277-280
- Mansour, Aa, Wanoose, Hl, Hani, I, Abed-Alzahrea, A, & Wanoose, Hl. Diabetes Screening In Basrah, Iraq: A Population-Based Cross-Sectional Study. *Diabetes Research And Clinical Practice*. 2008; 79(1): 147-150
- Moulik, P, & Gill, G. Mortality In Diabetic Patients With Foot Ulcers.(Clinical). *The Diabetic Foot*. 2002; 5(1): 51-54
- Pascale, R, Vitale, M, Zeppa, P, Russo, E, & Esposito, S. Diabetic Foot: Definitions. *Le Infezioni In Medicina: Rivista Periodica Di Eziologia, Epidemiologia, Diagnostica, Clinica E Terapia Delle Patologie Infettive*. 2012; 20: 5-7
- Reiber, Ge. *Epidemiology Of Foot Ulcers And Amputations In The Diabetic Foot*. The Diabetic Foot. 2001:
- Tabatabaei-Malazy, O, Mohajeri-Tehrani, Mr, Pajouhi, M, Fard, As, Amini, Mr, & Larijani, B. Iranian Diabetic Foot Research Network. *Advances In Skin & Wound Care*. 2010; 23(10): 450-454
- Zabetian, A, Keli, Hm, Echouffo-Tcheugui, Jb, Narayan, Ky, & Ali, Mk. *Diabetes In The Middle East And North Africa*. *Diabetes Research And Clinical Practice*. 2013; 101(2): 106-122