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Amputation Rate of Diabetic Foot Ulcers and Associated Factors in Diabetes Mellitus Patients Attending Selected Public Hospitals in Addis Ababa, Ethiopia: A Multicenter Cross-Sectional Study.

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Addis Ababa, Ethiopia

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This is to affirm that the thesis prepared by Jenber Workye entitled “*Amputation rate of diabetic foot ulcers and associated factors in diabetes mellitus patients attending selected public hospitals in Addis Ababa, Ethiopia: a multicenter cross-sectional study*” and submitted for partial fulfillment of the requirements for the degree of Master in Pharmacy Practice. I have adhered to all ethical research principles during the data collection, analysis, and completion of this thesis, and it complies with the regulations of the university and meets the accepted standards concerning originality and quality.

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Abstract

Background: Diabetic foot ulcer is the most severe and feared complication of diabetes mellitus, which primarily results from peripheral nerve damage and arterial disease. It is a leading cause of nontraumatic lower limb amputations and a source of major suffering and financial costs for diabetic patients. The amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients have not been well-studied in Ethiopia.

Objectives: To assess the amputation rate of diabetic foot ulcers and associated factors in diabetes mellitus patients attending selected public hospitals in Addis Ababa from July 10, 2023, to January 10, 2024.

Materials and Methods: A multicenter cross-sectional study was conducted from July 10, 2023, to January 10, 2024. Consecutive sampling was used to recruit 151 study participants. Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 27. Multicollinearity tests among the independent variables were done by the variance inflation factors (VIF) and a result of <10 was included. Hosmer and Lemeshow's goodness of fit test was used to assess the binary logistic regression model fitness. Bivariate analysis was performed to find candidate variables for a multivariate binary logistic regression model to identify factors associated with amputations in diabetic foot ulcer patients. In a bivariate analysis variables with a p-value of <0.2 were entered into a multivariate binary logistic regression model to identify strong factors associated with lower extremity amputations. A p-value of < 0.05 was considered statistically significant.

Results: The study included 151 diabetic foot ulcer patients. The majority, 141(93.4%), had type 2 DM, and about 96 (63.6%) were diagnosed with diabetes for 10 years and above. Additionally, about 70(46.4%) took oral antidiabetic medications. More than half, 89(58.9%) of the study participants, had poor glycemic control, with a mean HbA1c level of $8.24 \pm 2.011\%$.

Of the diabetic foot ulcer patients evaluated during the study period, 106(70.2%) were not amputated, and the remaining 45(29.8%) underwent amputations. Among amputated diabetic foot ulcer patients, 17(11.3%) underwent minor amputation, while 28(18.6%) patients experienced major amputations.

Late presentation to hospital (AOR=3.769, 95% CI:1.378-10.304, P=0.010), poor glycemic control (AOR=2.993, 95% CI:1.102-8.129, P=0.032), advanced grades of ulcer (AOR=3.518, 95% CI:1.300-9.520, P=0.013), presence of peripheral artery diseases (AOR=3.161, 95% CI:1.119-8.932, P=0.030), and study site TASH (AOR=0.149, 95% CI:0.043-0.520, P=0.003) were independent predictors of lower extremity amputations. The commonly utilized antibiotics for treating diabetic foot infections were metronidazole (55%), followed by ceftriaxone (49.5%) and ciprofloxacin (33%). According to the available culture results the most specific pathogens identified from the ulcer were Staphylococcus aureus (26.9%) followed by Polymicrobial infections (11.5%) and Enterococcus species (7.7%).

Conclusion and Recommendations: The amputation rates of diabetic foot ulcers in our study were high. Late presentation to the hospital, poor glycemic control, presence of peripheral artery diseases, advanced grades of the ulcer, and study sites were factors that significantly predicted lower extremity amputations. The provision of special attention to these factors may reduce the rates of lower extremity amputations among diabetic foot ulcer patients.

Keywords: Diabetic foot ulcer, rate, associated factors, amputations, Ethiopia

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Acronyms and Abbreviations

CAD	Coronary Artery Diseases
DFU	Diabetic Foot Ulcer
DFI	Diabetic Foot Infections
DM	Diabetes Mellitus
DPN	Diabetic Peripheral Neuropathy
FBS	Fasting Blood Sugar
HbA1c	Glycosylated Hemoglobin
IDF	International Diabetes Federation
IDSA	Infectious Diseases Society of America
IWGDF	International Working Group on the Diabetic Foot
LEA	Lower Extremity Amputation
MRH	Menelik II Referral Hospital
MRSA	Methicillin Resistant Staphylococcus Aureus
PAD	Peripheral Arterial Disease
PVD	Peripheral Vascular Diseases
SPHMMC	Saint Paul's Hospital Millennium Medical College
SPSS	Statistical Package for Social Sciences
TASH	Tikur Anbessa Specialized Hospital
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

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1. Introduction

1.1. Background

Diabetes mellitus (DM) refers to a group of metabolic disorders characterized by chronic hyperglycemia. This condition has a diverse etiology, including a problem with insulin secretion, insulin action, or both, and disturbances in carbohydrate, fat, and protein metabolism (1). It is a worldwide health issue with a rising prevalence, presenting substantial challenges for healthcare systems around the globe (2), significantly impairing patients' quality of life and even shortening their life expectancy (3).

According to the 2021 International Diabetes Federation (IDF), the global prevalence of diabetes among individuals aged 20 to 79 was estimated at 10.5%, rising to 12.2% in 2045, and global diabetes-related health expenditures were estimated at \$966 billion, with projections suggesting an increase to \$1,054 billion by 2045 (4). Of these figures, approximately 24 million, or 1 in 22 adults, living with diabetes reside in Africa (5). In Ethiopia, the prevalence of diabetes ranges from 2.0% to 6.5%, with rural areas reporting as low as 2% (6). Diabetes mellitus complications have become a significant public health concern in every country (7). It is commonly linked to various macro and microvascular complications, including diabetic peripheral neuropathy (DPN), nephropathy, heart diseases, peripheral artery diseases (PAD), stroke, retinopathy, and foot ulceration (7, 8).

A Diabetic Foot Ulcer (DFU) is defined as a break in the protective skin layers of the foot in an individual with diabetes, which involves at least the epidermis and part of the dermis (9). It is among the most serious complications of DM, primarily resulting from peripheral nerve damage and arterial diseases (10). The prevalence rates of DFUs are rising, with the incidence increasing at a faster rate than other diabetes-related complications (11).

The global prevalence of DFUs is approximately 6.3% with the highest prevalence reported in North America (13.0%), followed by Africa (7.2%), and the lowest prevalence reported in Oceania (3.0%) (12). A systematic review and meta-analysis revealed that the prevalence of DFUs in Ethiopia is 12.98% (13). It is estimated that 19-34% of individuals with diabetes may develop

DFUs over their lifetime (14, 15, 16), and this figure is increasing with the growing longevity and medical complexity of the diabetic population (14).

Diabetic foot ulcers have significant negative effects on the lives of individuals with diabetes and healthcare providers. This is largely due to the overall poor prognosis of the disease, which often leads to prolonged hospital stays and substantial healthcare costs (17). Patients with DFUs experience an average increase in hospitalization duration of 59%, and the risk of amputation increases for these patients, consequently raising mortality rates (7). About 40% to 60% of non-traumatic lower limb amputations worldwide are caused by diabetes complications; out of these amputations, 80% are related to diabetic foot ulcers (DFUs) (3). Additionally, People with diabetes who have experienced limb loss often face high levels of depression and anxiety (18). Therefore, the early identification and effective management of modifiable risk factors could help prevent major amputations and their negative consequences (19, 20).

Over half of DFUs are showing clinical signs of infection at the time of presentation, leading to poor outcomes (21). Up to 20% of infected ulcers may necessitate hospitalization, and 15% to 20% of moderate to severe infections ultimately result in lower extremity amputations (22).

Several patient and ulcer characteristics have been identified as potential factors that could influence the outcomes of DFUs (17). These factors include heart failure, end-stage renal diseases, depth of the ulcer, and anatomical location of the ulcer (23). Furthermore, high Body Mass Index (BMI), retinopathy, DPN, peripheral vascular disease (PVD), elevated levels of glycosylated hemoglobin (HbA1c), infections, and inadequate foot self-care habits can also impact outcomes (24).

Diabetic foot ulcers are a significant health concern in Ethiopia primarily due to the high prevalence of diabetes and the limited resources dedicated to their prevention and management. Studies have shown that DFUs substantially increase healthcare costs, morbidity, and disability in the country (13, 25).

1.2. Statements of the Problem

The consequences of diabetes-related foot problems have become a significant public health issue, placing a heavy burden on many African countries where resources are already limited (26). In contrast, Western countries have seen a decline in amputation rates among DFU patients, largely due to the early recognition of risk factors (27). However, in many African countries, the situation is different, patient delays in seeking medical care, late referrals influenced by sociocultural factors, medication shortages, difficulties in achieving an accurate diagnosis, and limited use of a multidisciplinary team approach often result in advanced cases of DFUs by the time patients present for treatment (28).

Despite advancements in medical science, managing DFU remains a complex challenge that necessitates a multidisciplinary approach (29, 30). The amputation rate of DFUs varies across different geographical locations within the country or between countries (32). For example, the incidence of LEA in patients with DFU ranges widely: it is approximately 0.03% in Denmark, 0.86% in the USA, can be as high as 33% in Africa (33), and 30.43% in Ethiopia (34). This data highlights that amputation is a serious issue for diabetic patients in developing countries (19). In Ethiopia, foot infection that leads to limb amputation may have been caused by patient behavior of poor DFU treatment practice and the lack of good quality services (35).

Globally, around 1.6 million amputations are performed each year; of these, approximately 33% are major amputations, and in the USA, more than 150000 non-traumatic LEAs are conducted annually in individuals with diabetes (22). The overall amputation rate in China was 19.03% (16.88% major and 2.14% minor amputations) (36). In Africa, the reported rate of major amputations is about 15% (1). In Ethiopia, from Nekemte Referral Hospital, the LEA rate was 30.43%, consisting of 57.14% major amputations and 42.86% minor amputations (34). It has been estimated that following major LEAs, the five-year mortality rates range between 53% and 100%, and following minor amputations it was 44.1%, additionally, patient survival rates post-amputation are worse than those for many common cancers, including Hodgkin's disease, breast cancer, oropharyngeal cancer, kidney cancer, prostate cancer, and colon cancer (37). Furthermore, diabetic patients who have undergone lower limb amputations face a 50% risk of developing a serious lesion in the other limb within two years (38). LEAs significantly impact individual patients and

are considered the last resort for limbs that cannot be salvaged (39). The impact of DFUs extends beyond physical discomfort, affecting patients' quality of life, mobility, and overall well-being (29). Particularly, DFUs disproportionately affect those blacks, low socioeconomic status, and people living in rural areas; for example, in California, the prevalence-adjusted LEA rates among individuals with diabetes in low-income neighborhoods were double those in higher-income neighborhoods (22). In developed countries, the amputation rates have been reduced by 50% via proactive management with a multidisciplinary approach (40).

Diabetic foot ulcers impose a significant financial burden on patients and the healthcare systems, despite being preventable (41). The costs related to this debilitating condition are extremely high, both directly and indirectly (16). In the UK, the total annual cost of managing DFUs exceeds \$1.32 billion, which accounts for nearly 1% of the entire National Health Service budget (42). In the United States, the direct costs of treating DFUs are estimated to range from \$9 billion to \$13 billion annually (22).

Studies that have looked at foot ulcer outcomes in people living with diabetes reported conflicting results, with several patient and ulcer characteristics, including age, sex, cross-sectional area of ulcer, PAD, infection, ulcer site, duration of diabetes, and comorbidity, reported as possible factors that could influence ulcer healing (17). Even though there are geographical differences in amputation rates as well as variations among surgeons concerning the decision to amputate or not (43), the incidence of amputations continues to increase in diabetic populations despite public health efforts (44).

Diabetic foot ulcers treated by a multidisciplinary team specializing in foot care show a better prognosis and lower rates of amputation (28). Although diabetic patients have a higher risk of LEA, it is important to note that half of these amputations could be prevented with early treatment, increased awareness, education about foot care, and a strong emphasis on maintaining good glycemic control (45). Effective care for diabetic foot infections could prevent more than 40% of amputations (46). Studies have shown that the incidence of LEA can be reduced by 49-87% by preventing the development of DFUs (24). Although there are well-defined risk factors for developing DFUs, limited data is available on the factors that predict its progression to minor or major LEAs (47); therefore, understanding the outcomes associated with the ulcers is essential for

optimizing patient care and enhancing treatment strategies (29). Additionally, determining the comorbidities and risk factors linked to LEAs is crucial for reducing the significant medical expenses and disability brought on by amputations (48). In Ethiopia, there have been multiple studies on the prevalence, foot care practices, and risk factors associated with DFU development. However, research focusing on the amputation rate of diabetic foot ulcers and associated factors in diabetes mellitus patients is limited. As far as our knowledge, there is no published evidence-based literature assessing the amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients at Tikur Anbesa Specialized Hospital (TASH), Menelik II Referral Hospital (MRH), and St.Paul's Hospital Millennium Medical College (SPHMMC), so the present study aims to investigate the amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients; to identify high-risk individuals promptly and prevent potentially unfavorable outcomes at Tikur Anbesa Specialized Hospital (TASH), Menelik II Referral Hospital (MRH), and St.Paul's Hospital Millennium Medical College (SPHMMC) in Addis Ababa, Ethiopia.

1.3. Significance of the study

Evaluation of the amputation rate of DFU and associated factors in DM patients in this setting may provide evidence-based information on the severity of the problems and factors associated with it. It will help to improve the management practice and quality of care by quantifying the rates of amputations. It will also help healthcare professionals to individualize treatment decisions by identifying high-risk individuals and patients with diabetic foot ulcers to receive timely and appropriate medical care to prevent amputations.

The findings of this study will provide valuable insights for various stakeholders, including healthcare professionals involved in diabetic foot care, policymakers, and program planning bodies to evaluate the quality of existing policies, and programs to improve or revise them, and to develop local treatment guidelines. Further, it might serve as a reference for future public health and clinical research.

2. Literature review

A diabetic foot ulcer is a break in the protective layers of skin on the foot of diabetic patients, which involves at least the epidermis and part of the dermis (9). Once this protective layer is breached, deep tissues are exposed to bacterial infections that can progress rapidly (49, 50). Studies reported that an estimated 19-34% of DM patients may develop DFU over their lifetime and this number is rising with increased longevity and medical complexity of the patients (14, 15, 16). It is the leading cause of non-traumatic LEAs (51). DFU is preventable, and the rate of LEA can be reduced by 49-87% by preventing the development of DFU (24). Similarly, studies suggest that the prevalence of ulceration may be lowered by 44% to 85% with the early identification and management of diabetic foot problems (52). Furthermore, LEA is preventable to an extent of 45% to 85% if an aggressive, prompt, and appropriate line of treatment is administered (53). However, DFUs related LEA rates are still very high in many parts of Africa (26).

2.1. The amputation rates of DFU in DM patients

Patients with DFU frequently require amputation of the lower limbs (50). The expense for care of diabetic patients with a lower extremity ulcer is a major economic burden for both society and individual patients, and costs are significantly increased when ulcers get infected or require extended hospital stays and amputation (54). LEA rates have come to be seen as an indicator of the quality of preventative care for the DFU (11). Prompt vascular reconstruction and standardized debridement can successfully prevent amputation, therefore, amputation should be the last resort because it can be devastating for patients with DFU (55). A systematic review done in Africa found that lower limb amputation was the most reported clinical outcome in the included studies (56).

A meta-analysis conducted in China reported that the overall amputation rate of lower extremities in patients with DFUs was 31% (57). A prospective observational study conducted in Nigeria revealed that among 336 DFU patients, 119 (35.4%) underwent LEA during the follow-up period (58). Another prospective observational study in India reported that among 100 DFU patients, 65% of them were healed, whereas 35% had their limbs amputated (7). Additionally, a prospective observational study conducted at the University of Malta shows that 77% of ulcers had healed/resolved completely and 23% resulted in lower limb amputations over a maximum period of one year (59). A retrospective study in Taiwan, which included 646 DFU patients, demonstrated

that 17.5% had undergone minor and 7.1% major amputation between 2012 and 2017 (60). A survey in the Philippines including 216 DFU patients reported that 11% had undergone major amputation, and 21.5% had a minor amputation (61). A prospective study in Pakistan including 112 DFU patients stated that 27.7% underwent amputation during the study period (62). In addition, a cohort study in Southern Iraq on 100 DFU patients demonstrated that 25% of the patients had a minor amputation, whereas 5% had a major amputation (50). Furthermore, a prospective study conducted in Nekemte Ethiopia, reported that 30.43 DFU patients underwent amputations consisting of 57.14% major amputations and 42.86% minor amputations (34). However, foot ulceration is preventable, and relatively simple interventions can reduce amputation rates by up to 80 percent (58).

2.2. Factors associated with amputations in DFU patients

Diabetic foot ulcers have a multifactorial nature, which needs a comprehensive understanding of predisposing factors to help in prevention and management (12). The causes of amputation may vary among different populations. For example, PVD is the primary cause of amputation in developed countries, whereas trauma, infections, malignancies, and poorly managed diabetes are among the leading causes in developing countries (63). Patients with PVD have a threefold increased risk of amputations compared to those without this condition (64). Infection also frequently makes these ulcers worse (65). In comparison to DFU patients without infection, those with infections face a 50% higher risk of minor amputation; therefore carefully managing infections by properly diagnosing them, accurately classifying lesions, collecting appropriate specimens for culture, thoughtfully selecting empirical and definitive antimicrobial therapy, promptly determining when surgical intervention is necessary, and providing all other essential types of wound care are required (66).

About half of all patients with foot ulcers have PAD, which is thought to be a significant predictor of amputation (21). A prospective study in Europe showed that, in the entire study population, older age, being a male, heart failure, inability to stand or walk without assistance, end-stage renal disease, larger ulcer size, peripheral neuropathy, and PAD were independent baseline predictors of non-healing ulcers (65). Likewise, longitudinal data in Germany found that advanced age ≥ 70 years, polyneuropathy, long duration of DM, and HbA1c value $>7.5\%$ were the biggest risk factors

for amputation (67). A meta-analysis conducted in China showed that being a male was 1.3 times increased risk of amputation as compared to being female, DFU patients having a smoking history were 1.19 times more likely to have amputation, and those having a higher WBC count were 2.42 times increased risk of amputation as compared to their counterparts (3). Another study from India showed that diabetic patients who smoke are more likely to undergo amputation than non-smokers, and about 85% of LEA are followed by non-healing foot ulcers resulting from smoking (44).

A study conducted in the USA showed that wound size, duration of the ulcer, and advanced wound grades are all significantly associated with the likelihood of wound healing (68). Another study conducted in Turkey reported that limb ischemia, osteomyelitis, presence of gangrene, CAD, and smoking were associated with either overall or major amputations and considered major independent predictors of amputations, moreover, baseline levels of acute phase reactants (WBC, polymorphonuclear leukocyte count, platelet count, erythrocyte sedimentation rate (ESR), serum C-reactive protein (CRP) and albumin) and decreased hemoglobin levels were associated with higher risk of amputations (69). On the other hand, a prospective study conducted in Pakistan indicates that Patients aged 50 years and older, long duration of diabetes (>10 years), rural origin, and heel ulcers were significantly associated with poor outcomes (62).

A study in Brazil showed that a lack of guidance about how to care for the feet was associated with approximately 3.6 times greater chance of requiring amputations (11). Another prospective observational study conducted in Nizamabad and Nekemte Ethiopia found that foot ulcer Wagner grade 4, improper antibiotic use, overweight, obesity, poor glycemic control, and neuropathy were independent predictors of amputation (7, 34). A study from Indonesia reported that older people and males are more likely to have an amputation; for every 10 years of age increase, an 11% increase in the risk of amputations (70). Furthermore, other variables that increase the risk of LEAs include hypertension, high levels of WBC, triglycerides, Low-density lipoprotein cholesterol (LDL-C), High-density lipoprotein cholesterol (HDL-C), and serum C-reactive proteins (71).

A study conducted in Korea revealed that the rate of LEA in diabetic patients was increased by current cigarette smoking and heavy alcohol consumption, however, it was reduced by regular exercise (72). Different forms of foot-related exercises, including strengthening and stretching are supported to improve modifiable risk factors of foot ulceration; aim to improve plantar pressure

distribution, neuropathy symptoms, reduced foot sensation, and foot-ankle joint mobility. However, weight-bearing and foot-related activities are recommended to be avoided if there are pre-ulcerative lesions or active ulceration (73). On the other hand, a systematic review in Portugal reported that exercise may positively improve peripheral circulation and reduce peak plantar pressures, reducing DFU risk and improving diabetic foot outcomes (74). A study conducted in India reported that out of 20 DFU patients walking in bare feet, 12 of them underwent LEAs (75). Although some risk factors are difficult to reverse, understanding them and their impact on outcomes allows multidisciplinary teams to create effective management and treatment protocols for patients with DFU (3). Studies have shown that a multidisciplinary team not only lowers the rates of amputation by 50% to 85% but also reduces the risks associated with DFU, leading to a better quality of life (76). On the other hand, statin users had a 52% lower risk of total LEA compared with matched nonusers (77).

2.3. Commonly utilized antibiotics to treat diabetic foot infections

Studies showed that the use of inappropriate antibiotics has become a major problem in the management of DFIs, and multidrug-resistant pathogen rates have been increasing to alarming levels (78). It will cause problems including increasing the incidence of both microbial resistance to single and combined antibiotics, increasing toxicity due to incorrect selection, dosing, frequency, and duration, triggering other side effects beyond the patient's illness, and making infection take longer to heal which has an impact on the length of treatment and the expense of patient care (79). In Indonesia, 46% of antibiotics were used inappropriately, but it did not significantly affect the outcome of DFU (80). On the other hand, a prospective study in Nekemte Ethiopia revealed that 50.7% of the antibiotics were prescribed inappropriately and strongly associated with amputation of the lower limb (35). However, a study from the UK reported that mortality and amputations have significantly improved with appropriate antibiotic therapy (81). Additionally, in the UK, the amputation rate dropped from about 70% to 30%, and the mortality rates from about 9% to 4% with appropriate antibiotic therapy (82).

A study in Indonesia stated that ampicillin-sulbactam, meropenem, and levofloxacin (80), in Surakarta, ceftriaxone (76.2%), ceftriaxone + metronidazole (47.6%), and ciprofloxacin (19%) (79) were the commonly prescribed antibiotics. Additionally, a prospective study in Nekemte

Ethiopia revealed that cloxacillin (34.15%), metronidazole (26.22%), and ceftriaxone (20.12%) were the most commonly used antibiotics for the treatment of DFI (34). Similarly, a prospective study in Nizamabad reported that the most generally recommended antibiotic for treating DFU was cloxacillin + metronidazole (39%), followed by ceftriaxone (15%) (7).

2.4. Causative microorganisms isolated from the DFU

A systematic review done in Africa found that LEA was more prevalent in the multi-drug-resistant organism, and it affects both amputation rates and mortality rates (56). According to the study conducted in Singapore, having a polymicrobial culture with *Pseudomonas aeruginosa*, a monomicrobial culture with other gram-negatives, greater disease severity, and being transferred from another hospital were significant independent risk factors associated with higher mortality rates (81). Another prospective study conducted in Singapore found that pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA) and *Staphylococcus aureus* significantly predict lower extremity losses (83).

In China, *Staphylococcus aureus* (38.2%) was the predominant isolated bacteria, followed by *Staphylococcus epidermidis* (29.2%) and *Escherichia coli* (*E.coli*) (28.1%) (84). In Africa, *Staphylococcus aureus* was the most prevalent bacteria isolated from DFU, followed by *E. coli* and *P. aeruginosa* in descending order of frequency (85). On the other hand, in Mexico, gram-negative bacteria were more predominant than gram-positive bacteria (86). Similarly, in China, the proportion of gram-negative bacteria (54.1%) was higher than gram-positive bacteria (45.9%). Enterobacteriaceae was the main gram-negative bacteria (73.2%), including *E. coli*, *Enterobacter cloacae*, and *Klebsiella pneumonia* (87). In Ethiopia, 32% were Gram-positive, 68% were Gram-negative isolates, and 68% of the samples had polybacterial growth (88). An institutional-based cross-sectional study conducted in Addis Ababa reported that the predominant bacterial species isolated from the DFUs were *Staphylococcus aureus* (25.19%), *Pseudomonas* species (18.89%), and *Escherichia coli* (16.53%).

2.5. Conceptual Frameworks

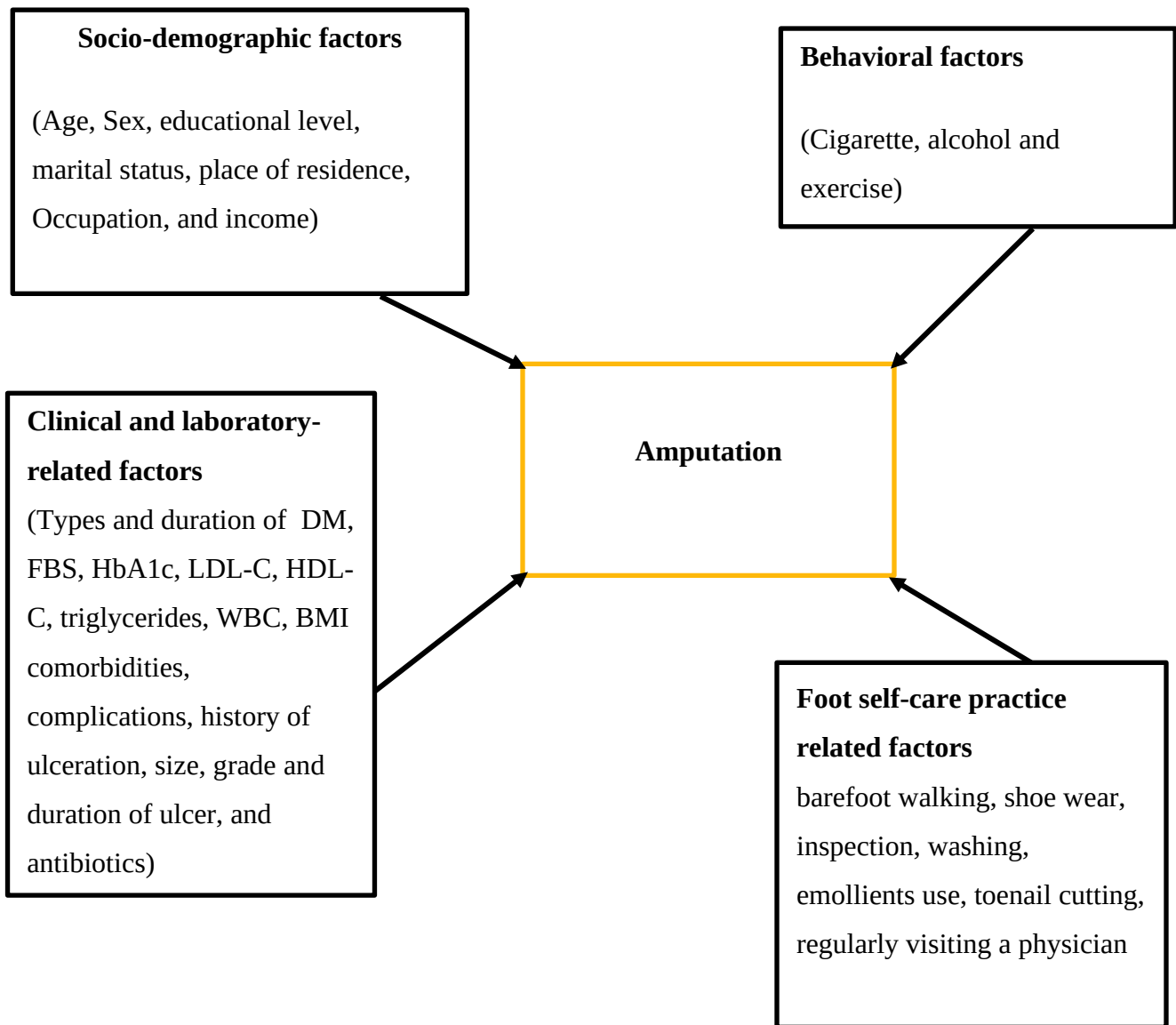


Figure 1: Conceptual framework which shows the association between amputation and associated factors in diabetic foot ulcer patients adopted from different kinds of literature.

3. Objective of the study

3.1. General objective

To assess the amputation rates of diabetic foot ulcers and associated factors in DM patients attending TASH, SPHMMC, and MRH, in Addis Ababa, Ethiopia.

3.2. Specific objectives

- To assess the amputation rates of DFU in DM patients
- To identify factors associated with amputation of DFU in DM patients
- To identify the commonly utilized antibiotics to treat diabetic foot infections
- To identify the causative microorganisms isolated from the DFU

4. Materials and Methods

4.1. Study setting

This study was conducted at the emergency unit, medical, surgical, orthopedic wards, and the diabetes outpatient clinics of TASH, SPHMMC, and MRH. Tikur Anbessa Specialized Hospital is the largest tertiary care teaching hospital found in Addis Ababa, the capital city of Ethiopia, and provides multidisciplinary healthcare services to the country's population. It is a government-owned referral and teaching hospital managed by Addis Ababa University, offering undergraduate and postgraduate studies. The Endocrine Clinic is part of the internal medicine department and it provides specialized foot care services. The clinic has 6 sessions per week serving patients with endocrine diseases. Out of the 6 sessions, 4 of them are allocated for diabetic patients including the gestational diabetic clinic and diabetic foot clinic. In the diabetic foot clinic, according to the hospital health management information system (HMIS), an average of 70 to 85 diabetic patients are registered each day, with 5 to 7 patients coming in for foot issues every Friday.

Menelik II Referral Hospital (MRH) is part of the Addis Ababa City Administration Health Bureau, located near Jan Meda on Russia Street, and offers various medical services for diabetic patients. Based on the hospital HMIS, on average, 30 to 40 diabetic patients visit the center weekly, and 4 to 5 DFU patients come to the center monthly. SPHMMC is the second largest hospital in Ethiopia, located in the Gulelle sub-city and provides care to more than 500,000 clients annually with 40,000 emergency patient flows, and offers residency training across most medical specialties (89). Addis Ababa Burn, Emergency & Trauma Hospital (AaBET Hospital) is the largest government-owned trauma & emergency center in the country and is affiliated with SPHMMC, where every month, 4 to 7 DFU patients are admitted to the orthopedic ward.

4.2. Study design and period

A multi-center cross-sectional study design was employed from July 10, 2023, to January 10, 2024 (for six consecutive months).

4.3. Population

4.3.1. Source population

All adult DM Patients who were attending TASH, SPHMMC, and MRH were considered the source population.

4.3.2. Study population

All adult DM patients who had DFU attending in TASH, SPHMMC, and MRH during the study period and who fulfilled the eligibility criteria.

4.4. Eligibility criteria

4.4.1. Inclusion criteria

- ✓ Patients aged ≥ 18 years and who had a confirmed clinical diagnosis of DFU attending TASH, SPHMMC and MRH
- ✓ Patients who were willing to participate in the study

4.4.2. Exclusion Criteria

- ✓ Patients who were critically ill and had mental illness who were unable to provide the required information by themselves

4.5. Sample size determination and sampling technique

4.5.1. Sample size determination

All adult DFU patients attending TASH, SPHMMC, and MRH during the study period (6 months) were recruited. The sample includes all patients diagnosed as DFU cases by the physician who met the eligibility criteria and volunteered to participate in the study during the study period.

4.5.2. Sampling Technique

The study participants were enrolled from TASH, SPHMMC, and MRH using a consecutive sampling technique. All DFU patients attending these three hospitals during the study period who met the eligibility criteria and volunteered to participate in this study were registered.

4.6. Study Variables

4.6.1. Dependent Variable

- ✓ Amputation

4.6.2 Independent variables

- ✓ **Socio-demographic related factors** (age, sex, educational level, marital status, place of residence, occupation, and average monthly income).
- ✓ **Clinical and laboratory-related factors** (types of diabetes, duration of diabetes, DM treatment, FBS, HbA1c, total cholesterol, triglycerides, LDL-C, HDL-C, BMI serum creatinine, WBC count, comorbidities and complications, history of ulceration, size of ulcer, grade of ulcer and duration of ulcer, antibiotics prescribed to treat DFI, pathogens isolated from the ulcer).
- ✓ **Behavior-related factors** (history of smoking, history of alcohol drinking, regular exercise).
- ✓ **Foot self care-related factors** (walking in barefoot, ever wearing shoes without socks, daily foot inspection, daily foot washing, using emollients after washing, using emollients between toes, cutting toenails properly, footwear and inspecting shoes for foreign objects or torn linings).

4.7. Data collection and management

4.7.1. Data collection instrument

A structured questionnaire was used to collect data from the study participants on sociodemographic characteristics such as sex, age, marital status, place of residence, level of

education, and average monthly income. In addition, a data abstraction form was created by an extensive review of different previously published literature with related study topics (7, 34, 40, 62, 90) to collect data from the medical records and the patients such as; clinical, laboratory, behavior-related, and self-foot care-related characteristics (types of diabetes, duration of diabetes, HbA1c, WBC count, BMI, total cholesterol, triglycerides, LDL-C, HDL-C, comorbidities and complications, history of ulceration, size of the ulcer, grade of the ulcer, duration of the ulcer before health care visit, antibiotics, history of smoking, alcohol drinking, regular exercise, walking in barefoot, ever wear shoes without socks, daily foot inspection, daily foot washing, use emollients after washing, use emollients between toes, cut toenails properly, footwear and inspect shoes for foreign objects or torn linings. A sterile swab was used to collect samples from the foot ulcer, and a sterile needle was used to collect pus before any ulcer cleaning and to avoid other contamination. Then, samples were delivered to the laboratory immediately. The isolates were identified by culture and Gram staining.

4.8. Data quality assurance

The questionnaire was first translated from the original English version into Amharic by a bilingual person fluent in Amharic and English. A second bilingual translator, who did not know the original English version, back-translated the instrument from the Amharic version into English. Any discrepancies in the translation were resolved with discussion. A pretest was administered to 5% of DFU patients at MRH to ensure that the respondents understood the questions and to check the content uniformity and consistency of the data collection tool before the actual data collection. After the pretest was done, data collection was performed by 2 clinical pharmacists and 2 nurses. A one-day training was given by the principal investigator about the objectives of the study and how to use the data collection tool to collect data directly from the patient and medical records before their engagement in the data collection process. The completeness and consistency of the data to be collected were reviewed by the principal investigator to certify the quality of the data.

4.9. Data processing and analysis

The data were checked, cleaned, and coded daily by the principal investigator and then entered into the SPSS version 27. Descriptive statistics like frequency, percentage, mean, standard

deviation, and range were used to describe the distribution of socio-demographic, behavioral, clinical, laboratory, and foot self-care-related characteristics of the study participants. Multicollinearity tests among the independent variables were done by the variance inflation factors (VIF) and a result of <10 was included. Hosmer and Lemeshow's goodness of fit test was used to assess the binary logistic regression model fitness. Bivariate analysis was performed to find candidate variables for a multivariate binary logistic regression model to identify factors associated with amputations in DFU patients. In a bivariate analysis variables with a p-value of <0.2 were entered into a multivariate binary logistic regression model to identify strong factors associated with LEAs. A p-value of < 0.05 was considered statistically significant.

4.10. Operational definitions

Diabetic foot ulcer: The presence of a break in the skin of the foot in a person with diabetes.

Amputation: The complete or partial removal of a limb by surgical means due to the ulcer.

Healed foot ulcer: A full epithelialization of a previously ulcerated location without any drainage (91).

Persisting unhealed: Defined as incomplete re-epithelialization of the wound (50).

Minor amputation: The surgical removal of a toe(s), ray(s), or forefoot (92).

Major amputation: Amputation of the entire foot by any level of the leg (including the ankle) (92).

Grades of diabetic foot ulcers: For this study, the Wagner system of ulcer classification was used because this method is the most commonly used in our study setting. For the determination of the grade of ulcer (0-6) based on the depth of the skin lesion and the presence or absence of infection and gangrene (93).

- **Grade 0 diabetic foot ulcer:** no open lesion in the skin, but the foot is at risk for ulceration.
- **Grade 1 diabetic foot ulcer:** Superficial ulceration.
- **Grade 2 diabetic foot ulcer:** Ulcer with deep infection but without involvement of the bone or joint.
- **Grade 3 diabetic foot ulcer:** Ulcer with bone involvement, osteomyelitis, or abscess formation.
- **Grade 4 diabetic foot ulcer:** presence of gangrene in toes or forefoot.
- **Grade 5 diabetic foot ulcer:** Presence of gangrene of the whole foot.

Good foot care practice: This included participants who scored mean or above on practice questions.

Poor foot care practice: This included participants who scored below the mean on practice questions.

Glycemic control: Based on ADA-2023 (94)

- **Good control:** HbA1c <7 %
- **Poor control:** HbA1c $\geq$ 7%

Dyslipidemia: Abnormal lipid profile consists of the following abnormalities either singly or in combination. These include:

- Triglyceride (TG) levels $\geq$ 150 mg/dl, high-density lipoprotein cholesterol (HDL-C) (for men $\leq$ 40 mg/dl and women $\leq$ 50 mg/dl), low-density lipoprotein cholesterol (LDL-C) $\geq$ 100 mg/dl (95).

Neuropathy: It was determined whether the patient had at least one symptom from the list of symptoms that included burning pain, vibration from the skin, gradual numbness, freezing, extreme sensitivity to touch, muscle weakness, and lack of coordination.

Peripheral Artery Disease (PAD): Was considered to be present if ankle–brachial pressure index was <0.9, and/or two foot pulses were absent.

Duration of the ulcer: The number of days from the onset of the ulcer to the hospital visit of the patients.

- **Late presentation:** Defined as an ulcer presenting to the hospital after three weeks and is reported to be the hallmark of DFUs in some studies from Africa and other resource-poor countries (96).

Infection: Diagnosed in cases when two or more of the following signs were present: frank purulence, local warmth, erythema, lymphangitis, edema, pain, fever, and foul smell (59).

Regular physical exercise: DM patients, if they perform physical exercise, which could be either walking, jogging, or running three times per week that lasts 30 minutes or more before the development of DFUs.

Body Mass Index (BMI): The weight in kilograms divided by the square of the height in meters (kg/m^2). It is classified as a BMI less than $18.5 \text{ kg}/\text{m}^2$ =underweight, a BMI ranging from 18.5 – $24.9 \text{ kg}/\text{m}^2$ =normal range, a BMI ranging from 25 – $29.9 \text{ kg}/\text{m}^2$ =overweight, a BMI $\geq 30 \text{ kg}/\text{m}^2$ =obese (97).

4.11. Ethical consideration

The study was conducted after obtaining ethical clearance from AAU, CHS, School of Pharmacy ethical review board (approval number: ERB/SOP/546/15/2023). Before the data collection, a written permission letter was obtained from TASH, SPHMMC, and MRH administrations. All the study participants were provided with clear information on the purpose of the study, and written informed consent was obtained from each participant before joining the study. During the data collection time, the participant's name and other identifiers were not recorded on the data collection tools, and information related to those patients was kept strictly confidential and was not disclosed to any person throughout the study period.

4.12. Plan for dissemination of the result

The thesis will be prepared in both paper and electronic formats and submitted to the Department of Pharmacology and Clinical Pharmacy, School of Pharmacy, College of Health Sciences, Addis Ababa University. Additionally, the results of the study will be disseminated to TASH, SPHMMC, MRH, and other key stakeholders involved in DFU management. Finally, there are plans to publish the findings in an internationally reputable journal to make it accessible to every concerned body.

5. Results

5.1. Socio-demographic characteristics

A total of 151 study participants were enrolled in the study. Of these 101(66.9%), 28(18.5%), and 22(14.6%) were from TASH, SPHMMC, and MRH respectively; the majority 103(68.2%) were males with an approximate male-to-female ratio of 2 to 1. The mean age of the participants was 59.13 ± 11.6 years and ranged from 20 to 90 years. More than half 80(53%) of the study participants were in the 46 to 64 (old adults) years age group. More than two-thirds 114 (75.5%) of them were married (Table 1).

Table 1: Socio-demographic characteristics of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Frequency	Percentage
Study site	TASH	101	66.9
	MRH	22	14.6
	SPHMMC	28	18.5
Sex	Male	103	68.2
	Female	48	31.8
Age	18-45 (young adults)	20	13.2
	46-64 (old adults)	80	53
	≥ 65 (elderly)	51	33.8
Marital status	Unmarried*	37	24.5
	Married	114	75.5
Educational level	unable to read and write	8	5.3
	read and write	14	9.3
	primary(1-8 th grade)	23	15.2
	secondary (9-12 th grade)	49	32.5
	Diploma and above	57	37.7
Occupation	Farmer	11	7.3

	Government employee	31	20.5
	Non-government	30	19.9
	Unemployed	19	12.6
	housewife	15	9.9
	retired	45	29.8
Residence	Rural	19	12.6
	Urban	132	87.4
Monthly income(Ethiopian birr)	<1000	16	10.6
	1000-1999	34	22.5
	2000-2999	29	19.2
	≥3000	72	47.7

Note *=single, divorced, widowed

TASH: Tikur Anbessa Specialized Hospital, SPHMMC: St. Paul's Hospital Millennium Medical College, MRH: Menellik II Referral Hospital

5.2. Behavior related characteristics

Sixty-two (41.1%) and seven (4.6%) of the respondents were previous and current alcohol drinkers, respectively. In addition, forty-one (27.2%) and eight (5.3%) were previous and current smokers, respectively. Regarding physical exercise, 80(53%) of the study participants were engaged in different physical exercises. The majority of types of exercise reported by the study participants were walking during the routine working activity followed by jogging as described in Table 2.

Table 2: Behavior-related characteristics of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Frequency	Percentage
Currently, alcohol drinking	Yes	7	4.6
	No	144	95.4
Previous alcohol drinking	Yes	62	41.1
	No	89	58.9
Never drink alcohol	Yes	89	58.9
	No	62	41.1
Previous cigarette smoker	Yes	41	27.2
	No	110	72.8
Never smoked	Yes	108	71.5
	No	43	28.5
Current cigarette smoker	Yes	8	5.3
	No	143	94.7
Regular physical activity	Yes	80	53
	No	71	47
Number of times per week	<3 times per week	19	23.8
	≥3 times per week	61	76.3
Kinds of physical activity	Walking	50	62.5
	Jogging	21	26.3
	Running	9	11.3

5.3. Foot self-care practices

Regarding the foot care practice of the study participants, the majority 123(81.5%) of the study participants were walking by wearing shoes, and 121(80.1%) were not applying emollients between toes. In addition, 113(74.8%) of them were wearing shoes with appropriate socks, 108(71.5%) were cutting toenails properly, and about two-thirds of the study participants had well-fitted footwear 100 (66.2%). However, more than half of them were not inspecting their feet daily and not using emollients after washing their feet (Table 3).

Table 3: Foot self-care practice of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Frequency	Percentage
Walking in barefoot	Yes	28	18.5
	No	123	81.5
Ever wear shoes without socks	Yes	38	25.2
	No	113	74.8
Daily foot inspection	Yes	62	41.1
	No	89	58.9
Daily foot washing	Yes	85	56.3
	No	66	43.7
Use emollients after washing	Yes	61	40.4
	No	90	59.6
Use emollients between toes	Yes	30	19.9
	No	121	80.1
Cut toenails properly	Yes	108	71.5
	No	43	28.5
Footwear	Well fit	100	66.2
	Ill fit	51	33.8
Inspect shoes for foreign objects or torn linings	Yes	130	86.1
	No	21	13.9

5.4. Clinical characteristics

5.4.1. Diabetes mellitus related characteristics

Of the total study participants, 141 (93.4%) had T2DM, and the majority 96 (63.6%), were diabetic for greater than 10 years with a median duration of 11 years. Forty percent of the DFU patients were overweight, and 15 (9.9%) were obese, while the mean body mass index (BMI) was 25.15 ± 3.33 (range 18.7-37.5) kg/m^2 . More than half 89 (58.9%) had poor glycemic control with a mean HbA1c level of $8.24 \pm 2.01\%$. Seventy (46.4%), 65 (43%), and 16 (10.6%) were on oral anti-diabetics, both oral and insulin therapy, and only on insulin treatment, respectively. One hundred nineteen (78.8%) of them were taking statins, and 87 (57.6%) were on aspirin treatment (Table 4).

Table 4: Diabetes mellitus-related clinical characteristics of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Frequency	Percentage
Types of DM	Type 1	10	6.6
	Type 2	141	93.4
Duration of DM	<5 years	37	24.5
	5-10 years	18	11.9
	>10 years	96	63.6
Treatment for diabetes	Insulin alone	16	10.6
	Oral anti-diabetics only	70	46.4
	Both oral and insulin	65	43.0
BMI (kg/m^2)	18.5-24.9	75	49.7
	25-29.9	61	40.4
	≥ 30	15	9.9
Glycemic control	Poor control	89	58.9
	Good control	62	41.1
Statin use	Yes	119	78.8
	No	32	21.2
Aspirin use	Yes	87	57.6

	No	64	42.4
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5.4.2. Diabetic foot ulcer-related characteristics

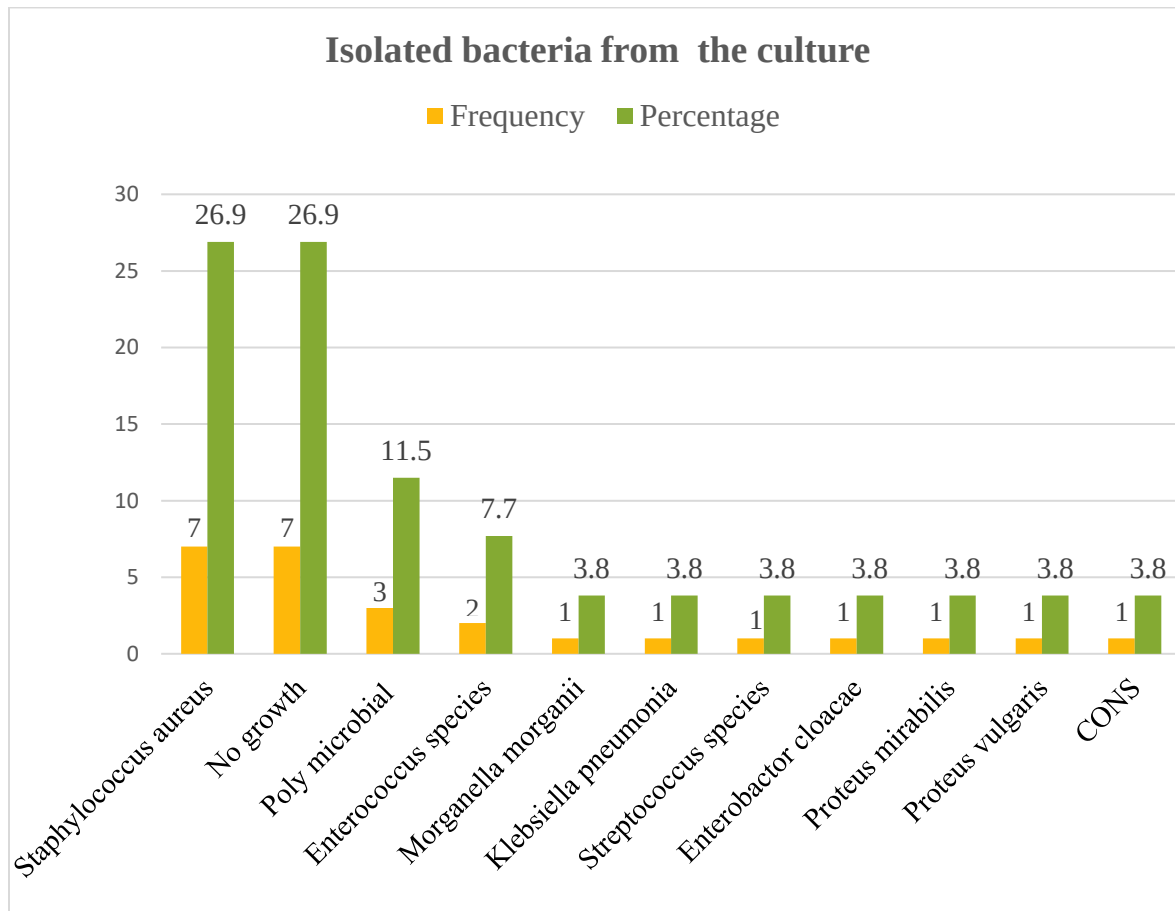
One-third, 51(33.8%) of the study participants had a previous history of DFU, among whom 23(15.2%) had a previous history of amputation. The majority 95(62.9%), had ulcer area greater than 5 cm². One hundred (66.2%) of the study participants had ulcer duration of one month or less before a visit to a health care center. Ninety-four (62.3%) of ulcers were infected. Among those DFU patients, gram stains were done for 31 (20.5%), and culture was done for 26 (17.2%) patients. From the gram stain tests 11(35.5%) were found to be gram-positive bacteria, 4(12.9%) gram-negative bacteria, 4(12.9%) polymicrobial, and the remaining 12(38.7%) no bacteria as described in Table 5.

Table 5: Diabetic foot ulcer-related characteristics of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Frequency	Percentage
Size of ulcer	<1cm ²	8	5.3
	1-5cm ²	48	31.8
	≥5cm ²	95	62.9
Duration of ulcer before a visit to hospitals	<1 month	100	66.2
	≥1 month	51	33.8
Infected ulcers	Yes	94	62.3
	No	57	37.7
Previous history of DFU	Yes (Healed)	28	18.5
	Yes (Amputated)	23	15.2
	No	100	66.2
Gram stain result	No bacteria	12	38.7
	Gram-positive	11	35.5
	Gram-negative	4	12.9
	Poly microbial	4	12.9

Note: Duration of ulcer before first visit; is the time in months.

Based on the culture results, 7(26.9%) isolated bacteria were *Staphylococcus aureus*, 7 (26.9%) were no bacteria growth, 3(11.5%) were polymicrobial, and 2(7.7%) were *Enterococcus* species (Figure 2).



Note: CONS; Coagulase Negative *Staphylococcus*

Figure 2: Bacteria isolated from the culture of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

From the total 151 study participants, the majority 47(31.1%) of ulcers were located on dorsal/interdigital toes followed by 34(22.5%) on dorsal feet, and 27(17.9%) on plantar toes as described in Figure 3.

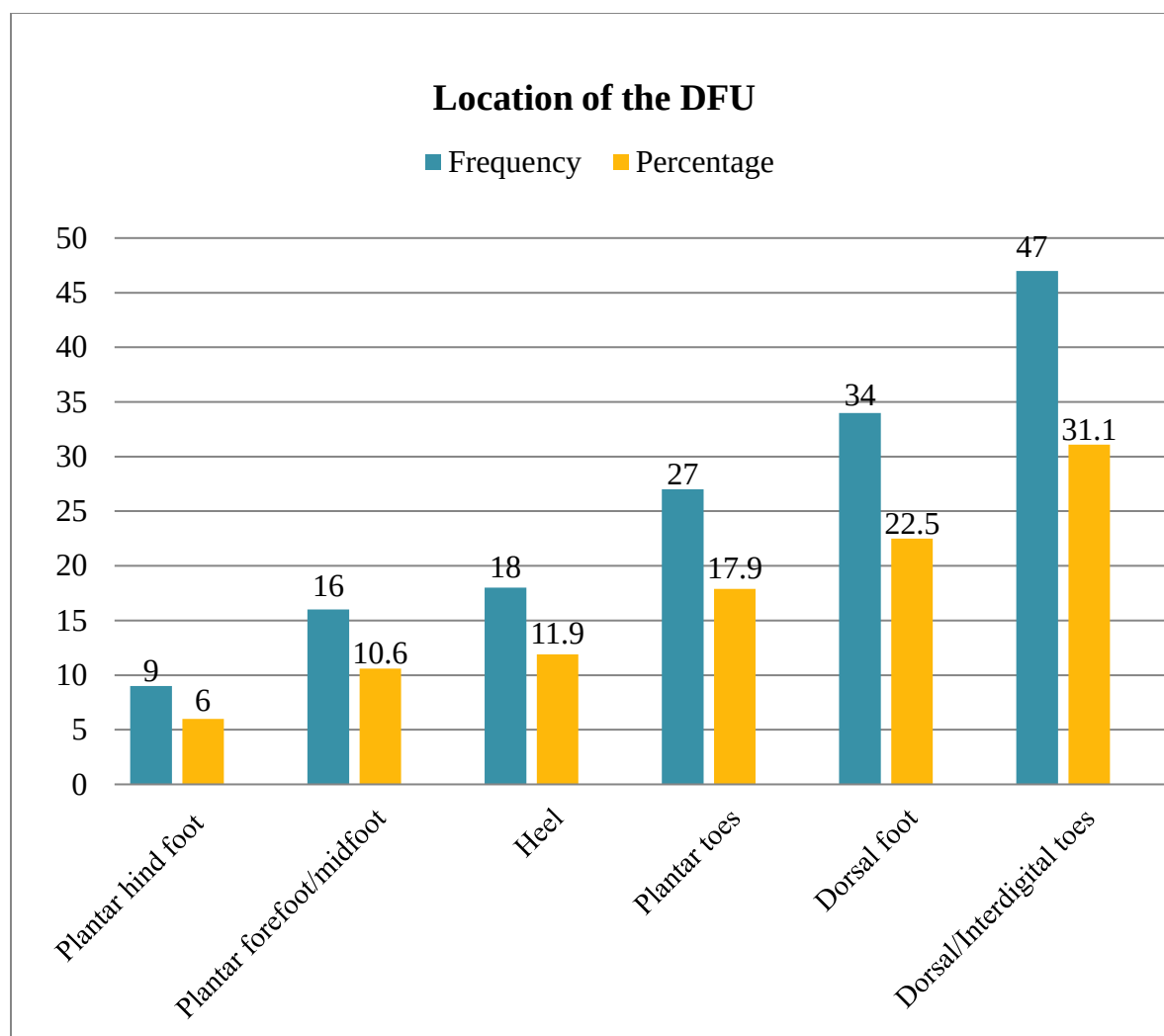


Figure 3: Location of the diabetic foot ulcer of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Regarding the grade of diabetic foot ulcers at the time of diagnosis, over half of the study participants 76(50.4%), presented with mild ulcers (grades 0 to 2), whereas the remaining 75 (49.6%) had moderate to severe ulcers (grades 3 to 5). Among those classified as having moderate to severe ulcers, 29.8% were identified with Wagner grade four ulcers (Figure 4).

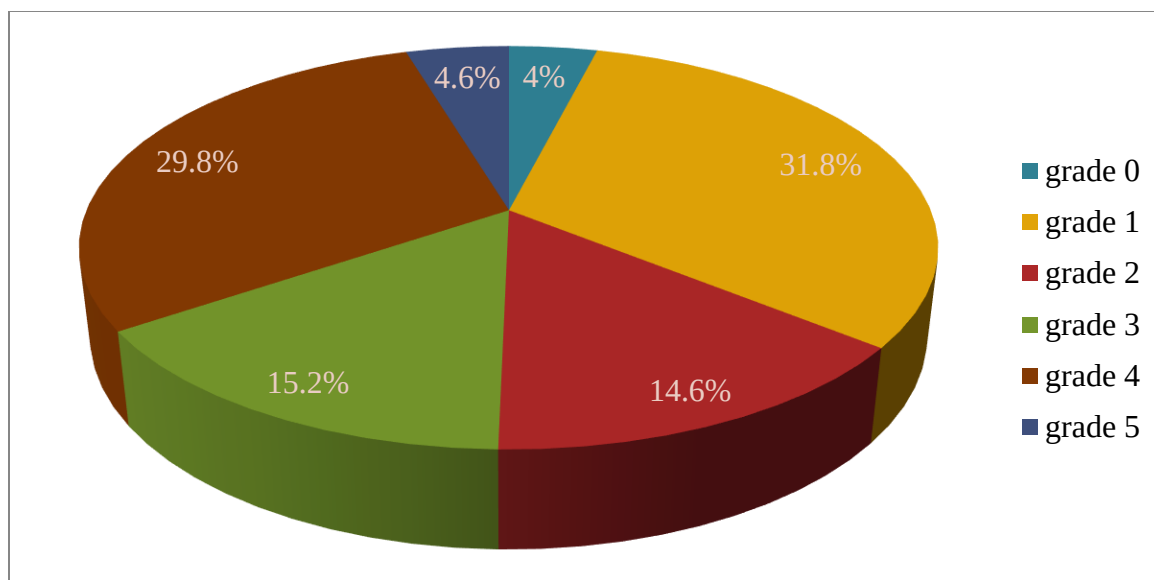


Figure 4: Grades of the diabetic foot ulcer of the study participants based on Wagner classification attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

5.4.2.1. Antibiotics used in the treatment of diabetic foot infections

Among the total study participants, 109 (72.2%) received antibiotics. Out of these, 60 (55%) patients were taking metronidazole, followed by ceftriaxone 54 (49.5%), ciprofloxacin 36 (33%), and cloxacillin 29 (26.6%) (Table 6).

Table 6: Antibiotics used in the treatment of DFI of the study participants in TASH, SPHMMC, and MRH, Addis Ababa, Ethiopia, 2023 (n=151).

Variables	Frequency	Percentage
Metronidazole	60	55
Ceftriaxone	54	49.5
Ciprofloxacin	36	33
Cloxacillin	29	26.6
Amoxicillin+ clavulanic acid	24	22
Vancomycin	19	17.4
Clindamycin	9	8.3

Cefepime	8	7.3
Doxycycline	6	5.5
Cephalexin	3	2.8
Meropenem	1	0.9

5.4.3. Comorbidities and complications

About 123(81.5%) of our study participants had chronic comorbidities, with 116 (76.8%) of those being hypertensive, making it the most common comorbidity identified in this study, followed by ischemic heart diseases (IHD). Furthermore, 135(89.4%) patients experienced complications related to diabetes, with 83 (55%) of these having peripheral artery diseases, followed by 68 (45%) suffering from peripheral neuropathy, and 54(35.8%) had nephropathy (Figure 5).

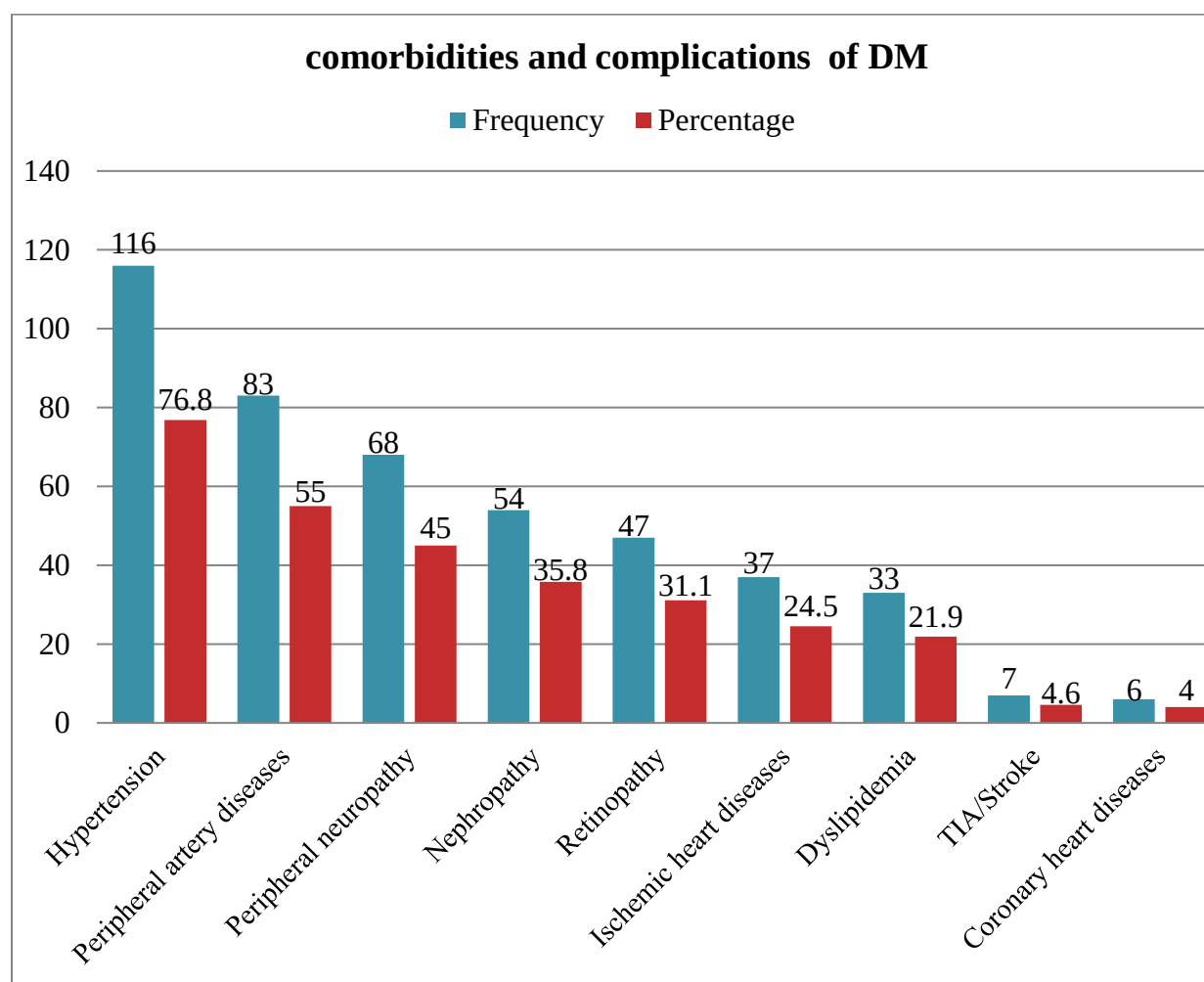


Figure 5. Diabetes mellitus-related complications and comorbidities of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

5.5. Laboratory related characteristics

Of the total 151 participants in this study, more than half, 89 (59%), presented with a HbA1c level of $\geq 7.0\%$, and the mean HbA1c level was $8.24 \pm 2.011\%$, with values ranging from 5% to 16%. Similarly, 102 (67.5%) of patients had fasting blood sugar (FBS) levels of ≥ 130 mg/dL, yielding a mean FBS of 163.57 ± 70 mg/dL, with ranges from 60 to 480 mg/dL. Regarding the lipid profiles of the study participants, 32(21.2%) had LDL-C levels of ≥ 100 mg/dL, and 35(23.2%) had triglyceride levels of ≥ 150 mg/dL. Over half of the patients, 81(53.6%), exhibited a systolic blood pressure of ≥ 130 mmHg, while 67 (44.4%) had a diastolic blood pressure of ≥ 80 mmHg. Additionally, concerning the white blood cell count, only 42(27.8%) patients had levels of $\geq 110.0 \times 10^3$ cells/mm³ (Table 7).

Table 7: Laboratory-related characteristics of the study participants attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Frequency	Percentage
Total cholesterol	Abnormal	15	9.9
	Normal	136	90.1
Triglycerides	Abnormal	35	23.2
	Normal	116	76.8
High-density lipoproteins	Abnormal	52	34.4
	Normal	99	65.6
Low-density lipoproteins	Abnormal	32	21.2
	Normal	119	78.8
FBS(mg/dL)	≤ 130	49	32.5
	> 130	102	67.5
HbA1c (%)	< 7	62	41
	≥ 7	89	59
Serum creatinine (mg/dL)	< 1.3	122	80.8

	1.3-1.7	17	11.3
	>1.7	12	7.9
WBC count (cells/mm ³)	4.0X10 ³ -11.0X10 ³	109	72.2
	>11.0X10 ³	42	27.8
Blood pressure(systolic) (mm Hg)	<130	70	46.4
	≥130	81	53.6
Blood pressure(diastolic) (mm Hg)	<80	84	55.6
	≥80	67	44.4

5.6. Amputation rates of DFU in DM patients

According to the findings of this study, out of the 151 DFU patients, 45(29.8%) underwent LEAs throughout the 6-month study period. Among the patients with LEAs, 17(11.2%) underwent minor amputations, of which 13(8.6%) had below-ankle amputations. Whereas 28(18.6%) patients experienced major amputations; of which 19 (12.6%) had below-the-knee amputations (Table 8).

Table 8: The amputation rates of DFU in DM patients attending TASH, SPHMMC, and MRH in Addis Ababa, Ethiopia, 2023 (n=151).

Variables				Frequency	Percentage
Amputation rate	Not amputated (n=106)			106	70.2
	Amputated (n = 45)	Minor Amputation (n=17)	Amputated-below ankle	13	8.6
			Amputated-above ankle	4	2.6
		Major amputation (n=28)	Amputated-below knee	19	12.6
			Amputated-above knee	9	6

5.7. Factors associated with amputations

To assess the possible factors associated with LEAs in DFU patients, variables showing a marginal association at $p < 0.2$ in a bivariate analysis were included in the multivariate binary logistic regression analysis. Out of the twelve variables (study sites, sex, previous alcohol drinking, previous smoking, foot self-care practice, duration of the ulcer, glycemic control, ulcer size, grades of the ulcer, neuropathy, PAD, and WBC- count) that meet the inclusion criteria for binary logistic regression analysis, only five (study site, duration of the ulcer, grades of the ulcer, glycemic control and PAD) were significantly associated with LEAs in DFU patients.

Patients with DFU who experienced poor glycemic control were 2.993 times more likely to have amputation (AOR=2.993, 95% CI: 1.102-8.129, $P=0.032$) compared to those with good glycemic control. Likewise, DFU patients with advanced ulcer grades (≥ 4 Wagner grade) were 3.518 times more likely to be amputated (AOR=3.518, 95% CI: 1.300-9.520, $P=0.013$) as compared to those with mild to moderate ulcer grades (< 4 Wagner grade). Similarly, individuals with PAD were 3.161 times more likely to have an amputation (AOR=3.161, 95% CI: 1.119-8.932, $P=0.030$) compared to those without PAD. Additionally, patients who presented late to the hospital had a 3.769 times greater likelihood of amputation (AOR=3.769, 95% CI: 1.378-10.308, $P=0.010$) compared to those who presented early. Moreover, DFU patients who visited TASH were less likely to experience amputation (AOR=0.149, 95% CI: 0.043-0.520, $P=0.003$) than those who visited SPHMMC and MRH (Table 9).

Table 9: Bivariate and multivariate logistic regression analysis results of factors associated with amputations among diabetic foot ulcer patients attending TASH, SPHMMC, and MRH, in Addis Ababa, Ethiopia, 2023 (n=151).

Variables		Amputations		COR of 95% CI	P value	AOR of 95% CI	P value
		Yes N(%)	No N(%)				
Study sites	TASH	22(21.8)	79(78.2)	0.278(0.116-0.670)	0.004	0.149(0.043-0.520)	0.003*
	MRH	9(40.9)	13(59.1)	0.692(0.224-2.138)	0.532	0.349(0.072-1.699)	0.192
	SPMMC	14(50.0)	14(50.0)	1		1	
Sex	Male	38(36.9)	65(63.1)	3.424(1.398-8.388)	0.007	2.346(0.647-8.509)	0.195
	Female	7(14.6)	41(85.4)	1		1	
Previous alcohol drinking	Yes	25(40.3)	37(59.7)	2.331(1.145-4.745)	0.020	1.342(0.339-5.314)	0.675
	No	20(22.5)	69(77.5)	1		1	
Previous smoking	Yes	17(41.5)	24(58.5)	2.074(0.975-4.414)	0.058	1.206(0.305-4.776)	0.789
	No	28(25.5)	82(74.5)	1		1	
Foot self-care practice	Poor	18(42.9)	24(57.1)	2.278(1.076-4.822)	0.031	1.180(0.415-3.356)	0.757
	Good	27(24.8)	82(75.2)	1		1	
Duration of ulcer	<1 month	23(23.0)	77(77.0)	1		1	
	≥ 1 month	22(43.1)	29(56.9)	2.540(1.231-5.238)	0.012	3.769(1.378-10.304)	0.010*
Glycemic control	poor	33(37.1)	56(62.9)	2.455(1.145-5.265)	0.021	2.993(1.102-8.129)	0.032*
	Good	12(19.4)	50(80.6)	1		1	

Ulcer size	<1cm ²	2(25.0)	6(75.0)	1		1	0.101
	1-5cm ²	6(12.5)	42(87.5)	0.429(0.070-2.631)	0.360	0.173(0.013-2.392)	0.191
	≥5cm ²	37(38.9)	58(61.1)	1.914(0.367-9.991)	0.441	0.628(0.055-7.144)	0.708
Grade of the ulcer	<4	19(19.2)	80(80.8)	1		1	
	≥4	26(50.0)	26(50.0)	4.211(2.011-8.814)	<0.001	3.518(1.300-9.520)	0.013*
Neuropathy	Yes	26(38.2)	42(61.8)	2.085(1.027-4.233)	0.042	1.870(0.725-4.826)	0.195
	No	19(22.9)	64(77.1)	1		1	
PAD	Yes	34(41.0)	49(59.0)	3.596(1.649-7.842)	0.001	3.161(1.119-8.932)	0.030*
	No	11(16.2)	57(83.8)	1		1	
WBC	4.0x10 ³ -11.0x10 ³	18(18.4)	80(81.6)	1		1	
	>11.0x10 ³	27(50.9)	26(49.1)	4.615(2.196-9.699)	<0.001	2.449(0.901-6.655)	0.079

Note:*= P<0.05

Abbreviations: TASH; Tikur Anbessa Specialized Hospital, MRH; Menelik II Referral Hospital, SPHMMC; Saint Paul's Hospital Millennium Medical College, PAD; Peripheral Artery Disease, WBC; White Blood Cell count.

6. Discussion

Lower extremity amputations are among the most feared consequences for DFU patients, resulting from a combination of multiple causes (49). Nearly 50% of patients who have previous LEA may require another one within 3-5 years (3), identifying the risk factors is of great importance in preventing extremity losses in patients with DFU (98). Complication of DFU varies by ethnicity and geography, studies are essential to address these factors locally (20). This study aimed to investigate the amputation rate of DFU and associated factors among DM patients attending TASH, SPHMMC, and MRH.

In the present study, the rate of amputations in DFU patients was 29.8%. This figure was consistent with the findings from Pakistan (27.7%) (62), 10 European countries (28%) (99), and Nekemte Ethiopia (30.43%) (34). The rate of amputation in our study was lower than in studies conducted in Korea (58.9%) (100), Indonesia (53.8%) (70), India (48%) (75), and Taiwan (42.2%) (48). However, in our study, the rate of amputations was higher than in studies conducted in Catalonia (9.7%) (101), Portugal (10.02%) (102), and Indonesia (16.7%) (46). These differences in the rate of amputation among studies might be due to differences in the duration from presentation to health care centers, adequacy of resources, and a local approach by surgeons related to better preventative measures and standard of care (27). Additionally, the reason for this discrepancy in the rate of amputations could be linked to the patient's refusal to give informed consent because of cultural concerns, where losing a limb is viewed as more tragic than death (7, 34); and it might be due to differences in the study design and severity of the diseases.

In our study, the proportions of males were greater than in studies conducted in Nigeria (44.3%) (39), Indonesia (40.4%) (103), and Bangladesh (37.1%) (104). These sex differences might be due to differences in the role of males and females in society and family; as males are more commonly involved in heavy physical activities and deal with more social pressure to keep providing the family income, most of the time males are working outdoors and may be exposed to injury, which is a risk factor for the development of DFU. A meta-analysis from China explained that men may not take as much care of their feet as women do, and they may see a doctor later if they have any foot issues, but women are typically more driven to take care of their health than men, which could explain the correlation between the incidence of amputation and male sex (3). In addition, males are known to have limited joint mobility, higher foot pressure, higher mean height, and peripheral insensate neuropathy (105). Being male is also identified as an important risk factor for amputation

in many studies (34, 47, 63, 98, 106). In the present study, although the number of amputations was higher among male DFU patients than females, sex was not identified as a risk factor for amputation in the multivariate binary logistic regression analysis. In accordance with this study, studies conducted in Indonesia (3), Turkey (107), Pakistan (62), and Israel (108) reported that being male was not a risk factor for LEA in DFU patients.

The mean age of DFU patients in this study was 59.13 ± 11.6 years. It is comparable to the other studies from Nigeria 56.29 ± 12.71 years (109), Saudi Arabia 60 ± 11.4 years (39), India 58.49 ± 11.04 years (110), and Turkey 62.4 ± 12.2 years (111). A maximum number of patients was found in the 46-64 age group ($n=80, 53\%$). This may be because DM type 2 is typically associated with older individuals; however, recent studies have indicated that it also impacts the adolescent population (110).

Cigarette smoking is reported to be a behavioral risk factor associated with amputation (27) and strongly associated with incident DFU, longer healing time, higher rates of non-healing DFU, and a subsequent 1.5- to 2.5-fold increased risk of amputation (14). Those who had smoked for more than 20 years and those who had stopped smoking during the last five years had a bad prognosis; 71% of them had LEA (112). In this study, smoking did not significantly affect amputation. Our result was in line with studies conducted in Israel (108), Nizamabad (7), and Taiwan (60). However, in contrast to results found in Iran (113) and the Philippines (61), where smoking had a significant association with amputation. This difference might be a variation in the number of smokers in the setting.

In our study, 93.4% of the study participants had type 2 DM, which is more common than type 1 DM. This is comparable with the studies conducted in Iraq (96%) (50), Turkey (96.1%) (63), Argentina (95%) (114), and Iran (96.4%) (20). However, the types of DM did not affect amputation in our study, which is similar to studies conducted in Pakistan (62), Brazil (115), and Portugal (102).

In our study, 46.4% of DFU patients were on oral antidiabetic medications, 43% were on both oral and insulin, and 10.6% were on insulin therapy alone. A comparable study in India revealed that 53.85%, 36.92%, and 9.23% were on oral antidiabetic medication, insulin alone, and a combination of oral and insulin, respectively (110). In the UK, the figures were 26.6% for patients on oral antidiabetic medication only, 29.4% for those using a combination of oral and insulin, and 43.6% for those on insulin therapy alone (21), whereas in Chennai, 36% of patients were on oral

antidiabetic medication only, 28% were taking both oral and insulin therapy, and 35% were on insulin therapy alone (29). However the category of treatments in this study did not affect amputation rates; in agreement with the data reported in Indonesia (103), and Irak (50). This difference might be because the majority of our study participants were type II DM.

According to this study, about 63.6% of patients were under the duration of DM 10 years and above. This result is consistent with the study conducted in Pakistan (64.3%) (62). In our study, the duration of DM was not found to be a significant factor for LEAs. Our finding was in line with many other studies that claimed the duration of diabetes is not a baseline factor that predicts amputation (29, 62, 71, 98, 103).

In this study, DFU patients who had a late presentation to the hospital were 3.8 times more likely to undergo amputation as compared to those who sought immediate care. This was consistent with studies conducted in Brazil, where, patients who had a foot problem for longer than 1-month duration had a 4.4-fold greater probability of suffering an amputation than those whose problem had been detected early (11), another study conducted in Nigeria revealed that ulcer longer than 1-month duration increased amputation risk in 10 folds (58). This may be because ulcers lasting for a longer duration increase the likelihood of wound infection and tissue necrosis. According to the patient responses, the factors that contributed to the delay in obtaining medical treatment included fear of losing a limb, spiritual beliefs, and the perception that the wound would heal on its own, along with the use of natural remedies like honey, which ultimately prolong the ulcers and worsen their condition.

Hemoglobin A1c can be effectively used as a laboratory parameter in DFU patients, and it can be used as a target to reduce amputation rates (19). In contrast to admission plasma glucose, fasting plasma glucose, or post-prandial blood glucose, the HbA1c level is directly related to the average glucose concentration over the life span of the hemoglobin (103). Therefore, elevated HbA1c levels are a significant risk factor for LEAs, reinforcing the approach of lowering glucose levels to decrease amputation rates among diabetic patients (107, 116). Similarly, poor glycemic control was significantly associated with LEAs in this study. Our finding showed that DFU patients who had $\text{HbA1c} \geq 7\%$ increased amputation risk by 3 folds as compared with those having $\text{HbA1c} < 7\%$. Correspondingly, a study conducted in Iran revealed that DFU patients having poor glycemic control had a 4.2-fold increased risk of LEA (27), in Indonesia, $\text{HbA1c} \geq 8\%$ increased the risk of LEA by 20.5-fold (103). Likewise, in Chennai, poor glycemic control increased the risk of

amputation by 1.4 folds (29). In contrast to our study, poor glycemic control was not associated with LEA in studies from Turkey (98, 117), China (3), Nigeria (51), and Pakistan (62). The possible explanation might be there was no significant difference in the baseline HbA1c between the amputees and nonamputees in the area.

Previous studies reported that the Wagner classification has a strong predictive factor for amputation (17, 27, 107). In this study, DFU patients who had advanced Wagner grade ulcers were found to be 3.5 times more likely to require amputation compared to those with mild to moderate grade ulcers. This was consistent with the finding from India, where DFU patients with advanced grade ulcers had a 3-fold higher risk of amputations (101), similarly, a study in Iran indicated a 6.4-fold increased risk (27), whereas a study in Nekemte, Ethiopia showed a 1.7-fold risk (34), additionally studies from China reported a 6.5-fold risk (118) of amputation as compared to mild to moderate grades of ulcers.

In our study, based on the clinical presentation, gram stain, and culture results, 62.3% of the DFUs were found to be infected. Our finding was consistent with the study conducted in Canada, where 59% of ulcers were infected at first presentation or during follow-up until healing (31). In Ethiopia, from the previous finding 66.96% of DFUs developed infection (34). Similarly, in Indonesia, clinical evidence of infection was observed in 98.8% of ulcers (103).

In our study area, the most commonly isolated bacteria from DFU consist of 38.7% with no bacterial growth, 35.5% being gram-positive, with the remainder being gram-negative and polymicrobial at 12.9%. These results are in line with the findings from Turkey, where 30.5% were gram-positive bacteria (78). Conversely, a study conducted in Addis Ababa revealed that 68% were gram-negative, while 32% were gram-positive bacteria (88). Similarly, in TASH, 88.55% of the bacteria identified were gram-negative, and 11.47% were gram-positive (25). Furthermore, in India, 71.43% of bacteria isolated from DFU were gram-negative (110).

In this study, the most commonly prescribed individual antibiotics to treat DFU were metronidazole (55%), ceftriaxone (49.5%), followed by ciprofloxacin (33%) and cloxacillin (26.6%). Study in Surakarta showed that the most commonly prescribed antibiotics were ceftriaxone (76.2%), ceftriaxone + metronidazole (47.6%) followed by ciprofloxacin (19%) (79), in Nekemte, it was cloxacillin (34.15%) followed by metronidazole (26.22%) and ceftriaxone (20.12%) (34). The antibiotics used in a variety of settings mostly depend on the etiologic agent

identified, patient condition, availability of the antibiotics, local susceptibility patterns, and preference of the physicians.

Overall, in our study from the pus culture; *Staphylococcus aureus*, polymicrobial, *Enterococcus* species, *Morganella morganii*, CONS, *Klebsiella pneumonia*, *Proteus vulgaris*, *Streptococcus* species, *Enterobacter cloacae*, and *Proteus mirabilis* were isolated. Among those bacteria, *Staphylococcus aureus* (26.9%) followed by Poly microbial (11.5%) and *Enterococcus* species (7.7%), were the most common organisms isolated from the pus culture of the DFU patients in our study. This result was consistent with other studies where *Staphylococcus aureus* is the most common bacteria isolated from the cultures of diabetic foot infection: 25.19% in Ethiopia (85), 47.5% in Indonesia (46), and 52.3% in Turkey (119). However, the types of bacteria had no significant association with LEA in our study.

Studies reported that peripheral neuropathy was associated with the incidence of amputation in DFU patients by causing repeated trauma that can be caused by conditions that are not realized (70). It was not a significant predictor of LEA in our multivariate logistic regression model. Chennai (29), India (101), Iraq (50), and Malaysia (120) also reported similar findings. However, other studies conducted in Indonesia and Nekemte Ethiopia, revealed that it was a significant predictor of LEAs (34, 70). A potential reason for neuropathy that was not shown to be significant in the multivariate model could be that it depends on infection and ischemia (120).

Our study further showed that DFU patients who had PAD were linked to a 3.2-fold higher risk of amputation. This is in line with the study conducted in Korea where PAD was associated with a 4.4-fold (100), in Indonesia 13-fold (103), in Taiwan 3.2-fold (60), and in Turkey 2.7-fold (98) increased risk of amputations. The association of PAD with LEA is attributed to compromised wound healing resulting from insufficient circulation (103).

7. Limitations of the study

- ✓ The study period was short thus, non-healing ulcers may result in amputations.
- ✓ Six months was used to recruit the study participants, but the event is rare in our setting. due to this sample size was small, and it is difficult to generalize the whole population.
- ✓ The data was extracted cross-sectionally from the medical chart and directly from the patient, so the study design limited the determination of causal relationships between the variables.

8. Conclusion and Recommendations

8.1. Conclusion

The rate of amputations in our study sites was found to be high. The study sites, late presentation to the hospital, poor glycemic control, advanced Wagner grades of ulcer, and the presence of PAD were found to be independent predictors of lower extremity amputations of DFU patients in this study. The most commonly prescribed individual antibiotics were metronidazole, ceftriaxone, ciprofloxacin, and cloxacillin, respectively. The most specific pathogens identified from the ulcer were *Staphylococcus aureus*, Polymicrobial infections, and *Enterococcus* species.

8.2. Recommendations

Based on the findings of our study, the following recommendations are forwarded to the respective bodies:

Policymaker (Federal Ministry of Health, NGOs)

- ✓ Preparing educational campaigns targeting patients and first-line health care providers highlighting the urgency to obtain prompt and proper care, and glycemic control for patients with DFUs is needed to reduce associated lower extremity amputation.
- ✓ Develop strategies to reduce the devastating consequences of lower extremity loss by implementing multidisciplinary diabetes care.
- ✓ Preparing local guidelines on the overall management of diabetic foot ulcers.

Clinicians

- ✓ All clinicians treating DFU patients should identify high-risk individuals, and special attention should be given to patients with PAD, advanced grades of ulcer, and poor glycemic control to save limbs.
- ✓ Creating awareness among the patients with DFU on the advantage of early access to the healthcare system and optimal foot care as delayed presentation risks amputation.
- ✓ In addition to the routine practice, laboratory services, especially culture and sensitivity tests, should be strengthened to identify the specific pathogens for definitive treatment.

To the patients

- ✓ Early access to the health care system if any lesion is observed on the foot

To the researchers

- ✓ Previous research had indicated that death is a key outcome in DFU patients, even though it was not recorded in our investigation. Therefore, we recommend that further studies be conducted to determine death rates and associated variables.

References

1. Organization WH. Classification of diabetes mellitus. 2019.
2. Kumbhar S, Bhatia M. Advancements and best practices in diabetic foot Care: A comprehensive review of global progress. *Diabetes Research and Clinical Practice*. 2024;111845.
3. Lin C, Liu J, Sun H. Risk factors for lower extremity amputation in patients with diabetic foot ulcers: A meta-analysis. *PloS one*. 2020;15(9):e0239236.
4. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes research and clinical practice*. 2022;183:109119.
5. Kibirige D, Chamba N, Andia-Biraro I, Kilonzo K, Laizer SN, Sekitoleko I, et al. Indicators of optimal diabetes care and burden of diabetes complications in Africa: a systematic review and meta-analysis. *BMJ open*. 2022;12(11):e060786.
6. Bishu KG, Jenkins C, Yebyo HG, Atsbha M, Wubayehu T, Gebregziabher M. Diabetes in Ethiopia: a systematic review of prevalence, risk factors, complications, and cost. *Obesity Medicine*. 2019;15:100132.
7. Sirasu M, Ramchandraiah C, Muralidhar C. Prospective Observational Study: Risk Factors and Outcomes of Diabetic Foot Ulcer among Diabetes Mellitus Patients Admitted to Government Medical College, Nizamabad. *Journal of Advances in Medicine and Medical Research*. 2022;34(16):1-10.
8. Mohammad Zadeh M, Lingsma H, van Neck JW, Vasilic D, van Dishoeck AM. Outcome predictors for wound healing in patients with a diabetic foot ulcer. *International wound journal*. 2019;16(6):1339-46.
9. Senneville É, Albalawi Z, van Asten SA, Abbas ZG, Allison G, Aragón-Sánchez J, et al. IWGDF/IDSA guidelines on the diagnosis and treatment of diabetes-related foot infections (IWGDF/IDSA 2023). *Diabetes/metabolism research and reviews*. 2024;40(3):e3687.
10. Monteiro-Soares M, Boyko E, Ribeiro J, Ribeiro I, Dinis-Ribeiro M. Predictive factors for diabetic foot ulceration: a systematic review. *Diabetes/metabolism research and reviews*. 2012;28(7):574-600.
11. Santos ICRV, Carvalho EFd, Souza WVd, Albuquerque ECd. Factors associated with diabetic foot amputations. *Jornal Vascular Brasileiro*. 2015;14:37-45.

12. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis. *Annals of medicine*. 2017;49(2):106-16.
13. 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;20:1-14.
14. McDermott K, Fang M, Boulton AJ, Selvin E, Hicks CW. Etiology, epidemiology, and disparities in the burden of diabetic foot ulcers. *Diabetes Care*. 2023;46(1):209-21.
15. Foot IWGotD. IWGDF guidelines on the prevention and management of diabetic foot disease. Maastricht, The Netherlands: International Working Group on the Diabetic Foot. 2019.
16. Miranda C, Da Ros R, Marfella R. Update on prevention of diabetic foot ulcer. *Archives of Medical Science-Atherosclerotic Diseases*. 2021;6(1):123-31.
17. Vella L, Formosa C. Characteristics predicting the outcome in individuals with diabetic foot ulcerations. *Journal of the American Podiatric Medical Association*. 2017;107(3):180-91.
18. Barshes NR, Sigireddi M, Wrobel JS, Mahankali A, Robbins JM, Kougias P, et al. The system of care for the diabetic foot: objectives, outcomes, and opportunities. *Diabetic foot & ankle*. 2013;4(1):21847.
19. Ammar AS, Khalid R, Malik U, Zeb M, Abbas HM, Khattak SB. Predictors of lower limb amputations in patients with diabetic foot ulcers presenting to a tertiary care hospital of Pakistan. *J Pak Med Assoc*. 2021;71(9):2163-6.
20. Niakan MH, Dehghankhalili M, Pourdavood A, Vahidi A, Nazemi S, Piranviseh A, et al. Clinical outcome and determinants of amputation in a large cohort of Iranian patients with diabetic foot ulcers. *The Foot*. 2020;45:101688.
21. Ndosu M, Wright-Hughes A, Brown S, Backhouse M, Lipsky BA, Bhogal M, et al. Prognosis of the infected diabetic foot ulcer: a 12-month prospective observational study. *Diabetic Medicine*. 2018;35(1):78-88.
22. Armstrong DG, Tan T-W, Boulton AJ, Bus SA. Diabetic foot ulcers: a review. *Jama*. 2023;330(1):62-75.

23. Pickwell KM, Siersma VD, Kars M, Holstein PE, Schaper NC, Consortium E. Diabetic foot disease: impact of ulcer location on ulcer healing. *Diabetes/Metabolism Research and Reviews*. 2013;29(5):377-83.
24. Khan Y, Khan MM, Farooqui MR. Diabetic foot ulcers: a review of current management. *International Journal of Research in Medical Sciences*. 2017;5(11):4683-9.
25. Amogne W, Reja A, Amare A. Diabetic foot disease in Ethiopian patients: a hospital based study. *Ethiopian Journal of Health Development*. 2011;25(1):17-21.
26. Rigato M, Pizzol D, Tiago A, Putoto G, Avogaro A, Fadini GP. Characteristics, prevalence, and outcomes of diabetic foot ulcers in Africa. A systemic review and meta-analysis. *Diabetes research and clinical practice*. 2018;142:63-73.
27. Yekta Z, Pourali R, Nezhadrahim R, Ravanyar L, Ghasemi-Rad M. Clinical and behavioral factors associated with management outcome in hospitalized patients with diabetic foot ulcer. *Diabetes, metabolic syndrome and obesity: targets and therapy*. 2011:371-5.
28. Sikhondze MM, Twesigye D, Odongo CN, Mutiibwa D, Tayebwa E, Tibaijuka L, et al. Diabetic foot ulcers: Surgical characteristics, treatment modalities and short-term treatment outcomes at a tertiary hospital in South-Western Uganda. *Open Access Surgery*. 2022:75-87.
29. Sanjeeviraj S, Subburaj A, Aluri S, Sekar BRT, Jalan M, Joseph AG. A Cohort Study on the Outcome of Diabetic Foot Ulcers. *Cureus*. 2023;15(10).
30. Rayman G, Vas P, Dhatariya K, Driver V, Hartemann A, Londahl M, et al. Guidelines on use of interventions to enhance healing of chronic foot ulcers in diabetes (IWGDF 2019 update). *Diabetes/metabolism research and reviews*. 2020;36:e3283.
31. Fournier C, Singbo N, Morissette N, Thibeault M-M. Outcomes of diabetic foot ulcers in a tertiary referral interdisciplinary clinic: a retrospective Canadian study. *Canadian Journal of Diabetes*. 2021;45(3):255-60.
32. Zubair M, Malik A, Ahmad J. Diabetic foot ulcer: a review. *American Journal of Internal Medicine*. 2015;3(2):28-49.
33. Riaz M, Miyan Z, Zaidi SI, Alvi SF, Fawwad A, Ahmadani MY, et al. Characteristics of a large cohort of patients with diabetes having at-risk feet and outcomes in patients with foot ulceration referred to a tertiary care diabetes unit. *International wound journal*. 2016;13(5):594-9.

34. Bekele F, Chelkeba L, Fekadu G, Bekele K. Risk factors and outcomes of diabetic foot ulcer among diabetes mellitus patients admitted to Nekemte referral hospital, western Ethiopia: Prospective observational study. *Annals of Medicine and Surgery*. 2020;51:17-23.
35. Bekele F, Chelkeba L. Amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients admitted to Nekemte referral hospital, western Ethiopia: prospective observational study. *Journal of foot and ankle research*. 2020;13:1-8.
36. Jiang Y, Ran X, Jia L, Yang C, Wang P, Ma J, et al. Epidemiology of type 2 diabetic foot problems and predictive factors for amputation in China. *The international journal of lower extremity wounds*. 2015;14(1):19-27.
37. Yammine K, Akiki S, Assi C, Hayek M, Fady. Amputation as a First Treatment is Highly Associated With Late Presentation: An Underestimated Modifiable Major Risk Factor for Diabetic Foot Ulcer. *Foot & Ankle Specialist*. 2021:19386400211067625.
38. Abbas ZG, Boulton AJ. Diabetic foot ulcer disease in African continent: ‘From clinical care to implementation’—Review of diabetic foot in last 60 years—1960 to 2020. *Diabetes research and clinical practice*. 2022;183:109155.
39. Musa IR, Ahmed MO, Sabir EI, Alsheneber IF, Ibrahim EM, Mohamed GB, et al. Factors associated with amputation among patients with diabetic foot ulcers in a Saudi population. *BMC research notes*. 2018;11:1-5.
40. Thewjitcharoen Y, Krittiyawong S, Porramatikul S, Parksook W, Chatapat L, Watchareejirachot O, et al. Outcomes of hospitalized diabetic foot patients in a multi-disciplinary team setting: Thailand's experience. *Journal of clinical & translational endocrinology*. 2014;1(4):187-91.
41. Singh S, Pai DR, Yuhhui C. Diabetic foot ulcer—diagnosis and management. *Clin Res Foot Ankle*. 2013;1(3):120.
42. Jeffcoate WJ, Vileikyte L, Boyko EJ, Armstrong DG, Boulton AJ. Current challenges and opportunities in the prevention and management of diabetic foot ulcers. *Diabetes care*. 2018;41(4):645-52.
43. Lane KL, Abusamaan MS, Voss BF, Thurber EG, Al-Hajri N, Gopakumar S, et al. Glycemic control and diabetic foot ulcer outcomes: A systematic review and meta-analysis of observational studies. *Journal of Diabetes and its Complications*. 2020;34(10):107638.

44. Pal B, Raveender N, Sudipta P. A study on the impact of smoking and alcoholism as determinant factors in the prognosis and outcome of diabetic foot ulcer disease. *Int J Res Med Sci.* 2016;4(5):1720-4.
45. Rehman R, Malik FR, Rehman Z. A comparative study on diabetic foot ulcers leading to amputations. *Journal of Postgraduate Medical Institute.* 2018;32(1).
46. Radji M, Putri CS, Fauziyah S. Antibiotic therapy for diabetic foot infections in a tertiary care hospital in Jakarta, Indonesia. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews.* 2014;8(4):221-4.
47. Bal BS, Khanna G, Bhardwaj A, Singh K. Evaluation of risk factors for lower extremity amputation in diabetic foot ulcer: a hospital based observational study in Northern India. *Int J Res Med Sci.* 2019;7(4):1190-5.
48. Sun J-H, Tsai J-S, Huang C-H, Lin C-H, Yang H-M, Chan Y-S, et al. Risk factors for lower extremity amputation in diabetic foot disease categorized by Wagner classification. *Diabetes research and clinical practice.* 2012;95(3):358-63.
49. Arunkumar T. Assessment Of Predisposing Factors, Clinical Profile and Outcomes Of Diabetic Foot Ulcer.
50. Marzoq A, Shiaa N, Zaboon R, Baghlany Q, Alabbod MH. Assessment of the outcome of diabetic foot ulcers in Basrah, Southern Iraq: A cohort study. *International Journal of Diabetes and Metabolism.* 2019;25(1-2):33-8.
51. Ezeani IU, Ugwu ET, Adeleye FO, Gezawa ID, Okpe IO, Enamino MI. Determinants of wound healing in patients hospitalized for diabetic foot ulcer: results from the MEDFUN study. *Endocrine Regulations.* 2020;54(3):207-16.
52. Abdissa D, Adugna T, Gerema U, Dereje D. Prevalence of diabetic foot ulcer and associated factors among adult diabetic patients on follow-up clinic at Jimma medical Center, Southwest Ethiopia, 2019: An institutional-based cross-sectional study. *Journal of diabetes research.* 2020;2020(1):4106383.
53. Srinivas Veerraju G, BB RVSD, Singh G. A study of the risk factors predicting amputation in diabetic foot. *Age (years).*56:55.2.
54. Pena G. Predicting Outcomes in Patients with Diabetic Foot Ulcers 2021.
55. Liu X, Ren Q, Zhai Y, Kong Y, Chen D, Chang B. Risk factors for multidrug-resistant organisms infection in diabetic foot ulcer. *Infection and Drug Resistance.* 2022:1627-35.

56. Matta-Gutierrez G, Garcia-Morales E, Garcia-Alvarez Y, Álvaro-Afonso FJ, Molines-Barroso RJ, Lazaro-Martinez JL. The influence of multidrug-resistant bacteria on clinical outcomes of diabetic foot ulcers: a systematic review. *Journal of Clinical Medicine*. 2021;10(9):1948.
57. Luo Y, Liu C, Li C, Jin M, Pi L, Jin Z. The incidence of lower extremity amputation and its associated risk factors in patients with diabetic foot ulcers: A meta-analysis. *International Wound Journal*. 2024;21(7):e14931.
58. Ugwu E, Adeleye O, Gezawa I, Okpe I, Enamino M, Ezeani I. Predictors of lower extremity amputation in patients with diabetic foot ulcer: findings from MEDFUN, a multi-center observational study. *Journal of foot and ankle research*. 2019;12:1-8.
59. Formosa C, Vella ML, Gatt A. Characteristics predicting foot ulceration outcomes in the diabetic foot. *Diabetic Complications* [Internet]. 2016.
60. Perng C-K, Chou H-Y, Chiu Y-J. Identifying major predictors of lower-extremity amputation in patients with diabetic foot ulcers. *Journal of the Chinese Medical Association*. 2021;84(3):285-9.
61. Felipe RR, Plata-Que MT. Predictors of outcomes of foot ulcers among individuals with type 2 diabetes mellitus in an outpatient foot clinic. *Journal of the ASEAN Federation of Endocrine Societies*. 2021;36(2):189.
62. Saleem S, Hayat N, AHMAD I, AHMAD T, REHAN A. Risk factors associated with poor outcome in diabetic foot ulcer patients. *Turkish journal of medical sciences*. 2017;47(3):826-31.
63. Demirkol D, Aktaş Ş, Özcan T, Tannier X, Erol ÇS. Analysis of risk factors for amputation in patients with diabetic foot ulcers: a cohort study from a tertiary center. *Acta Orthopaedica et Traumatologica Turcica*. 2022;56(5):333.
64. Chellan G, Srikumar S, Varma AK, Mangalanandan T, Sundaram K, Jayakumar R, et al. Foot care practice—The key to prevent diabetic foot ulcers in India. *The Foot*. 2012;22(4):298-302.
65. Prompers L, Schaper N, Apelqvist J, Edmonds M, Jude E, Mauricio D, et al. Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease. The EURODIALE Study. *Diabetologia*. 2008;51:747-55.

66. Noor S, Khan RU, Ahmad J. Understanding diabetic foot infection and its management. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. 2017;11(2):149-56.
67. Pscherer S, Dippel F-W, Lauterbach S, Kostev K. Amputation rate and risk factors in type 2 patients with diabetic foot syndrome under real-life conditions in Germany. *Primary care diabetes*. 2012;6(3):241-6.
68. Margolis DJ, Allen-Taylor L, Hoffstad O, Berlin JA. Diabetic neuropathic foot ulcers: the association of wound size, wound duration, and wound grade on healing. *Diabetes care*. 2002;25(10):1835-9.
69. Yesil S, Akinci B, Yener S, Bayraktar F, Karabay O, Havitcioglu H, et al. Predictors of amputation in diabetics with foot ulcer: single center experience in a large Turkish cohort. *Hormones*. 2009;8:286-95.
70. Rizki E, Rustam R, Rivaldy V. Risk Factors Related Amputation on Diabetic Foot Patients in Dr. M. Djamil General Hospital Padang. *Bioscientia Medicina: Journal of Biomedicine and Translational Research*. 2022;6(5):1732-7.
71. Li X, Xiao T, Wang Y, Gu H, Liu Z, Jiang Y, et al. Incidence, risk factors for amputation among patients with diabetic foot ulcer in a Chinese tertiary hospital. *Diabetes research and clinical practice*. 2011;93(1):26-30.
72. Lee YJ, Han K-D, Kim JH. Association among current smoking, alcohol consumption, regular exercise, and lower extremity amputation in patients with diabetic foot: nationwide population-based study. *Endocrinology and Metabolism*. 2022;37(5):770-80.
73. Tran MM, Haley MN. Does exercise improve healing of diabetic foot ulcers? A systematic review. *Journal of foot and ankle research*. 2021;14:1-9.
74. Matos M, Mendes R, Silva AB, Sousa N. Physical activity and exercise on diabetic foot related outcomes: a systematic review. *Diabetes Research and Clinical Practice*. 2018;139:81-90.
75. Nulukurthi TK, Kumar SR, Kutikuppala LVS. A clinical study of risk factors associated with amputation in diabetic foot disease patients attending a tertiary care hospital in a rural setting. *Journal of Current Research in Scientific Medicine*. 2020;6(1):34-8.
76. 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. *International wound journal*. 2019;16(3):768-72.

77. Hsu C-Y, Chen Y-T, Su Y-W, Chang C-C, Huang P-H, Lin S-J. Statin therapy reduces future risk of lower-limb amputation in patients with diabetes and peripheral artery disease. *The Journal of Clinical Endocrinology & Metabolism*. 2017;102(7):2373-81.
78. Saltoglu N, Surme S, Ezirmik E, Kadanali A, Kurt AF, Sahin Ozdemir M, et al. The effects of antimicrobial resistance and the compatibility of initial antibiotic treatment on clinical outcomes in patients with diabetic foot infection. *The International Journal of Lower Extremity Wounds*. 2023;22(2):283-90.
79. Hajma LPA, Karuniawati H, Mutmainah N. Antibiotic Evaluation Use towards Diabetic Foot Ulcer Inpatient at Hospital in Surakarta. *Pharmacon: Jurnal Farmasi Indonesia*. 19(2):187-96.
80. Aviatin M, Sauriasari R, Yunir E, Risni HW. Evaluation of the use of antimicrobial therapy for treating diabetic foot infections in an Indonesia referral hospital: a retrospective cohort study. *Infection & Chemotherapy*. 2023;55(1):80.
81. Lipsky BA, Tabak Y, Johannes R, Vo L, Hyde L, Weigelt J. Skin and soft tissue infections in hospitalised patients with diabetes: culture isolates and risk factors associated with mortality, length of stay and cost. *Diabetologia*. 2010;53:914-23.
82. Lipsky BA. Diabetic foot infections: Current treatment and delaying the ‘post-antibiotic era’. *Diabetes/metabolism research and reviews*. 2016;32:246-53.
83. Nather A, Bee CS, Huak CY, Chew JL, Lin CB, Neo S, et al. Epidemiology of diabetic foot problems and predictive factors for limb loss. *Journal of Diabetes and its Complications*. 2008;22(2):77-82.
84. Shi M-L, Quan X-R, Tan L-M, Zhang H-L, Yang A-Q. Identification and antibiotic susceptibility of microorganisms isolated from diabetic foot ulcers: A pathological aspect. *Experimental and Therapeutic Medicine*. 2022;25(1):53.
85. Wada FW, Mekonnen MF, Sawiso ED, Kolato S, Woldegiorgis L, Kera GK, et al. Bacterial profile and antimicrobial resistance patterns of infected diabetic foot ulcers in sub-Saharan Africa: a systematic review and meta-analysis. *Scientific Reports*. 2023;13(1):14655.
86. Sánchez-Sánchez M, Cruz-Pulido WL, Bladinieres-Camara E, Alcala-Duran R, Rivera-Sanchez G, Bocanegra-Garcia V. Bacterial prevalence and antibiotic resistance in clinical isolates of diabetic foot ulcers in the Northeast of Tamaulipas, Mexico. *The international journal of lower extremity wounds*. 2017;16(2):129-34.

87. Xie X, Bao Y, Ni L, Liu D, Niu S, Lin H, et al. Bacterial profile and antibiotic resistance in patients with diabetic foot ulcer in Guangzhou, Southern China: focus on the differences among different Wagner's grades, IDSA/IWGDF grades, and ulcer types. *International journal of endocrinology*. 2017;2017(1):8694903.
88. Atlaw A, Kebede HB, Abdela AA, Woldeamanuel Y. Bacterial isolates from diabetic foot ulcers and their antimicrobial resistance profile from selected hospitals in Addis Ababa, Ethiopia. *Frontiers in Endocrinology*. 2022;13:987487.
89. Tufa MK, Andargie AT. Self-Care Practices and Associated Factors in Diabetes Patients at Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2021. *Mathews Journal of Case Reports*. 2023;8(11):1-12.
90. Gazzaruso C, Gallotti P, Pujia A, Montalcini T, Giustina A, Coppola A. Predictors of healing, ulcer recurrence and persistence, amputation and mortality in type 2 diabetic patients with diabetic foot: a 10-year retrospective cohort study. *Endocrine*. 2021;71:59-68.
91. Van Netten JJ, Bus SA, Apelqvist J, Lipsky BA, Hinchliffe RJ, Game F, et al. Definitions and criteria for diabetic foot disease. *Diabetes/metabolism research and reviews*. 2020;36:e3268.
92. Martins-Mendes D, Monteiro-Soares M, Boyko EJ, Ribeiro M, Barata P, Lima J, et al. The independent contribution of diabetic foot ulcer on lower extremity amputation and mortality risk. *Journal of Diabetes and its Complications*. 2014;28(5):632-8.
93. Wagner Jr FW. The dysvascular foot: a system for diagnosis and treatment. *Foot & ankle*. 1981;2(2):64-122.
94. Care D. Standards of care in diabetes—2023. *Diabetes care*. 2023;46:S1-S267.
95. Ogbera AO, Fasanmade OA, Chinenye S, Akinlade A. Characterization of lipid parameters in diabetes mellitus—a Nigerian report. *International archives of medicine*. 2009;2:1-7.
96. Adeleye OO, Williams AO, Dada AO, Ugwu ET, Ogbera AO, Sodipo OO. Sequelae of hospitalization for diabetic foot ulcers at LASUTH Ikeja Lagos: A prospective observational study. *Frontiers in Clinical Diabetes and Healthcare*. 2022;3:889264.
97. Organization WH. Global database on body Mass Index: BMI classification. 2006. World Health Organization: Geneva, Switzerland. 2015.

98. Alay H, Yılmaz S, Can FK, Parlak M. An evaluation of risk factors affecting amputation in patients with diabetic foot Infection. *Journal of Health Sciences and Medicine*. 2021;4(1):49-54.
99. Pickwell K, Siersma V, Kars M, Apelqvist J, Bakker K, Edmonds M, et al. Predictors of lower-extremity amputation in patients with an infected diabetic foot ulcer. *Diabetes care*. 2015;38(5):852-7.
100. Jeong E-G, Cho SS, Lee S-H, Lee K-M, Woo S-K, Kang Y, et al. Depth and combined infection is important predictor of lower extremity amputations in hospitalized diabetic foot ulcer patients. *The Korean journal of internal medicine*. 2018;33(5):952.
101. 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 research and clinical practice*. 2020;162:108113.
102. Ferreira L, Carvalho A, Carvalho R. Short-term predictors of amputation in patients with diabetic foot ulcers. *Diabetes & Metabolic Syndrome: clinical Research & Reviews*. 2018;12(6):875-9.
103. Pemayun TGD, Naibaho RM, Novitasari D, Amin N, Minuljo TT. Risk factors for lower extremity amputation in patients with diabetic foot ulcers: a hospital-based case–control study. *Diabetic foot & ankle*. 2015;6(1):29629.
104. Banik PC, Barua L, Moniruzzaman M, Mondal R, Zaman F, Ali L. Risk of diabetic foot ulcer and its associated factors among Bangladeshi subjects: a multicentric cross-sectional study. *BMJ open*. 2020;10(2):e034058.
105. Moon K-C, Kim S-B, Han S-K, Jeong S-H, Dhong E-S. Risk factors for major amputation in hospitalized diabetic patients with forefoot ulcers. *Diabetes Research and Clinical Practice*. 2019;158:107905.
106. Guest JF, Fuller GW, Vowden P. Diabetic foot ulcer management in clinical practice in the UK: costs and outcomes. *International wound journal*. 2018;15(1):43-52.
107. İçer M, Durgun HM. Factors affecting amputations in patients with diabetic foot ulcer referring to the emergency units. *Dicle Tıp Dergisi*. 2017;44(1):91-8.

108. Leibovitch M, Cahn A, Gellman YN, Haze A, Peled S, Amit S, et al. Predictors and outcomes of diabetic foot ulcer infection with ESBL-producing bacteria in a large tertiary center. *International Journal of Infectious Diseases*. 2021;113:318-24.
109. Edo AE, Edo GO, Ezeani IU. Risk factors, ulcer grade and management outcome of diabetic foot ulcers in a Tropical Tertiary Care Hospital. *Nigerian Medical Journal*. 2013;54(1).
110. Seth A, Attri AK, Kataria H, Kochhar S, Seth SA, Gautam N. Clinical profile and outcome in patients of diabetic foot infection. *International Journal of Applied and Basic Medical Research*. 2019;9(1):14-9.
111. Uysal S, Arda B, Taşbakan MI, Çetinkalp Ş, Şimşir IY, Öztürk AM, et al. Risk factors for amputation in patients with diabetic foot infection: a prospective study. *International wound journal*. 2017;14(6):1219-24.
112. Manikanta K, Monisha G. Comparative study of diabetic foot outcome between normal vs high BMI individuals-Is obesity paradox a fallacy in ulcer healing. *Clin Surg*. 2019;4:1-6.
113. Kogani M, Mansournia MA, Doosti-Irani A, Holakouie-Naieni K. Risk factors for amputation in patients with diabetic foot ulcer in southwest Iran: a matched case-control study. *Epidemiology and Health*. 2015;37.
114. Carro GV, Saurral RN, Witman EL, Alterini P, Braver JD, Carrió LM, et al. Clinical features and outcomes of diabetic foot in Argentina: a longitudinal multicenter study. *MEDICINA (Buenos Aires)*. 2023;83:428-41.
115. Moura Neto A, Zantut-Wittmann DE, Fernandes TD, Nery M, Parisi MCR. Risk factors for ulceration and amputation in diabetic foot: study in a cohort of 496 patients. *Endocrine*. 2013;44:119-24.
116. Bikramjit P, Raveender N, Sudipta P. The importance of HbA1C and erythrocyte sedimentation rate as prognostic factors in predicting the outcome of diabetic foot ulcer disease. *International Journal of Advances in Medicine*. 2017;4(1):137-42.
117. Tabur S, Eren MA, Celik Y, Dağ OF, Sabuncu T, Sayiner ZA, et al. The major predictors of amputation and length of stay in diabetic patients with acute foot ulceration. *Wien Klin Wochenschr*. 2015;127(1-2):45-50.

118. Gong H, Ren Y, Li Z, Zha P, Bista R, Li Y, et al. Clinical characteristics and risk factors of lower extremity amputation in the diabetic inpatients with foot ulcers. *Frontiers in Endocrinology*. 2023;14:1144806.
119. Ozan F, Gürbüz K, Celik I, Dursun ZB, Uzun E. Evaluation of major and minor lower extremity amputation in diabetic foot patients. *Turkish journal of medical sciences*. 2017;47(4):1109-16.
120. Yusof NM, Ab Rahman J, Zulkifly AH, Che-Ahmad A, Khalid KA, Sulong AF, et al. Predictors of major lower limb amputation among type II diabetic patients admitted for diabetic foot problems. *Singapore medical journal*. 2015;56(11):626.

Annex I: Data collection tool for diabetic foot ulcers

The consent form and participant information sheet

Title of the study: Amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients attending Tikur Anbessa Specialized Hospital, St Paulo's Hospital Millennium Medical College, and Menelik II Referral Hospital, Addis Ababa, Ethiopia.

Principal investigator: Jenber Workye (B.pharm) Phone number: 0937629149

Adviser: Assefa Mulu (MSc, assistant professor of clinical pharmacy)

The objective of the study: To assess the amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients attending Tikur Anbessa Specialized Hospital, St Paulo's Hospital Millennium Medical College, and Menelik II Referral Hospital Addis Ababa, Ethiopia.

Subject Participation and Procedure: The method of the research is an institutional-based cross-sectional study. The expected duration of the participants' contact with the interviewer at a time is not more than 15 minutes. Ask participants in this research because the trustful information provided an understanding of the purpose.

Confidentiality: To establish a secured safeguard of confidentiality of research data, the patient information was coded during the data collection period rather than using a name. The information is not disclosed in the way it identifies your characteristics & privacy.

Benefit: The research does not have a short-term financial, health care, & capacity building benefit to the research participant as an individual or group but in the long run, it will help the concerned organization & policy maker to have a policy consideration, direction, formation of strategy & design to improve DFU patient outcomes.

Incentive, & compensation: This study has no form of incentive or compensation for the

Risk and discomfort: The study has no health-related, psychological, economic, or social risks for the study participants.

The right to not participate in the study. You should not be forbidden from accessing any service by not participating in this study or not to respond any questions.

Person to contact: The participant has the right to ask for information that is not clear about the context before and during the time of data collection; anyone can contact the principal investigator. If you have/will have any questions or problems, you can contact the principal investigator by;

Phone number: 0937629149

E.mail:jenberworkye@gmail.com

I voluntarily agree to participate in this research program Yes ☐ No ☐

I understand that I will be given a copy of this signed Consent Form.

Name of Participant _____ Signature: _____ Date: _____

Person Obtaining Consent: _____ Signature: _____ Date: _____

Thank you for your willingness to participate in this study!

Code _____

This questionnaire is designed to assess the amputation rate of diabetic foot ulcer and associated factors in diabetes mellitus patients in three selected hospitals.

Instruction: For the following questions. **Encircle** the response from the participants and the medical records (clinical and biologic-related data) for **close-ended questions** and write the response in the space provided for **open-ended questions**.

Part I: Socio-demographic characteristics of the study participants

S.N	Background information	Response
01	Card/I-Care number	_____
02	Sex	1. Male 2. Female
03	Age	_____ (years)
04	Weight	_____ (Kg)
05	Height	_____ (cm) _____ BMI (kg/m ²)
06	Place of residence	1. Rural 2. Urban
07	Marital status	1. Single 2. Married 3. Divorced 4. Widowed
08	Occupation	1. Farmer 3. Merchant 2. Government employee 4. Private 5. Student 6. Housewife 7. Daily labor 8. Retired 9. Others (specify) _____
09	Level of education	1. Unable to read and write 2. Only read and write 3. Primary (1-8th grade) 4. Secondary (9-12th grade) 5. Diploma and Above
10	Average monthly income	_____ ETB birr

Part II: Behavior-related factors of the study study participants

S.N	Questions	Response
11	Do you drink alcohol regularly?	1. Previously A. Yes B. No 2. Currently A. Yes B. No
12	Do you smoke Cigarettes?	1. Previously A. Yes B. No 2. Currently A. Yes B. No
13	Do you do physical activity regularly?	1. Yes 2. No
14	If your response to question 13 is yes how many times?	_____ (weekly)
15	If your response to question 13 is yes What kind of exercise?	1. Running 2. Walking 3. Jogging 4. Others (specify)_____
16	Do you ever walk around in your bare feet?	1. yes 2. No
17	Do you ever wear shoes without wearing any socks?	1. Yes 2. No
18	Do you inspect your feet daily?	1. Yes 2. No
19	Do you wash your feet daily?	1. Yes 2. No
20	Do you use moisturizer after feet washing?	1. Yes 2. No
21	Do you use moisturizing cream between your toes?	1. Yes 2. No
22	Footwear	1. Well fit 2. Ill fit
23	Do you always inspect your shoes for foreign objects or torn linings?	1. Yes 2. No
24	Do you visit your physician regularly for evaluation and treatment of your diabetes?	1. Yes 2. No

Part III: Clinical-related characteristics of the study participants

S.N	Questions	Response
25	Types of diabetes mellitus?	1.Type1 2.Type 2
26	Duration of diabetes mellitus?	_____years
27	DM treatment regimen?	1. Insulin 2. Oral antidiabetic agents 3. Both oral and insulin
28	Did current medication control the blood glucose level?	1 . Good control 2. Poor control
29	Did you take Antiplatelet agents?	1. Yes 2. No
30	If the response to question 29 is Yes which Antiplatelet agent you are taking?	_____
31	Did you take statins?	1. yes 2. No
32	Previous history of ulcer?	1. Yes 2. No
33	If the response to question 32 is yes what happens as a result?	1. Healed 2. Amputated
34	Size of the ulcer (determined by multiplying the largest by the second largest diameter perpendicular to the first)	_____cm ²
35	Location of the ulcer	1. Dorsal/interdigital toes 2. Plantar forefoot/midfoot 3. Plantar hind foot 4. Plantar toes 5. Dorsal foot 6. Heel

36	ulcer infected?	1. Yes 2.No
37	Does culture/gram stain do?	1. Yes 2. No
38	Which organisms are isolated from foot ulcers?	1_____
		2_____
		3_____
39	Antibiotics given to treat diabetic foot ulcers (types, dose, frequency, duration)	1_____
		2_____
		3_____
40	Present grade of ulcer (based on Wagner classification)	1. Grade 0
		2. Grade 1
		3. Grade 2
		4. Grade 3
		5. Grade 4
		6. Grade 5
41	Current status of the ulcer	1. Not amputated
		2. Amputated
42	If amputated, specify the location	1. Below the ankle
		2. Above the ankle
43	If it is a major amputation specify the location	1. Below-knee
		2.Above- knee

Part IV: Comorbidities and DM Complications

S.N	Questions	Response
44	Presence of comorbidities	1. Yes 2. No
45	If the response Yes in question 44 which comorbidities present? (can encircle more than once)	1. Hypertension
		2.Ischemic Heart Disease
		3. Dyslipidemia
46	Presence of diabetic complications	1. Yes 2. No

47	If the response Yes in question 46 which complications present? (can encircle more than once)	1. Retinopathy 2. Nephropathy 3. Neuropathy 4. Peripheral artery disease 5. Coronary Heart disease 6. Transient ischemic attack/stroke
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Part IV: Biologic factors of the respondents (from laboratory results)

S.N	Investigations	Value at presentation
48	Total cholesterol	_____mg/dl
49	Triglycerides	_____mg/dl
50	HDL-C	_____mg/dl
51	LDL-C	_____mg/dl
52	Fasting blood sugar (FBS)	_____ mg/dl
53	Glycosylated hemoglobin (HbA1c)	In the past three months _____%
54	Blood pressure	_____mmHg
55	Renal function test	Scr_____mg/dl

Annex-II Amharic data collection tool for diabetic foot ulcers

የምርምር ወይም ጥናት ማብራሪያ እና የስምምነት መግለጫ ቅጽ

የጥናቱ ርዕስ:- ከስኳር በሽታ ጋር የተያያዘ የእግር ቁስለት ያለባቸው ታካሚዎች ላይ የሚከሰት የእግር መቆረጥ መጠን እና ተያያዥ ምክንያቶች ላይ በጥቁር አንበሳ ስፔሻላይዝድ ሆስፒታል፣ በቅዱስ ጳውሎስ ሚሊኒየም ሜድካል ኮሌጅ፣ እና በዳግማዊ ሚኒሊክ ሪፈራል ሆስፒታል ታካሚዎች ላይ የሚደረግ ጥናት።

ዋና መርማሪ ጆንበር ወርቅዬ (B.pharm) ስልክ ቁጥር: 09 37 62 91 49

ዋና አማካሪ: አሰፋ ሙሉ (የክሊኒካል ፋርማሲ ረዳት ፐሮፌሰር)

የጥናቱ ዓላማ: በአዲስ አበባ፣ ኢትዮጵያ በሚገኘው በጥቁር አንበሳ ስፔሻላይዝድ ሆስፒታል፣ በቅዱስ ጳውሎስ ሚሊኒየም ሜድካል ኮሌጅ፣ እና በዳግማዊ ሚኒሊክ ሪፈራል ሆስፒታል ከስኳር በሽታ ጋር የተያያዘ የእግር ቁስለት ያለባቸው ታካሚዎች ላይ የሚከሰት የእግር መቆረጥ መጠን እና ተያያዥ ምክንያቶች ለመገምገም።

የርእሰ ጉዳይ ተሳትፎ እና አሰራር: የጥናቱ ዘዴ ተቋማዊ መሰረት ጥናት ነው። ተሳታፊዎች ከጠያቂው ጋር በመገናኘት በአንድ ጊዜ የሚጠበቀው ከ 15 ደቂቃ ያልበለጠ ይሆናል። የዚህ ጥናት ዓላማ የተፈለገው ግብ እንዲመታና በጥናቱ መሠረት የሚለዩ የተለያዩ ችግሮችን በመንግሥትና በሌሎች ድጋፍ ሰጪ ድርጅቶች አካላት ትብብር አማካኝነት በጥናቱ የተደረሰባቸውን ችግሮች ለመፍታት እርስዎ እንዲሳተፉ ተጋብዘዋል። በዚህ ጥናት ውስጥ ለመሳተፍ ከተስማሙ ስምምነቱን በደንብ መረዳትና እንዲሁም መፈረም ይገባዎታል። ከዚያ በመቀጠል በጥናቱ መረጃ ሰብሳቢዎች ለሚጠየቁት ጥያቄ መልስ እንዲሰጡ ፈቃደኝነትዎ ይጠየቃል። በዚህ ጥናት ሲሳተፉ የሚሠጡት መልስም ሆነ የሚገኘው ውጤት በምስጢር ይጠበቃል።

የጥናቱ ተሳታፊዎች መረጃ ሚስጥራዊነት: ከዚህ ጥናት የሚገኝ መረጃ በሙሉ በምስጢራዊነት ይጠበቃል። ለዚህ ጥናት የሚሠበሰበው እርሰዎን የሚመለከት የትኛውም መረጃ በማህደር የሚቀመጥ ሲሆን ማህደሩም በስመዎ ሳይሆን በተለየ ኮድ ስለሆነ ኮዱ ከዋናው ተመራማሪ ውጭ ለማንም አይገለጽም።

የጥናቱ ተሳታፊዎች ጥቅማ ጥቅሞች: በዚህ ጥናት በመሳተፍዎ የተለየ ጥቅም አያገኙም። ነገር ግን የርስዎ በጥናቱ መሳተፍ ለጥናቱ መሳካት በጥናቱ ማስረጃ መሰረት ለችግሮች መፍትሄ ሲሰጥ እርስዎ እና ሌሎች ታማሚዎች ተጠቃሚ ይሆናሉ። ከዚህም ተጨማሪ የሚመለከተው ድርጅት እና ፖሊሲ አውጪ የፖሊሲ አይታ፣ አቅጣጫ እንዲይዝ ይረዳል።

ለጥናቱ ተሳታፊዎች ማበረታቻ እና ማካካሻ: ይህ ጥናት ለተሳታፊዎቹ ምንም አይነት ማበረታቻ ወይም ማካካሻ የለውም።

ለጥናቱ ተሳታፊዎች ስጋት/ጉዳት: ይህ ጥናት ምንም አይነት ከጤና ጋር የተገናኘ፣ ስነ-ልቦናዊ፣ ኢኮኖሚያዊ እና ማህበራዊ ስጋት/ጉዳት የለውም።

በጥናቱ ያለመሳተፍ ወይም ራስን የማግለል መብት፡ በጥናቱ ላለመሳተፍ ከፈለጉ በዚህ ጥናት ያለመሳተፍ ይችላሉ። በዚህ ጥናት ባለመሳተፍ ወይም በከፊልም ሆነ በሙሉ ጥያቄዎችን ባለመመለስዎ ማንኛውንም አገልግሎት ከማግኘት አይከለከሉም፡

የመረጃ ስብሳቢ፡ ተሳታፊው መረጃ ከሚሰበሰብበት ጊዜ በፊት እና በሚሰበሰብበት ወቅት ግልጽ ያልሆነልዎት ነገር ካለ መረጃ የመጠየቅ መብት አለዎት። ማንኛውም ሰው ዋናውን መርማሪ ማነጋገር ይችላል።

ስልክ ቁጥር፡- 09 37 62 91 49 ኢ-ሜል፡- jenberworkye@gmail.com

በዚህ የምርምር ፕሮግራም ለመሳተፍ በፈቃዴ ተስማምቻለሁ አልተስማማሁም

የዚህ የተፈረመ የስምምነት ቅጽ ቅጂ እንደሚሰጠኝ ተረድቻለሁ።

የተሳታፊው ስም _____ ፊርማ፡ _____ ቀን፡ _____

ፈቃድ የሚያገኝ ሰው፡ _____ ፊርማ፡ _____ ቀን፡ _____

ክፍል አንድ፡- የተሳታፊውን ማህበራዊ ባህርያት የሚመለከቱ ቃለመጠይቆች፡፡

መመሪያ፤ ከዚህ በታች ያሉት ጥያቄዎች ከተሳታፊው በተሰጠው መልስ መሰረት በማክበብ እና ባዶ ቦታው ላይ በመሙላት ይመለሳል

ተ.ቁ	ማንነት ፤ ማህበራዊ እና ኢኮኖሚያዊ	መልስ
01	ካርድ ቁጥር	_____
02	ፆታ	1. ወንድ 2. ሴት
03	ዕድሜ	_____ (በዓመት)
04	ክብደት	_____ (በኪ.ግራም)
05	ርዝመት	_____ (በሳ.ሜ) _____ BMI(
06	የመኖሪያ አካባቢ	1. ገጠር 2. ከተማ
07	የጋብቻ ሁኔታ	1. ያገባ/ች/ 2. ያላገባ/ ች/ 3. የተፋታ/ ች/ 4. ባል ወይም ሚስት የሞተበት/ ባት/
08	ሥራዎች ምንድን ነው?	1. አርሶ አደር 3. ነጋዴ 2. የመንግስት ሰራተኛ 4. የግል ስራ 5. ተማሪ 6. የቤት እመቤት 7. የጉልበት ስራ 8. ጡረተኛ 9. ሌላ ካለ (ይጥቀሱ) _____
09	የትምህርት ደረጃዎች ስንት ነው ?	1. ማንበብና መፃፍ የማይችል/ትችል 2. ማንበብና መፃፍ የሚችል/ትችል 3. አንደኛ ደረጃ (1-8) 4. ሁለተኛ ደረጃ (9-12) 5. ዲፕሎማና እና ከዚያ በላይ
10	አማካይ ወርሃዊ ገቢዎ ስንት ነው?	_____ ብር

ክፍል ሁለት ፡ከባህሪ ጋር የተገናኙ መረጃዎችን በተመለከተ የተዘጋጀ ቃለመጠይቅ፡፡

ተ.ቁ	ጥያቄ	መልስ
11	አልኮል ዘወትር ይጠጣሉ?	1. ከአሁን በፊት ሀ. አዎን ለ. አይ 2. አሁን ሀ. አዎን ለ. አይ

12	ሲጋራ ያጨሳሉ?	1. ከአሁን በፊት 2. አሁን	ሀ. አዎን ሀ. አዎን	ለ. አይ ለ. አይ
13	ዘወትር አካላዊ እንቅስቃሴ ያደርጋሉ?	1. አዎን	2. አይ	
14	ለ13ኛው ጥያቄ መልስዎ አዎ ከሆነ, በሳምንት ስንት ጊዜ?	_____		
15	ለ 13ኛው ጥያቄ መልስዎ አዎ ከሆነ, ምን ዓይነት እንቅስቃሴ?	1. ሩጫ 2. የእግር ጉዞ 3. ቀላል ሩጫ 4. ሌሎች (ይጥቁሉ)		
16	በባዶ እግርዎ ይጓዛሉ?	1. አዎን	2. አይ	
17	ያለካልሲ ጫማ ያደርጋሉ?	1. አዎን	2. አይ	
18	በየቀኑ እግርዎን ይመረምራሉ?	1. አዎን	2. አይ	
19	እግርዎን በየቀኑ ይታጠባሉ?	1. አዎን	2. አይ	
20	እግርዎን ከታጠቡ በኋላ የቆዳ ቅባት ይጠቀማሉ?	1. አዎን	2. አይ	
21	በጣትዎ መሃል የቆዳ ቅባት ይጠቀማሉ?	1. አዎን	2. አይ	
22	ጫማዎች	1. በሚገባ የገጠሙ 2. በሚገባ የገጠሙ አይደሉም		
23	በጫማዎ ውስጥ የውጭ የሆኑ ነገሮች እንዲደከሙት ወይም የተቀደደ እንዲደሆን ይፈትሻሉ?	1. አዎን	2. አይ	

ክፍል ሶስት፡ የተሳታፊውን ክሊኒካዊ መረጃዎች በተመለከተ የተዘጋጀ ቃለመጠይቅ፡፡

ቁጥር	ጥያቄ	መልስ
24	የትኛው አይነት የስኳር በሽታ አለብዎት?	1. አንደኛው አይነት 2. ሁለተኛው አይነት
25	የስኳር በሽታ እንዳለብዎ ካዎቁ ስንት አመት ሆነዎት	_____
26	ለስኳርዎ ምርመራ እና ሕክምና በመደበኛነት ሀኪምዎን ይጎበኛሉ?	1. አዎን 2. አይ
27	የትኛውን ዓይነት የስኳር መድኃኒት ይወስዳሉ?	1. በመርፌ (ኢንሱሊን) 2. በአፌ የሚዋጥ 3. ሁለቱም 4. ሌላ (ይጥቁሉ)

28	የሚወሰዱት መድሃኒት የስኳር መጠኑን ተቆጣጥሮታል	1. በደንብ ተቆጣጥሮታል 2. በደንብ አልተቆጣጠረውም
29	የአንቲ ፕላትሌት መድሃኒቶችን ይወስዳሉ?	1. አዎን 2. አይ
30	ለ ጥያቄ 29 መልስዎ አዎ ከሆነ ምን ይወስዳሉ?	_____
31	ስታቲን ይወስዳሉ?	1. አዎን 2. አይ
32	ከዚህ በፊት የእግር ቁስለት በሽታ / አሉብህ/ብሽ	1. አዎን 2. አይ
33	ለ32 ኛው ጥያቄ መልስዎ አዎን ከሆነ በዚያ ጊዜ ውጤቱ ምን ነበር?	1. ድኗል 2. ተቆርቷል
34	የቁስሉ ስፋት	_____cm ²
35	ቁስሉ ያለበት ቦታ	1. ሁለቱ ጣቶች መሐል 2. የእግር ፈትለፈት/የእግር ሰር 3. የእግር ሆላ 4. የእግር ጣቶች ሰር 5. እግር ላይ 6. የእግር ተረከዝ
36	የእግር ቁስሉ ኢንፌክሽን ፈጥሯል?	1. አዎን 2. አይ
37	ከእግር ቁስሉ ላይ የተገኘው አርጋኒዝም ምንድን ነው?	1 _____ 2 _____ 3 _____
38	የእግር ቁስሉን ለማከም የተወሰደ መድሐኒት (ዓይነት,መጠን, ድግግሞሽ ,ቆይታ)	1 _____ 2 _____ 3 _____
39	ባሁኑ ሰዓት የእግር ቁስሉ ደረጃ (based on Wagner classification)	1. ደረጃ 0 2. ደረጃ 1 3. ደረጃ 2 4. ደረጃ 3 5. ደረጃ 4 6. ደረጃ 5
40	የእግር ቁስሉ አሁን ያለበት ሁኔታ	1. ድኗል 2. ተቆርቷል

41	የተቆረጠ ከሆነ የት ቦታ ተቆረጠ ?	1. ከቁርጭምጭሚት ቦታች 2. ከቁርጭምጭሚት በላይ
42	ከእግር ቁርጭምጭሚት በላይ የተቆረጠ ከሆነ ቦታው	1. ከጉልበት ቦታች 2. ከጉልበት በላይ

ክፍል አራት: ሌሎች በሽታዎች እና የስኳር ኮምፕሊኬሽን

ተ. ቁ	ጥያቄ	መልስ
43	ሌሎች በሽታዎች አሉት	1. አዎን 2. አይ
44	ለ 43ኛው ጥያቄ ምልሱ አዎን ከሆነ ምን ዓይነት በሽታ ? (ከአንድ በላይ ማክበብ ይቻላል)	1. የደም ግፊት 2. ልብ በሽታ 3. ዲስሊፒኒሚያ
45	ስስኳር በሽታ ጋር የመጡ በሽታዎች አሉ?	1. አዎን 2. አይ
46	ለ 45ኛው ጥያቄ መልሱ አዎ ከሆነ ስስኳር በሽታ ጋር ተያይዘው የመጡ ችግሮች ምን ምን አሉ (ከአንድ በላይ ማክበብ ይቻላል)	1. የዓይን ችግር 2. የኩላሊት ችግር 3. መደንዘዝ 4. የደም ቱቦ ችግር 5. የልብ ድካም 6. ስትሮክ

ስለ ትብብርዎ እና ስለጊዜዎ ክልብ እናመሰግናለን !!