PREVALENCE OF DIABETIC FOOT ULCERS AND DURATION OF DIABETES AMONG ADULT PATIENTS WITH DIABETES MELLITUS PRESENTING TO ALDARGA DIABETIC CENTER, WADMEDANI, SUDAN 2020 - A LONGITUDINAL CROSS SECTION STUDY

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Abstract

Objectives: To assess the prevalence of diabetic foot ulcer (DFU) in Wad Medani, Gezira state, Sudan, and the duration of diabetes associated with it.

Methods: The study was comprehensively based on primary data obtained via a longitudinal cross-section random sample of 400 patients with diabetic mellitus presenting with Aldarga. The data collection tool was a structured questionnaire. Core questions were on main dimensions: Sociodemographic variables and duration, type of diabetes. Data were analyzed with SPSS program version 20, using descriptive and inferential statistics, namely, frequency tables and graphs, Fisher Chi-square, exact test of association, and logistic regression.

Results: The static profile of the participants indicated that genetic background is an important factor in contracting diabetic mellitus. The calculated prevalence rate was 16.6% (17.1% for males and 16.1% for females) with overall probability limits. The analyses of associations indicated that the number of variables in all three dimensions have significant association with the development of DFU. The logistic regression pinpointed two factors with significant odds to develop DFU, namely, the duration of diabetic last fasting blood glucose value and that the duration of the illness is notable.

Conclusion: The result suggests extensive awareness programs to control the negative effect of prolonged duration of diabetic's are necessary especially crucial aspect of monitoring the blood sugar level under strict medical supervision.

Keywords: Prevalence of diabetic foot ulcer**,** Person with diabetic, Diabetic food ulceration; Duration of diabetes mellitus (duration of DM); Sudan

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INTRODUCTION

- Diabetes mellitus is one of the leading causes of death in the US; common complications that result in death are myocardial infarction and end stage renal failure. [1]

Diabetes care should be patient-centered and comprehensive, including lifestyle modifications and assessment of psychosocial health. Consider social determinants of health and formulate a treatment plan together with the patient.

The goals of diabetes management include eliminating symptoms of hyperglycemia, reducing or eliminating complications, and enabling as healthy a lifestyle as possible. [2].

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder affecting about 425 million people worldwide in 2017, and, according to the International Diabetes Federation (IDF) report, is expected to affect up to 629 million people by 2045[3].

Sub-Saharan Africa is currently enduring the heaviest global burden of diabetes[4].

Diabetic foot disease (DFD) is one of the diabetic complications associated with major morbidity, mortality, and reduced quality of life and is the most serious complication of diabetes mellitus[3,4].The incidence of DFD is still rising[5]. According to the international consensus on diabetic foot, a foot ulcer is defined as a full-thickness wound below the ankle in a diabetic patient, irrespective of duration[6].

Diabetic foot ulcer (DFU) is becoming more than an indicator of complication status, having an independent impact on lower-extremity amputation and mortality risk[7].

It is also one of the complications of diabetes that can result in economic, social and public health burden, especially in low-income communities because it usually affects economically productive age groups, 30–45 years[8].

However, the risk factors of the problem are less or not studied in Gezira State, Sudan. Hence, this study was conducted to assess the determinants of diabetic foot ulcer and type, duration of diabetics among adult patients with diabetes attending a diabetic clinic in Aldarga Diabetic Center, Wadmedani, Sudan 2020**.**

MATERIAL AND METHOD

An institutional longitudinal, cross-sectional design was used to conduct the study among patients presenting at Aldarga Diabetic Health Center in Wadmedani Town, Gezira State, Sudan between the periods September 2020 to December 2020. The center is located in the North of Wadmedani town 186 KM south of Khartoum, the capital of Sudan.

The study includes all diabetes mellitus patients who attend the diabetic follow-up clinic at Aldarga Diabetic Center in Wadmedani town.

♦ **Data collection:** A structured data collection tool was developed after carrying out a literature review mainly adapted from the publications of WHO and UNICEF. Core questions were adapted from previous studies with four main dimensions:

Sociodemographic variables: age, sex, family type, marital status, educational status, residence, and average monthly income;

Foot self-care attention variables: foot wear, fear of ulcers, foot cleaning, and foot washing; occasional foot inspection, **Clinical variables** were taken from the patients themselves, type of diabetes treatment, duration of diabetes.

Operational Definitions:
Diabetic foot: The International Working Group on the Diabetic Foot (IWGDF) has defined the diabetic foot as infection, ulceration, or destruction of tissues of the foot of a person with currently or previously diagnosed diabetes mellitus, usually accompanied by neuropathy and/or peripheral arterial disease (PAD to the lower extremity [9] **Diabetic foot ulcer**: these are nondramatic lesions of the skin on the foot distal to malleoli of a person who has diabetes mellitus**.**

Diagnostic criteria for diabetes mellitus or Measurement of Diabetes Mellitus:
Random plasma glucose values of ≥ 200 mg/dL (≥ 11.1 mmol/L) or 1(2) fasting plasma glucose values of ≥ 126 mg/dL (≥ 7.0 mmol/L) or (3) 2-h. Oral glucose tolerance test (GTT) value in venous plasma ≥ 200 mg/dL (≥ 11.1 mmol/L) (4) glycated hemoglobin (HbA$_{1c}$) $\geq 6.5\%$ (≥ 48 mmol/molHb)[10].

♦ **Sample size and sampling design**
A random sampling method was used to select the sample in which population (Total diabetic

patients in 2020 reported to the diabetic follow-up clinic.) The simple random sampling equation for the provisional sample size n*was calculated using the following formula:

n = (t²× p × q) / (d²)

Where:-
n*: Required sampling size.
P: Anticipated population proportion was taken as 50% because it gives the maximum possible sample size. If we take the estimated prevalence rate for Sudan of 0.15 as P, the sample size will be 195, but we prefer a larger sample.
t: Confidence level taken as 95%.
d: Absolute precision required on either side of the anticipated proportion taken as 5 %
Then the provisional sample was multiplied by a design effect of 2 to give the final sample n:-

n = (2²×50×50) / (25) = 400

♦ **Data Analysis methods**
A structured data collection tool was developed after carrying out a literature review mainly adapted from the publications
Descriptive statistics was initially undertaken to analyze the composition of the sample. Data were coded and entered into a computer using two of the latest versions of the prepared packages of statistical analysis, Quantitative analysis of the question responses obtained from the questionnaire were summarized, portrayed, and analyzed on a statistical basis to offer the researcher the opportunity to analyze the responses and identify whether the results are skewed [11].

Prevalence of Diabetic Foot Ulcer
Of the 400 participants, 96 participants were clearly diagnosed as foot ulcer, giving a proportion of 33% in the sample. However, this proportion has to be adjusted by the total

population of diabetic patients reported to the center, recorded as 40,127 in 2020 using the following equation.

$$Prevalence = \frac{p}{1 + \frac{p}{k}} * \sqrt{(N - n)l}(N - 1)$$

Where:
P = the proportion with diabetic foot ulcer in the sample in 2020.
K= Total Patients with diabetic foot ulcer recorded in Aldarga center in 2020. (17,350)
N= Total patients with diabetic mellitus recorded in Aldarga Center in 2020.
n= sample size.

The values of p and key were obtained from Aldarga Center statistical office. Substituting in the prevalence equation, the prevalence rate in this study is estimated as 16.6% with 5 percent probability limit of (14.0 -19.2).

The DFU segregated by gender using the same methodology gives the prevalence rate for females as 16.1%, which is a little less than that for males of 17.1%.

RESULTS
(1) Respondent's socioeconomic characteristics
Table (1) shows the frequency distribution and descriptive statistics of the participant's socioeconomic characteristics. The youngest patient in the sample was 30 years of age and the oldest was the oldest was 89 years. The age distribution classified in the 5 years age group shows an expected pattern with sharp skewness to the right, where the majority are over age 50 years (79%) and more than half are above 60 years of age. The mean age is 59.9 years with approximately similar median and mode, indicating that the distribution is mesokurtic showing confidence interval 59.9±1.31.

Table (1): frequency distribution and descriptive statistics Of the major respondent's indicators

Variable	N	Percent	Central tendency	Standard error of the mean
Age				
30-34	15	3.8		
35-39	10	2.5		
40-44	31	7.8	**Mean = 59.5**	**1.31**
45-49	28	7.0	**Median = 60**	**-**
50-54	42	10.5	**Mode = 58**	**-**
55-59	61	15.3	**Skewness = -.222**	**- 0.012**
60-64	48	12.0		
65-69	57	14.3	**Kurtosis = 0.555**	**0.243**
70 and over	108	26.8		
Total	**400**	**100**		

Marital Status				
Single	27	6.8	**Median=2.0**	-
Married	277	69.3	**Skewness= 0.976**	**0.122**
Widow	72	18.0	**Mode = 2.0**	-
Divorced	24	6.0	**Kurtosis= 0.132**	**0.233**
Total	**400**			
Educational Level				
Illiterate	34	8.5		
Khalwa	77	19.3	**Median=3.0**	-
Basic	159	39.8	**Skewness = 0.163**	**0.057**
Secondary	81	20.3	**Mode=3.0**	-
University	42	10.5	**Kurtosis = 0.232**	**0.223**
Postgraduate	7	1.8		
Total	**400**	**100**		
Occupation				
Professional	4	1.0		
Business	60	15.0	**Median=8.0**	
Employee and uniform	38	9.6	Skewness = 0.163	0.234
Worker and farmer	35	8.8	Mode=9.0	-
Housewife	54	13.5	Kurtosis = 0.232	0.122
Unemployed and others	209	52.3		
Total	**400**			

Source: Researchers own survey, 2020

(2)-*Factors relating to clinical issues*

Among the96, participants were clearly diagnosed as foot ulcer, giving a proportion of 33% in the sample. Respondents 47.3% had Type II diabetic mellitus and 4.8 % had Type I. The majority of diabetic patients have disease duration between 5 and 10 years, 24.5% are living with the disease for more than 10 years and 17.3% have it for less than 5 years. 10.3 % of the participants have the disease in their families and 48.3% have the disease in the first or second (kinship) with a duration between 1 to 5 years.

Table (2)-Factors relating to clinical issues

| Association of DFU with Clinical variables				
Variable (N = 400)	*Chi-square (Fisher Exact Test)*	*DF*	*P- value*	
Type of diabetic	*6.154*	*1*	*0.013**	
Duration of diabetic	*88.19*	*2*	*0.000***	
Wearing diabetic shoes	*6.23*	*1*	*0.043**	

Source: Researchers own survey, 2020

(3)- Factors relating to measurement of diabetic mellitus based on the last fasting plasma glucose level

The measurement of diabetic mellitus based on the last fasting plasma glucose level is shown in Fig.1. The majority of respondents (50.7%) were having a level between 126-275 mg/dL, classified as poorly controlled diabetic. Respondents classified as controlled (fasting plasma glucose value of ≥ 126 mg/dL (≥ 7.0 mmol/L) represent only 4.8%, 38% are classified as uncontrolled and 7.5% are classified as severely uncontrolled. The mean last fasting plasma glucose level is 250 mg/dL with standard error 4.35, thus giving
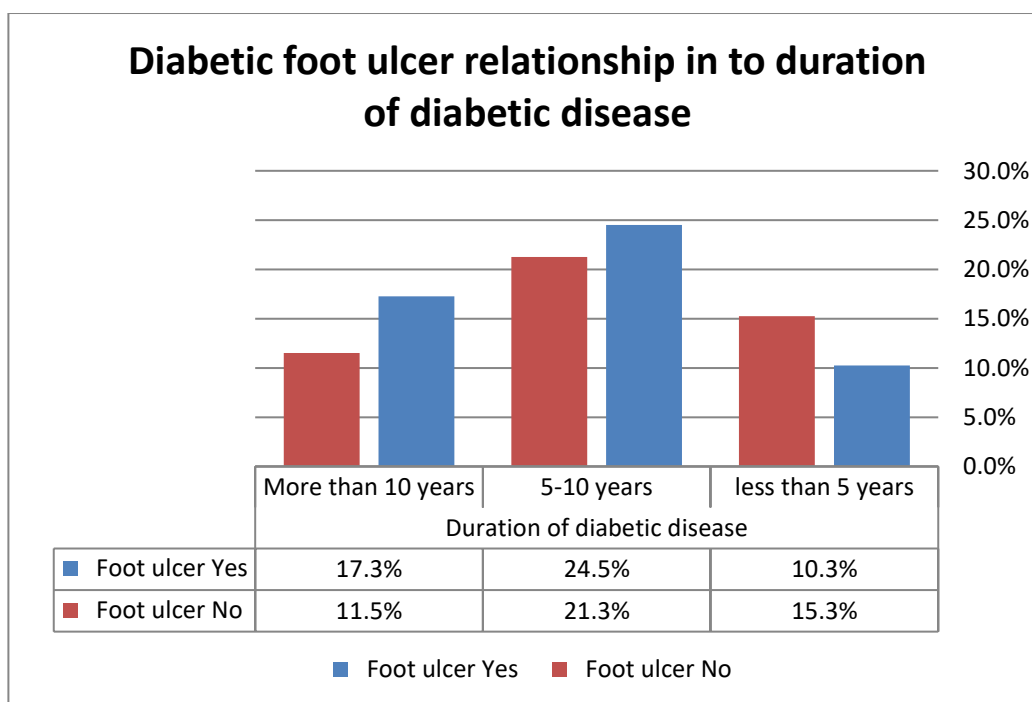
probability limits of (242,259) and the probability is 5% found that a newly reported patient to center has fasting plasma glucose level will be out of this range up or down.
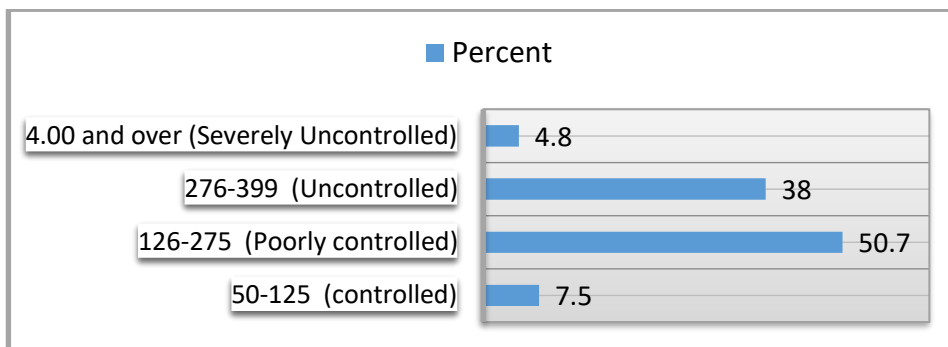

Descriptive Statistics	
Last fasting blood glucose level	
N N	**400**
Mean	**250.38**
Std. Error of Mean	**4.330**
Median	**234.50**
Mode	**320**
Std. Deviation	**86.606**
Minimum	**50**
Maximum	**500**

Source: Researchers own survey, 2020
Fig.1: Last Fasting Blood Glucose level

	More than 10 years	5-10 years	less than 5 years
Foot ulcer Yes	17.3%	24.5%	10.3%
Foot ulcer No	11.5%	21.3%	15.3%

Source: Researchers own survey, 2020
Fig. (2): Diabetic foot ulcer in relation to duration of diabetic disease
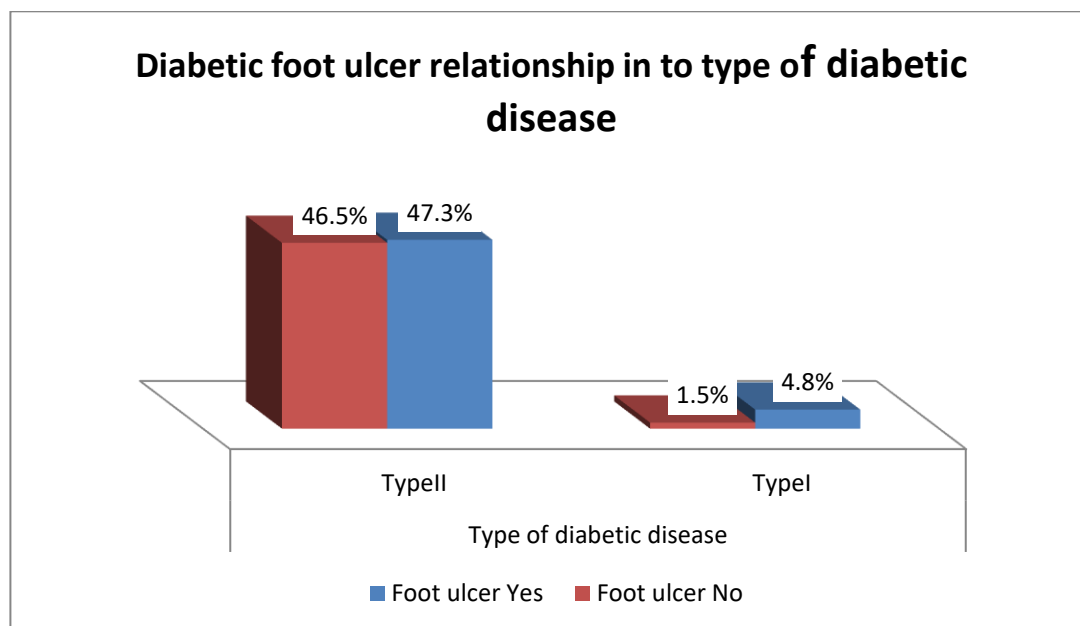
Fig(3): Diabetic Foot Ulcer in relation to the type of diabetic disease
Source: Researcher from Alderaga health center, Gezira state, Sudan, 2020

Logistic Regression

Logistic regression is used here to filter the highly significant associates of DFU by Odds Ratios for ranking purposes. The Fisher exact test showed that the highly significant associates are: diabetic in the family (kinship), a , duration of diabetic to diabetic,, last fasting plasma glucose ,. These are fitted as explanatory variables in a binary logistic model. Only two variables were selected by the model: duration of diabetic, last fasting plasma glucose. The Wald statistics for all independent variables confirmed the significant effect on DFU.

Looking at the result of regression for the last fasting plasma glucose value, there is a highly significant overall effect (Wald = 5.806, df=1, p=.016) "Sig at 5%.".. Based on our output, we can see that 2 factors are particularly highly significant. Putting them in order,r we notice that the duration of diabetic has the highest odds ratio of 35.6 times more likely to cause DFU (p value=0.000), the last fasting plasma glucose value comes second with (35.66) times more likely to cause DFU.

Table (3) Logistic Regression

Variables	B	S.E.	Wald	Df	Sig.	Exp(B) odd ratio	Lower	Upper
Last fasting plasma glucose value	1.971	.818	5.806	1	0.016	35.656	34.053	37.259
Diabetic monitoring with doctor	8.06	0.468	2.973	1	.0.085	1.117	0.200	2.034
Duration of diabetic	2.692	1.149	5.494	1	0.00	40.306	38.054	42.558
Kinship	.140	0.017	65.055	1	0431	.899	0.866	0.932
Constant	4.55	3.349	1.849	1	0.174			

Source SPSS output based on: own survey, 2020

Discussion

This study as far as we know may be the first to estimate the prevalence of DFU in Gezira state-Sudan, although a number of studies on the subject have been done in Khartoum In a study to

determine the DFU prevalence in Khartoum, the capital of Sudan Albobarak *Etal*. Estimated the prevalence as 18.1% with a 95% confidence interval of (13.78-22.34) from a sample of 301 adults over 18 years with type II diabetes

attending the diabetic center in Khartoum in 2017[12] . We notice that our own estimate of DFU prevalence (16.6), which is the first attempt in Gezira as stated above, lies within the probability limits of the estimate provided by this study. We also believe that our estimate is superior since it was adjusted by the population of all diabetic patients reported to the study unit during 2020. They also found that among all metabolic variants, duration of diabetic was the major risk factor in contracting DFU. In a study of ten amalgamated studies in Ethiopia covering 3029 patients with diabetes millets, DFU prevalence rate was 15.3% with.3.91 OR at 95% CI for duration of illness as a risk factor, just a little less than our estimate, but it lies in the same interval. [13]. in the Southwest regional hospitals of Cameroon. Cross- sectional study, of the 203 participants included, 63.1% were females. Age ranged from 26 to 96 years. The median duration of diabetes was 4.0 years (The prevalence of diabetic foot ulcer was 11.8%) [14].in our study the duration of diabetes in relation to diabetic foot ulcer is very significant p value was (0.000**) and DFU prevalence (16.6). The finding of this study showed that the type of diabetes, duration of diabetic was very significant, p value was [0.013, 0.000], this is consistent with the study conducted in diabetic foot ulcer in Nigeria A total of 336 patients (55.1% male) with a mean age of 55.9 ± 12.5 years were enrolled in this study. Majority (96.1%) had type 2 diabetes [15]. In this study, there was a significant correlation between the duration of diabetic and presence of diabetic foot ulcer **Chi-square(Fisher Exact Test), DF, P-value (88.19, 2, 0.000**)** respectively as research done by Zubair M, Malik A, Ahmad J showed that It has been examined that there is a positive correlation between ulcer duration and BMI, amputation rate and BMI [16]. and liked same results done by Hicks CW, Selvin E showed that The prevalence of peripheral neuropathy is estimated to be between 6 and 51% among adults with diabetes depending on age, duration of diabetes, glucose control [17]. Also another study had a strong association with duration of diabetes and DFU found that out of 196 patients 80.1% were male. One hundred and forty-six (74.48%) patients were in the range of 40-70) years. Right foot was more commonly involved (65.3%). 91.3% patients had diabetes of more than 5 years duration [18.]. So from all above literatures, reviews and results of our study give us as family doctors especially in Gezira State, Sudan, Tobe more attention to our diabetics patients especially type 2 to decrease the risk factors that can

accelerate diabetic foot ulcer and put in our mind that newly discover diabetes after 5 to 10 years most probably will develop [DFU] from all these published paper so we negotiate all these complication with our patients to put them in picture, and hope that we can decrease prevalence of [DFU] in our Gezira locality.

Conclusion:
All these three variants are controllable, if the blood sugar level were kept under control under close medical supervision and patients own health attention.

Recommendations:
• The etiology of diabetic foot ulcers is multifactorial, so recommendations that management needs collaboration of multi-factorial disciplines.
• Doctors especially family doctors, should have great responsibility to decrease (DFU) because he had catchment map and the area of their health center where he worked and known in and out of family history.
• The researcher suggested that consultants of family doctors especially in Gezira state, Sudan, must play a major role in decreasing (DFU) because the family medicine concept established years ago in Gezira state and health care providers should spend more time educating and training diabetic patients on foot care.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest statement:
The authors declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Approval:
Before initiating the field survey, the objective of ethics in research was insured by obtaining ethical clearance from the Director of Health Affairs in Wad Medani locality of Gazira state. A supportive formal letter was written to Aldarga diabetic Center. Data collection was done after permissions were obtained from the center managers, and oral informed consent was obtained from the study participants to start data collection after insuring them that ethical aspects regarding the confidentiality, privacy, and consent

Eur. Chem. Bull. **2023**, *12(Special Issue 5), 4280 – 4288*

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of the data will be seriously considered during the research process.

Acknowledgement:
The authors express their sincere appreciation for Wad Medani ALderaga Health Center in Gezira State, Sudan, mentioned above for giving their co-operation. Thanks are also extended to the diabetic patients who participated willingly in the study.

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