Frequency and Severity of Three Diabetic Foot Ulcer Types Utilizing Ten Points Scoring Scale- A Study from a Tertiary Care Hospital of Islamabad

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Abstract

Objective: The present study aimed to assess the frequency of types of foot ulcers, and its clinical features among diabetic patients.

Methods: This prospective cross-sectional study was conducted at the Medicine Department of Pakistan Institute of Medical Sciences, Islamabad, between July to December 2019. A total of 133 diabetic patients presenting at the study site for foot ulcer treatment were recruited after obtaining informed consent. The foot ulcers were classified as neuropathic, ischemic ulcer, or neuroischemic. The severity/degree of the ulcer was determined using an internally developed ten points scoring system in which a score of $\leq$ 3 was considered as non-severe ulcers, 4 to 6 score was considered as mild/moderate disease, and a score >6 was referred as a severe disease for neuropathic and ischemic ulcers. Further, neuroischemic foot ulcers were established if a score of e 3 (each) was obtained in the sensory examination score for neuropathy and vascular examination score for ischemic ulcer. The collected data were analysed using SPSS version 22.0.

Results: There was a high frequency of neuropathic ulcers (69.2%) among the enrolled diabetic patients, followed by ischemic ulcer (30.8%) and neuroischemic (24.8%). The mean neuropathic scores were significantly high among males (4.83 ± 2.09) than females (4.02 ± 1.77) (p= 0.025). It was also higher in those aged 50 years or greater (4.84 ± 2.09) as compared to those with less than 50 years of age (3.80 ± 2.13) (p=0.01). While the mean vasculopathic scores were quite similar between the two genders and age groups i.e. p=0.772 and p=0.125, respectively.

Conclusion: Neuropathic ulcers were the most frequent type of diabetic foot ulcer. Increased severity of these foot ulcers was observed with advancing age.

Keywords: Diabetes Mellitus, Diabetic Ulcer, Neuropathic Ulcer, Foot Ulcer, Ischemic Ulcer, Neuroischemic Ulcer

IRB: The ethical approval was obtained for the study from the Hospital Ethical Board prior to initiation (Reference no: F.1-1/2019/ERB/SZABMU/176; Dated 4th June 2019).

Citation: Farhan A, Sufyan A, Tahir A, Ahmed A, Farooq MA. Freqency and severity of three Diabetic Foot ulcer types utilizing ten points scoring sacle-A study from a tertiary & care hospital of Islamabad. [online]. Annals ASH & KMDC; 28(1)

Introduction

Diabetes mellitus is the most common endocrinopathies, and it comes with numerous side effects. It is characterized by the hyperglycemic incidence in response to impaired insulin secretion or action or both. It is a global public health emergency of the 21st century approaching epidemic proportions[1].

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Date of Submission: 3rd March 2022
Date of Acceptance: 28 Feb 2023

The International Diabetes Federation (IDF) reported 537 million adults (between 20-79 years) worldwide have diabetes, accounting for one in every ten people. By 2030, this number is expected to increase up to 643 million, and 783 million by 2045, with 6.7 million fatalities, or one every five seconds[2]. In Pakistan, one in every four adults, i.e. 26.7%, are diabetic. After China and India have 141 million and 140 million diabetics respectively, Pakistan presently has the world's third-largest diabetic population, i.e., 33 million. Additionally, 11 million of Pakistan's population have impaired glucose tolerance (IGT), putting them at a high risk of acquiring type-2 diabetes[2].

Diabetes mellitus can cause foot ulcers, which are a major limb-threatening condition. Diabetic foot illness is a typical reason for surgical ward admissions, and it is sometimes the first sign of this severe disease. Patients with diabetes mellitus have an increased chance of developing kidney disease. Compared to their non-diabetic counterparts, diabetic patients have greater lower extremity issues. Amputation is a possibility in 25% of cases of foot ulcers. As a result, diabetic foot disease has significant medical, societal, and economic implications. If proper protocol is not followed, it is extremely difficult to treat, resulting in a lengthier hospital stay. The occurrence of a full-thickness lesion distal to the ankle is described as a diabetic foot ulcer[3]. Diabetic foot ulcer is more frequently reported among those having type 2 diabetes mellitus, with a prevalence of 6.3% globally[4].

The most frequent ulcer type is neuropathic, which is caused by tissue damage that is mainly linked to putting mechanical weight on foot[5]. Any blood vessels injury leading to peripheral arterial disease is one of the well-known macrovascular consequences of diabetes mellitus. Diabetics have a higher incidence of peripheral arterial disease, which can lead to the formation of foot ulcers[6]. Poor blood glucose control reduces collagen cross-linking and matrix metalloproteinase action, which has a negative impact on wound healing[5]. Hyperglycemia also impairs the function of polymorph nuclear leukocytes, increasing the risk of onychomycosis and toe-web infections, as well as skin damage[7].

There are multiple health and socioeconomic problems that have a profound effect on the quality of life of patients with diabetic foot ulcers, as it not only brings health challenges but also increases the overall economic burden of the household[8]. Although the condition is largely preventable, yet it accounts for a hospital stay with longer durations and increases lifetime risk[9].

As diabetic foot ulcers are currently the leading cause of hospitalization and lower limb amputation among diabetics, it is critical to screen all diabetic patients to identify those who are at risk of developing foot ulcers. The aim of the present study is to determine the local epidemiology of types of diabetic foot ulcers, frequency of hallmark clinical features via a ten-point scoring system and its clinical features in Islamabad and neighboring regions.

Patients and Methods

This hospital-based prospective cross-sectional study was conducted at the Medicine Department of Pakistan Institute of Medical Sciences, Islamabad, from July to December 2019. The ethical approval was obtained for the study from the Hospital Ethical Board prior to initiation (Reference no: F.1-1/2019/ERB/SZABMU/176; Dated 4th June 2019), and patient consent was acquired before enrollment.

Using WHO sample size calculator with level of significance 5%, power of test 99%, test value of prevalence for neuropathic ulcers using the reference study 0.74 while anticipating an equal distribution in our population at 0.50, the sample size was calculated to be 99[14]. Patients of age 15 to 60 years who were diagnosed cases of type 1 or type 2 Diabetes Mellitus and presented with foot ulcers were included. Patient with known history of foot trauma, psychiatric illness, pregnant females or those with sepsis or multiorgan failure were excluded. A total of 140 patients fulfilling inclusion criteria were consulted for enrollment out of which 7 refused to give consent. Remaining 133 patients were enrolled in the study via non probability consecutive sampling technique.

A ten-point scoring system was developed to label the patients as having either diabetic neuropathic ulcer, diabetic ischemic ulcer, or neuroischemic ulcer. The severity/degree of the ulcer was determined. Patients with a score of up to 3 were labeled as having non-severe ulcers, 4 to 6 score indicated mild/moderate disease, and a score >6 referred severe disease for neuropathic and ischemic ulcers. Neuroischemic foot ulcers were established if a score of 3 or more was obtained in each of the two examination components (Sensory exa-

mination score for neuropathy and vascular examination score for ischemic ulcer). All patients underwent a complete examination, including ankle-brachial index (ABI), monofilament testing, vibration sensations, reflexes, and examination of the peripheral pulses (Appendix I).

The data was recorded using a predesigned questionnaire, patients' demographic (age and gender), and ulcer-related characteristics, including vasculopathic characteristics (site, number of ulcers, pain, involvement of appendages, dorsalis pedis, posterior tibial, and ankle-brachial index), and neuropathic characteristics (proprioception, vibration, reflexes, and monofilament testing) were recorded. The analysis was performed on SPSS version 22.0. All qualitative variables were expressed as frequency and percentages, while the mean and standard deviation were used to display the quantitative variables. An independent sample T-test was used to assess the variation in the vasculopathic and neuropathic pain scores with respect to age and gender, where a $p<0.05$ was considered statistically significant.

Results

A total of 133 patients presenting to the diabetic foot clinic were evaluated for the type of ulcer. Their mean age was 56.53 ± 9.43 years, and out of them, 64.7% were males. The data regarding vasculopathic and neuropathic characteristics are shown in table 1. Solitary ulcer was present in 78.2% of patients. The pain was mostly absent (58.6%), and abnormal involvement of appendages were observed among 53.4% of cases. ABI was >0.9 among 81.2% of the patients. Among the neuropathic characteristics, proprioception was absent among 78.9% of the patients, vibrations and reflexes were observed among 8.3% and 31.6% of the cases, respectively (Table 1).

Out of 133, thirty-three (24.8%) patients had neuroischemic ulcers, 92 (69.2%) had neuropathic ulcers, and 41 (30.8) had vasculopathic ulcers (Table 2). Observing the ulcer severity, 51.9% of those with neuropathic ulcers had mild/moderate severity, and a majority of those with ischemic ulcers had non-severe ulcers (66.9%) while 27.1% had mild to moderate ulcer severity.

The mean neuropathic scores were significantly high among patients aged ≥50 years (4.84 ± 2.09) than those <50 years (3.80 ± 2.13) (p=0.01). While the mean vasculopathic scores were quite similar between the two age groups (p=0.125) (Table 3).

The gender-based distribution showed that there was a significant difference in the mean neuropathic scores among males and females (4.83 ± 2.09 vs. 4.02 ± 1.77; p=0.025), whereas the vasculopathic scores were similar in both males and females (p=0.772) (Table 3).

Table 1. Baseline characteristics of the patients enrolled

Baseline Variables		n=133
Age (year); Mean ± SD		56.53 ± 9.43
< 50 years		35(26.3)
> 50 years		98(73.7)
Gender	Male	86(64.7)
	Female	47(35.3)
Vasculopathic Characteristics		
Site	Atypical	53(39.8)
	Typical	80(60.2)
Number of Ulcers		
	One	104(78.2)
	More than one	29(21.8)
Pain	Absent	78(58.6)
	Present	55(41.4)
Involvement of appendages		
	Normal	62(46.6)
	Abnormal	71(53.4)
Dorsalis Pedis	Palpable	11(86.5)
	Not palpable	18(13.5)
Posterior Tibial	Palpable	91(68.4)
	Not Palpable	42(31.6)
Ankle-Brachial Index	Greater than 0.9	108(81.2)
	0.7 – 0.9	25(18.8)
	Lower than 0.7	-
Neuropathic Characteristics		
Proprioception	Absent	105(78.9)
	Present	28(21.1)
Vibration	Present	11(8.3)
	Absent over the big toe	68(51.1)
	Absent over the medial malleolus	39(29.3)
	Absent till the shin	15(11.3)
Reflexes	Present	42(31.6)
	Ankle Absent	91(68.4)
	Knee Absent	-
Monofilament Testing	Normal	-
	Less than 3	33(24.8)
	4 – 6	55(41.4)
	7, 8	28(21.1)
	9,10	17(12.8)

Table 2. Frequency of ulcers among patients with diabetic foot

Type of Ulcer	Severity of Ulcer	N(%)
Neuropathic Ulcer	Non-Severe Ulcers	41(30.8)
	Mild/Moderate	69(51.9)
	Severe	23(17.3)
	Non-Severe Ulcers	92(66.2)
Ischemic Ulcer	Mild/Moderate	34(25.7)
	Severe	7(5)
Neuroischemic Ulcer		33(24.8)

Table 3. Variation in the neuropathic and vasculopathic ulcer scores with respect to age and gender

Variables		Neuropathic Scores	Vasculopathic Scores
Gender	Male	4.83±2.09	2.89±2.04
	Female	4.02±1.77	2.78±2.07
	p-value	0.025*	0.772
Age Group	< 50 Years	3.80±2.13	2.40±1.63
	> 50 Years	4.81±1.91	3.02±2.16
	p-value	0.01*	0.125

*p<0.05 is considered significant

Discussion

As known, diabetes has been linked to numerous long-standing complications affecting various body systems[10], namely microvascular complications like nephropathy, retinopathy, neuropathy, and macrovascular complications like atherosclerosis and stroke[10,11]. Lower limb problems in adults with diabetes have become a major health concern, with rates rising in both developed and developing nations[12,13]. Hence, the present study aimed to assess the frequency of diabetic foot ulcer types. Utilizing a 10 point scoring system, ulcers were classified into neuropathic, ischemic, and neuroischemic. The maximum frequency was that of neuropathic ulcers (69.2%) followed by ischemic, and then ulcers having both neuropathic and ischemic characteristics, which is quite similar to that reported by another study, i.e. 74%, 19%, and 7% of the diabetic patients had neuropathic, neuroischemic and ischemic ulcers, respectively[14].

A multicentre cross-sectional study in Pakistan assessed the prevalence of diabetic foot. The study did not classify the ulcer into ischemic or neuropathic, however the examination findings like monofilament test, vibration assessment, and pulses were assessed. A higher percentage of neuropathic abnormalities, which is quite consistent with a high prevalence of neuropathic ulcers, were observed[15]. Another large sample-based study demonstrated a higher prevalence of neuropathic ulcers; they observed a significant reduction in amputations with the implementation of training and services. The study also demonstrates a higher prevalence of diabetic foot ulcers among the male gender, which is also consistent with our study[16]. Younis et al. revealed the prevalence of neuropathic foot ulcers as high as 74%, a value quite close to the present study. The study also demonstrates a higher prevalence in males. The patients who had diabetic foot ulcers were older as compared to the diabetics who didn't have foot ulcer[14].

Upon stratification with respect to age, it was found that the majority of the enrolled diabetic patients (73.7%) were greater than 50 years of age. The average age of the participants was 56.3 years, indicating that greater age is related to a poorer outcome, most likely due to a delayed immunological response to infection and the presence of certain other comorbidities that hinder healing, such as reduced vascular blood flow. It can be seen that the mean neuropathic scores were significantly high among patients aged ≥ 50 years than those <50 years (p=0.04), while the mean vasculopathic scores were quite similar between the two age groups. A significant number of patients >50 years developed neuropathic (73.4%), vasculopathic (37.7%), and neuroischemic foot ulcers (29.6%), which is also supported by previous data[17]. Younis et al. reported the development of foot ulcers in 89% of the patients aged >45 years while only 11% were younger[14].

Among the two studied risk factors, age and gender, only age was found to be significantly associated with a high prevalence of foot ulcers. A similar Sudanese study studied the association of risk factors including age, gender, diabetes duration, hypertension, dyslipidemia, retinopathy, and albuminuria with the prevalence of diabetic foot ulcers. They found a significant association between the duration of diabetes and ulcer prevalence[18]. Another local study from Karachi also supports our findings[19]. Other than these factors, increased BMI

has also been linked to a significant risk of diabetic foot ulcers among patients with diabetes mellitus. Although this factor isn't studied in the present population, a study from Ethiopia also supported that obesity increases the risk of atherosclerosis and subsequently decreases the blood supply to lower extremities making the environment suitable for bacterial growth resulting in diabetic foot ulcers[20].

Furthermore, a systematic review also determined that residing in rural areas has a significant association with the frequency of diabetic foot ulcers; the possible cause may be the lack of awareness regarding self-care. The deficient self-care practices, walking barefoot increases the exposure to bites and injuries, enhancing the risk of feet ulceration with ultimately decreased wound healing among diabetic patients. Studies also demonstrated that prolonged disease duration increases the likelihood of foot ulcers among diabetic patients. As long as the diabetic patient is living with the disease, the risk of occurrence of diabetic foot ulcer also increases because the disease severity escalates over time if not controlled adequately[20]. Last of all, the frequency of diabetic foot ulcers is also affected by the existence of callus on the feet, which may develop due to peripheral neuropathy, mostly associated with reduced blood supply. Deformity and loss of sensations cause persistent abnormal pressure on the foot leading to keratinization and callus formation, which ultimately predisposes an individual to a diabetic foot ulcer.

Though diabetic foot ulcers is preventable; however still increased morbidity, mortality, and hospitalization rate have been associated with the condition. Therefore, the literature highly suggests screening of all diabetic patients for early diagnosis of those at higher risk of foot ulceration. Patient health education, self-examination, self-care practices, and controlled blood glucose concentration are among the primary recommended preventive measures for foot ulcers. Moreover, for prevention and control of serious complications associated with the limbs, the physicians must have in-depth and updated information regarding the disease.

The limitations of this study include the inability to assess the past history in order to determine the recurrence of diabetic foot ulcers. The subjects could have been followed prospectively until the outcome was amputation. Fasting blood glucose levels and HbA1c levels were not assessed, that signific-antly correlates with types of ulcers. The strengths of the study include the utilization of a ten score system to effectively classify the ulcers and com-pare patient characteristics based on ulcer types. As the prevalence of diabetes in Pakistan is accel-erating, so is the burden of diabetic foot disease. There is a scarcity of foot care specialists and clinics worldwide as well as in Pakistan. In order to prevent the progression of foot ulceration to limb amputation, patient education regarding self-exam-ination of the foot is essential. Moreover, the train-ing of family physicians to perform routine foot exa-minations could also help reduce the disease prog-ression and complications. A better prognosis is ensured by proper diabetic foot ulcers assessment and management.

Conclusion

It is concluded from the study results that the most frequent types of diabetic foot ulcers are neuropathic with loss of proprioception being the most common clinical feature. A rising trend in the severity of these ulcers was observed with advancing age. Early recognition of signs of foot ulcer and classification into neuropathic and ischemic is recommended to ensure optimal management and prevention of further complications. The ten point scoring system may be employed in validation studies or to assess possible associations with clinical outcomes.

References

1. Tabish SA. Is diabetes becoming the biggest epidemic of the twenty-first century? Int J Health Sci. 2007;1(2): V–VIII. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3068646/pdf/ijhs-1-2-005a.pdf. Accessed on 22/2/23

2. IDF Diabetes Atlas. Diabetes around the world in 2021. Available from: https://diabetesatlas.org/. Accessed on. 22/2/23

3. Mariam TG, Alemayehu A, Tesfaye E, Mequannt W, Temesgen K, Yetwale F, et al. Prevalence of diabetic foot ulcer and associated factors among adult diabetic patients who attend the diabetic follow-up clinic at the University of Gondar Referral Hospital, North West Ethiopia, 2016: institutional-based cross-sectional study. J Diabetes Res 2017;1-8. [DOI: 10.1155/2017/2879249]. Available from:https://www.hindawi.com/journals/jdr/2017/2879249/. Accessed on. 22/2/23

4. Rastogi A, Goyal G, Kesavan R, Bal A, Kumar H, Kamath P, et al. Long term outcomes after incident diabetic foot ulcer: Multicenter large cohort prospective study (EDI-FOCUS investigators) epidemiology of diabetic foot complications study: Epidemiology of diabetic foot complications study. Diabetes Res. Clin. Pract. 2020;162:108113. [DOI: 10.1016/j.diabres.2020.108113]. Available from: https://www.diabetesresearchclinicalpractice.com/article/S0168-8227(20)30363-6/fulltext. Accessed on. 22/2/23

5. Waaijman R, de Haart M, Arts ML, Wever D, Verlouw AJ, Nollet F, et al. Risk factors for plantar foot ulcer recurrence in neuropathic diabetic patients. Diabetes Care 2014;37(6):1697-705. [DOI: 10.2337/dc13-2470]. Available from: https://diabetesjournals.org/care/article/37/6/1697/29712/Risk-Factors-for-Plantar-Foot-Ulcer-Recurrence-in. Accessed on. 22/2/23

6. Mathur R, Sahu K, Saraf S, Patheja P, Khan F, Gupta P. Low-level laser therapy as an adjunct to conventional therapy in the treatment of diabetic foot ulcers. Lasers Med Sci. 2017;32(2):275-82. [DOI:10.1007/s10103-016-2109-2]. Available from: https://link.springer.com/article/10.1007/s10103-016-2109-2. Accessed on 20th December 2022.

7. Thiruvoipati T, Kielhorn CE, Armstrong EJ. Peripheral artery disease in patients with diabetes: epidemiology, mechanisms, and outcomes. World J Diabetes.2015;6(7):961-69. [DOI: 10.4239/wjd.v6.i7.961]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4499529/pdf/WJD-6-961.pdf. Accessed on. 22/2/23

8. Kumhar M, Dara N, Saini T. Foot wear and footcare knowledge-an independent risk factor for diabetic foot in Indian diabetics. Ind Med Gaz 2014;148(1):25-28.[DOI:10.4103/0973-3930.45269]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2822153/?report=printable. Accessed on. 22/2/23

9. Sothornwit J, Srisawasdi G, Suwannakin A, Sriwijitkamol A. Decreased health-related quality of life in patients with diabetic foot problems. Diabetes Metab Syndr Obes. 2018;11:35. [DOI:10.2147/DMSO.S154304]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5846758/pdf/dmso11035.pdf. Accessed on. 22/2/23.

10. Safaa M, Hassanein ZME-S. Predicted complications factors among patients with diabetes mellitus: suggested nursing map of care. J Nurs Health Sci. 2019;8(6):49-62.8. [DOI: 10.9790/1959-0806104962]. Available from: https://www.iosrjournals.org/iosr-jnhs/papers/vol8-issue6/Series-10/G0806104962.pdf. Accessed on. 22/2/23.

11. Leontis LM, Hess-Fischl A. Type 2 diabetes complications; how to prevent short and long-term complications; 2019. Available from: https://www.endocrineweb.com/conditions/type-2-diabetes/type-2-dia betes-complications. Accessed on. 22/2/23

12. Yazdanpanah L, Shahbazian H, Nazari I, Arti HR, Ahmadi F, Mohammadianinejad SE, et al. Incidence and risk factors of diabetic foot ulcer: a population-based diabetic foot cohort (ADFC study)—two-year follow-up study. Int. J. Endocrinol. 2018:[DOI:10.1155/2018/7631659]. Available from: https://www.hindawi.com/journals/ije/2018/7631659/. Accessed on. 22/2/23.

13. Amin N, Doupis J. Diabetic foot disease: from the evaluation of the "foot at risk" to the novel diabetic ulcer treatment modalities. World J Diabetes. 2016;7(7):153–164.[DOI10.4239/wjd.v7.i7.153]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4824686/pdf/WJD-7-153.pdf. Accessed on. 22/2/23.

14. Younis BB, Shahid A, Arshad R, Khurshid S, Ahmad M, Yousaf H. Frequency of foot ulcers in people with type 2 diabetes, presenting to specialist diabetes clinic at a Tertiary Care Hospital, Lahore, Pakistan. BMC Endocr. Disord. 2018 ;18 (1): 1-6. [DOI: 10.1186/s12902-018-0282-y]. Available from: https://bmcendocrdisord.biomedcentral.com/articles/10.1186/s12902-018-0282-y. Accessed on. 22/2/23.

15. Khan A, Junaid N. Prevalence of diabetic foot syndrome amongst population with type 2 diabetes in Pakistan in primary care settings. JPMA. 2017;67(12):1818-1824. Available from: https://www.jpma.org.pk/PdfDownload/8473.Accessed on. 22/2/23.

16. Riaz M, Miyan Z, Waris N, Zaidi SI, Tahir B, Fawwad A, et al. Impact of multidisciplinary foot care team on outcome of diabetic foot ulcer in term of lower extremity amputation at a tertiary care unit in Karachi, Pakistan. Int Wound J. 2019;16(3):768-72. [DOI:10.1111/iwj.13095]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/iwj.13095. Accessed on. 22/2/23.

17. Apelqvist J, Agardh C-D. The association between clinical risk factors and outcome of diabetic foot ulcers. Diabetes Res Clin Pract. 1992;18(1):43-53. [DOI:10.1016/0168-8227(92)90054-u]. Available from: https://www.diabetesresearchclinical practice.com/article/0168-8227(92)90 054-U/pdf. Accessed on 22/2/23.

18. Almobarak AO, Awadalla H, Osman M, Ahmed MH. Prevalence of diabetic foot ulceration and associated risk factors: an old and still major public health problem in Khartoum, Sudan?. Ann Transl Med.2017;5(17):340.[DOI:10.21037/atm.2017.07.01.]. Available from: https://atm.amegroups.com/article/view/15863/16255. Accessed on. 22/2/23.

19. Khalique S. Evaluation of the effect of inadaptable risk factors & social status on Diabetic Foot. IJEHSR. 2014;2(2):78-81. [DOI: 10.29052/IJEHSR.v2.i2.2014.78-81]. Available from: https://aeirc-edu.com/ojs14/index.php/IJEHSR/article/view/65. Accessed on. 22/2/23.

20. Tolossa T, Mengist B, Mulisa D, Fetensa G, Turi E, Abajobir A. Prevalence and associated factors of foot ulcer among diabetic patients in Ethiopia: a systematic review and meta-analysis. BMC Public Health. 2020 Dec;20(1):1-4. [DOI: 10.1186/s12889-019-8133-y]. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-8133-y#:~:text=The%20overall%20magnitude%20of%20foot,(95%25CI%3A%202.7.. Accessed on. 22/2/23