

PRECIPITATING FACTORS FOR DIABETES FOOT ULCER IN A NIGERIAN TERTIARY HOSPITAL

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ABSTRACT: *The diabetic foot ulcer (DFU) continues to afflict patients with diabetes despite the knowledge of its precipitants. Given the high cost of managing DFU, we sought to determine whether the immediate precipitating factors for the development of foot ulcerations have changed, in order to suggest effective preventive strategies. Methods: This is a descriptive study. The case records of patients admitted for diabetic foot ulcer at Lagos University Teaching Hospital between 2003-2005 were retrospectively reviewed. Information extracted from the notes included age, sex, duration and type of diabetes, fasting and or random/casual plasma glucose at presentation, grade of foot ulcer, and the immediate precipitating factors. Results: Twenty seven case records of patients with DFU were available for analysis. There were 15 (55.6%) males. The age range was 43-83 years with a mean of 61.04years. Type 2 diabetes was present in 92.6% of the patients, while the mean duration of diabetes was 7.98 years (range, 0-27years). Diagnosis of DM was made for the first time in 2(7.4%) of the patients at presentation of the foot problem. The mean admitting fasting and random plasma glucose was 133.3mg% (7.4mmol/L) and 227.2 mg% (12.6mmol/L) respectively. Of the 27 patients, 13 (48.1%) had the lesion on the right foot while 6(22.2%) had bilateral DMFS. Majority (85.2%) of the patients had grades 2-4 ulcers. Trauma was the most frequent precipitant occurring in 33.3% of cases followed by tight/ inappropriate shoe or ill-fitting foot wear (18.5%). Tinea pedis alone and burns precipitated DMFS in 7.4% and 3.7% cases respectively, while both tinea pedis and inappropriate foot ware further contributed to DMFS in 3.7% of patients. In 29.6% of cases, the ulcers developed spontaneously. Conclusions/Recommendations: The immediate precipitating factors for diabetic foot ulcer remain unchanged, and can be prevented through patients' adherence with diabetes treatment, and health education on proper foot care and foot ware practices.*

KEYWORDS: Diabetes, Foot Ulcer, Precipitants, Prevention

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease associated with acute and chronic complications, and its prevalence is increasing worldwide. It was projected that worldwide, the number of adults with DM will increase from the current 451million to 693million by 2045 (Cho et al., 2018). Diabetic foot ulcer (DFU) is a common and serious chronic complication of diabetes mellitus, associated with significant morbidity and mortality, and with attendant enormous healthcare expenditure (Ibrahim, 2017). The lifetime incidence of foot ulcers in people with diabetes is about 25%, while the 5-year mortality rate is between 43%-55% and may be as high as 74% after an amputation (Robbins et al., 2008; Jupiter et al., 2016). This is similar to or even worse than mortality from cancers. Yet, it is one of the most preventable complications of diabetes mellitus (Bowling, Rashid and Boulton, 2015)

The risk factors for DFU include peripheral arterial disease, neuropathy, retinopathy, nephropathy, foot deformity and past diabetic foot ulcer (Bowling, Rashid and Boulton, 2015; Al-Rubeaan et al., 2015). Others include long duration of diabetes, poor glucose control, increasing age, male gender and smoking (Al-Rubeaan et al., 2015).

But, not all patients with these risk factors develop DFU, and the microvascular and macrovascular complications can be prevented or minimized by optimizing glycaemic control and other cardiovascular risk factors (Nathan, 2014). There are immediate precipitating factors that herald the onset DFU in people with existing risks. These factors include walking barefoot, inappropriate foot-ware, web space infection, and burns (Maghsoudi et al., 2008; Akkus et al., 2016; Goutos et al., 2015; Zhong et al., 2017). Foot trauma may be due to walking bare feet or inappropriate foot-ware resulting in ulceration (Macfarlane & Jeffcoate, 1997; Jayasinghe et al., 2007).

Given the high cost of managing DFU, it is desirable to determine the immediate precipitating factors for the development of foot ulcerations, in order to mount or plan effective preventive strategies. Even though there have been reports on the precipitants of DFU in Nigeria, with recommendations on how to prevent it, the burden is yet to abate (Eregie and Edo, 2008; Ogbera et al., 2008; Edo et al., 2013; Anumah et al., 2017). Have the immediate precipitating factors for DFU changed? If not, why is it still plaguing the patients with diabetes mellitus in our environment? Are the guidelines and recommendations being followed or not? If the guidelines are being followed but the precipitating factors have changed, the scourge of DFU will likely remain. On the other hand, if the precipitating factors remain the same, and guidelines are not followed, DFU will continue to afflict people with diabetes.

This study aims to identify the immediate precipitants of DFU among patients who were managed at Lagos University Teaching Hospital, Nigeria, and compare the old and new studies for differences in these risk factors. Our primary hypothesis is that the immediate precipitating factors for DFU remain unchanged.

METHODOLOGY

This is a descriptive study. The case records of patients admitted for diabetic foot ulcer at Lagos University Teaching Hospital (LUTH) between 2003-2005 were retrospectively reviewed. Information extracted from the notes included age, sex, type and duration of diabetes, admitting fasting and random/casual plasma glucose at presentation, grade of foot ulcer, and the immediate precipitating factors. Continuous data were presented as means (standard deviation) and compared with student's t-test, while categorical data were presented as number (percentages) and compared with Chi-square. The level of significance was taken as $p < 0.05$. Data was analysed with SPSS (IBM Inc. US) version 20.

RESULTS

Twenty seven (27) case records of patients with DMFS were available for analysis. There were 15 (55.6%) males. The age range was 43-83 years with a mean of 61.04 years. Type 2 diabetes was present in 92.6% of the patients while the mean duration of diabetes was 7.98 years (range, 0-27 years). Diagnosis of DM was made for the first time in 2 (7.4%) of the patients at

presentation of the foot problem. The mean admitting fasting and random plasma glucose was 133.3mg% (7.4mmol/L) and 227.2 mg% (12.6mmol/L) respectively. Of the 27 patients, 13 (48.1%) had the lesion on the right foot while 6(22.2%) had bilateral DMFS. There were no differences in demographic and clinical parameters between men and women (**Table 1**)

Table 1: Clinical And Laboratory Characteristics Of The Patients With Diabetic Foot Ulcer

Characteristics	All participants	Men (15)	Women (12)	p
Age	61.04 (9.93)	61.33 (10.88)	60.67(9.07)	0.866
Duration of DM (years)	7.98 (7.27) 0-27	5.58 (5.39) 0-20	11.00 (8.38) 0-27	0.052
FPG (mg/%) Means(sd) Range	133.25 (52.58) 78-241	102.0(28.01) 78-134	164.50(55.33) 109-241	0.090
RPG (mg/%) Means(sd) Range	227.2 (151.0) 29-595	191.38(130.88) 29-447	270.00(168.05) 46-595	0.211
Diabetes type				
1	2 (7.4%)	1(6.7%)	1(8.3%)	0.869
2	25 (92.6%)	14(93.3%)	11(91.7%)	
Total	27(100.0%)	15(100.0%)	12(100.0%)	
Foot involved				0.834
Right	13 (48.1%)	8 (53.3 %)	5(41.7%)	
Left	8 (29.6%)	4 (26.7%)	4 (33.3%)	
Bilateral	6 (22.2%)	3 (20.0%)	3 (25.0%)	
Total	27(100%)	15(100%)	12(100%)	

Keys: DM, diabetes mellitus; FPG, fasting plasma glucose; RPG, random plasma glucose;

Most (33.3%) of the patients had grade 4 ulcer. Grade 3 ulcer occurred in 4 (26.7%) males, and 3 (25.0%) females. Grades 2 and 1 ulcers occurred in 6 (22.2%) and 3 (11.1%) of all patients respectively. One male patient had grade 5 ulcer whereas no female patient had grade 5 ulcer (**Figure 1**).

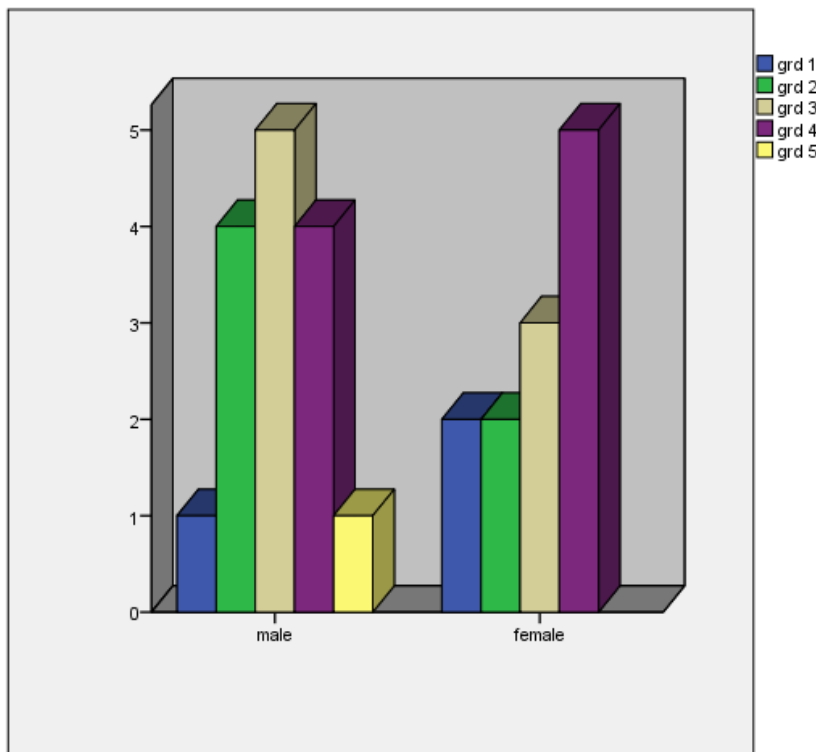


Figure 1: Ulcer grade (Wagner's classification) of the patients

Trauma was the most frequent precipitant occurring in 33.3% of cases followed by tight/inappropriate shoe or ill-fitting foot wear (18.5%). Tinea pedis alone and burns precipitated DMFS in 7.4% and 3.7% cases respectively while both tinea pedis and inappropriate foot ware further contributed to DMFS in 3.7% of patients. In 29.6% of cases, the ulcers developed spontaneously (**Figure 2**).

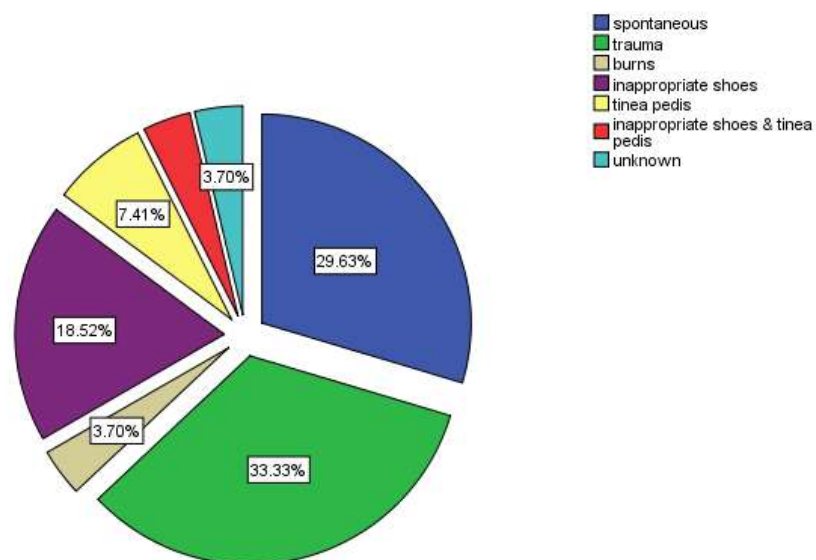


Figure 2: Immediate precipitating factors for diabetic foot ulcer

DISCUSSION

Given the high cost of managing DFU, and the associated morbidity and mortality efforts should be made to identify the precipitants, in order to mount effective preventive strategies. The objective of this study is to determine the immediate precipitating factors for diabetes foot ulcer among patients managed for DFU, and compare the older and newer studies.

Consistent with previous reports, most of the people studied had Type 2 diabetes (Morbach et al., 2004; Ogbera et al., 2008; Edo et al., 2013; Assad et al., 2015). Worldwide, this is the most prevalent type of diabetes mellitus. More men than women had DFU in this study, and most of them tend to be old. Some studies suggested that male gender and increasing age predisposed to DFU (Al-Rubeaan et al., 2015; Assad et al., 2015). Men tend to be exposed to situations that may cause injury or trauma. For example, farming is predominantly done by men and this in addition to occupations that involve prolonged standing, such as clergy and police work, were identified as important contributors to development of DFU in some parts of the Nigeria (Eregie & Edo, 2008). Furthermore, more men than women smoke cigarette, and this is a major risk factor for peripheral arterial disease. Increasing age is also associated with atherosclerosis. Nevertheless, Edo et al., (2013) and Anumah et al. (2017) found slight female preponderance in their studies. Some of the differences in the earlier and recent studies may be due to the changing lifestyle of women in the country.

Most of the people studied had had diabetes for at least 5 years, and about two thirds had poor glycaemic control at presentations. Long duration of diabetes and poor glycaemic control are recognized risk factors for DFU (Al-Rubeaan et al., 2015; Assad et al., 2015; Zhong et al., 2017). The longer the duration of diabetes the more likely the patient will develop microvascular and macrovascular complications of diabetes. Similarly, poor glycaemic control is associated with these complications. On the contrary, optimizing or achieving good glycaemic control has been shown to reduce or prevent these complications (Nathan, 2014). More than half of the patients had grade 3-4 ulcers. Edo et al, (2013) reported that more than three quarters of their patients had grade 3-4 ulcers. Delayed presentation to the hospital, with attendant disease progression is not uncommon among Nigerians, and this may be due to paucity of funds and ignorance. Prior visit to alternative health practitioners, chemist shops, and self home treatment may contribute to late presentations (Anumah et al., 2017). Late presentations do occur even in developed countries where most patients enjoy health insurance, though for different reasons (Macfarlane and Jeffcoate, 1997; Manu et al., 2018).

Trauma was the leading precipitating event before the onset of DFU in our study. The most frequently occurring causal pathways to the development of foot ulcers include peripheral neuropathy and vascular disease, foot deformity or trauma (Bowling, Rashid and Boulton, 2015). Trauma is frequently caused by inappropriate footwear, or foreign body in the footwear. It may also result from injury from sharp objects that penetrate footwear or in those who walk barefoot (Jayasinghe et al., 2007). Nearly one third of the patients in this study developed ulcer spontaneously. This is a commonly reported phenomenon (Ogbera et al., 2008; Edo et al., 2013; Anumah et al., 2017). Even though the ulcers developed without notice, it was not impossible that underlying neuropathy contributed to this in the face of trauma. Inadequate footwear precipitated DFU in a significant number of cases. Footwear that fit poorly or too tight may be associated with foot injury. Previous workers reported this to be a major precipitant for DFU in both developed and developing countries (Macfarlane and Jeffcoate, 1997; Morbach et al., 2004; Ogbera et al., 2008; Anumah et al., 2017). While Morbach et al. (2004) reported it to be the most frequent cause of ulcer in Germany, Ogbera et al. (2008) and

Edo et al. (2013) found it to be responsible in 17% and 8.2% respectively. For this reason guidelines on DFU prevention emphasized the need for light footwears that fit, provide stability, prevent extremes of temperature, protect and accommodate the shape of the feet, as well be orthotic friendly (Ibrahim, 2017; van Netten et al., 2018).

Tinea pedis contributed to DFU in about one tenth of cases in this study, and it was commonly reported by other workers (Ogbera et al., 2008; Edo et al., 2013; Zhong et al. 2017). In the study by Ogbera et al. (2008), up to 23.4% of patients had tinea pedis. Fungal infections are common in patients with diabetes mellitus due to compromised cellular immunity. The Nigeria climate may also act synergistically to promote fungal infection, since these organisms thrive in a warm, humid environment. Akkus et al. (2016) demonstrated a positive association between poor long term glycaemic control and fungal foot infection among patients with diabetes. Additionally, they found that fungal infection was more prevalent among those with DFU. Contrary to these reports, Anuma et al., (2017) found no patient with tinea pedis in their report.

Thermal injury or burns was responsible for DFU in one patient, and this has been reported in the literature (Morbach et al., 2004; Assaad-Khalil et al., 2015). Neuropathy may predispose to thermal injuries due to loss of protective sensation. Local food preparation by placing hot pot between the two feet is common in Nigeria. Some patients may also indulge in warm water compress in an attempt to treat painful neuropathy, resulting in burns. Of note, this patient was a 60year old woman, who has had diabetes for 27 years and presented with fasting and causal plasma glucose of 241mg% (13.39mmol/L) and 437mg% (24.28mmol/L) respectively. Additionally, both feet were involved suggesting that she may have suffered domestic burn injury. The long duration of diabetes coupled with poor glycaemic control might have resulted in microvascular complications, notably neuropathy, leading to burns.

DFU continue to afflict people with diabetes despite the fact that the immediate precipitants in Nigeria remain largely the same over more than a decade. Reasons for this may be multifactorial. These may include failure of health care givers to educate patients on DFU prevention, and non-adherence to preventive measures by the patients. Since more recent studies suggest that paucity of funds is a contributory factor, health insurance coverage for Nigerians with diabetes should be pursued vigorously, and efforts to identify other reasons should be intensified.

CONCLUSIONS, RECOMMENDATIONS AND FUTURE DIRECTIONS

The immediate precipitating factors for DFU such as trauma, inappropriate footwear, tinea pedis and burns remain unchanged and can be prevented or minimized through patients' adherence to diabetes treatment and health education on proper foot care and foot ware practices. Health care givers should actively look for, and treat fungal foot infections. Diabetic foot care prevention education should be intensified by health care providers. Studies should be conducted to evaluate adherence to foot prevention guidelines by healthcare givers.

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