Prevalence of diabetic foot ulcer risk factors and its etiology among non-amputated diabetic foot patients in Aseer region

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**ABSTRACT**

**Background:** Diabetes mellitus (DM) is a common health problem worldwide associated with several complications, such as diabetic foot ulcers. The current study aimed to assess the prevalence of diabetic foot ulcer risk factors and etiology among non-amputated diabetic foot patients in the Aseer region, Saudi Arabia.

**Methodology:** A cross-sectional study was conducted among adult patients, who visited a diabetic foot clinic from 15 November 2012 to 22 September 2017. A total of 359 patients’ records were enrolled to improve reliability.

**Results:** The majority of the patients (73.5%) were male; the highest percentage of patients (74.7%) was without previous amputation. Approximately, 94.2% of the patients had type 2 diabetes mellitus and trauma was the leading cause of diabetic foot ulcer with 47.1%, followed by tinea (21.1%). The lowest cause of diabetic foot ulcers was dryness (5.6%) and blisters (5.3%).

**Conclusion:** The current study was close to the global ratio with regard to the prevalence of diabetic foot ulcers, wherein this issue exists in most countries of the world with a high prevalence score found in Asian countries.

**Keywords:** Diabetic mellitus, foot dorsum, foot sole, hyperglycemia, Type 1 DM, Type 2 DM.

**Introduction**

Diabetes mellitus (DM) is considered one of the most common chronic diseases globally. With 415 million DM patients worldwide, 35.4 million are in the Middle East and North Africa region, and these numbers are still growing. The concentration of glucose in the blood increases (hyperglycemia) due to the non-production of insulin by the pancreas or the amount produced is insufficient [1,2]. There are three types of DM including (1) type 1 diabetes, where there is no insulin production, usually onset early in childhood, and hence previously known as childhood-onset diabetes. Only 5% of DM patients have this form. (2) Type 2 diabetes (previously known as non-insulin-dependent) in which the insulin is produced, but it cannot affect potently, often due to excess body weight and sedentary lifestyle. (3) Gestational diabetes occurs in pregnancy [1,3].

Hyperglycemia causes damage to blood vessels primarily and nerves, consequently, which leads to complications. When a nerve is damaged, it might stop the conduction of signals or conduct it slowly. It also causes loss of feelings in the feet. Inadequate blood supply caused by sugar-coated vessels contributes to the development of peripheral artery disease [4,5]. Diabetic foot ulcer is the most critical DM patients’ complication. The incidence rate suggested that 15% of DM patients would develop a lower extremity ulcer [6]. Diabetic foot ulcer is caused by many factors, including non-fitting shoe pressure, trauma, predisposing infection, deformity, uncontrolled glucose level and male gender [4]. The hospital length of stay for diabetic foot ulcer patients is extended by 59% than patients without an ulcer [7]. Studies in the United States and Europe have shown that the most common non-traumatic lower extremity amputations are caused...
Prevalence of diabetic foot ulcer by DM [8,9]. Thereby, the current study aimed to assess the prevalence of diabetic foot ulcer risk factors and its etiology among non-amputated diabetic foot patients in the Aseer region, Saudi Arabia.

Subjects and Methods

A cross-sectional record-based study was conducted at the foot care clinic of the diabetic center in Aseer Central Hospital, Abha, Saudi Arabia. The clinic received patients with type 1 DM after 5 years of being diagnosed, and at the date of diagnosis for those with type 2 DM or any known diabetic patient who had developed an injury to their feet. The files were reviewed for patients who attended the clinic from 15 November 2012 to 22 September 2017. The data were collected for about 6 months in the diabetic center starting from 22 September 2017 to 17 February 2018.

The study’s inclusion criteria included adult patients who visited diabetic foot clinics from 15 November 2012 to 22 September 2017. Exclusion criteria were (1) patients under the age of 18 years, (2) patients’ records that contained missing information, and (3) patients who visited the clinic before or after 15 November 2012 to 22 September 2017. Records were selected by systematic random sampling, where every third record was picked that was listed in the clinic visit logs.

Data for age, gender, type of diabetes, duration of diabetes, type of treatment, body mass index (BMI) according to patients’ last measured weight and height was collected and categorized as <18.5 underweight, 18.5–24.9 normal, 25–30 overweight, and >30 obese. A smoking history which was divided into current smoker and non-smoker, diabetic complications [hypertension (HTN), ischemic heart disease, myocardial infarction, cerebrovascular accident, dyslipidemia, peripheral vascular disease (PVD), diabetic ketoacidosis (DKA), and hypoglycemia], family history of diabetes (either first degree, second degree, or none), blood sugar control through Hba1C where one reading above 8% was uncontrolled, history of previous ulcer and amputation, affected site, and the cause of the ulcer from the patients’ records were also collected.

Variables were described by means. The null hypotheses of no difference were rejected when the p-value was 0.05. Analyses were carried out using the Statistical Package for the Social Sciences 22.0 version.

Results

The study revealed that 264 (73.5%) patients were male, and 95 (26.5%) were female. Diabetic foot patients with the previous amputation were 91 (25.3%) and diabetic foot patients with no amputation earlier were 268 (74.7%) (Figure 1).

Two hundred eighty-seven (79.9%, n = 287) patients were above the age of 50 years. Three hundred thirty-eight (94.2%, n = 338) patients were of type 2 DM. Patients with DM for 10–20 years of onset were 149 (41.5%) (Table 1).

Two hundred ten (58.5%) patients had visual impairment. Peripheral vascular disease and peripheral neuropathy were found in 42.1% (n = 151) and 23.4% (n = 84) of the patients, respectively (Table 2). Hypertensive patients were 33.1%.

Trauma was the leading cause of diabetic foot ulcers with 47.1% (n = 143). The second leading cause of diabetic foot ulcers was tinea with 21.1% (n = 64). Twenty-six (8.6%, n = 26) patients had diabetic foot ulcers caused by neuropathy. Dryness caused diabetic foot ulcers was seen 17 patients (5.6%), whereas 16 patients (5.3%) had diabetic foot ulcers due to blisters (Table 3).

Dorsum of foot and sole of foot were highly affected with foot ulcers in the right foot with 10.3% and 6.1%, respectively. Foot dorsum and sole (5.6%) were highly affected in both feet (right and left). All toes and feet were highly affected (9.5%) (Table 4).

Almost, 59.9% of the patients did not have any associated co-morbidities, while 33.1% had HTN, and the lowest co-morbidities was DKA (2.2%) (Figure 2).

Figure 1. Diabetic foot amputation record of the patients.
Prevalence of diabetic foot ulcer

Discussion

The present study was carried out to investigate the prevalence of diabetic foot ulcer risk factors and its etiology among non-amputated diabetic foot patients at Aseer region. The result demonstrated that diabetic foot was significantly associated with male gender, age older than 50 years, illiteracy, type 2 diabetes, longer duration of the disease, earlier age of the onset of diabetes, presence of PNP, PVD, and HTN. In agreement, a cross-sectional study revealed that the main risk factors for complications were male gender, poor level of education, long disease duration, type 2 diabetes mellitus, and presence of HTN [10]. However, in this paper, peripheral neuritis and diabetic retinopathy were the most complicating and had approximately the same proportion.

Moreover, diabetic foot was reported mainly at age of 40 years or more in many studies. Al-Maskari et al. [11] found a comparable mean age of 60 years. These studies were conducted in different centers that offered diabetes care of different qualities. This comparable mean age might suggest certain time-dependent risk factors in the evolution and course of diabetic septic foot. Another research confirmed that the type of DM affects the rate of infection with diabetic foot [12]. About 77.8% of the patients with type 2 DM suffer from diabetic foot these days.

The current study revealed that 264 (73.5%) patients were male and 95 (26.5%) were female. Diabetic foot patients with the previous amputation were 91 (25.3%)
Prevalence of diabetic foot ulcer

Table 4. Site of foot ulcers in the patients.

<table>
<thead>
<tr>
<th>Site</th>
<th>Right No</th>
<th>Right %</th>
<th>Left No</th>
<th>Left %</th>
<th>Both No</th>
<th>Both %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toe</td>
<td>44</td>
<td>12.3</td>
<td>22</td>
<td>6.1</td>
<td>11</td>
<td>3.1</td>
</tr>
<tr>
<td>Dorsum of foot</td>
<td>37</td>
<td>10.3</td>
<td>12</td>
<td>3.3</td>
<td>30</td>
<td>8.4</td>
</tr>
<tr>
<td>Sole of foot</td>
<td>22</td>
<td>6.1</td>
<td>12</td>
<td>3.3</td>
<td>8</td>
<td>2.2</td>
</tr>
<tr>
<td>Toe with foot dorsum</td>
<td>8</td>
<td>2.2</td>
<td>1</td>
<td>0.3</td>
<td>13</td>
<td>3.6</td>
</tr>
<tr>
<td>Toe with foot sole</td>
<td>6</td>
<td>1.7</td>
<td>2</td>
<td>0.6</td>
<td>16</td>
<td>4.5</td>
</tr>
<tr>
<td>Foot dorsum and sole</td>
<td>13</td>
<td>3.6</td>
<td>8</td>
<td>2.2</td>
<td>20</td>
<td>5.6</td>
</tr>
<tr>
<td>All foot and toe</td>
<td>8</td>
<td>2.2</td>
<td>9</td>
<td>2.5</td>
<td>34</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Figure 2. Associated co-morbidities for diabetic patients.

and diabetic foot patients with no previous amputation were 268 (74.7%). Importantly, only the duration of DM was a statistically significant risk factor. Diabetic foot could be significantly developed among patients with diabetes for more than 10 years [13]. Several risk factors are responsible for amputation among diabetic patients, such as prolonged diabetes duration, previous amputation, poor long-term glycemic and lipids’ control, and ulceration [14]. The reviews showed that 210 (58.5%) patients had visual impairment. Peripheral vascular disease and peripheral neuropathy were 42.1% (n = 151) and 23.4% (n = 84), respectively. In another research, patients were screened for diabetes complications at the time of diagnosis. The high prevalence of retinopathy, which is the most specific complication of hyperglycemia, suggested a delay between the onset of diabetes and diagnosis [15]. Patients’ lack of knowledge about diabetes complications might also contribute to the high rates of complications. Macky et al. [16] found that about 80% of the patients lacked knowledge about the ocular hazards of diabetes.

There were some limitations to the current research. This study was a cross-sectional study; therefore, the temporal relationship between potential risk factors and outcomes could not be considered in the account. Additionally, the study was conducted within a short period, and the later effects of diabetes could not be assessed.

Conclusion

One of the essential microvascular complications of diabetic patients is diabetic foot ulcers, mainly in the lower extremities, which is a common chronic disease that ends with amputation. The current study is close to the global ratio in the prevalence of diabetic foot ulcers, where this issue exists in most countries of the world, with a high prevalence score found in Asian countries.

List of abbreviations

DKA  Diabetic ketoacidosis
DM  Diabetes mellitus
HTN  Hypertension
PNP  Peripheral neuropathic disease
PVD  Peripheral vascular disease

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Funding

None.

Consent to participate

Informed consent was obtained from all the participants.

Ethical approval

Ethical approval was obtained from ACH ethics and internal review board (IRB) committee in accordance with departmental and hospital policy REC # 2017-C2-39.

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