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**Original Research Article**

# A prospective study of analyzing foot wear practice in patients with diabetic foot problems

**Amit Kumar C. Jain*, Rajagopalan S.**

Department of Surgery, Rajarajeswari Medical College, Bangalore, Karnataka, India

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***Correspondence:**
Dr. Amit Kumar C. Jain,
E-mail: dramitkumarcj@yahoo.in



## ABSTRACT

**Background:** The aim is to study usage and type of footwear practices in patients with diabetic foot and assess their socioeconomic status of these patients.
**Methods:** A prospective descriptive study was carried out in the Department of Surgery of Rajarajeswari Medical College, Bangalore, India. The study period was for 6 months.
**Results:** A total of 38 patients were included in this study. There were 30 males (78.9%) and 8 females (21.1%). Majority of patients (47.4%) were illiterate and around 31.6% of the patient's education was less than 10th standard. Only 2.6% of them had completed their degree. Majority of patients had type 1 diabetic foot complication accounting for 50 % of patients. Only 5.3% of patients were on therapeutic foot wear with 94.7% using inappropriate footwear. 81.6 % of patients walked barefoot outside house and 94.7% walked barefoot inside the house with only 5.3% of patients use some footwear even in house. Only 15.8% of patients with diabetic foot had received advice on footwear by their doctors.
**Conclusions:** Diabetic foot is often neglected by patients and health care professionals. Except for 5.3% who used therapeutic footwear, 94.7% of the patients with diabetic foot were on inappropriate footwear. 81.6 % of patients walked barefoot outside house and 94.7% walked barefoot inside the house. Only 10.5% of patients change their footwear every year. None of the patients after surgery received any foot wear advice.

**Keywords:** Amputation, Barefoot, Diabetic foot, Footwear

## INTRODUCTION

It is estimated that around 387 million people worldwide are diagnosed with diabetes mellitus.[1] India is estimated to have 61.3 million diabetics, which is projected to be more than 100 million by the year 2030.[2] By the time diabetes mellitus is diagnosed, more than 10% of patients would have one or two risk factors like neuropathy or peripheral vascular disease.[3]

Diabetes mellitus and its complication like foot problems results in increased morbidity, cost of treatment and mortality.[2] It's believed that annually one million limb amputations occur worldwide due to diabetic foot.[1]

Prevention of diabetic foot complication is thus an important health care strategy. Patient education and foot care are very important measures that reduce foot complications.[4] However, literature suggests that many of these do not happen in practice.[4]

Footwear usage is one of the important modalities of foot care in order to maintain a good foot health and protect it from trauma.[5] Once the patient has diabetic foot, the usage of footwear by patient becomes essential. This

study was planned to assess and analyze the footwear practice by patients with established diabetic foot complications.

## METHODS

A prospective descriptive study was carried out in the Department of Surgery, Rajarajeswari Medical College, Bangalore, India. This is a tertiary care teaching hospital that caters to Bangalore.

The study period was from July 2017 to Dec 2017. All diabetic foot patients who visited our OPD for regular dressing for diabetic foot complications and were treated by our Department were included in this study. Patients operated elsewhere were excluded from this study.

This study was approved by our Institutional Ethics Committee [RRMCH –IEC/161/2016-2017].

Data analysis: Data was analyzed using statistical software SPSS 18.0 and R environment Ver.3.2.2. Microsoft word and excel were used for general graphs and tables. Both descriptive and inferential statistical analysis was carried out in this study.

Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumption on data is made.

*Assumptions*

- Dependent variables should be normally distributed,
- Samples drawn from the population should be random, Cases of the samples should be independent.[6-8]

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis.

Fisher exact test was used when cell samples were very small.

Significant figures

- + Suggestive significance (P value: 0.05<P<0.10)
- Moderately significant (P value:0.01<P 0.05)
- ** Strongly significant (P value: P≤0.01).

## RESULTS

A total of 38 patients were included in this study. There were 30 males (78.9%) and 8 females (21.1%) (Figure 1) with age ranging from 31 years - 85 years with mean age 56.66±12.29 (Table 1).

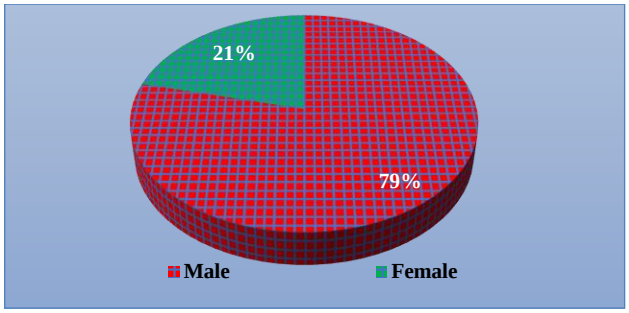


**Figure 1: Distribution of gender.**

**Table 1: Age distribution of patients studied.**

| Age in years | No. of patients | % |
|---|---|---|
| 31-40 | 3 | 7.9 |
| 41-50 | 12 | 31.6 |
| 51-60 | 10 | 26.3 |
| 61-70 | 9 | 23.7 |
| 71-80 | 3 | 7.9 |
| >80 | 1 | 2.6 |
| Total | 38 | 100.0 |

Majority of patients (47.4%) were illiterate and around 31.6% of the patient's education was less than 10th standard. Only 2.6% of them had completed their degree (Table 2).

**Table 2: Education distribution of patients studied.**

| Education | No. of patients | % |
|---|---|---|
| Illiterate | 18 | 47.4 |
| Less than 10th std | 12 | 31.6 |
| SSLC completed | 6 | 15.8 |
| PUC | 1 | 2.6 |
| Degree | 1 | 2.6 |
| Total | 38 | 100.0 |

Most patients (39.5%) of diabetes mellitus were between 1- 10 years range with 7.9% of them having diabetes of more than 20 years duration (Figure 2).

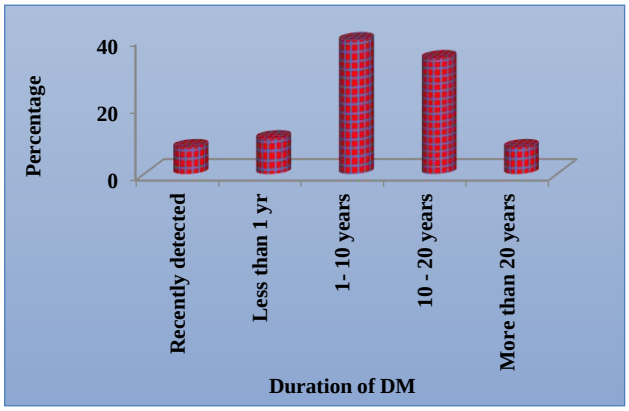


**Figure 2: Distribution of duration of diabetes mellitus among patients.**

7.9% of the patients had recently detected diabetes whereas 34.2% had diabetes of 10 -20 years duration. Majority of patients had type 1 diabetic foot complication accounting for 50 % of patients followed by 42.1% of them having type 3 diabetic foot complication (Figure 3). The reason of type 3 diabetic foot complications being slightly high in this study could be because of patients coming from long periods for dressings due to longstanding problem.

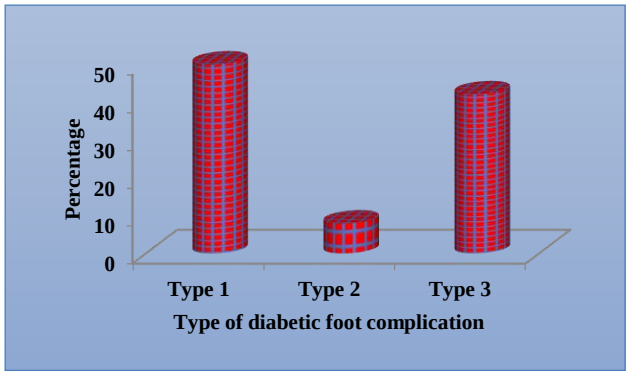


**Figure 3: Distribution of cases according to Amit Jain's types of diabetic foot complication.**

Around 7 patients (18.4%) already had previous history of amputation (Figure 4).

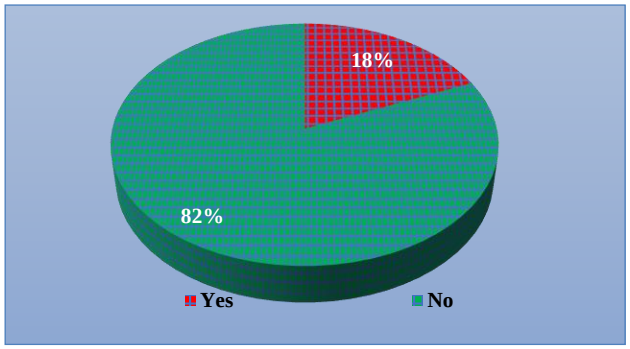


**Figure 4: History of previous amputations in the patient.**

50% of patients were treated by general practitioners prior to getting operated for diabetic foot complication and around 26.7% were treated by internal medicine specialist (Physicians). 18.4% of patients did not consult any doctor from past 1 year before developing diabetic foot problems (Table 3).

**Table 3: Doctors who were seeing the patients prior to surgical intervention.**

| Doctor seen | No. of patients | % |
|---|---|---|
| GP | 19 | 50.0 |
| Physician | 10 | 26.3 |
| Surgeon | 2 | 5.3 |
| None | 7 | 18.4 |
| Total | 38 | 100.0 |

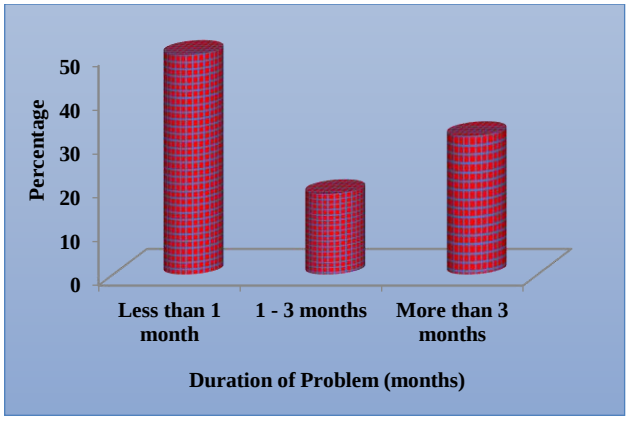


**Figure 5: Duration of diabetic foot problems in patients.**

19 patients (50%) had diabetic foot problem of one-month duration whereas 31.6% were having wounds for more than 3 months durations and they were reporting for dressing (Figure 5).

The commonest surgical procedure (Table 4) done was debridement (39.5) followed by toe amputation (36.8%). Major amputation was performed in 10.5% of patients.

**Table 4: Surgical procedures done on patients.**

| Surgery done | No. of patients | % |
|---|---|---|
| Debridement | 15 | 39.5 |
| Toe amputation | 14 | 36.8 |
| TMT | 4 | 10.5 |
| Major amputation | 4 | 10.5 |
| Conservative | 1 | 2.6 |
| Total | 38 | 100.0 |

Overall, around 22 patients (57.9%) underwent some form of amputation (Figure 6).

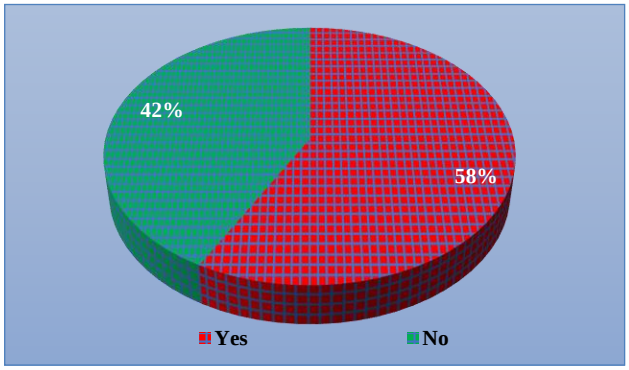


**Figure 6: Patients undergoing recent amputation.**

21 patients were on ordinary slippers (55.3%) and 12 patients (31.6%) were in Hawaii slippers (Table 5). Only 5.3% of patients were on therapeutic foot wear (diabetic foot wear). 2.6% of patients were either on ordinary shoes or sandals each.

**Table 5: Type of footwear used and distribution of patients studied.**

| Type of footwear used | No. of patients | % |
|---|---|---|
| Hawaii slippers | 12 | 31.6 |
| Ordinary slippers | 21 | 55.3 |
| Shoes (ordinary) | 1 | 2.6 |
| Therapeutic foot wear | 2 | 5.3 |
| No footwear | 1 | 2.6 |
| Sandals | 1 | 2.6 |
| Total | 38 | 100.0 |

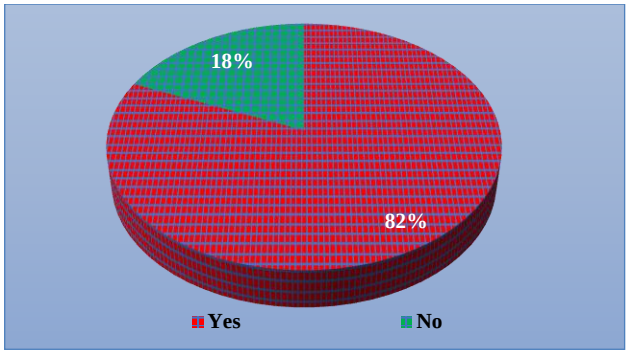


**Figure 7: Patients walking barefoot.**

**Table 6: Association of clinical and baseline variables in relation to barefoot walking outside house.**

| Variables | Bare-foot outside | | Total (n=38) | P value |
|---|---|---|---|---|
| | Yes (n=31) | No (n=7) | | |
| **Age in years** | | | | |
| 31-40 | 3 (9.7%) | 0 (0%) | 3 (7.9%) | 0.382 |
| 41-50 | 11 (35.5%) | 1 (14.3%) | 12 (31.6%) | |
| 51-60 | 6 (19.4%) | 4 (57.1%) | 10 (26.3%) | |
| 61-70 | 8 (25.8%) | 1 (14.3%) | 9 (23.7%) | |
| 71-80 | 2 (6.5%) | 1 (14.3%) | 3 (7.9%) | |
| >80 | 1 (3.2%) | 0 (0%) | 1 (2.6%) | |
| **Gender** | | | | |
| Male | 23 (74.2%) | 7 (100%) | 30 (78.9%) | 0.307 |
| Female | 8 (25.8%) | 0 (0%) | 8 (21.1%) | |
| **Education** | | | | |
| Illiterate | 15 (48.4%) | 3 (42.9%) | 18 (47.4%) | 0.204 |
| Less than 10th std | 11 (35.5%) | 1 (14.3%) | 12 (31.6%) | |
| SSLC completed | 4 (12.9%) | 2 (28.6%) | 6 (15.8%) | |
| PUC | 0 (0%) | 1 (14.3%) | 1 (2.6%) | |
| Degree | 1 (3.2%) | 0 (0%) | 1 (2.6%) | |
| **Duration of DM** | | | | |
| Recently detected | 3 (9.7%) | 0 (0%) | 3 (7.9%) | 0.140 |
| Less than 1 year | 4 (12.9%) | 0 (0%) | 4 (10.5%) | |
| 1- 10 years | 11 (35.5%) | 4 (57.1%) | 15 (39.5%) | |
| 10 - 20 years | 12 (38.7%) | 1 (14.3%) | 13 (34.2%) | |
| More than 20 years | 1 (3.2%) | 2 (28.6%) | 3 (7.9%) | |
| **Type of diabetic foot complication** | | | | |
| Type 1 | 16 (51.6%) | 3 (42.9%) | 19 (50%) | 0.688 |
| Type 2 | 2 (6.5%) | 1 (14.3%) | 3 (7.9%) | |
| Type 3 | 13 (41.9%) | 3 (42.9%) | 16 (42.1%) | |
| **History of previous amputation** | | | | |
| Yes | 5 (16.1%) | 2 (28.6%) | 7 (18.4%) | 0.592 |
| No | 26 (83.9%) | 5 (71.4%) | 31 (81.6%) | |
| **Doctor seen** | | | | |
| GP | 15 (48.4%) | 4 (57.1%) | 19 (50%) | 1.000 |
| Physician | 8 (25.8%) | 2 (28.6%) | 10 (26.3%) | |
| Surgeon | 2 (6.5%) | 0 (0%) | 2 (5.3%) | |
| None | 6 (19.4%) | 1 (14.3%) | 7 (18.4%) | |
| **Type of footwear used** | | | | |
| Hawaii slippers | 11 (35.5%) | 1 (14.3%) | 12 (31.6%) | 0.245 |
| Ordinary slippers | 17 (54.8%) | 4 (57.1%) | 21 (55.3%) | |
| Shoes | 0 (0%) | 1 (14.3%) | 1 (2.6%) | |
| Therapeutic foot wear | 1 (3.2%) | 1 (14.3%) | 2 (5.3%) | |
| No footwear | 1 (3.2%) | 0 (0%) | 1 (2.6%) | |
| Sandals | 1 (3.2%) | 0 (0%) | 1 (2.6%) | |

81.6% of them gave history of walking barefoot outside house compound frequently (Figure 7).

There was no significant association of barefoot walking in regard to age, gender, education status of patients, duration of diabetes, type of diabetic foot complication, history of prior amputation, doctors consulted, or type of footwear worn (Table 6).

Only 5.3% of patients used some footwear some footwear at home with 94.7% walking barefoot even in house and within house compound (Figure 8).

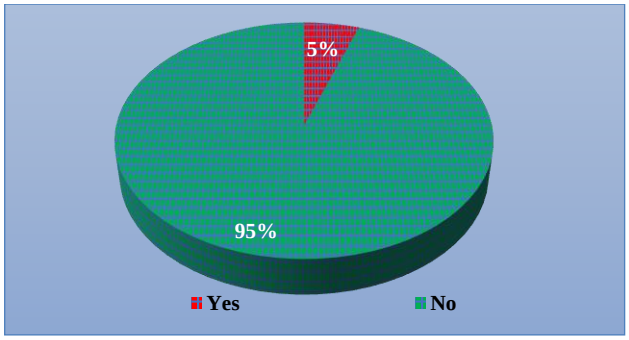


**Figure 8: Usage of in-house foot wear among patients.**

**Table 7: Association of clinical and baseline variables in relation to in house footwear used of patients studied.**

| Variables | In house footwear used | | Total (n=38) | P value |
|---|---|---|---|---|
| | Yes (n=2) | No (n=36) | | |
| **Age in years** | | | | |
| 31-40 | 1 (50%) | 2 (5.6%) | 3 (7.9%) | 0.151 |
| 41-50 | 0 (0%) | 12 (33.3%) | 12 (31.6%) | |
| 51-60 | 0 (0%) | 10 (27.8%) | 10 (26.3%) | |
| 61-70 | 1 (50%) | 8 (22.2%) | 9 (23.7%) | |
| 71-80 | 0 (0%) | 3 (8.3%) | 3 (7.9%) | |
| >80 | 0 (0%) | 1 (2.8%) | 1 (2.6%) | |
| **Gender** | | | | |
| Male | 2 (100%) | 28 (77.8%) | 30 (78.9%) | 1.000 |
| Female | 0 (0%) | 8 (22.2%) | 8 (21.1%) | |
| **Education** | | | | |
| Illiterate | 1 (50%) | 17 (47.2%) | 18 (47.4%) | 1.000 |
| Less than 10th std | 1 (50%) | 11 (30.6%) | 12 (31.6%) | |
| SSLC completed | 0 (0%) | 6 (16.7%) | 6 (15.8%) | |
| PUC | 0 (0%) | 1 (2.8%) | 1 (2.6%) | |
| Degree | 0 (0%) | 1 (2.8%) | 1 (2.6%) | |
| **Duration of DM** | | | | |
| Recently detected | 0 (0%) | 3 (8.3%) | 3 (7.9%) | 0.723 |
| Less than 1 year | 0 (0%) | 4 (11.1%) | 4 (10.5%) | |
| 1- 10 years | 2 (100%) | 13 (36.1%) | 15 (39.5%) | |
| 10 - 20 years | 0 (0%) | 13 (36.1%) | 13 (34.2%) | |
| More than 20 years | 0 (0%) | 3 (8.3%) | 3 (7.9%) | |
| **Type of diabetic foot complication** | | | | |
| Type 1 | 0 (0%) | 19 (52.8%) | 19 (50%) | 0.073+ (significant) |
| Type 2 | 1 (50%) | 2 (5.6%) | 3 (7.9%) | |
| Type 3 | 1 (50%) | 15 (41.7%) | 16 (42.1%) | |
| **History of previous amputation** | | | | |
| Yes | 1 (50%) | 6 (16.7%) | 7 (18.4%) | 0.339 |
| No | 1 (50%) | 30 (83.3%) | 31 (81.6%) | |
| **Doctor seen** | | | | |
| GP | 0 (0%) | 19 (52.8%) | 19 (50%) | 0.050+ (significant) |
| Physician | 1 (50%) | 9 (25%) | 10 (26.3%) | |
| Surgeon | 1 (50%) | 1 (2.8%) | 2 (5.3%) | |
| None | 0 (0%) | 7 (19.4%) | 7 (18.4%) | |
| **Type of FOOTWEAR used** | | | | |
| Hawaii slippers | 1 (50%) | 11 (30.6%) | 12 (31.6%) | 0.189 |
| Ordinary slippers | 0 (0%) | 21 (58.3%) | 21 (55.3%) | |
| Shoes (ordinary) | 0 (0%) | 1 (2.8%) | 1 (2.6%) | |
| Therapeutic foot wear | 1 (50%) | 1 (2.8%) | 2 (5.3%) | |
| No footwear | 0 (0%) | 1 (2.8%) | 1 (2.6%) | |
| Sandals | 0 (0%) | 1 (2.8%) | 1 (2.6%) | |

It was seen that patients walking in-house barefoot had higher incidence of type 1 diabetic foot complication (P - 0.073+, significant).

It was also seen that in house barefoot walkers who developed complications had significant association with doctors seen by them being general practitioners and physician (P-0.05+, significant). There was no association between in-house barefoot walking in relation to gender, age, education status, type of footwear used commonly and duration of diabetes mellitus (Table 7).

Only 15.8% of patients with diabetic foot had received advice on footwear by their health care professionals with 84.2% not receiving any footwear advice (Figure 9).

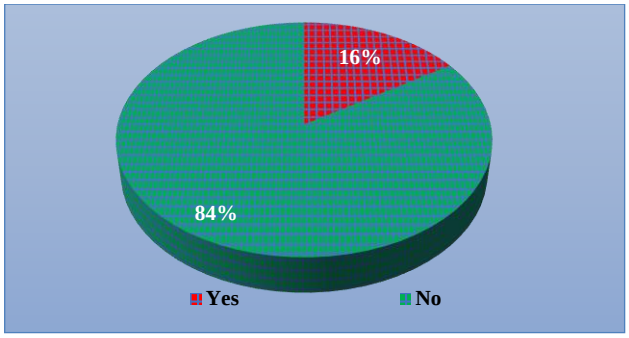


**Figure 9: Patients who received footwear advice.**

There was no significant association between footwear advice in regard to gender, education, diabetes mellitus duration, history of previous amputation, doctors consulted, recent amputation or foot wear used (Table 8).

**Table 8: Association of clinical and baseline variables in relation to any footwear advice given to patients.**

| Variables | Any footwear advice given | | Total (n=38) | P value |
|---|---|---|---|---|
| | Yes (n=6) | No (n=32) | | |
| Male | 6 (100%) | 24 (75%) | 30 (78.9%) | 0.309 |
| Female | 0 (0%) | 8 (25%) | 8 (21.1%) | |
| **Education** | | | | |
| Illiterate | 3 (50%) | 15 (46.9%) | 18 (47.4%) | 0.311 |
| Less than 10th std | 2 (33.3%) | 10 (31.3%) | 12 (31.6%) | |
| SSLC completed | 0 (0%) | 6 (18.8%) | 6 (15.8%) | |
| PUC | 0 (0%) | 1 (3.1%) | 1 (2.6%) | |
| Degree | 1 (16.7%) | 0 (0%) | 1 (2.6%) | |
| **Duration of DM** | | | | |
| Recently detected | 0 (0%) | 3 (9.4%) | 3 (7.9%) | 0.742 |
| Less than 1 yr | 1 (16.7%) | 3 (9.4%) | 4 (10.5%) | |
| 1- 10 years | 2 (33.3%) | 13 (40.6%) | 15 (39.5%) | |
| 10 - 20 years | 2 (33.3%) | 11 (34.4%) | 13 (34.2%) | |
| More than 20 years | 1 (16.7%) | 2 (6.3%) | 3 (7.9%) | |
| **History of previous amputation** | | | | |
| Yes | 1 (16.7%) | 6 (18.8%) | 7 (18.4%) | 1.000 |
| No | 5 (83.3%) | 26 (81.3%) | 31 (81.6%) | |
| **Doctor seen** | | | | |
| GP | 2 (33.3%) | 17 (53.1%) | 19 (50%) | 0.596 |
| Physician | 3 (50%) | 7 (21.9%) | 10 (26.3%) | |
| Surgeon | 0 (0%) | 2 (6.3%) | 2 (5.3%) | |
| None | 1 (16.7%) | 6 (18.8%) | 7 (18.4%) | |
| **Recent amputation done** | | | | |
| Yes | 2 (33.3%) | 20 (62.5%) | 22 (57.9%) | 0.217 |
| No | 4 (66.7%) | 12 (37.5%) | 16 (42.1%) | |
| **Type of Footwear used** | | | | |
| Hawaii slippers | 1 (16.7%) | 11 (34.4%) | 12 (31.6%) | 0.117 |
| Ordinary slippers | 3 (50%) | 18 (56.3%) | 21 (55.3%) | |
| Shoes | 0 (0%) | 1 (3.1%) | 1 (2.6%) | |
| Therapeutic foot wear | 2 (33.3%) | 0 (0%) | 2 (5.3%) | |
| No footwear | 0 (0%) | 1 (3.1%) | 1 (2.6%) | |
| Sandals | 0 (0%) | 1 (3.1%) | 1 (2.6%) | |

None of the patients had footwear advice after the surgical intervention in this study even by the treating surgical team.

Majority of patients (36.8%) change their footwear once in 3 years followed by 23.7% who change their foot wear

once in 4 years. Around 7.9% of patients change their footwear once in 5 years or more (Table 9).

**Table 9: Duration of footwear change among patients.**

| Duration of footwear change | No. of patients | % |
|---|---|---|
| 1 | 4 | 10.5 |
| 2 | 8 | 21.1 |
| 3 | 14 | 36.8 |
| 4 | 9 | 23.7 |
| 5 | 3 | 7.9 |
| Total | 38 | 100.0 |

## DISCUSSION

Footwear plays an important role in the management of foot problems.[5] It is often considered to be one of the most common interventions for biomechanical abnormalities of the foot.[10]

Footwear serves to protect the feet, reduce abnormal pressure and limits formation of ulcers.[10] There has been recommendation on use of usage of footwear for different risk level in western literature.[10] Often usage of appropriate footwear has been advised.[11]

However, in practice the realities seem to be different. People with poor knowledge and practice regarding diabetic foot care are known to have higher diabetic foot complication.[2]

It was reported that high risk patients were less likely to wear their prescribed footwear in home when compared to outside.[12] Often, patients have also been found to use inappropriate footwear like Hawaii chappals.[13]

**Figure 10: Ordinary slippers used by male patients.**

In Chandalia et al series, unsafe footwear were prevalent in 46.9% of diabetic and 71% of non-diabetics. In present study, where the patients already have established diabetic foot complications, usage of inappropriate footwear was high.[13]

55.3% used ordinary chappals (Figure 10) and usage of Hawaii slippers (Figure 11) was 31.6%. Around 2.6% of patients were found to use ordinary sandals (Figure 12) and ordinary shoes (Figure 13) each. Present study had high number of illiterates (47.4%).

**Figure 11: Hawaii slippers used by the diabetic foot patient.**

**Figure 12: Ordinary sandals.**

**Figure 13: Ordinary shoes used by a diabetic foot patient.**

A Nigerian study showed that 38% of patients walked barefoot.[14] In Chandalia et al series, 45% walked barefoot indoors. In present study, 87.6% of patients gave history of walking barefoot outdoors and 94.7% gave history of walking barefoot in house.[13] Present study also showed that in-house barefoot walking had significantly higher prevalence of Amit Jain's type 1 diabetic foot complications.[15,16] and these patients were significantly

seen by general practitioners and physicians prior to development of diabetic foot complications.

In Trinidad, 49% of diabetic patients reported walking barefoot in the house and 23% walked barefoot outside the house.[14]

Authors have higher prevalence of barefoot walking in this series and this could be habitual, due to customs and religious factors in India of not wearing footwear in one's home. Studies have shown that barefoot walking had two-fold increases in the odds of amputation.[14] In yet another study, it was observed that 39% of people with amputation reported barefoot walking.[14] In present study, 57.9% of them underwent some amputation recently with 18.4% already had previous amputation. Although people with poor knowledge and practice of foot care have been blamed for high complication, even the health care professionals have been negligent of this disease.[2]

Present study showed that 84.2% of patients treated by doctors were never advised on footwear with only 15.8% of them being recommended for footwear usage. Majority of diabetic foot patients were seen by the general practitioners and physicians prior to developing foot complications. Further, even after surgical intervention, none of them received any advice on footwear by the surgeons.

**Figure 14: Hawaii slippers not changed for past 3 years.**

**Figure 15: Patient who was neither advised on footwear and nor did he change his sandals over past 4 years.**

It was also noted that the patients do not change their footwear frequently. Around 68.4% of the patients change their footwear once in 3 years or more (Figure 14 and 15).

One can see that the footwear is worn-out. This study is unique because there are few studies from Indian subcontinent on usage of footwear in diabetes patients but there are hardly any studies that have been done exclusively on footwear usage on patients with established diabetic foot complication.[13] There was paucity of data on actual usage of footwear and the type used in patients with diabetic foot complication and an in-depth analysis was required to know the actual status.

With just 5.3% of patients using therapeutic footwear and 2.6% of patients using shoes, authors could not analyze the footwear's in regard to its suitability like whether the heel size of foot wear was less than 2.5 cm, whether patients use shoe with 1 cm space between great toe and shoe end, whether the footwear had padded insole with the type and thickness of insole used and so on.

## CONCLUSION

Diabetic foot is undoubtedly a debilitating disease that results in amputation. Prevention and protection of foot thus become essential. There is negligence both from patients and healthcare professionals in taking things lightly in diabetic foot even in today's era of awareness and technology.

Except for 5.3% who used therapeutic footwear, 94.7% of the patients with diabetic foot were on inappropriate footwear. 81.6% of patients walked barefoot outside house and 94.7% walked barefoot inside the house. Present study also found a significant higher prevalence of type 1 diabetic foot complications in patients who walked barefoot in-house. Only 10.5% of patients change their footwear every year. None of the patients after surgery received any foot wear advice. There needs to be a joint effort by both patients and the doctors on improvement on usage of good footwear.

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