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Assessment of Knowledge, Attitude and Practice of Diabetic Foot Care among diabetic patients In Tikur Anbessa Specialized Hospital, Ethiopia

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List of abbreviations

ADA	American Diabetes Association
AAU	Addis Ababa University
CAD	Coronary Artery disease
DFU	Diabetic Foot Ulcer
DM	Diabetes Mellitus
DPN	Diabetic Peripheral Neuropathy
ETB	Ethiopian Birr
GDM	Gestational Diabetes Mellitus
HCP	Health Care Practitioners
IDF	International Diabetes Federation
IHD	Ischemic Heart Disease
IWGDF	International Working Group on Diabetic Foot
MD	Medical Doctor
NAFFC	Nottingham Assessment of Functional Foot Care
NCD	Non-Communicable Disease
PAD	Peripheral Artery Disease
PI	Principal Investigator
SPSS	Statistical Package for Social Sciences
STEPs	STEP Wise Approach to Surveillance
T2D	Type 2 Diabetes
UDM	Undiagnosed Diabetes Mellitus
WHO	World Health Organization

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Abstract

Background- The prevalence of diabetes continues to be a growing problem throughout the world and contributes significantly to the health care burden. One of the major complications that diabetes carries is foot ulcer. Diabetic foot ulcer (DFU) is one of the most feared complications and a common reason for the hospitalization of diabetic patients. The ultimate endpoint of diabetic foot disease could be amputation, which is associated with significant morbidity and mortality. It also has significant social, psychological, and financial consequences**.**
Objective- This study is designed to address the status of knowledge, attitude and practice of diabetic foot care and barriers to foot care practice among diabetic patients on follow up at Endocrine clinic in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia.
Methodology- This is a descriptive cross-sectional study which was done on diabetic patients on follow up at Endocrine clinic in Tikur Anbessa specialized hospital. The study included 378 diabetic patients using a convenient sampling technique. All patients whose records met the inclusion criteria were reviewed. SPSS version 25 was used for data analyses. Knowledge, attitude, and practice of foot care were assessed using descriptive statistics and bivariable and multivariable logistic regression.
Results- A total of 378 study diabetic patients were included in this study where the mean age of the participants was 54 years. There was comparable sex distribution. The mean knowledge score using questionnaires adapted from recommendations by American College of Foot and Ankle surgeons was 12.1 $\pm$1.94 of which 47.6% and 52.4% had good and poor knowledge of diabetes foot care respectively. The mean attitude score using questionnaires adapted from a previous Saudi study was 3.85$\pm$0.90 of which 73.5% had good attitude and the remaining 26.5% had poor attitude towards foot care. The practice score using questionnaires that were adapted from the Nottingham Assessment of Functional Foot Care (NAFFC) was considered good if the participants scored above mean. Based on that, 54.5% of the participants had good practice while 45.5% of the participants were considered to have poor practice. With regards to barriers of foot care nearly one third didn't know what to do, 27.5% didn't think it was important, and 6.9% of the participants mentioned poor communication between patients and HCP.
Conclusion and recommendation- Knowledge and practice of foot care among diabetes patients in our study participants weren't satisfactory. The result of this study displays the gaps in their knowledge and practice and puts an emphasis on the need for patient education. Most patients are reported to have good attitude which can signify that patients are willing to learn and practice if they get access to proper diabetes education.

In conclusion, it is important to focus on the role of health education to minimize diabetic foot complications.

1. Introduction

1.1 Background

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Even though much is known about the mechanism, clinical features, and management, DM remains a major health problem. The rising prevalence is related to socioeconomic, demographic, environmental and genetic factors. Type 2 diabetes has contributed the lions share for the rise due to the changing lifestyle with urbanization and obesity. However, levels of childhood-onset type 1 diabetes are also on the rise. Global prevalence of diabetes in urban areas is higher than rural areas accounting for 10.8% and 7.2% respectively [1].

According to 2019 IDF, around 463 million people are estimated to be living with diabetes. It was estimated in 2010 that there will be around 438 million people diagnosed with diabetes in 2025. With some years still to go, that estimation has already been transcended by 25 million. Out of the 463 million, 1.1 million are under the age of 20 mostly diagnosed with Type 1 diabetes. Around 352 million people are between the age group of 20 and 64. People older than 65 account for almost 28% [2].

An estimated 19.4 million adults aged 20-79 years were living with diabetes in the IDF Africa Region in 2019, which is a prevalence of 3.9%. In Africa, around 60% of adults are currently living with diabetes unaware of their condition making it the region with the highest rate of undiagnosed diabetes [2].

Ethiopia is one of the top five countries with the largest number of people affected by DM in sub-Saharan Africa. The prevalence of diabetes in Ethiopia was observed as lower as 1.3% as in an institutional study and was as higher as 5% among 35 years and above older people, 6.6% among females and 6.4% among men. Likewise, the prevalence of undiagnosed diabetes in Ethiopia was found at 5% [3].

In a community-based survey that was conducted using the WHO NCD STEPS survey, 2015 prevalence of diabetes mellitus including those on medication was 3.2% (3.5% males and 3.0% females). The prevalence of impaired fasting glucose was 9.1% with ADA criteria and 3.8% with WHO criteria [4].

The UK Prospective diabetes study has also shown that a significant portion of patients present evidence of microvascular and macrovascular complication at initial diagnosis. This is suggestive of presence of diabetes many years prior to diagnosis [5].

Undiagnosed diabetes mellitus (UDM) is thought to be associated with many factors including poor health system, lack of knowledge in both the general population and medical professionals and gradual onset and progression of Type 2 diabetes. UDM which is characterized by poorly controlled blood glucose level that leads to the development of both micro and macrovascular complications which include nephropathy, neuropathy, retinopathy, CAD, peripheral vascular disease, and foot ulcers [6].

One of the most devastating complications of DM is the diabetic foot ulcer which is defined as a foot affected by ulceration that is associated with neuropathy and/or peripheral arterial disease of the lower limb in a patient with diabetes [7]. It is a major public health problem and one of the leading reasons for hospital admission, amputations, and even death among diabetic patients.

The annual incidence of foot ulceration among people with diabetes is about 2%. Approximately 15% of people with diabetes suffer lower-limb amputation at some stage and it is 10 to 20 times more common compared to those without diabetes. Foot ulcers and amputations are more common in low- and middle-income countries than in high-income countries [7].

The reasons for developing foot ulcer disorders in DM patients involve the interaction of several pathogenic factors: neuropathy, abnormal foot biomechanics, PAD, and poor wound healing. The ADA aims to have patients diagnosed early on by reducing the diagnostic glycemic threshold for diabetes and by practicing regular screening of people at increased risk. This will help delay occurrence of complications, adverse clinical outcomes, and poor quality of life [8].

1.2 Statement of the Problem

Diabetic foot ulcer is a common complication of diabetes which occurs due to the breaking down of the protective skin and layers underneath. Diabetic foot complications may eventually lead to amputation especially when wound infection, vascular compromise, or osteomyelitis are involved.

Diabetic foot ulcer has multifactorial nature which needs a comprehensive understanding of predisposing factors to help in prevention and management.

Proper care of the diabetic foot needs identification of the most common risk factors for ulceration and limb loss. The most common risk factors for diabetic ulcer formation include neuropathy, structural foot deformity and peripheral arterial disease. Patient education concerning foot and nail hygiene and appropriate footwear is pivotal in decreasing the risk of an injury that can lead to the formation of ulcers [9].

In patients having diabetes, nerve damage, circulation problems and infections can lead to serious life-threatening foot problems. However, having good diabetes control and maintaining a good foot care habit can hinder these complications.

1.3 Significance of the Study

As discussed in the above-mentioned introduction, diabetes is becoming a major health care burden in the world as well as in Ethiopia, and it is estimated to increase in the years ahead as estimated by IDF. Treatment of foot ulcers once developed is multidisciplinary and challenging; hence prevention should be the focus of management. Effective treatment mainly relies on knowledge and practice of preventive measures taken by the patients and by HCPs.

There is limited data assessing the knowledge and practice of diabetic foot care in TASH. Considering the significant burden of the disease morbidity of foot ulcers and difficulty of treatment, identifying the gaps in prevention is worthwhile, making assessment of knowledge about preventive measures and their practice among patients essential.

2. Literature Review

Every year, the incidence of diabetes increases globally, creating burdensome treatment costs and worsening of quality of life of people who suffer from the disease. The major toll of diabetes in terms of morbidity, mortality and economic burden is the result of chronic complications such as retinopathy, nephropathy, neuropathy, and atherosclerosis. It is a burgeoning cause of disability and early death [10].

Diabetic foot ulcer is one of the most dreaded and challenging yet preventable complications of diabetes. It is one of the major causes of disability, morbidity, and mortality among diabetic patients and around 15% develop foot ulcers in their lifetime [2]. It has been reported that patients with foot ulcers or amputation have higher risk of depression and inability to do simple or recreational activities. The major risk factors of diabetic foot ulcer are the combination of loss of protective sensation due to DPN, PAD and trauma. Therefore, examining the diabetic foot is a necessary preventive step that is barely practiced [11].

According to a hospital based cross sectional study done at Tikur Anbessa Specialized Hospital among 200 study participants on Risk factors assessment of Diabetes Foot Ulcer using the sixty seconds screening tool, it was identified that only 4.5% of the participants had foot examination in the past 5 years. In addition, the study had revealed that about 35.5% patients had at least one risk factor for the development of DFU. This study indicated that the patients failed to benefit from the cheap and effective ways of preventing foot ulcers during their hospital visits [12].

In a multicentric cross sectional study done among 1200 subjects with T2D run by Diabetic association of Bangladesh, 44.5% of the study subjects were found to be at risk of developing diabetic foot ulcer and the rural population was mostly affected [13].

Based on their modified DFU risk classification as per IWGDF, the higher burden was observed in those who had a history of foot ulcer compared to the other groups. Overall, the odds for risk of DFU was higher among men with history of foot ulcer or amputation. Those >50 years old, rural residents, lower and lower middle-income class, insulin use and history of diabetic complications such as retinopathy or nephropathy were associated with an overall increased risk [13].

In a systematic review and meta-analysis done by *Mulugeta et.al in 2019* which evaluated a total of 10 studies with 3,029 diabetic patients, the pooled national prevalence of diabetic foot ulcers among Ethiopian diabetic patients was 11.27% (95% CI 7.22, 15.31%, I^2=94.6). This shows there is a significant burden of Diabetic foot ulcer in our setup. This review also showed that diabetic patients with duration of diabetes more than 10 years were 3.91 times more likely to develop diabetic foot ulcers as compared to patients with duration of diabetes less than 10 years (OR, 3.91, 95% CI 2.03, 7.52, I^2=63.4%). Patients who lived in rural areas were also 3.4 times more likely to develop diabetic foot ulcers than those living in urban area (OR = 3.40; 95% CI: 2.09, 5.54, I^2=0.0%). The possible explanation for the high prevalence of diabetic foot in Ethiopian diabetic patients might be due to poor diabetes related knowledge and poor foot self-care practice [14].

In an observational cross-sectional study conducted in the Jazan Diabetic Center, Jazan town, Saudi Arabia, out of 250 participants the prevalence of diabetes was higher among patients with lower to middle income, and there was no significance difference in prevalence between males and females. In this study, there was a high prevalence of tingling sensation reaching 72.8% and 18% reported history of foot ulcer [15].

Regarding attitude towards foot wound, there was no significant difference between males and females in foot inspection, nail care, adherence to medication and shoes check. But it was found that males practiced foot drying by 65.2% while females pay more attention to softening of the skin by 72.3% [15].

The main aim of this study was to assess knowledge level among diabetic patients on diabetic foot and to assess the adherence level to foot care. The result showed that significant proportion had poor knowledge of foot care (46.4%). It revealed that generally foot care is inadequate considering only 68% inspect their foot regularly, 57.2% dry their toes and foot and 44% walk bare foot. 23.8% of the subjects don't inspect their footwear and 29.6% wear shoes without socks. The poor practice of foot care in this study may be related to lack of knowledge. The study

highlighted the gaps in knowledge and practice and underscores urgent need for patient centered educational intervention [15].

In another study done in Riyadh, Saudi Arabia which assessed attitude towards foot care, 318 patients out of a total of 368 patients (86.4%) had poor attitude towards diabetic foot care. Patients who had frequent visits to the diabetes clinic had a better attitude as compared to the others. There was no significant difference in attitude in patients among different age groups or duration of diabetes [16].

Another institution based descriptive cross-sectional study was conducted in Felege Hiwot Referral hospital, Bahir dar, North western Ethiopia regarding knowledge, attitude, and barriers of diabetic foot care. It involved 313 diabetic patients recruited from both inpatient and outpatient medical department. Of the participants, 84% have never heard of diabetic foot self-care. A majority of the participants (61.7%) didn't have a history of foot problems whereas the remaining 38.3% had a history of foot ulcer ranging from simple superficial laceration to deep wound infection that required amputation. 73.8% of the participants reported that their feet were never examined by health care professionals during follow up [17].

Based on the mean knowledge score obtained in this study 43.8% of the participants had poor knowledge of diabetic foot care. 79.9% of diabetes patients weren't aware that smoking causes poor circulation to the feet and 74.1% were unaware of the level of temperature of water that should be used to wash feet. On the contrary, 98.1% had knowledge that diabetes complications could happen if medications aren't taken regularly [17].

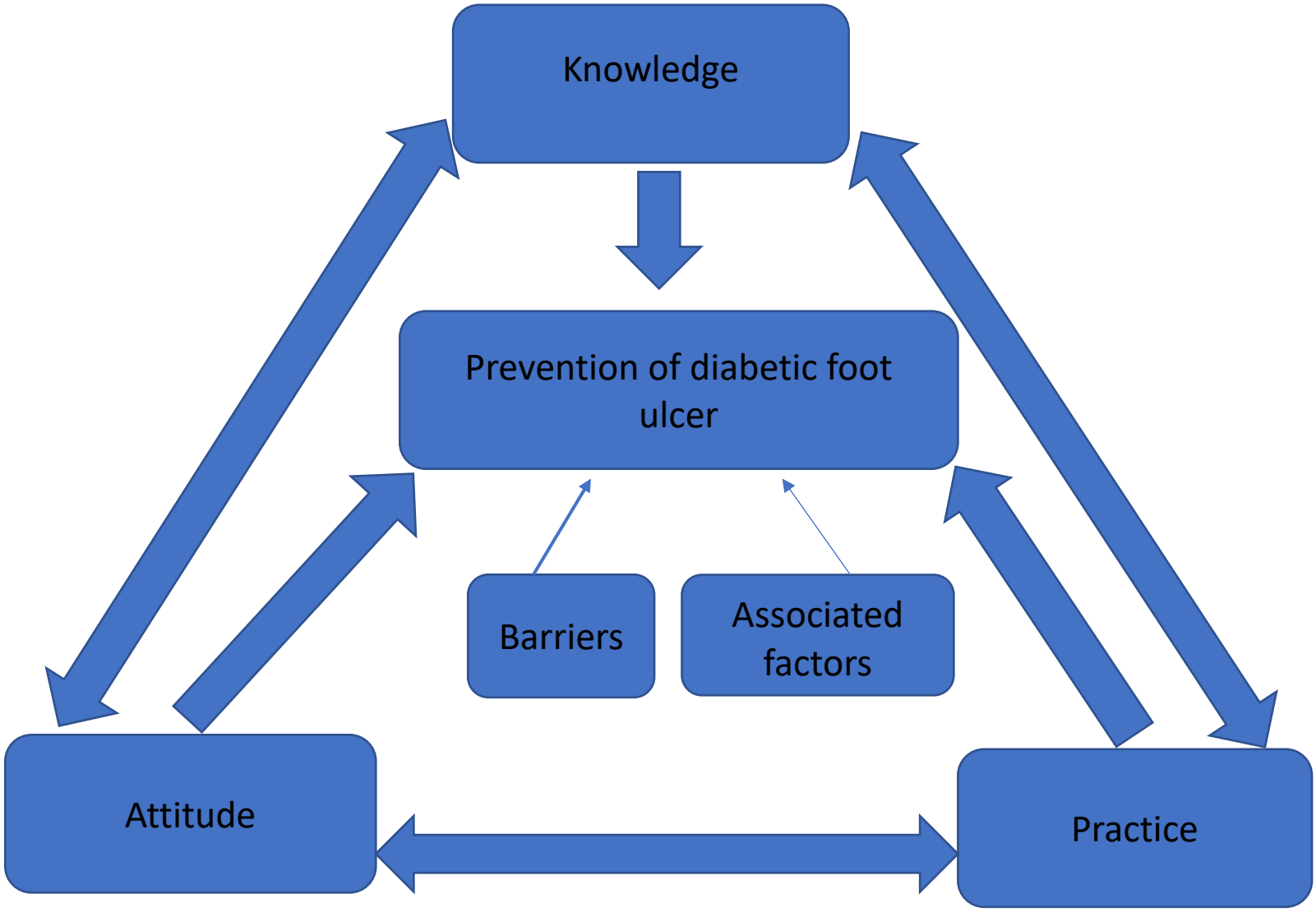
Regarding the foot self-care practice scored using Nottingham assessment of functional foot care (NAFFC) and translated into local language, 45.4% had poor overall diabetic foot care practice. The study showed that 41.2% of the participants inspect their feet daily, 38.7% have never checked their shoes before putting them on and 45.7% never checked their shoes when they take them off. Almost half wash their feet more than once daily and when we see practice of drying feet majority 59.1% and 69.3% have never dried their feet and between toes respectively. 72.5% of the participants have never used moisturizing cream. Another practice of foot care is trimming toenails in which 66.5% cut their toenails about once per month. Among the study participants

44.1% of the participants wear sandals. 55% wear shoes with socks but almost 75.4% change socks less frequently which was less than 4 times per week. This study also assessed the application of wound dressing when their feet is exposed to blisters, cut, or burn and only 13.1% were found to have good practice [17].

In the Felege Hiwot study, when participants were asked if there are any barriers that limit them from applying proper foot care 52% responded “Yes”. Of the participants who have encountered barriers 56.8% reported “Poor communication between patients and health care providers” and 50.6% said “I didn’t know what to do” and 44.4% responded “inconveniences for work”. The study concluded that knowledge and practice of foot care of diabetic patients are still substandard. Poor communication between patients and health care professionals, lack of adequate knowledge, and inconveniency for work were commonly cited barriers of foot care. All sociodemographic characteristics are tested with the categorized knowledge score of foot care using a binomial logistic regression (COR). The result shows that knowledge of diabetic foot care is significantly associated ($P < 0.05$) with educational status, monthly income, duration of diabetic therapy, and place of residence. Relatively educated participants, married individuals, and patients with long duration of diabetic therapy had better knowledge and practice of foot care [17].

Our main expectation on the outcome of our research is that knowledge about prevention of foot ulcer in DM patients is not only inadequate but also the actual practice of preventive methods in those patients with good understanding of preventive methods is also poor, henceforth the information acquired in this research will not only help design an intervention that tries to address the knowledge gap, but also to understand and tackle issues that prevent knowledge into becoming practice in foot care in DM patients.

2.1 Conceptual framework



3. Objective

3.1 General Objectives

- To assess levels of knowledge about diabetic foot care, attitude and their practice amongst diabetic patients on follow at Endocrine clinic, TASH.

3.2 Specific Objectives

- To assess knowledge on diabetes foot care
- To assess attitude towards diabetes foot care
- To assess practice of diabetes foot care
- To assess factors affecting knowledge, attitude and practice of foot care
- To assess factors that influence development of diabetic foot ulcers
- To describe barriers for diabetes foot care practice

4. Materials and Methodology

4.1 Study Setting

The study was conducted in Tikur Anbessa Specialized Hospital, which is a tertiary care Hospital found in Addis Ababa, Ethiopia. The hospital gives multidisciplinary health care services to the population of the country. It is also part of Addis Ababa University running as the College of Health Sciences offering both undergraduate and postgraduate studies. The Endocrine clinic is part of the internal medicine department. 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 gestational diabetic clinic and diabetic foot clinic.

The study was conducted from September 15, 2021- October 31, 2021.

4.2 Study Design

Descriptive prospective cross-sectional design.

4.3 Study Population

This study population includes diabetic patients that are on follow up at endocrine clinic in TASH, Addis Ababa Ethiopia. Subjects satisfying the inclusion criteria were selected based on convenience method until sample size was achieved.

4.4 Inclusion and Exclusion Criteria

4.4.1 Inclusion Criteria

1. Subjects who are diagnosed with diabetes and came for follow up at Endocrine clinic, TASH from September 15- October 31, 2021
2. Age greater than 18 years
3. Subjects who are willing to participate in the study

4.4.2 Exclusion Criteria

1. Patients not willing to participate
2. Diabetes in pregnancy
3. First visit to diabetes clinic

4.5 Sampling and Sample Size Determination

The 378 diabetic patients who have follow up at Endocrine clinic in TASH during the study period will be included in the study excluding patients with diabetes in pregnancy. The sample size was calculated using an institution based descriptive cross-sectional study which was conducted in Felege Hiwot Referral hospital, Bahir dar, North western Ethiopia regarding knowledge, attitude, and barriers of diabetic foot care, which showed poor knowledge of diabetic foot care of 43.8%.

A single population proportion formula with level of significance being 5%, Z= confidence level at 95% (standard value of 1.96) and absolute precision (margin of error) at 5% (α= 0.05) was used to calculate the sample size as follows:

$$\text{Sample size} = \frac{Z_{1-\alpha/2}^{2}\, p(1-p)}{d^2}$$

Where,

Z= The standard normal deviation at 95% confidence interval (1.96)

P= Expected proportion of (43.8%)

d= Absolute precision or tolerated margin of error (5%)

Sample size (n) = $\frac{(1.96)^2 \times 0.438 \times (1-0.438)}{(0.05)2}$

n = 378.25315 rounding n= 378

Subjects satisfying the inclusion criteria were selected based on convenience method until sample size was achieved.

4.6 Study Variables

4.6.1 Independent Variables

- Age
- Sex
- Occupation
- Level of education
- Income
- Marital status
- Place of residence
- Duration of the diagnosis
- Diabetes associated complications
- Other clinical history (smoking, history of foot ulcer, amputation, tingling sensation)

4.6.2 Dependent Variables

- Knowledge about diabetes foot care in diabetes patients.
- Attitude towards diabetes foot care in diabetes patients.
- The practice of foot self-care in diabetes patients.

4.7 Operational Definition

- Good knowledge of foot care- This included participant who scored mean or above on knowledge questions.
- Poor knowledge of foot care- This included participant who scored below the mean on knowledge questions.
- Positive attitude towards foot care- This included participant who scored mean or above on attitude questions.
- Negative attitude towards foot care- This included participant who scored below mean on attitude questions.
- Good foot care practice- This included participant who scores mean or above on practice questions.
- Poor foot care practice- This included participant who scored below mean on practice questions.

4.8 Data Collection, Management and Safety Considerations

Data was collected using a structured questionnaire that is derived from similar studies and adapted to address the objectives of this study. The questionnaire was prepared in English and the questions were translated verbally in Amharic for the ease of the interviewee.

Questionnaires were filled by well-trained interns. The objective of the study and the fashion in which the questionnaire is to be filled was discussed in detail with the interviewers. Amendments were done after assessing the gap found upon revision of the filled questionnaires.

4.9 Data Processing and Analysis

Data entry was done using Epidata version 4.6.2 and analyzed with SPSS version 25 statistical package. The data was cleaned and checked for completeness. Descriptive statistic such as mean, standard deviation, and range as well frequencies and percentage were used to summarize data.

Tables were used to assist data presentation. Additionally, association between variables was determined with odds ratio. P value of < 0.05 was taken as statistically significant.

4.10 Data Quality Control Method

Before starting the data collection, data-collecting format was cross-matched with available information on records, then the study questions were arranged. Completeness of the data was cross-checked weekly. When an incomplete data was found, the data was reassessed.

5. Ethical Consideration

Ethical clearance was obtained from the ethical review committee from Addis Ababa University, College of Health Sciences the Department of Internal Medicine. The patients to be involved in the study had the objective of study explained to them and the consent form was read to them in the language they understand. Those patients who agree to take part in the study signed an informed consent. The patients were informed that they had the right to withdraw from the interview session before completion if they decide to. The data was used using the medical record number and no names were disclosed.

6. Dissemination of Results

After completion of this study, result will be copied and given to regional health bureau, Addis Ababa University health science college library and the department of internal medicine. Attempts will also be made to publish the information on journals of internal medicine.

7. Result

7.1 Sociodemographic Characteristics

The study was a hospital based cross sectional study in which a total of 378 participants were enrolled. Out of the 378 participants, 188 (49.7%) were males and 190 (50.3%) were females. Most patients were above the age of 40 (79%). A majority of the patients were married (68.3%) and 34.9% of the patients had received a university education degree. Majority of the patients had monthly income <2000 birr (54.8%). Rate of unemployment among the participants was 38.9%. (Table 1)

Table 1. Demographic and Socio-economic characteristics of the respondents

Variables	Frequency	Percent
Sex		
Male	188	49.7%
Female	190	50.3%
Age		
18-40	79	21.0%
41-60	160	42.4%
>60	138	36.6%
Residence		
Urban	354	93.7%
Rural	24	6.3%
Current marital status		
Single	46	12.2%
Married	258	68.3%
Divorced	15	4.0%
Widowed	59	15.6%

Educational status		
Illiterate	44	11.6%
Read and write	44	11.6%
Primary education	55	14.6%
Secondary education	103	27.2%
Tertiary education	68	18.0%
Advanced degree	64	16.9%
Occupation		
Farmer	7	1.9%
Daily laborer	14	3.7%
Civil servant	65	17.2%
NGO	14	3.7%
Self employed	64	16.9%
Unemployed	147	38.9%
Student	9	2.4%
Contract employee	39	10.3%
Other	19	5.0%
Monthly income		
<2000	178	54.8%
2000-3000	55	16.9%
>3000	92	28.3%

n=378

7.2 Clinical Data and Risk Factors

Table 2 below indicated the clinical data of patients included in this study. More than half (56.1%) of the study participants have been diabetic for more than 10 years. Almost all the participants (96.0%) reported that they take their anti-diabetic medications regularly. 14.0% of the participants have history of cigarette smoking. From patients who reported to have history of smoking 7.5%

are current smokers. 2.1% of the study population report foot deformity. 11.9% of the study population reported history of foot ulcer, while history of amputation was 2.1%. Prevalence of tingling sensation was 40.1%. 60.6% of the participants had at least one diabetes related complication. Diabetes retinopathy being the commonest accounting for 27%, followed by diabetes neuropathy and nephropathy, 23.5% and 22.9% respectively.

Table 2. Medical history of the respondents

Variables	Frequency	Percent (%)
Duration of diabetes		
<5 years	75	19.8%
5-10 years	91	24.1%
>10 years	212	56.1%
Taking anti-diabetic medications regularly		
Yes	363	96.0%
No	15	4.0%
Tingling sensation on feet		
Yes	151	40.1%
No	226	59.9%
History of foot ulcer		
Yes	45	11.9%
No	333	88.1%
History of amputation		
Yes	8	2.1%
No	370	97.9%
History of smoking		
Yes	53	14.0%
No	325	86.0%
Current smoking(n=53)		
Yes	4	7.5%
No	49	92.5%
Foot deformity		
Yes	8	2.1%
No	370	97.9%

Diabetes complications		
Retinopathy	100	27 %
Nephropathy	85	22.9%
Neuropathy	87	23.5%
Ischemic heart disease	60	16.2%
Diabetic foot ulcer	45	12.0%
Peripheral arterial disease	18	4.9%
Cerebrovascular disease/stroke	11	3.0%
Erectile dysfunction	6	3.2%
Didn't have any complications	146	39.4%
Other	7	1.9%

n = 378

7.3 Knowledge of Study Participants Towards Diabetic Foot Care

Knowledge was assessed using questionnaires adapted from similar study conducted previously which used recommendations by the American College of Foot and Ankle Surgeons. The mean knowledge score was 12.1 ± 1.94. The range of knowledge score obtained in this study was 3-15 out of the maximum possible score of 15. When assessing the knowledge score of the study participants, 180 (47.6%) had good knowledge; 95% CI and 52.4% had poor knowledge of diabetic foot care.

More than 95% of the participants are aware that they should take their medications regularly to prevent complications (98.7%) and that they should avoid smoking (99.2%). Similar percentage of the participants are also aware that they should look after their feet because wounds may not heal quickly (96.3%) and that diabetic patients may get foot ulcer and infection (97.4%). On the contrary, only 48% of the participants know the temperature of the water they should use to wash their feet and 59% of them didn't know that they shouldn't put moisturizers on the interdigital areas. 42.9% of the study participants didn't know that they should get periodic foot exam. (Table 3)

Table 3 Knowledge on diabetic foot care

	Frequency	Percent (%)
Those who know that they should take medications regularly to prevent complications	373	98.7
Those who know that they should inspect their feet daily	324	85.7
Those who know that they should look after their feet because wounds may not heal quickly	364	96.3
Those who know that diabetic patients may get foot ulcer and infection	368	97.4
Those who know that they should avoid smoking	375	99.2
Those who know that they should wash their feet daily	335	88.6
Those who know that they should wash their feet with lukewarm water, never hot water	181	48.0
Those who know that they should dry their feet and interdigital areas after washing	310	82.2
Those who know that they should use moisturizers on their feet and not on interdigital areas	155	41.0
Those who know that they should inspect their footwear before wearing it	307	81.2
Those who know that they should change their socks daily	259	68.5
Those who know that they should never treat wounds at home	**306**	**81.4**

Those who know that they should never walk around barefoot	344	91.0
Those who know that they should cut their toenails carefully	367	97.1
Those who know that they should get periodic foot exam	216	57.1

n= 378

7.4 Attitude Towards Diabetic Foot Care

Attitude was assessed using questions adapted from the Riyadh, Saudi study which was a descriptive cross-sectional study conducted in the diabetic clinic of tertiary care hospital. The mean attitude score in our study was 3.85 ± 0.90. The range of attitude score obtained was 1-5 out of the maximum score of 5. 73.5% of the participants had good attitude; 95% CI. 94.7% and 95.8% of the study participants measure their blood glucose level and think that nutrition is a factor to control blood glucose level respectively. Majority reported that they would visit health care centers if they had cuts on their feet (85.7%). 78.3% have attended an education on diabetic foot care during their clinic visits. However, only 31.2% of the participants take responsibility for self-foot examination. (Table 4)

Table 4 Attitude on diabetic foot care

	Frequency	Percent
Those who attended to an education on diabetic foot care during your clinic visits	296	78.3
Those who take responsibility for self-foot examination	118	31.2
Those who follow blood glucose level	358	94.7
Those who think nutrition is a factor to control blood glucose level	362	95.8
Those who would visit healthcare center if you had cuts and sores on your feet	324	85.7

n= 378

7.5 Practice of Foot Care

From the Nottingham Assessment of Functional Foot Care 14 out of 29 items were chosen based on their applicability to our setup. The mean practice score was found to be 25.7 ± 4.04. the range of practice score obtained was 12-39 out of the maximum score of 42. Based on the mean score, 54.5% of the participants had good practice of diabetic foot care; 95% CI. The remaining 45.5% had poor practice.

The study showed that 55.3% of the participants inspect their feet once a day. 69.3% and 62.7% check their shoes before putting them on and after taking them off respectively. When assessing the frequency of washing feet, 54.2% of the study participants wash their feet once a day. Concerning drying their feet and drying between their toes 66.7% and 54.5% often practiced drying their feet and between toes, respectively.

Regarding the use of moisturizing cream on feet 37.3% often used cream and 25.4% applied it sometimes. Majority of the participants (61.3%) have never (36.2%) or rarely (25.1%) used moisturizers in between their toes. 45.2% of the study participants cut their toenails about once a month and 28.3% cut their toenails about once a week. The study also showed that 41.3% have never worn shoes without socks/stocking and 42.9% change their socks daily. The majority 81.2% have reported to have never walked around the house bare foot. Contrarily, 69.3% of the participants admitted having never broken into a new shoe gradually and 65.3% said they won't put a dry dressing on a blister had they had one.

Table 5 Practice of diabetic foot care

Drying between toes	**Never**	**6**	**1.6**
	rarely	58	15.3
	sometimes	108	28.6
	often	206	54.5
Use of moisturizing cream on feet	Never	83	22.0
	rarely	58	15.3
	sometimes	96	25.4
	often	141	37.3
Use of moisturizing cream between toes	never	137	36.2
	rarely	95	25.1
	sometimes	53	14
	often	93	24.6
Cutting of toenails	Less than once a month	100	26.5
	About once a month	171	45.2
	About once a week	107	28.3
Breaking in a new shoe gradually	never	262	69.3
	rarely	82	21.7
	sometimes	27	7.1
	often	7	1.9
Wearing shoes without socks/stocking	never	156	41.3
	rarely	32	8.5
	sometimes	91	24.1
	often	99	26.2

Changing socks	**Less than 4 times a week**	**111**	**29.4**
	4-6 times a week	102	27.0
	Daily	162	42.9
	More than once a day	3	.8
Walking around the house bare foot	never	307	81.2
	rarely	35	9.3
	sometimes	31	8.2
	often	5	1.3
Putting a dry dressing on a blister when getting one	never	247	65.3
	rarely	70	18.5
	sometimes	34	9.0
	often	27	7.1

n=378

7.6 Barriers Regarding Practice of Foot Care

Table 6 addresses barriers to foot care practice. Nearly one third of the participants didn't know what to do regarding foot care practice (32.3%) whereas 27.5% of them didn't think it was important. Poor communication between patients and HCP was mentioned in 6.9% of the participants.

Table 6 Barriers to foot care practice

Barriers	Frequency	Percent
Couldn't see well enough	30	7.9%
Could not reach their foot	62	16.4%
Could not afford buying shoes	44	11.6%
Don't think it is important	104	27.5%
Didn't know what to do regarding practice	122	32.3%
Poor communication between patients and HCP	26	6.9%
Lack of family support	23	6.1%
Barefoot walking is common in society	15	4%
Inconveniency for work	38	10.1%
Lack of motivation/ negligence	50	13.2%
Delay in accessing health service	19	5.0%
Illiteracy	22	5.8%

Language barrier	24	6.3%
Forgot what they were taught (lack of documentation)	22	5.8%

7.7 Factors Related to Development of Diabetic Foot Ulcer

The odds of diabetic foot ulcer were 5 times higher in participants who has tingling sensation on their feet as compared to the counter group. [COR= 5.4; 95% CI: 1.95-15.06; P= .01]

The odds of diabetic foot ulcer were 19 times higher in patients who have foot deformity on their feet as compared to the counter group. [COR=19.16; 95% CI: 4.43-82.91; P=.001] (Table 7)

There was no statistical association between duration of diabetes and foot ulcer (P=.23)

Table 7 Bivariable Logistic Regression analysis results of factors associated with DM foot ulcer

		Diabetic foot ulcer		**Bivariable analysis (COR)**	**P-value**
Explanatory Variable		no	yes		
Tingling sensation	No	214(97.7%)	5(2.3%)	1	
	Yes	134(88. %)	17(11.3%)	5.43(1.95-15.06)	0.01*
History of smoking	No	302(95.0%)	16(5.0%)	1	
	Yes	47(88.7%)	6(11.3%)	2.41(0.89-6.46)	0.081
Foot deformity	No	345(95.0%)	18(5.0%)	1	
	Yes	4(50.0%)	4(50.0%)	19.1(4.43-82.91)	<0.001*

7.8 Factor Affecting Knowledge

Regarding factors associated with knowledge, variables such as age, sex, marital status, educational status, income, residence, and duration of diabetes were analyzed first by bivariable analysis. Based on the p-value of the bivariable analysis, five variables were identified as candidate variables for the multivariable analysis in case of knowledge; these are: age, marital status, educational status, monthly income, and urban residence.

The results of the multivariable analysis revealed divorced and married as compared to single and >3000 ETB monthly income was significantly associated with knowledge. The odds of good knowledge were 65% lower in married individuals as compared to singles [AOR=0.35; 95% CI: 0.13-0.90; P=.030]. The odds of good knowledge were 79.0% lower in divorced individuals as compared to singles [AOR=0.21; 95% CI: 0.05-0.88; P=.033]. The odds of good knowledge were 2 times higher in individuals with income >3000 ETB as compared to individuals with income <2000 ETB [AOR=1.94; 95% CI: 1.00-3.78; P=.050].

Bivariable analysis showed the odds of good knowledge in participants with advanced level of education were 2 times as compared to illiterates, but not statistically significant; P= .082. Duration of diabetes didn't have a statistically significant association with level of knowledge on diabetic foot care. (Table 8 and 8.1)

7.9 Factors Affecting Attitude

When assessing factors associated with attitude, variables including sex, age, marital status, educational level, residence, monthly income, and duration of diabetes were analyzed first by bivariable analysis. The odds of good attitude were 2 times higher in individuals with diabetes duration >10 years compared to individuals with diabetes duration <5 years [COR =2.278 (1.297-3.999), P=.004]. The odds of good knowledge were also 2 times higher in individuals with diabetes duration 5-10 years than in individuals with duration <5 years [COR=2.091 (1.074-4.070), P= .030].

The results of multivariable analysis showed the odds of good attitude were 2 times higher in individuals with income >3000 ETB as compared to individuals with income <2000 ETB [AOR=2.28; 95% CI: 1.33-3.88; P= .002]. (Table 9)

Table 8 Bivariable and Multivariable logistic regression analysis of factors affecting knowledge

Variable	Knowledge of foot care	
	AOR (95%CI).	P value
Age		
18-40		.195
41-60	1.753 (.756-4.067)	.191
61-83	2.213 (.928-5.280)	.073
Marital status		
Single		.076
Married	.353 (.138-.904)	**.030** *
Divorced	.219 (.054-.888)	**.033** *
Widowed	.500 (.158-1.579)	.238
Level of education		
Illiterate		.567
Read and write	1.502 (.565-3.993)	.415
Primary education	.788 (.292-2.126)	.639
Secondary education	.887 (.362-2.175)	794
Tertiary education	.908 (.353-2.334)	.841
Advanced education	1.465 (.515-4.170)	.474
Monthly income		
<2000		.133
2000-3000	1.058 (.548-2.044)	.866

>3000	1.947 (1.000-3.789)	**.050 ***
Residence		
Rural	1.684 (.665-4.264)	.271

Duration of diabetes	**Knowledge of foot care**	
	COR (95% CI).	**P value**
<5 years		.628
5-10 years	1.258 (.680-2.327)	.465
>10 years	1.294 (.761-2.200)	.341

Table 8.1 Bivariable and Multivariable logistic regression analysis of factors affecting knowledge

		Knowledge		Bivariable analysis (COR)	Multivariable analysis (AOR)	P-value
Explanatory Variable		Poor	Good			
Marital status	Single	22(47.8%)	24(52.2%)	1	1	0.076
	Married	141(54.7%)	117(45.3%)	0.76(0.40-0.13)	0.35(0.13-0.90)	**0.030***
	Divorced	10(66.7%)	5(33.3%)	0.45(0.13-1.55)	0.21(0.05-0.88)	**0.033***
	Widowed	25(42.4%)	34(57.6%)	1.2(0.57-2.70)	0.50(0.15-1.57)	0.238
Income	<2000	103(57.9%)	75(42.1%)	1	1	0.13
	2000-3000	31(56.4%)	24(43.6%)	1.06(0.57-1.95)	1.05(0.54-2.04)	0.27
	>3000	36(39.1%)	56(60.9%)	2.13(1.27-3.57)	1.94(1.00-3.78)	**0.05***

Table 9- Bivariable and Multivariable logistic regression analysis of factors affecting attitude

Variables	**Attitude towards foot care**	
	AOR (95% CI).	**P value**
Monthly income		
<2000		.008
2000-3000	1.101 (.589-2.058)	.762
>3000	2.281 (1.339-3.887)	**.002 ***

Duration of diabetes		
<5 years		.381
5-10 years	1.423 (.726-2.790)	.30
>10 years	1.515 (.840-2.732)	.168

Explanatory Variable		**Attitude**		**Bivariable analysis (COR)**	**Multivariable analysis (AOR)**	**P-value**
		Poor	Good			
Income	<2000	48(27.0%)	130(73.0%)	1	1	
	2000-3000	9(16.4%)	46(83.6%)	1.88(0.85-4.14)	1.10(0.58-2.05)	0.76
	>3000	20(21.7%)	72(78.2%)	1.32(0.73-2.41)	2.28(1.33-3.88)	0.002*

7.10 Factors Affecting Practice

Regarding factors associated with practice, variables such as age, sex, marital status, educational status, income, residence, and duration of diabetes were analyzed first by bivariable analysis. The results of bivariable analysis showed the odds of good practice were 2.5 times higher in individuals with monthly income >3000 ETB than in individuals with income <2000 ETB [COR= 2.650 (1.564-4.488), P=.000]. the odds of good practice were also 1.7 times higher in individuals with duration of diabetes >10 years as compared to duration <5 years [COR=1.733 (1.019-2.945), P= 0.042]. Residence and advanced level of education didn't have statistically significant association with practice; P= .090 and P= .082, respectively.

Based on the p-value of the bivariable analysis, five variables were identified as candidate variables for the multivariable analysis in case of practice; these are level of education, monthly income, and residence. The results showed the odds of good practice was 2 times higher in participants with monthly income >3000 ETB as compared to income <2000 ETB [AOR=1.883; 95% CI: .981-3.612; P=.057]; not statistically significant.

Table 10- Bivariable logistic regression analysis of factors affecting practice

Variables	Foot care practice	
	COR (95% CI)	P value
Monthly income		
<2000		.001*
2000-3000	1.330 (.725-2.437)	.357
>3000	2.650 (1.564-4.488)	.000*
Duration of diabetes		
<5 years		.105
5-10 years	1.288 (.698-2.378)	.418
>10 years	1.733 (1.019-2.945)	.042*

Table 10.1 Multivariable logistic regression analysis of factors affecting practice

Variables	Foot care practice	
	AOR (95% CI).	P value
Level of education		
Illiterate		.482
Read and write	1.375 (.530-3.572)	.513
Primary education	.678 (.257-1.783)	.430
Secondary education	.804 (.342-1.892)	.617
Tertiary education	.777 (.308-1.959)	.593
Advanced education	1.282 (.463-3.545)	.633
Residence		
Urban	1.779 (.712-4.443)	.218
Monthly income		
<2000		.158
2000-3000	1.107 (.580-2.111)	.758
>3000	1.883 (.981-3.612)	.057
Duration of diabetes		
<5 years		.442
5-10 years	1.394 (.702-2.765)	.342
>10 years	1.476 (.808-2.697)	.205

8. Discussion

Diabetic foot ulcer is a common complication of diabetes which occurs when there is breakage of the protective skin and the layers underneath. It is also the most preventable complication of diabetes with adequate knowledge and practice of self-foot care.

There were 378 participants included in this study. When assessing sex of the participants, comparable percentage of both sexes have participated in the study; 50.3% were females and 49.7% were males. Patients in the age group of 41-60 year accounted for the majority of participants (42.4%). Majority of the patients (93.7%) reside in urban areas. Regarding educational status 27.2% of the participants attended secondary level of education followed by tertiary level 18.0%. Considerable percentage of the participants were unemployed which accounted for 38.9%. More than half of the participants (54.8) had monthly income <2000 ETB.

Significant proportion of the study participants had poor knowledge of foot care (52.4%). Compared to a local study done in Felege Hiwot referral hospital, 43.8% of the participants had poor knowledge, which is slightly lower compared to our study. Another study done in Jazan diabetic center; Saudi Arabia showed 46.4% of the participants had poor knowledge regarding diabetic foot care; which is comparable to our study.

The result showed that marital status and monthly income were associated with knowledge of foot care. The probability of having good knowledge was higher among participants who were single and participants with higher income. Our study was not in agreement with other studies as single marital status was associated with good knowledge.

Majority of our study participants (73.5%) had good attitude towards diabetic foot care. The Saudi study revealed that 86.4% of their participants had poor attitude towards diabetic foot and diabetic foot care which was significantly different from what we have found. Longer duration of diabetes and higher income were associated with good attitude in our study which was in agreement with the Saudi study. Participants with higher income were also linked to having good attitude.

The mean practice score was 25.7 ± 4.04 which is more than half percent of the maximum score. The mean score was comparable to the Felege Hiwot study which had mean practice score of 25.2 ± 6.4.

The Jazan, Saudi study practice assessment revealed that 68% of their participants inspect their foot regularly, 57.2% dry their foot after washing, 44% walk bare foot, and 29.6% wear shoes without socks.

The Felege Hiwot study showed 41% of the participants inspect their foot regularly and 73.5% said they have never walked barefoot around the house. However, 59.1% don't dry their feet after washing.

In our study 55.3% of our study participants inspect their foot once a day which was higher than the Felege Hiwot study. Practice of drying of feet after washing was higher in our participants, 66.7% of our participants often dry their feet after washing which was significantly high compared to the Felege Hiwot study.

Compared to the Saudi study practice of bare foot walking was better in our study, 81.2% reported to have never walked bare foot.

In our study, longer duration of diabetes and higher income was associated with good practice of foot care.

We found that there was no difference between males and females and different age groups in the aspects that were assessed. Place of residence also didn't have an effect on knowledge, practice, and attitude of foot care since 93.7% of our participants reside in urban areas. Tingling sensation was reported in 40.1% of our study participants and it was strongly associated with development of foot ulcer. Foot deformity was identified in 2.1% of our participants. Callus, clawed toes and Charcot foot were the foot deformities that were identified. Presence of foot deformity was identified as a risk factor for foot ulcer.

A total of 14% of our participants are past or current cigarette smokers. In this study smoking wasn't significantly related to development of foot ulcer (P=.081). There was no statistical

association between duration of diabetes and foot ulcer in our study (P= 0.23). This finding was incompatible to the systematic review and meta-analysis that was done by Mulugeta et.al which showed that patients with duration of diabetes more than 10 years were 3.91 times more likely to have diabetic foot ulcers.

A third of patients reported lack of knowledge as a barrier to foot care practice and a quarter didn't think it was important. 6.9% of our study participants mentioned poor communication between patients and HCP as barrier to practice of foot care.

9 Strength and Limitation of Study

9.1 Strength of the Study

The study has recruited adequate amount of study population. The instruments used in the questionnaire were adapted from a structured tool of Nottingham Assessment of functional foot care (NAFFC) and the knowledge questionnaires were adapted from diabetic foot care education recommended by American College of Foot and Ankle Surgeons.

The Knowledge could help as a preliminary input in the formulation a more organized patient education method.

This study used prospective study design.

9.2 Limitation of the Study

This study informs us about the KAP of diabetic foot care among patients who are on follow up at diabetic clinic in TASH. However, the study was conducted only in a single center. Hence, generalization of this information to our general population may not be appropriate.

10. Conclusion and Recommendation

Knowledge and practice of foot care among diabetes patients in our study participants weren't satisfactory. The result of this study displays the gaps in their knowledge and practice and puts an emphasis on the need for patient education. Most patients are reported to have good attitude which can signify that patients are willing to learn and practice if they get access to proper education.

In conclusion, it is important to focus on the role of health education to minimize diabetic foot complications. Patients should also be encouraged to apply what they have learned.

Higher officials and policy makers should give an emphasis on health education programs and accessibility of health care services and resources.

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12. Annexes

I. Assurance of Principal Investigators

My name is Elfign Fekadu. I am in the researcher. I put my signature below to confirm that I take over the responsibility for the scientific, ethical, and technical conduct of the research project and for provision of progress reports for all stakeholders of the research project.
Signature: _____ Date: ----------

Contact Address of PI:

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II. Questionnaire

Part 1- Sociodemographic data

1. I-care number	
2. Sex	o Male o Female
3. Age in years	
4. Marital status	o Single o Married o Divorced o Widowed
5. Residence	o Rural o Urban
6. Level of education	o Illiterate o Read and write o Primary education o Secondary education o Tertiary education o Advanced degree
7. Occupational status	o Farmer o Daily laborer o Civil servant o NGO o Self employed o Unemployed o Student o Other

8. Monthly income	o <2000 o 2000-3000 o >3000
Part 2- Medical history	
9. Duration of diabetes	o <5 years o 5-10 years o >10 years
10. Do you take your medications regularly?	o Yes o No
11. Do you have tingling sensation on your feet?	o Yes o No
12. Diabetic complications	- Retinopathy - Nephropathy - Neuropathy - Ischemic heart disease - Diabetic foot ulcer - Peripheral arterial disease - Cerebrovascular disease/stroke - Erectile dysfunction -None Other_____
13. History of ulcer	o Yes o No

		If yes when
14.	History of amputation	o Yes o No
15.	History of smoking	o Yes o No If yes, how much in pack years
16.	Current smoking	o Yes o No If yes, how much in pack years
17.	Foot deformity If yes- specify (callus, hammer toes, clawed toes…)	o Yes o No

Part 3- Knowledge on diabetic foot care

18.	Do you know you should take your medications regularly to prevent complications?	0. No 1. Yes
19.	Do you know you should inspect your feet daily?	0. No 1. Yes
20.	Do you know you should look after your feet because wounds may not heal quickly?	0. No 1. Yes

21.	Do you know diabetic patients may get foot ulcer and infection?	0. No 1. Yes
22.	Do you know you should avoid smoking?	0. No 1. Yes
23.	Do you know you should wash your feet daily?	0. No 1. Yes
24.	Do you know you should wash your feet with lukewarm water, never hot water?	0. No 1. Yes
25.	Do you know you should dry your feet and interdigital areas after washing?	0. No 1. Yes
26.	Do you know you should use moisturizers on your feet and not on interdigital areas?	0. No 1. Yes
27.	Do you know you should inspect your footwear before wearing it?	0. No 1. Yes
28.	Do you know you should change your socks daily?	0. No 1. Yes
29.	Do you know you should never treat wounds at home?	0. No 1. Yes

30.	Do you know you should never walk around barefoot?	0. No 1. Yes
31.	Do you know you should cut you toenails carefully? (straight and file the edges)	0. No 1. Yes
32.	Do you know you should get periodic foot exam?	0. No 1. Yes

Part 3- Attitude on diabetic foot care

33.	Have you attended an education on diabetic foot care during your clinic visits?	0. No 1. Yes
34.	Do you take responsibility for self-foot examination?	0. No 1. Yes
35.	Do you follow your blood glucose level?	0. No 1. Yes
36	Do you think nutrition is a factor to control blood glucose level?	0. No 1. Yes
37.	Would you visit healthcare center if you had cuts and sores on your feet?	0. No 1. Yes

Part 4- Practice of diabetic foot care

38.	Do you examine your feet?	0. Once a week or less 1. 2-6 times a week 2. Once a day 3. More than once a day
39.	Do you check your shoes before you put them on?	0. Never 1. Rarely 2. Sometimes 3. Often
40.	Do you check your shoes when you take them off?	0. Never 1. Rarely 2. Sometimes 3. Often
41.	Do you wash your feet?	0. A few days a week 1. Most days a week 2. Once a day 3. More than once a day

42.	Do you check your feet are dry after washing?	0. Never 1. Rarely 2. Sometimes 3. Often
43.	Do you dry between your toes?	0. Never 1. Rarely 2. Sometimes 3. Often
44.	Do you use moisturizing cream on your feet?	0. Never 1. Rarely 2. Sometimes 3. Often
45.	Do you put moisturizing cream between your toes?	0. Often 1. Sometimes 2. Rarely 3. Never
46.	Do you cut your toenails?	0. Never 1. Less than once a month 2. About once a month

		3. About once a week
47.	Do you break in a new shoe gradually?	0. Never 1. Rarely 2. Sometimes 3. Often
48.	Do you wear shoes without socks/stockings?	0. Often 1. Sometimes 2. Rarely 3. Never
49.	Do you change your socks/stockings?	0. Less than 4 times a week 1. 4-6 times a week 2. Daily 3. More than once a day
50.	Do you walk around the house bare foot?	0. Often 1. Sometimes 2. Rarely 3. Never

51.	Do you put a dry dressing on a blister when you get one?	0. Never 1. Rarely 2. Sometimes 3. Often

Part 5- What are the barriers you have regarding practice of foot care?

- I could not see well enough
- I could not reach my foot
- I could not afford buying shoes
- I didn't think it was important
- I didn't know what to do
- Poor communication between patients and HCP
- Lack of family support
- Barefoot walking is common in society
- Inconveniency for work
- Lack of motivation/ negligence
- Others