



Prevalence and Factors Influencing Diabetic Foot Ulcers among Saudi Diabetic Patients Attending Diabetes Outpatient Clinics in the Governmental Hospitals in Riyadh City

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Abstract. Diabetes is a major health problem worldwide. It is related to the autoimmune destruction of beta cell in the pancreas that secretes insulin (type I) or from insulin resistance and deficiency (type II); characterized by increased blood glucose level. Uncontrolled diabetes is associated with many serious long-term complications. including renal failure, retinopathy, neuropathy, foot ulcer, and amputation of diabetes. The current study aims to investigate Prevalence and Factors Influencing Diabetic Foot Ulcers Among Saudi Diabetic Patients Attending Diabetes Outpatient Clinics in the three Governmental Hospitals in Riyadh City through the distribution of a semi-structured questionnaire on a randomly selected sample (N=100). Study findings had indicated that 49% of the study participants had good knowledge level regarding diabetes and diabetic foot self-care practice was observed among (53%) of the patients. Moreover, Findings had shown that 19% of the Saudi diabetic patients attending diabetes outpatient clinics in the governmental hospitals in Riyadh city have diabetic foot ulcers. Furthermore, findings had shown that 63% of the diabetic patients with foot ulcers were from rural areas. The study recommended that about the risk of developing foot ulcers and the importance of the diet and weight reduction, regular blood pressure check and wearing the suitable fitting shoes.

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1. Introduction:

Diabetes is known since antiquity when the Greek physician Aretaeus had noticed in early 200BC that some patients show symptoms of frequent urination and extreme thirst. This phenomenon has been called the diuresis or "Diabetes", a Latin word meaning to go to the bathroom chair or frequent urination. In 1675 AD, the scientist Thomas Willis added the word "Mellitus", which means in Latin "sweet as honey", after noticing that the blood and urine of diabetics have a sweet taste ,so became the naming of this disease ,"Diabetes Mellitus", or Diabetes (Gale et al., 2014).

But there is also a rare condition called "Diabetes Insipidus", in which does not have the sweet taste of urine. This situation is due to the malfunction in the kidney and pituitary gland (American Diabetes Association, 2003).

In 1889, Joseph Von Mering and Oskar Minkowski had found the role of the pancreas in diabetes, when had found the role of the pancreas in diabetes, when they completely isolated and removed the pancreas from the dogs where they showed signs and symptoms of diabetes and died shortly after that. In 1910, the scientist Sir Edward

Sharpey-Schafer had found that diabetic patients suffer from the shortage of a chemical substance produced by the pancreas, and called it as "Insulin", a word that is derived from the Latin word *Insula* , which means island, due to the word "Langerhans " islands in the pancreas that produce insulin. Later, in 1920, Bating and his colleagues in Toronto university in Canada, were able to extract and purify insulin hormone for the first time from cow' pancreas. This led to the availability of insulin injections which used for the first time on diabetics in 1922 (Shah et al., 1997; Joshi et. al., 2007).

Diabetes is at present one of the most prevalent diseases in the world as a whole and developing countries in specific, it affects rich and poor, young and old, men and women (Aanstoot et. al., 2007).

Scientific studies have shown that approximately 8.3% of individuals living with diabetes, and many patients do not show any symptoms of the disease, besides they do not know they are infected with diabetes (Federation & Atlas., 2013).

The high prevalence of diabetes could be due to changing food habits, obesity, psychological well-being,



anxiety tension, the incidence of certain viruses, and other causes. Based on the world health organization report issued in 2006, the number of people infected with this disease was nearly 171 million people worldwide. Unfortunately, the number is on the rise and expected to double by the year 2030 due to increased obesity which leads to the imbalance in the secretion of insulin hormone, as well as the rising of the average age of people in developed countries (Deaths, 2008; Federation & Atlas., 2013).

The problem of diabetes is not just in the high proportion of sugar in blood, it's a symptom of the disease that penetrates the human body silently and slowly but strikes violently, where most studies have shown that the risk of dying as a result of complications that occur for a diabetic is equivalent twice compared to other healthy people who are in such age and sex. Specifically, diabetics likely to die of cardiovascular diseases by more than three-fold, with about 75% of deaths in diabetic patients are due to cardiovascular diseases, they are susceptible to brain stroke as well more than three-fold. Diabetes is the primary cause of blindness among those over the age of twenty, which is why in the incidence of 44% of the cases of complete kidney failure, diabetics suffering from weakness and sexual dysfunction, and about 30% suffer from depression wither they knew it or did not know (Grundy et al., 1999).

Finally, the heavy bill incurred by diabetic treatment and medical sources estimated that only for the treatment of those who are over the age of twenty years of age by about 245 billion USD per year worldwide. This includes medical care, the cost of hospitals and laboratory tests, medical drugs and the number of days in which the patient is absent from work due to the complications of the disease (Centers for Disease Control and Prevention, 2014).

Saudi Arabia is one of the top countries in the high prevalence of diabetes, where studies have shown that the incidence of this disease in males accounted for 2.55% and 5.32% for females. The cost of medical care for diabetics in the kingdom of Saudi Arabia has been estimated at about 5% of the budget of the ministry of health (Alqurashi et al., 2011).

In 2013, It has been estimated that 382 million people are having diabetes mellitus worldwide. This number is predicted to increase up to 592 million by 2035. In Saudi Arabia, the prevalence of diabetes mellitus is estimated at approximately 24% among the Saudi adults, which is three times higher than the global prevalence, and locates Saudi Arabia in the top 10 countries regarding the prevalence of diabetes (Akbar et al., 2000).

The specific reasons behind this high disease burden in Saudi Arabia are yet to be explored and determined. However, traditional risk factors such as obesity, sedentary lifestyle, smoking, and hypertension were reported to be very prevalent in the Saudi population.

Given that the rapid increase in the prevalence of diabetes in Saudi Arabia is vital that future national efforts concentrate no only on treatment, but also on prevention.

In medical literature, it's reported that Saudi patients had poor knowledge of diabetes. Moreover, its reported that physicians of primary care centers have suboptimal awareness programs in primary care centers and in the community are essential to achieving control and prevention of diabetes mellitus in Saudi Arabia population (Nielsen, 1998).

The overarching concern motivation in this study is that Saudi diabetic patients attending diabetes outpatient clinics in the governmental hospitals in Riyadh city should be well educated about the diabetic foot ulcers and the factors influencing their development.

Different factors affecting the prevalence of the foot ulcers among the DM patients, but the better understanding and control of these factors, the more reduction of foot ulcers prevalence in the area.

The primary problem faced by this study is the issue of knowledge level about diabetic foot ulcers among the patients in the Riyadh area. So, a conceptual framework for the possible influencing factors was drawn and followed in this study.

2. Methodology:

2.1. Study design:

A descriptive cross-sectional study on the study population represented all patients diagnosed with diabetes and attending the hospital's diabetics follow-up clinic. A randomly selected sample (N=100) had been recruited to administer the study instrument. Participants were selected from three governmental hospitals in Riyadh city; they are King Salman hospital, Al-Imam Abdulrahman Al-Faisal hospital, and Prince Mohammad Bin Abdul-Aziz Hospital.

2.2. Sample selection criteria:

Participants should be Saudi diabetic patients attending diabetes outpatient clinics in the governmental hospitals in Riyadh city and patients' willingness to participate.

2.3. Study Instrument:

Random sample selection will be performed to get the study sample. Study instrument will include two distinct parts:

PART I: items investigating the socio-demographic characteristics of the study participants.

PART II: items exploring the patients' knowledge level regarding and factors influencing diabetic foot ulcers.

Instrument items consistency and validity had been checked before distributing the questionnaire. Data analysis had been performed after sorting, coding, and exporting the participants' responses to the Statistical Package for Social Sciences (SPSS) software (IBM Corporation v 23.0). Descriptive statistics, means, standard



deviation and correlation factor were calculated for the participants' responses. Finally, results were presented and interpreted textually and graphically.

3. Results:

3.1. Study sample distribution according to their demographic characteristics

One hundred diabetic patients were involved in the study of prevalence and factors influencing diabetic foot ulcers. Ulceration was observed among 19% of the diabetic patients. The mean age of the study population was 38.68±2.12. with regard to gender distribution, 78 (78%) were male. See table 1.

Table (1): Study sample distribution according to their demographic characteristics.

Age	N	Frequency
18-25	3	3%
26-33	18	18%
34-41	58	58%
42-49	21	21%
Sex		
Male	78	78%
Female	22	22%
Marital status		
Single	2	2%
Married	75	75%
Widowed	9	9%
Divorced	14	14%
Occupation		
Daily labour	25	25%
Employed	73	73%
Housewife	2	2%
Other	0	0

Seventy-five (75%) were married. corresponding to educational status 49 (49%) have a secondary school. Almost 73% of the study population were employed. Refer to table 1.

Regarding knowledge about diabetes, 49 (49%) of the study sample have good knowledge about diabetes (Table 2). Diabetic foot self-care practice was observed among 53 (53%) of the patients (See Table 3 and Figure 1). Concerning body mass index (BMI) majority of the study population lie within the range of 25.2-29.9 kg/m², which indicates an overweight (Table 4).

Table (2): Knowledge level about diabetic foot self-care among study participants.

DM knowledge level	N	Frequency
Good knowledge	49	49%
Poor knowledge	51	51%

Table (3): DM self-care Knowledge level percentage among study participants.

DM self-care	N	Frequency
Good Self-care	53	53%%
Poor Self-care	47	47%%

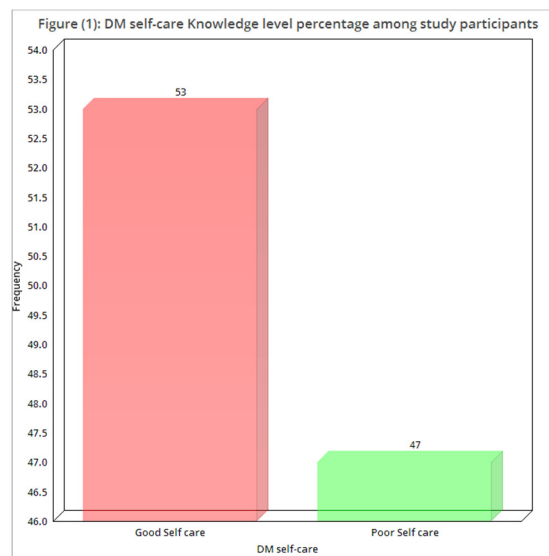


Table (4): Study sample distribution according to their BMI values.

Body Max Index (BMI)	N	Frequency
<18.5	2	2%
18.5-24.9	26	26%
25-29.9	72	72%

Moving to blood pressure, the majority of the study population sample 89 (89%) have systolic blood pressure less than 140mmhg. regarding the diastolic blood pressure, 16 (16%) of the study sample have a diastolic blood pressure greater than 90mmhg (Tables 5 and 6).

Table (5): Study sample distribution according to their Systolic blood pressure measurements.

Systolic blood pressure	N	Frequency
<140	89	89%
>140	11	11%

Table (6): Study sample distribution according to their Diastolic blood pressure measurements.

Diastolic blood pressure	N	Frequency
<90	84	84%
>= 90	16	16%

Regarding fasting blood glucose level, the mean fasting blood glucose level among diabetic patients with



foot ulcer is 169.87mg/dl, which is higher than those diabetic patients without diabetic foot ulcer (Table 7).

Table (7): Mean value of fasting blood sugar.

Mean FBS in mg/dl	169.87mg/dl
Mean	

Among the study population, 32 (32%) were diabetics for more than 8 years and above. Regarding foot skin texture, 37 (37%) have cracked and dry skin (Table 8).

Table (8): Study participants distribution according to the duration of DM.

Duration of Diabetes	N	Frequency
Less Than 8 years	68	68%
More than 8 Years	32	32%

Concerning smoking status, 9 (9%) of the study sample were smokers (Table 9). Among the study sample, 59 (59%) have chronic health problems or co-morbidity other than diabetes (Table 10).

Table (9): Study participants distribution according to smoking habit.

Smoker	N	Frequency
Yes	9	9%
No	91	91%

Table (10): Study participants distribution according to the occurrence of comorbidity.

Comorbidity	N	Frequency
Yes	59	59%
No	41	41%

Looking to use of ill-fitting shoes, the majority of the respondents, about 88% use shoes that do not fit their foot well (Table 11, Figure 2). Sensation to vibration using a relatively low-pitched tuning fork of 128Hz was detected in 39 (39%) of the study population (Table 12).

Table (11): Study participants distribution according to using ill-fitting shoes.

Use of ill-fitting shoes	N	Frequency
Yes	67	67%
No	33	33%

As shown in table 13, Callus of the foot makes diabetic patients 19.4 times more likely to have diabetic foot ulcers as compared to diabetic patients not having a callus on the foot. diabetic patients with loss of sensation to vibration of 128Hz of tuning fork were 4.3 times more likely to have diabetic foot ulcers as compared to those without sensory loss. if keeping all the factors, diabetic patients using ill-fitting shoes were 10.7 times more likely

to have foot ulcers as compared to those who do not use ill-fitting shoes.

Figure (2): Study participants distribution according to using of ill-fitting shoes

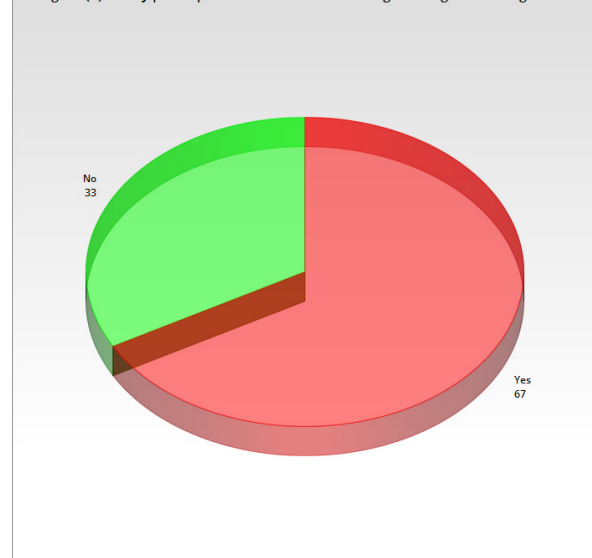


Table (12): Study participants distribution according to sensory to vibration.

Sensory To vibration	N	Frequency
Yes	39	39%
No	61	61%

Patients from the rural areas are 2.8 times more likely to develop foot ulcers compared to those from urban areas. regarding skin texture, the odds in favor of having diabetic foot ulcers among those diabetic patients with only cracked foot skin are 2.9 times higher as compared to those with smooth and moist foot skin.

The odds ratio for co-morbidity indicates that when holding all other factors constant in diabetic patients with co-morbidity are 6.9 times more likely to have foot ulcer than those who do not have co-morbidity.

Controlling all other factors constant, overweight diabetic patients are 13.1 times more likely to have diabetic foot ulcers as compared to those diabetic patients with normal body mass index (BMI).

Patients with hypertension were selected as a reference group, because of their abundance, keeping all other factors constant, patients with neuropathy were 4.79% times more likely to develop diabetic foot ulcers than diabetic patients with hypertension.

rural residence increases the chance of having diabetic foot ulcer by 3.8 times as compared to urban residence. farmer diabetic patients were 7.3 times more likely to develop diabetic foot ulcers as compared to other employees.

the odds in favor of diabetic patients' foot ulcer increases 5.94 times for diabetic patients with mean arterial



blood pressure greater than 90 mm Hg compared to those whose mean arterial blood pressure is less than 90 mm Hg.

Diabetic patients with duration of having diabetes more than 8 years are 9.65 times more likely to develop diabetic foot ulcers as compared to those who are their duration of diabetes is less than 8 years.

4. Discussion:

This study shows that a significant number of Saudi diabetic patients (19%) attending diabetes outpatient clinics in the governmental hospitals in Riyadh city have diabetic foot ulcers. According to standards books, this prevalence is within the reference range.

The possible explanation for this high prevalence of diabetic foot ulcers among Saudi diabetic patients attending diabetes outpatient clinics in the governmental hospitals in Riyadh city might be related to diabetic foot self-care practice, health-seeking behaviors and diabetes-related knowledge patients. besides a significant number of patients were coming from rural areas, which are far away from hospitals in catchments areas. besides our study flashed the need to do lots of jobs to prevent diabetic foot ulcers.

The occurrence of diabetic foot ulcers mostly in males and middle ages respondents has been reported by several researchers in other areas of Saudi Arabia.

Those figures have a slight variation with the present findings, this might reflect regional variation in the prevalence of diabetes mellitus, and locally operating factors like socio-demographic factors and socio-cultural variables.

The variation of diabetic foot ulcers related to sex and age might reflect the variation in societal role between males and females in the Riyadh area. Typically, in the study area, males spend most of their time outside homes doing jobs that need more energy, compared to women.

The increase in Diabetic foot ulcers among diabetic patients, particularly in the study area, is worrying situation for individual families as males are the backbone and the sole earning members of the family, particularly in Riyadh city, Capital of Saudi Arabia.

This study which is aimed to assess the prevalence and factors affecting diabetic foot ulcers found that (63%) of the diabetic patients with foot ulcers were from rural areas. Which is consistent with previous prevalence studies that indicated a higher prevalence of diabetic foot ulcers among rural areas inhabitants due to their hard-outdoor activities compared to urban areas. The people in rural areas are more exposed to external environmental effects more than urban area people.

The odds in favor of diabetic foot ulcer for overweight diabetic patients were (59%) more likely as compared to diabetic patients who were not overweight.

Body weight and Body Mass Index (BMI) were emerged as an influential factor for developing diabetic

foot ulcers, with higher risk associated with greater weight and increased body mass index.

Table 13: Univariate analysis with P value <0.05. Indicates to a reference group. AOR results are from a multivariate analysis indicating a significant factors association.

Factor	Crud/unadjusted odds ratio (COR) (95% CI)	Adjusted odds ratio (AOR) (95% CI)
Age		
18-25	1	-----
26-33	1	-----
34-41	3.61	3.371
42-49	4.016	3.971
Residence		
Rural	2.81	3.781
Urban	1	1
Use of ill-fitting shoes		
Yes	10.7	-----
No	1	-----
Hypertension	1	1
Neuropathy	4.79	-----
Occupation		
Daily labour	7.318	6.85
Employed	1	1
Housewife	3.67	3.931
Duration of Diabetes		
Less than 8 years	1	1
More than 8 years	9.311	9.65
Comorbidity		
Yes	6.913	1
No	1	0.131
Sensory To vibration		
Yes	4.317	-----
No	1	1
Practice		
Good Practice	1	-----
Poor Practice	3.1	-----
Body Mass Index		
<18.5	1	-----
18.6-24.9	2.13	-----
25-29.9	13.1	-----
Foot Skin Texture		
Smooth and moist	1	-----
Dry/Cracked	2.913	-----
Callus of the foot		
Present	19.4	8.6117
Absent	1	-----
Arterial Blood Pressure		
>= 90	6.321	5.94
<90	1	1

CI: Confidence Interval.

One potential mechanism for this association might be higher foot pressure in heavier and those with higher body mass index subjects.



Long duration of diabetes even after controlling for age, was a statistically significant finding in several studies, this cross-sectional study also found that the odds in favor of having diabetic foot ulcer are increased by four times higher in those who were diabetic for more than 9 years as compared to those whose duration is less than 9 years.

The possible explanation for that might be at more risk due to the development of long-term diabetic complications such as peripheral vascular diseases (PVD), neuropathy, nephropathy and retinopathy which could lead to the occurrence of foot ulcer in the diabetic patients.

This cross-sectional study identified use of ill-fitting shoes as an influential factor in the development of diabetic foot ulcer. This increased risk among those who use ill-fitting shoes might be related to high chance and frequency of foot injury which might result in subsequent ulceration.

The prevalence of diabetic foot ulcers among diabetic patients attending Riyadh city hospitals was 19%. This study confirms that foot ulcers in diabetes result from multiple influential factors. significant influential factors were rural residence, mean arterial blood pressure m co-morbidity, and duration of diabetes.

Though this is the first study to identify the prevalence and influential factors of diabetic foot ulcer using interviewer-administered questionnaire, patients medical record review, and foot observation checklist, it has certain limitations; it would have been better if a prospective cohort study has been conducted to identify the real-life determinants, besides there may be a recall bias on recalling duration of illness, self-reporting of patients regarding diabetic foot self-care practice and accuracy of measuring instruments such as blood pressure apparatus is a questionable issue.

In conclusion, the prevalence of diabetic foot ulcers among diabetic patients attending Saudi governmental hospitals was 19%. This study confirms that foot ulcers in diabetes result from multiple influential factors. significant influential factors were rural residence, mean arterial blood pressure m co-morbidity, and duration of diabetes.

According to the previous findings of the study, the following recommendations should be taken into consideration to minimize the prevalence of diabetic foot ulcers and its associated un-liked effects:

- Despite that the prevalence of the diabetic foot ulcers is within the range, the health sector represented by the ministry of health care providers should present more efforts to minimize its prevalence by improving the diabetic knowledge, and the diabetic self-care practice, as well as the regular diabetic foot evaluation.
- Rural areas patients with co-morbidity and sensory loss should receive special health care in addition to the routine care provided.
- More efforts should be directed towards educating people about the risk of developing foot ulcers and the importance of the diet and weight reduction, regular

blood pressure check and wearing the suitable fitting shoes.

- To conduct more studies, to identify more factors influencing the diabetic foot ulcers development.

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Conflicts of Interest:

There are no conflicts of interest among authors.

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