Original Article

Foot self-care practices among diabetic patients attending a teaching hospital in Tamil Nadu, India

Selvam Paramasivam, Govindarajan Ramalingam, Parveen Gani A R

Department of Community Medicine, K.A.P. Viswanatham Government Medical College, Tiruchirappalli, Tamil Nadu, India

Abstract

Introduction: Diabetes is a common non-communicable disease in the world. Diabetic foot ulcer is a common complication of diabetes mellitus. Awareness and practice of foot self-care play a major role in the prevention of complications due to diabetic neuropathy. **Methods:** Descriptive cross-sectional study was conducted among diabetic patients from Sep 2022 to Feb 2023. A semi-structured questionnaire containing four parts including socio-demographic including clinical details, questions related to knowledge and practice of foot self-care, and clinical examination was used. Ten grams monofilament and 128 Hz tuning fork were used to assess the sensation of the foot. **Results:** A total of 211 patients were included. The average age was found to be 58.4 ± 10.0 years and the majority were females (64.0%). The mean percentage score of knowledge on diabetes and foot self-care was found to be 59.6 ± 27.5 and 55.1 ± 11.9, respectively. Participants with low knowledge scores and those who do not engage in regular physical activity had significant poor foot care practices. The majority (54.5%) of the participants had at least one of the clinical problems related to diabetic foot. The most common problem was found to be heel fissures (29.4%), followed by deformed nails (15.2%), callus (5.2%), toe web infection (3.3%), and ulcer (2.8%). Monofilament test and vibration was not detectable in 12.3% and 15.2%, respectively. **Conclusion:** More than half of the participants were found to have good diabetic foot self-care practices. Diabetics having good knowledge on foot care and involving in regular physical activity showed good foot self-care practices.

Keywords: Diabetes, foot self-care, knowledge, neuropathy, practices, risk factors

Introduction

Diabetes is found to be a common non-communicable disease in the world. There are 537 million adults living with diabetes. This number may reach 643 million by 2030. One in ten adults lives with diabetes in South East Asia.[1] According to world health statistics 2022, the death rate in 2019 due to diabetes has increased by 3% while there is a decline in death due to chronic respiratory disease, cardiovascular, and cancer as compared to the year 2000.[2]

Address for correspondence: Dr. Selvam Paramasivam, Associate Professor, Department of Community Medicine, KAP Viswanatham Government Medical College, Tiruchirappalli, Tamil Nadu – 620 001, India.
E-mail: drslvmmathy@gmail.com

Received: 03-03-2023 **Revised:** 24-05-2023
Accepted: 01-06-2023 **Published:** 30-09-2023

Access this article online

Quick Response Code:

Website: http://journals.lww.com/JFMPC

DOI: 10.4103/jfmpc.jfmpc_409_23

And also in India, the prevalence of diabetes has risen to 8.9% (2019) from 7.1% (2009) with high preponderance in urban areas (11.2%).[3] This shows a 1.8% increase in the prevalence in one decade. These facts indicate that we need to give more focus on diabetes and its complications. Screening for diabetes mellitus has been given special emphasis by the public health department and hence more number of diabetics have been put on treatment now. Creating awareness about foot care among these patients will be very beneficial in preventing foot complications of diabetes mellitus.

Most of the morbidity and mortality in diabetes are due to microvascular and macrovascular complications.[4] Sensory neuropathy presents as paresthesia, loss of sensation of touch, pain, temperature, and vibration. Untreated neuropathy will lead to serious foot deformities and can end up with complications. In a study by

How to cite this article: Paramasivam S, Ramalingam G, Gani AR. Foot self-care practices among diabetic patients attending a teaching hospital in Tamil Nadu, India. J Family Med Prim Care 2023;12:2036-41.

Das *et al.*,[5] in India, it was found that most of the doctors (88.3%) reported neuropathy as a comorbidity among diabetic foot patients.

Diabetic foot ulcer is one of the complications of long standing diabetes mellitus.[6] The prevalence of diabetic foot ulcer among diabetic patients (in Ethiopia) was found to be 13.6%.[7] Diabetic foot ulcer and diabetes are major concerns of non-traumatic amputations. Diabetic patients should inspect the feet on a daily basis and report to the treating facility if there is any injury.

In a study by Saurabh *et al.*,[8] in rural Puducherry (2013) it was found that only 54% are aware that diabetes can lead to reduced sensation and foot ulcer. Awareness and practice of foot self-care play a major role in the prevention of complications due to diabetic neuropathy. Knowledge on foot care positively correlated with the foot care practices.[9] In a study by Taksande *et al.*,[10] in rural India, it was found that 82.9% of the participants are aware of the disease and 23.2% are aware of the complications of diabetes. 47.6% of the participants are not inspecting their feet regularly.[8] The aim of this study is to assess the knowledge and foot self-care practices among diabetic patients. Study of awareness level, how the patients are maintaining their feet and its associated factors will help the primary care providers to deliver appropriate health education measures which will improve the practice of good foot self-care, thereby reducing the burden of extensive treatment for foot ulcer and its complications. Objectives: To assess the practice of foot self-care among diabetic patients and to identify the factors associated with these practices.

Materials and Methods

Study Background: Descriptive cross-sectional study was conducted for a period of 6 months from Sep 2022 to Feb 2023 in the tertiary care hospital. Majority of the diabetic patients take treatment from primary health centers. Patients whose residences are close to our tertiary care hospital are attending our hospital out patient department for regular check up and treatment. Also, patients who are referred from the primary health center are coming to get the treatment for complications or for uncontrolled status.

Sample size and study population: According to a study by Selvakumar *et al.*,[11] in India, it was found that 64.5% of participants are unaware of foot care. Based on this prevalence, the calculated sample size was found to be 211 with an allowable error of 10%. All follow-up patients attending the Non-Communicable Disease Clinic (NCD) outpatient department with type II diabetes of at least one-year duration from the initiation of treatment were included. All the consented participants who made a visit to the hospital during the study period were included till the sample size was achieved. Seriously ill patients and those who were not able to communicate were excluded from the study.

Study instrument: Semi-structured questionnaire was prepared based on the previous literature and reviewed by all the investigators.[11-14] Our study tool contains four parts including socio-demographic details and clinical details, questions related to knowledge, questions related to practice of foot self-care, and clinical examination. There were seven questions to assess knowledge (diabetes affects various organs in the body, wounds may not heal quickly, tobacco affects wound healing, reduced foot sensation among diabetics, and should not walk on barefoot, diabetic foot needs special care, uncontrolled blood sugar status can lead to foot deformity). Correct responses were given a score of "1" and wrong responses were scored "0." There were 15 questions related to foot self-care practices (inspect the foot daily, using mirror to see entire feet, drying between toes, walking without footwear, type of footwear, inspecting the footwear daily, wear footwear indoor, wearing appropriate sized footwear, change of footwear when damaged, wearing therapeutic footwear recommended by physicians, encountered any injury while nail trimming recently, use of emollients, neglecting minor foot lesions, use of blades to remove callus, avoidance of exposure to excessive cold or heat) included. Healthy foot self-care practices were given a score "1" and unhealthy practices were given "0." Ten grams monofilament and 128 Hz tuning fork were used to assess the sensation on the foot clinically.

Methodology of data collection: Questionnaire was prepared in English and administered in Tamil for better understanding. Examination by 10 g monofilament and 128 Hz tuning fork was done individually by the investigators. At the end of the interview all the participants were given health education regarding foot care which can be practiced by them at home.

Data analysis: Data was collected, coded, and entered in sheets and was analyzed with Epi info 7.2.5 software using appropriate statistical tests such as proportions, mean, standard deviation, mean percentage score, and Chi-square test. BG Prasad scale was used for socioeconomic stratification.[15] Mean percentage score was calculated for knowledge and foot self-care practices by using the formula given below: (Sum of scores obtained/Maximum scores that could be obtained) ×100. These scores were categorized into good and poor scores by setting a cut-off of 50%. Chi-square test was used to assess the factors associated with foot self-care practices. *P* value of ≤0.05 was considered as significant.

Ethical concerns: Study was conducted after getting approval from the Institutional Ethics Committee (Certificate of clearance Ref No. KAPV/IEC/2022/03/006). Informed written consent was obtained from all the participants before the interview. Strict patient confidentiality was maintained throughout the study.

Results

In our study a total of 211 patients were included. The average age of participants was found to be 58.4 (10.0) years and the majority were in the age group of 45–60 years. The majority of the participants were female (64.0%), Hindus (69.2%), followed by Muslims (19.4%), and 30.3% from social class IV [Table 1]. The majority (64.9%) of the participants were married and 35.1%

Table 1: Socio-demographic details of study participants

Characteristics	*n* (%)
Age (in years)	
≤45	17 (8.1)
45–60	116 (55.0)
>60	78 (36.9)
Sex	
Male	76 (36.0)
Female	135 (64.0)
Social class	
I	10 (4.8)
II	53 (25.1)
III	35 (16.6)
IV	64 (30.3)
V	49 (23.2)
Religion	
Hindu	146 (69.2)
Muslim	41 (19.4)
Christians	24 (11.4)
Marital status	
Married	137 (64.9)
Unmarried	4 (1.9)
Divorced	1 (0.5)
Separated/Spouse died	69 (32.7)
Education	
Illiterate	55 (26.1)
Primary school	51 (24.2)
Middle school	45 (21.3)
High school	41 (19.4)
Higher secondary	12 (5.7)
Degree	7 (3.3)

were single which includes unmarried, widow (er), divorced, and separated. The average number of family members was found to be 3.4. A family history of diabetes was found to be present among 49.3%.

History of smoking was found in 12.3%, alcohol usage in 13.3%, and the majority preferred a mixed diet (91.9%). A good proportion of participants engaged in regular physical activity (46%). The average duration of diabetes was found to be 6.3 ± 5.4 years among the study participants. Three fourth of the participants are taking treatment for at least one comorbidity. Among these, majority of the diabetic patients are taking treatment for hypertension (71.1%) followed by dyslipidemia (9.0%) and heart disease (6.6%). Regarding current treatment for diabetes, the majority of the participants are on oral hypoglycemic drugs (92.9%) alone. Around 6.2% of the study participants had a previous history of foot ulcers.

Only 22.3% of the participants received advice on foot care practices and most of them (61.7%) had received information from multiple sources, followed by physicians (23.4%). A sizable proportion (52.1%) of participants had at least one of the neuropathy symptoms.

Knowledge on diabetes: The mean percentage score of knowledge on diabetes and foot care among study participants was found to be 59.6 ± 27.5 [Table 2].

Foot self-care practices: The mean percentage score of foot self-care practice was found to be 55.1 ± 11.9 [Table 2]. Around half of the participants (51.7%) are inspecting their feet daily. All these diabetics are inspecting their feet by themselves without any help from others and not using a mirror to inspect their feet. 70% of the diabetics walk occasionally without footwear. Majority (97.6%) wore open type footwear, 96.2% appropriate sized footwear, 62.1% inspect their footwear daily, 65.4% avoid exposure to excessive heat or cold, 14.6% uses therapeutic footwear, 9.5% wear footwear indoor, 17.1% neglected a minor foot lesion in the past, 7.1% had an injury while trimming the nail last time, 3.3% of the study participants removed the callus by themselves.

Participants with low knowledge scores and those who do not engage in regular physical activity had significant poor foot care practices. However, there was no significant association with other factors like gender, family history of diabetes, marital status, duration of diabetes, etc., [Table 3].

Examination findings: On foot examination, the majority (54.5%) of the participants had at least one of the clinical problems related to diabetic foot. The most common problem was found to be heel fissures (29.4%), followed by deformed nails (15.2%), callus (5.2%), toe web infection (3.3%), and ulcer (2.8%). Monofilament test and vibration sensation were not able to be detected by 12.3% and 15.2% of the study participants, respectively.

Discussion

Mean age of the study participants was found to be similar to a study by Pavithra *et al.*,[16] (in Southern India) where the average age was found to be 56.98 (10.54). However in another study (2019–20) the average age was found to be lower than in our study (49.37 ± 1.16).[17] Similar to a study in Tamil Nadu, in our study also females participants were more common than males.[11] However, in other studies, male diabetics are more than females.[16,18]

Similar to a study by Verma *et al.*,[18] (Haryana, India in 2019) around half of our study participants had a family history of diabetes. Mean duration of diabetes in our study is similar to a study in Tamil Nadu (2015), where the mean duration was 6.64 ± 10.52 years.[11] In the present study the history of previous ulcer was low compared to a study by Verma *et al.*,[18] where the previous history of ulcer was found to be 14%. In the present study almost three fourth of the diabetics are taking treatment for a comorbidity or a chronic disease. 53.2% of participants had health problems other than diabetics.[6] Hypertension was the most common comorbidity in our study. In a multicentre study in India, hypertension among diabetics was found to be 34%.[19]

In the present study, more than half of the diabetic patients had a good knowledge score which is similar to other studies.[16,18] Health education activities may be undertaken at the primary care level as the

Table 2: Mean percentage score for knowledge and foot self-care practice

	Mean (SD)	Median (Range)
Knowledge score	59.58 (27.53)	57.14 (0–100)
Foot self-care practice score	55.13 (11.89)	26.67 (26.67–80)

Table 3: Factors associated with poor foot self-care practices

Characteristics	Foot Self-care		OR (95% CI)
	Poor *n* (%)	Good *n* (%)	
Sex			
Male	25 (32.9)	51 (67.1)	1.21 (0.66–2.21)
Female	39 (28.9)	96 (71.1)	
Marital status			
Married	39 (28.5)	98 (71.5)	0.78 (0.43–1.43)
Single	25 (33.8)	49 (66.2)	
Family history of diabetes			
Yes	28 (26.9)	76 (73.1)	0.73 (0.40–1.31)
No	36 (33.6)	71 (66.4)	
Smoking			
Present	8 (30.8)	18 (69.2)	1.02 (0.42–2.49)
Absent	56 (30.3)	129 (69.7)	
Alcohol			
Present	9 (32.1)	19 (67.9)	1.10 (0.47–2.59)
Absent	55 (30.1)	128 (69.9)	
Diet			
Vegetarian	5 (29.4)	12 (70.6)	0.95 (0.32–2.83)
Mixed	59 (30.4)	135 (69.6)	
Physical activity			
No	44 (38.6)	70 (61.4)	2.42 (1.30–4.49)*
Yes	20 (20.6)	77 (79.4)	
Duration of diabetes			
≤6 years	43 (32.3)	90 (67.7)	1.30 (0.70–2.41)
>6 years	21 (26.9)	57 (73.1)	
Presence of comorbidity			
Present	52 (32.5)	108 (67.5)	1.56 (0.76–3.24)
Absent	12 (23.5)	39 (76.6)	
Current treatment			
Oral agents	60 (30.6)	136 (69.4)	1.21 (0.37–3.96)
Oral agents + insulin	4 (26.7)	11 (73.3)	
History of previous ulcer			
Present	3 (23.1)	10 (76.9)	0.67 (0.18–2.54)
Absent	61 (30.8)	137 (69.2)	
Received advice on foot care			
Yes	11 (23.4)	36 (76.6)	0.64 (0.30–1.36)
No	53 (32.3)	111 (67.7)	
Knowledge score			
≤50%	37 (42.1)	51 (57.9)	2.58 (1.41–4.71)**
>50%	27 (21.9)	96 (78.1)	

*p value - 0.007; **p value- 0.002; OR = Odds Ratio, CI = Confidence Interval, #single includes unmarried, widow(er), Divorced, Separated

majority of the diabetic patients are taking medication from primary health centers. Imparting knowledge at the primary care level will bring behavioral change and improve the practices. The knowledge score in the present study is higher than the scores reported in other studies.[6,20] In another study by Singh *et al.*,[21] it was concluded that there is a lack of awareness about diabetes and its complications and they recommended to create awareness on diabetic foot.

Mean percentage score of foot care practices in the current study is comparable with other studies.[6,16] Half of our study participants are inspecting their feet daily. In a multicentre study, it was found that 71.4% of urban and 76% of rural populations inspected their feet daily and 54% of the people wore footwear all the time.[22] In another multicentre study in India, it was found that 65% of type 2 diabetics do not follow foot care practices and 90% of subjects wore footwear outdoors and 3% wore footwear indoors. Barefoot walking is practiced by 7% of the study subjects.[19] In our study around 10% of diabetics wear footwear indoors. In general, wearing footwear indoors is not practiced here. Diabetic patients who walk barefoot for any reason may be advised on the importance of footwear. Less than half of the participants dry their feet between the toes after washing and inspect their footwear before wearing it.[23] Educating the diabetic patients on foot care practices and the right methods of use of footwear will help the patients to prevent callosity and foot ulcers.

In our study good knowledge and regular physical activity are positively associated with good foot self-care practices. Higher education, higher physical activity, and previous history of diabetic foot ulcers were found to be significant predictors of good foot care practices.[18] In another study, good practice score was found among secondary schooling and patients on insulin.[16] Less education, poor socioeconomic status, and unawareness of foot care were contributing to improper footwear practices.[10]

Neuropathy was the most common complication associated with the diabetic foot.[24] Sensation to vibration was detected in 34.7% of the diabetics attending follow-up visits.[6] In the present study, sensation to vibration was not able to detect by around 15% of the diabetics and not able to detect the monofilament by 12%. These findings are comparable with the multicentric study by Viswanathan *et al.*[19] in India, where the prevalence of neuropathy was found to be 15%, in the same study prevalence of infection and amputation was found to be 7.6% and 3% respectively. Among the diabetic foot ulcer patients, peripheral neuropathy was found to be in the range of 49.5–66.6%.[25-27] In our study, more than half of the participants had at least any one of the clinical findings related to diabetic foot. At the primary care level, checking for the presence of peripheral neuropathy and foot examination may be given special importance. This will help in the prevention of diabetic foot. There is a definite need to improve the knowledge of diabetic patients regarding foot care practices. Hence, every follow-up visit at the primary care level may be utilized for reinforcing the foot care practices.

The majority (67.6%) of the diabetic patients had callus.[6] In our study, the prevalence of foot ulcer was found to be 2.8%. The prevalence of diabetic ulcer is found to be low compared to other studies where the prevalence ranges from 2.9 to 14.8%.[6,8,28]

Conclusion

Diabetics having good knowledge on foot care and involving in regular physical activity showed good foot self-care practices.

Though our study participants follow good foot care practices still it has provision to improve. Continuous health education of diabetic patients on indoor and outdoor foot care practices will help them to improve their foot health and avoid complications. This can be accomplished at the primary care level by enhancing their knowledge about appropriate lifestyle modifications. Regular foot examination at the primary health level will lead to early detection and treatment of diabetic foot and prevent serious complications.

Ethical policy and Institutional Review board statement

Institutional ethical committee clearance was obtained.

Patient declaration of consent statement

Obtained.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. International Diabetes Federation. IDF Diabetes Atlas, 10th ed. Brussels, Belgium; 2021. Available from: https://www.diabetesatlas.org/. [Last accessed on 2022 Mar 04].
2. World health statistics 2022: Monitoring health for the SDGs, sustainable development goals. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.
3. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. Indian J Ophthalmol 2021;69:2932-8.
4. Unnikrishnan R, Anjana RM, Mohan V. Diabetes mellitus and its complications in India. Nat Rev Endocrinol 2016;12:357-70.
5. Das A, Pendsey S, Abhyankar M, Malabade R. Management of diabetic foot in an indian clinical setup: An opinion survey. Cureus 2020;12:e8636. doi: 10.7759/cureus.8636.
6. Deribe B, Woldemichael K, Nemera G. Prevalence and factors influencing diabetic foot ulcer among diabetic patients attending Arbaminch Hospital, South Ethiopia. J Diabetes Metab 2014;5:1-7.
7. Mariam TG, Alemayehu A, Tesfaye E, Mequannt W, Temesgen K, Yetwale F, *et al.* Prevalence of diabetic foot ulcer and associated factors among adult diabetic patients who attend the diabetic follow-up clinic at the University of Gondar Referral Hospital, North West Ethiopia, 2016: Institutional-based cross-sectional study. J Diabetes Res 2017;2017:2879249.
8. Saurabh S, Sarkar S, Selvaraj K, Kar SS, Kumar SG, Roy G. Effectiveness of foot care education among people with type 2 diabetes in rural Puducherry, India. Indian J Endocrinol Metab 2014;18:106-10.
9. Dhandapani S, Kambar S, Hiremath MB. Practice and associated factors regarding foot care among diabetes mellitus patients attending a rural primary health center in South India. Adv Biomed Res 2022;11:45.
10. Taksande BA, Thote M, Jajoo UN. Knowledge, attitude, and practice of foot care in patients with diabetes at central rural India. J Family Med Prim Care 2017;6:284-7.
11. Selvakumar S, Shah PB. Awareness and practice regarding foot self-care among patients of known type 2 diabetes mellitus in a rural area. Int J Community Med Public Health 2016;3:861-4.
12. Bus SA, Lavery LA, Monteiro-Soares M, Rasmussen A, Raspovic A, Sacco IC, *et al.* International Working Group on the Diabetic Foot. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). Diabetes Metab Res Rev 2020;36(Suppl 1):e3269. doi: 10.1002/dmrr. 3269.
13. Indian Council of Medical Research. ICMR Guidelines for management of type 2 diabetes 2018. New Delhi: Indian Council of Medical Research; 2018. Available from: https://main.icmr.nic.in/sites/default/files/guidelines/ICMR_GuidelinesType2diabetes2018_0.pdf. [Last accessed on 2022 Mar 03].
14. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA, *et al.* Practical Guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). Diabetes Metab Res Rev 2020;36:e3266. doi: 10.1002/dmrr. 3266.
15. Kapadiya J, Sampath N, Chhabra KG, Chaudhary P. Modified BG Prasad classification for socioeconomic scale updated-2022. Indian J Public Health 2022;66:530.
16. Pavithra H, Akshaya KM, Nirgude AS, Balakrishna AG. Factors associated with awareness and practice about foot care among patients admitted with diabetes mellitus: A cross sectional research from a medical college hospital of southern India. Nepal J Epidemiol 2020;10:897-904.
17. Shamim M, Alhakbani MS, Alqahtani MS, Alharthi OS, Alhaqbani YJ. Knowledge, attitude, and practice regarding diabetic foot care among Saudi and non-Saudi diabetic patients in Alkharj. J Family Med Prim Care 2021;10:859-64.
18. Verma M, Sharma N, Rashi VA, Bashar MA, Nath B, Kalra S. Diabetic foot care knowledge and practices in rural North India: Insights for preventive podiatry. J Assoc Physicians India 2021;69:22-6.
19. Viswanathan V, Thomas N, Tandon N, Asirvatham A, Rajasekar S, Ramachandran A, *et al.* Profile of diabetic foot complications and its associated complications-a multicentric study from India. J Assoc Physicians India 2005;53:933-6.
20. Pourkazemi A, Ghanbari A, Khojamli M, Balo H, Hemmati H, Jafaryparvar Z, *et al.* Diabetic foot care: Knowledge and practice. BMC Endocr Disord 2020;20:1-8.
21. Singh S, Jajoo S, Shukla S, Acharya S. Educating patients of diabetes mellitus for diabetic foot care. J Family Med Prim Care 2020;9:367-73.
22. Dixit S, Maiya A, Khetrapal H, Agrawal B, Vidyasagar S, Umakanth S. A questionnaire based survey on awareness of diabetic foot care in Indian population with diabetes: A cross-sectional multicentre study. Indian J Med Sci 2011;65:411-23.
23. Olowo S, Iramiot JS, Ssenyonga LV. Knowledge of diabetic foot complication, self-care beliefs and practices among patients attending a tertiary hospital in Eastern Uganda. Int J Afr Nurs Sci 2022;16:100402.
24. Mohammad Omar Shah, HuzaifaNazir Tak, MS Moosabba. Demographic Profile of Diabetic Foot Ulcers. International

Journal of Health and Clinical Research 2021;4:28-30.

25. Jyothylekshmy V, Menon AS, Abraham S. Epidemiology of diabetic foot complications in a podiatry clinic of a tertiary hospital in South India. Indian J Health Sci Biomed Res (KLEU) 2015;8:48-51.
26. Anand A, Biswal I, Soni RK, Sinha A, Rynga D, Deb M. A clinico-microbiological study of diabetic foot ulcer patients to identify risk factors and their correlation with prognosis in tertiary care hospital in India. Int Surg J 2016;3:669-73.
27. Zubair M, Malik A, Ahmad J. Clinico-bacteriology and risk factors for the diabetic foot infection with multidrug resistant microorganisms in north India. Biol Med 2010;2:22-34.
28. Shahi SK, Kumar A, Kumar S, Singh SK, Gupta SK, Singh TB. Prevalence of diabetic foot ulcer and associated risk factors in diabetic patients from North India. J Diabet Foot Complicat 2012;4:83-91.