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Prevalence and associated factors of diabetic foot ulcers among type 2 diabetic patients attending chronic follow-up clinics at governmental hospitals of Harari Region, Eastern Ethiopia: A 5-year (2013–2017) retrospective study

Assefa Tola[1], Lemma Demissie Regassa[1] and Yohanes Ayele[2]

Abstract

Introduction: Diabetic foot disease is a growing major public health problem and the leading cause of prolonged hospital admission, health-related costs, and reduced quality of life for diabetes patients. This study aimed to determine the prevalence of diabetic foot ulcers (DFU) and its associated factors among type 2 diabetes patients in Harari Region, East Ethiopia.

Methods: An institution-based retrospective study was conducted from 28 March to 30 April 2018, among type 2 diabetes patients diagnosed between 1 January 2013 and 31 December 2017, at three government hospitals of Harari Region. Data were collected using a standard checklist format. Data were entered into Epi Info Version 7 and analyzed using SPSS 24. Binary and multiple logistic regression models were used to determine the associated factors. Odds ratio with 95% confidence intervals was used to determine level of association.

Result: A document of 502 type 2 diabetes patients was reviewed and included in the final analysis in this study. The prevalence of DFU among type 2 diabetes patients was 21.1%. Being currently married decreased the odds of DFU by 60% (adjusted odds ratio = 0.40; 95% confidence interval: 0.17–0.96). Factors associated with increased diabetes ulcers chance were physical inactivity 2.29 (adjusted odds ratio = 2.29; 95% confidence interval: 1.17–4.48), starting treatment with insulin 4.43 times (adjusted odds ratio = 4.43; 95% confidence interval: 1.84–10.67), obesity 27.76 (adjusted odds ratio = 27.76; 95% confidence interval: 13.96–55.23), delay to start follow-up 2.22 (adjusted odds ratio = 2.22; 95% confidence interval: 1.03–4.82), history of infection 3.50 (adjusted odds ratio= 3.50; 95% confidence interval: 1.83–6.69), and hypertension 3.99 (adjusted odds ratio = 3.99; 95% confidence interval: 2.08–7.65).

Conclusion: The prevalence of DFU among type 2 diabetes is substantially high as more than one in five patients have this complication. Moreover, marital status, physical activity, baseline medication, obesity, delay for follow-up, infection history, and hypertension were significantly associated with the development of DFU.

Keywords

Diabetic foot ulcer, type 2 diabetes, Harari Region

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Introduction

Diabetic foot ulcer (DFU) is one of the main complications in diabetes mellitus (DM) with a lifetime risk of 15% in all diabetic patients and associated with major morbidity, mortality, costs, and reduced quality of life.[1–3] A global prevalence of DFU is 6.3% (95% confidence interval (CI): 5.4%–7.3%) with regional variation from 3.0% in Oceania to 13.0% in North America.[4] The incidence of DFU is

[1]Department of Epidemiology and Biostatistics, School of Public Health, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia
[2]Department of Clinical Pharmacy, School of Pharmacy, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia

Corresponding author:
Assefa Tola, Department of Epidemiology and Biostatistics, School of Public Health, College of Health and Medical Sciences, Haramaya University, P. O. Box 138, Harar, Dire Dawa, Haramaya, Ethiopia.
Email: asseharar91@gmail.com

1.0%–4.0% and the prevalence is between 5.3% and 10.5%,[5,6] and DFU is the leading cause of lower extremity amputation[7,8] Approximately, 20% of hospital admissions among DM patients are the result of foot problems,[9] and DFU is responsible for more days of hospital stay than any other complication.[10,11]

The diabetic foot disease is a growing major public health problem for diabetes patients in Sub-Saharan Africa and is an important cause of prolonged hospital admission and death in patients from this part of the continent. In Africa, the prevalence of DFU is estimated to be between 7.2% and 13.0%.[4,12] Moreover, the pooled prevalence of major amputation is 15.5% (95% CI: 12.5–18.6) and the hospital mortality is 14.2% (95% CI: 9.9–19.0) due to DFU among DM patient in Africa.[12]

Diabetic foot disease typically presents as ulcers, infection, and Charcot foot in the presence of peripheral neuropathy or peripheral arterial disease in people with diabetes,[13] and it is the most important precursor for lower extremity amputations.[14] DFU is usually considered a marker of diabetes complication status, that is, a marker for neuropathy and associated vascular disease in the foot.[15] Several studies have attempted to identify the source of diabetic foot in those with DM[1,7,15] which resulted from the side effect of hyperglycemia indirectly from peripheral neuropathy. DFU is predominantly caused by neuropathy.[10,11] Moreover, the presence of comorbidities like hypertension, obesity, and cardiovascular complications is the fuel for the diabetic foot and its outcome.[11,16–19]

In Ethiopia in general and in the study area in particular, data on prevalence and risk factors of DFU among type 2 diabetic patients are inadequate. Therefore, the aim of this study was to determine the prevalence of DFU and its associated factors among type 2 diabetes mellitus (T2DM) patients attending chronic follow-up clinics at governmental hospitals in the Harari Region, East Ethiopia.

Methods

Study setting

This study was conducted in a chronic follow-up clinic of the three governmental hospitals, namely, Hiwot Fana Specialized Hospital, Jugal General Hospital, and Federal Police Hospital of the Harari regional state, Eastern Ethiopia. Currently, there are six hospitals (three governmental, two private, and one non-governmental organization) in the region. The names of the three government hospitals are Hiwot Fana Specialized Hospital, Jugal General Hospital, and Federal Police Hospital. Hiwot Fana and Jugal hospitals are public hospitals that provide general medical services for more than 5 million people in the Eastern part of the country whereas Harar Federal Police Hospital is giving services for the police-community in the surrounding areas. All these hospitals have chronic follow-up clinics where patients with chronic diseases like diabetes, hypertension, and asthma follow their treatment regularly.

Study design

An institution-based retrospective document review was conducted from 28 March to 30 April 2018, among patients diagnosed with T2DM from 1 January 2013 to 31 December 2017.

Population

The source population was all T2DM patients who were on the follow-up at the governmental hospitals in Harari regional state, whereas the study population was all T2DM patients who were on follow-up from 1 January 2013 to 31 December 2017 at the governmental hospitals in Harari regional state.

Inclusion and exclusion criteria

The documents of all T2DM patients who were at follow-up at the governmental hospitals of Harari regional state from 1 January 2013 to 31 December 2017 were included. The documents of T2DM patients with unidentified diabetic foot status, incomplete baseline record, and transferred out history were excluded.

Sample size determination

The sample size was determined using a single population proportion formula with the assumptions of 95% level of confidence, 3% margin of error, and prevalence (p) of DFU from previous studies. The prevalence of DFU was 12%,[20] 13.6%,[10] and 14.8%.[21] Accordingly, the calculated sample size was 451, 501, and 538. We took the largest sample size which was 538.

Moreover, the double population proportion formula was used to determine the minimum sample size for assessing the predictors of DFU. The sample size was calculated using the online OpenEpi 2007 (Kelsey et al., Methods in Observational Epidemiology 2nd Edition; Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 and 3.19 version statistical software using the following assumptions: 95% confidence level, power of 80%, and one-to-one ratio). Different predictors from previous studies[10,21] were used to determine the sample size. The maximum sample size was obtained from the calculation based on the place of residence in the Arba Minch study. According to this study, 15% and 28% of DM patients from rural and urban areas had DFU, respectively. Based on this information, the total sample was 344. Finally, the largest sample from the two calculations was used for this study. Therefore, the final sample size was 538.

Sampling technique

In order to select a representative sample of T2DM patients from each hospital, the total number of T2DM patients in each hospital was considered. Based on the number of patients in each hospital, the sample size was allocated to each hospital proportionally. In each hospital, the card number of T2DM patients on follow-up from 1 January 2013 to 31 December 2017 was used as a sampling frame. Finally, the document of T2DM patients who fulfill the inclusion criteria was selected from each hospital using a simple random sampling method from the sample frame.

Measurement of variables

The outcome of interest for this study was DFU in T2DM patients. The explanatory variables included sociodemographic factors, behavioral factors, clinical factors, and comorbidities.

Data collection

Data were collected using the standard and pre-tested checklists from document review including patients' charts, follow-up cards, DM registration books, and electronic information databases. The standard checklist contains sociodemographic characteristics, behavioral factors, clinical characteristics, and comorbidity histories. Data were collected by six nurses working in the respective hospitals after taking 1-day training on the data collection process. In addition, the filled sheet was checked for completeness and consistency by study supervisors and the principal investigator to ensure the quality of data. Moreover, the data were cross-checked during the data entry and clarified any missing data.

Data analysis

Data were entered into Epi Info Version 7 and imported to SPSS Version 24 for a window for analysis. Important characteristics of the study participants were described by appropriate descriptive statistics including frequencies with percentages, mean values with standard deviation (SD), or median with interquartile range (IQR). Binary and multiple logistic regression models were calculated to explore the associations between the dependent and independent variables. Those variables that showed statistically significant association in bivariate logistic regression were entered into the final multivariate logistic regression model. Multivariate logistic regression analysis was employed to assess the independent association of each exposure variable with DFUs. The strength of the association was assessed using the odds ratio (OR) with 95% CI and *p*-value. The potential explanatory variables that fitted and optimal model were selected based on the Akaike information criterion (AIC). Accordingly, the model with the smallest AIC was selected and checked for good fitness. The goodness-of-fit for the final model was checked using the Pearson residual and the Hosmer–Lemeshow tests. *P – value* of less than 0.05 was considered statistically significant.

Operational definitions

The diabetic foot. It was said to present when there were documented patients who suffered from one or more of infection, ulceration or destruction of deep tissue in the lower limbs is invariably associated with neurological abnormalities, and varying degrees of peripheral vascular disease (PVD), especially affecting the lower limb.[22]

Obese. Those whose baseline body mass index (BMI) exceeded 30 kg/m^2.

Physically active. Patients who reported doing exercise for at least 30 min per day or working in the field.

Cigarette smoker. If the patient has a lifetime history of smoking any tobacco products, such as cigarettes, cigars, or pipes/shisha.

Alcohol drinker. If the patient ever consumed any alcoholic beverage such as beer, wine, and spirits.

Controlled DM. If the fasting blood glucose level was between 70 and 125 mg/dL, it was considered "controlled."[10]

Infection. Any infection that occurred in any site of the body other than the foot among T2DM patients. It includes urinary tract infection, respiratory tract infection, gastrointestinal infection, osteomyelitis or septic arthritis, deep soft tissue abscess (excluding skin and subcutaneous tissue), and any systemic infection.[23]

Ethical considerations

The Ethical Review Committee of the College of Medicine and Health Sciences, University of Gondar reviewed and approved the study protocol. A letter of cooperation was secured from the respective hospital directors. No personal identifiers such as names, addresses, and any private information were collected for the sake of privacy and confidentiality. Data were handled confidentially during all phases of research activities using anonymous medical registration numbers as identification. Softcopy registrations were protected using a password.

Result

Sociodemographic characteristics

A document of 502 T2DM patients was reviewed and included in the final analysis in the study. Among these patients, 287 patients (57.2%) were males, 371 (73.9%) were urban residents, 426 (84.9%) were currently married, 198

Table 1. Sociodemographic characteristics of type 2 diabetes mellitus patients attending chronic follow-up clinic at government hospitals in Harar town, Eastern Ethiopia, 2019 ($n = 502$).

Variables	Frequency	Percent
Sex		
Male	287	57.2
Female	215	42.8
Age		
15–29 years	49	9.8
30–44 years	156	31.1
45–59 years	151	30.1
>60 years	146	29.1
Place of residence		
Urban	371	73.9
Rural	131	26.1
Marital status		
Currently married	426	84.9
Currently unmarried	76	15.1
Occupation status		
Government employee	198	39.4
Private work	132	26.3
Unemployed	75	14.9
Farmer	52	10.4
Retired	35	7.0
Other	10	2.0
DM duration		
Less than 12 months	108	21.5
13–36 months	212	42.2
More than 36 months	182	36.3
DM family history		
Yes	119	23.7
No	383	76.3

DM: diabetes mellitus.

(39.4%) were government employees, and 119 (23.7) had a family history of diabetes. Their age ranged from 15 to 86 years with a mean value (±SD) of 48.13 ± 14.77 years. The majority (61.2%) of patients were in their third, fourth, and fifth decades. The median duration of diabetes was 28 months with the IQR of 14–40.25 months (Table 1).

Behavioral and clinical characteristics

About three-fourth (73.9%) of patients were physically active. Among total patients, 6.6% were smoking a cigarette and 7.8% were alcohol users. 441 (87.8%) patients started their DM treatment with oral hypoglycemic agents (OHAs). About one-third (33.5%) of patients had a history of taking different antibiotics after being DM. Even if the majority (85.5%) of the patients started their follow-up immediately after the diagnosis, 73 (14.5%) patients were delayed to start their follow-up. The delay time was ranging from 1 to 52 months with a median of 3 months and IQR of 1–10 months.

Table 2. Clinical and behavioral characteristics of type 2 diabetes mellitus patients attending chronic follow-up clinic at government hospitals in Harar town, Eastern Ethiopia, 2019 ($n = 502$).

Variables	Frequency	Percent
Chronic follow-up clinic		
Hiwot Fana Specialized Hospital	254	50.6
Jugal Hospital	129	25.7
Police Hospital	119	23.7
Physical activity		
Inactive	131	26.1
Active	371	73.9
Smoking habit		
Smokers	33	6.6
Non-smokers	469	93.4
Alcohol taking habit		
Yes	39	7.8
No	463	92.2
Baseline medication		
Insulin	61	12.2
Oral hypoglycemic agent (OHA)	441	87.8
Antibiotics taking history		
Yes	168	33.5
No	334	66.5
Year of diagnosis		
2013	95	18.9
2014	76	15.1
2015	118	23.5
2016	97	19.3
2017	116	23.1
Delay to star follow-up		
Yes	73	14.5
No	429	85.5
Baseline hemoglobin measurement		
No	349	69.5
Yes	153	30.5
Fasting blood sugar (FBS)		
Controlled FBS	133	26.5
Uncontrolled FBS	369	73.5

Only 153 (30.5%) patients had baseline hemoglobin measurement. The median hemoglobin level of these 153 patients was 14.0 with an IQR of 12–14. The majority (73.5%) of T2DM patients had an uncontrolled fasting blood sugar level (Table 2).

Medical conditions

Hypertension (37.8%) was the most common comorbidities among T2DM patients, followed by obesity (20.1%) and chronic kidney disease (CKD; 5.4%). However, infection (30.08%), diabetic ketoacidosis (15.9%), and retinopathy (8.2%) were the most common complications among T2DM patients (Table 3).

Table 3. Complication and comorbidity history among type 2 diabetes mellitus patients attending chronic follow-up clinic at government hospitals in Harar town, Eastern Ethiopia, 2019 ($n = 502$).

Variables	Frequency	Percent
Hypertension		
Yes	190	37.8
No	312	62.2
Chronic heart failure (CHF) history		
Yes	23	4.6
No	479	95.4
Obesity history		
Yes	101	20.1
No	401	79.9
Chronic kidney disease (CKD) history		
Yes	27	5.4
No	475	94.6
Infection history		
Yes	151	30.1
No	351	69.9
Diabetic ketoacidosis (DKA) history		
Yes	80	15.9
No	422	84.1
Retinopathy history		
Yes	41	8.2
No	461	91.8

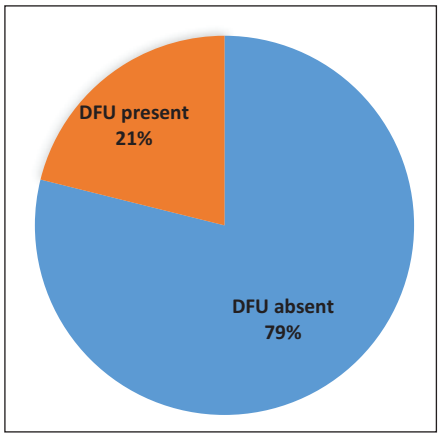

Figure 1. Prevalence of diabetic foot ulcer among type 2 diabetes mellitus patients attending chronic follow-up clinic at government hospitals in Harar town, Eastern Ethiopia, 2019.

Prevalence of diabetic foot and associated factors

Among 502 T2DM patients in the governmental hospital Harari Region, 106 patients (21.1%; 95% CI: 17.5%–24.7%) developed DFU in these 5 years (Figure 1).

Factors associated with diabetic foot ulcer

In bivariate analysis, from the sociodemographic characteristic of the study participants, only age shown a significant association with DFU, whereas sex, place of residence, marital status, occupational status, duration of DM, and family history of DM were not statistically associated with the occurrence of DFU. Among clinical, behavioral, comorbidities, and complications, the occurrence of DFU was associated with physical activity, smoking habits, alcohol taking habits, obesity, infection, hypertension, and CKD in bivariate analysis (see Supplemental Table 1).

Multiple logistic regression showed that marital status, physical activity, baseline medication, obesity, delay for follow-up, infection history, and hypertension were significantly associated with the development of DFU (Table 4). Currently married T2DM patients were 60% (adjusted odds ratio (AOR) = 0.40; 95% CI: 0.17–0.96) less likely to develop DFU as compared with currently unmarried patients.

Patients who did not perform physical activity were 2.29 times more likely to develop DFU than those who were physically active (AOR = 2.29; 95% CI: 1.17–4.48). The chance of developing DFU was 4.43 times (AOR = 4.43; 95% CI: 1.84–10.67) higher among T2DM patients with baseline insulin medication than those with OHAs. Obese T2DM patients were 27.76 times more likely to develop DFU as compared with T2DM patients with normal BMI (AOR = 27.76; 95% CI: 13.96–55.23).

The odds of developing DFU were 2.22 (AOR = 2.22; 95% CI: 1.03–4.82) times higher among the T2DM patients who were delayed to start the follow-up as compared with patients who started the DM follow-up immediately after diagnosis. Moreover, the chance of developing DFU was 3.50 times higher among T2DM patients with a history of infection than T2DM patients without infection history (AOR = 3.50; 95% CI: 1.83–6.69). T2DM patients with hypertension were about four times more likely to developed DFU than non-hypertensive T2DM patients (AOR = 3.99; 95% CI: 2.08–7.65).

Discussion

The quality of diabetes care can be evaluated by assessing the magnitude of DFU among DM patients since DFU is mainly preventable through appropriate diabetes management.[24] Therefore, the aim of this study was to determine the prevalence of DFU and its associated factors among T2DM patients at governmental hospitals in the Harari Region, East Ethiopia.

This study revealed that 21.1% (95% CI: 17.5%–24.7%) of T2DM patients had DFU. The prevalence in this study was consistent with other previous studies including Bahir Dar,[25] Nekemte,[1] and Nigeria,[26] where the prevalence was found to be 21.1%, 18%, and 24.9%, respectively. However, our finding was higher than several studies carried out in Saudi Arabia (3.3%),[27] Thailand (3.4%),[28] Jordan (4.6%),[29] Iran (6.4%),[30] Lahore, Pakistan (7.02%),[31] Norway (7.4%),[32] Brazil (10.6%),[33] Ghana (11%),[34] Cameroon (11.8%),[35]

Table 4. Factors associated with DFU among type 2 DM patients attending chronic follow-up clinic at governmental hospitals of Harar town, Eastern Ethiopia, 2019.

Characteristics	DFU		COR (95% CI)	AOR (95% CI)
	Present	Absent		
Age				
15–29 years	6 (12.2%)	43 (87.8%)	1.00	1.00
30–44 years	23 (14.7%)	133 (85.3%)	1.24 (0.47–3.24)	1.64 (0.44–6.18)
45–59 years	29 (19.2%)	122 (80.8%)	1.70 (0.66–4.38)	3.09 (0.84–11.34)
More than 60 years	48 (32.9%)	98 (67.1%)	**3.51 (1.40–8.82)**	3.11 (0.86–11.24)
Marital status				
Currently unmarried	22 (28.9%)	54 (71.1%)	1.66 (0.96–2.88)	**0.40 (0.17–0.96)**
Currently married	84 (19.7%)	342 (80.3%)	1.00	1.00
Physical activity				
Inactive	50 (38.2%)	81 (61.8%)	**3.47 (2.21–5.46)**	**2.29 (1.17–4.48)**
Active	56 (15.1%)	315 (84.9%)	1.00	1.00
Smoking habit				
Smokers	12 (36.4%)	21 (63.6%)	**2.28 (1.08–4.80)**	1.42 (0.37–5.34)
Non-smokers	94 (20.0%)	375 (80.0%)	1.00	1.00
Alcohol taking habit				
Yes	15 (38.5%)	24 (61.5%)	**2.56 (1.29–5.07)**	1.33 (0.36–4.86)
No	91 (19.7%)	372 (80.3%)	1.00	1.00
Baseline medication				
Insulin	19 (31.1%)	42 (68.9%)	**1.841 (1.020–3.322)**	**4.43 (1.84–10.67)**
OHA	87 (19.7%)	354 (80.3%)	1.00	1.00
Obesity history				
Yes	70 (69.3%)	31 (30.7%)	**22.89 (13.29–39.45)**	**27.76 (13.96–55.23)**
No	36 (9.0%)	365 (91.0%)	1.00	1.00
Delay for follow-up				
Yes	19 (26.0%)	54 (74.0%)	1.53 (0.88–2.63)	**2.22 (1.03–4.82)**
No	87 (20.3%)	342 (79.7%)	1.00	1.00
Infection history				
Yes	56 (37.1%)	95 (62.9%)	**3.55 (2.27–5.54)**	**3.50 (1.83–6.69)**
No	50 (14.2%)	301 (85.8%)	1.00	1.00
CKD				
Yes	14 (51.9%)	13 (48.1%)	**4.48 (2.04–9.86)**	3.30 (0.94–11.62)
No	92 (19.4%)	383 (80.6%)	1.00	1.00
Hypertension				
Yes	73 (38.4%)	117 (61.6%)	**5.27 (3.32–8.39)**	**3.99 (2.08–7.65)**
No	33 (10.6%)	279 (89.4%)	1.00	1.00

COR: crude odds ratio; AOR: adjusted odds ratio; 95% CI: 95% confidence interval; OHA: oral hypoglycemic agent; CKD: chronic kidney disease; DFU: diabetic foot ulcer.
Numbers in bold indicate statistical significance.

Mekelle (12%),[20] Gondar (13.6%),[10] and Arba Minch (14.8%).[21] This variation might be due to the difference in study design, study population, sample size, sociocultural, health-seeking behavior, and health-care service quality. All of those studies were cross-sectional studies whereas our study was a retrospective document review. In a cross-sectional study, recall bias is the main challenge, but it is not a problem in the document review. Except for Thailand and Pakistan studies, the study population of all of the studies was all diabetes patients while our study included only T2DM patients. As reported by TG Mariam et al., one of the strongest predictors of the occurrence of DFU is type of DM. Patients with T2DM had a higher chance for developing DFU than patients with type 1 DM.[4,10]

Identifying factors associated with the development of DFU is crucial in clinical practice to prevent its occurrence among high-risk DM patients. This study identified that T2DM patients who had been currently unmarried, physical inactivity, using insulin as baseline medication, obese, delay in initiation of follow-up, having a history of infection, and hypertensive were at higher risk of developing DFU.

Currently married T2DM patients had a lower chance of developing DFU. This might be the reflection of getting additional assistance of care from the partner. Those who lived

with the spouse may get support for self-care which can reduce the risk of developing DFU. W Bohanny et al. reported that married DM patients had better self-care behaviors than those who were not married.[36] Self-care practice was also associated with the development of DFU. Those patients who did not practice self-care were at high risk of developing DFU.[10]

Patients who did not perform physical activity were more likely to develop DFU. A similar finding was also observed in previous studies.[37–39] A study in the Udupi district of India was also reported that DM patients with sedentary physical activity had two times (OR = 2.29; CI: 0.77–6.78) a higher chance of developing diabetes food syndrome.[39] A systematic review on the effect of physical activity and exercise on diabetic foot suggested that physical activity and exercise are efficient interventions to reduce and control the risk of diabetic foot.[38] Performing physical activity is one of the main strategies to improve glycemic control among DM patients. Those physically active DM patients can control their blood glucose level whereas physically inactive DM patients encountered difficulties in their glycemic control. Unable to control the glycemic level is associated with various complications of DM like DFU.

Another factor associated with the risk of developing DFU was insulin use. AK Molvaer et al. and K Al-Rubeaan also stated that insulin use is among strong risk factors associated with a history of foot ulcers.[27,32] This is explained using insulin among type 2 diabetes, patients may reflect a high degree of disease severity. Patients with a history of infection had a higher chance of developing DFU. S-Y Chen et al. also stated that the presence of systemic infection caused increased morbid effects, the burden of care, and mortality risk among patients with DFU.[23] Development of infection among DM patients may be associated with poor glycemic control which intern increased the risk of other complications including DFU.

The relationship between the obesity and the risk of diabetic foot ulceration is still inconclusive.[4] There is a J-shaped association between weight and foot ulcer risk among DM patients, as DM patients with BMI $<25\,kg/m^2$ and BMI $\geqslant 45\,kg/m^2$ had a higher risk of developing diabetic foot ulceration.[40] In our study, obese T2DM patients had a higher chance of developing DFU. This finding is in line with the studies conducted in Gondar (Ethiopia), Iran, and Poland.[10,41,42] The possible reason could be due to the reduction of normal blood circulation to lower extremities and higher foot pressure on those obese diabetic patients than DM patients with normal body weight which might lead to the development of DFU. However, other studies indicated that BMI has no association with the development of DFU.[31,32,34,35,39] These findings indicated that the true relationship between BMI and risk of DFU is still unclear and needs further studies.

Hypertension is one of the strong and modifiable risk factors for the macrovascular and microvascular complications of diabetes.[43] Similar to our finding, some previous studies revealed that DFU is associated with hypertension comorbidity.[21,27,28,44] It is known that hypertension and type 2 diabetes are common comorbidities. Moreover, hypertension is twice as frequent in DM patients as compared with those who do not have diabetes.[43,45,46] Our study also revealed that more than one-third (37.8%) of T2DM had hypertension comorbidity. The main reasons for the co-existence of hypertension and diabetes are that they share several genetic and environmental risk factors including obesity, genetic preposition, and dyslipidemia.[45,46]

Limitation of the study

The use of retrospective document review is the main limitation of this study. In the document, there is no record about some very crucial variables like economic status, types and grading of foot ulcers, estimated glomerular filtration rate (eGFR), glycosylated hemoglobin A1c (HbAc1), antibiotic susceptibility self-care practice, knowledge, attitude, and adherence with treatment among DM patients. These variables might be associated with the development of DFU.

Conclusion

The prevalence of DFU among T2DM is substantially high as more than one in five patients have this complication. This study also revealed that marital status, physical activity, baseline medication, obesity, delay for follow-up, infection history, and hypertension were significantly associated with the development of DFU. The health-care providers are recommended to provide regular health education on risks and preventive measures of DFUs for all T2DM patients in general and high-risk groups in particular. Moreover, high-risk T2DM patients such as currently unmarried, physically inactive, started treatment with insulin, obese, delay to start follow-up, have a history of infection, and hypertension need regular screening and prompt intervention for the presence of any foot problem.

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Author contributions

A.T. contributed to the data curation, formal analysis, methodology, writing—original draft, and writing—reviewing and editing the manuscript. L.D.R. contributed to the proposal development, data curation, analysis, investigation, methodology, project administration, and reviewing and editing the manuscript. Y.A. contributed to formal analysis, methodology, writing—original draft, and writing—review and editing the manuscript. The manuscript was also developed through the active participation of all authors. All the authors read and approved the manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

The study protocol was reviewed and approved by the Ethical Review Committee of the College of Medicine and Health Sciences, University of Gondar (approved no. IPH: 246:2017).

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Informed consent

A letter of cooperation was obtained from the respective Hospital Directors after submitting the proposal. Before reviewing medical records of type 2 diabetes patients, permission was also obtained from the heads of the chronic follow-up clinic of the hospital. For the sake of privacy and confidentiality, no personal identifiers such as names, addresses, and any private information were collected. Data were handled confidentially during all phases of research activities using anonymous medical registration numbers as identification. Softcopy registrations were protected using a password. Written informed consent was obtained from legally authorized representatives before the study. Since the data were collected through a review of medical records of type 2 DM patients, informed consent and permission were obtained from a legally authorized representative of the public hospitals.

ORCID iDs

Assefa Tola https://orcid.org/0000-0002-2155-6097
Yohanes Ayele https://orcid.org/0000-0002-6473-7752

Data availability

The data sets of the study are available on reasonable request from the corresponding author.

Supplemental material

Supplemental material for this article is available online.

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