

# Foot Care Knowledge and Practices and the Prevalence of Peripheral Neuropathy Among People with Diabetes Attending a Secondary Care Rural Hospital in Southern India

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## ABSTRACT

**Background:** Diabetes mellitus is a multifaceted disease and foot ulceration is one of its most common complications. Poor foot care knowledge and practices are important risk factors for foot problems among people with diabetes. **Aims:** To assess the knowledge and practices regarding foot care and to estimate the proportion of people with peripheral neuropathy among people with diabetes. **Settings and Design:** The cross-sectional study was conducted in 212 consecutive diabetes patients attending the out-patient department of a rural secondary care hospital. **Materials and Methods:** A questionnaire which included demographic details, knowledge questionnaire, and Nottingham assessment of functional foot care was administered. The Michigan Neuropathy Screening Instrument was used to identify peripheral neuropathy. **Statistical Analysis Used:** Descriptive analysis with frequency distribution for knowledge and practice scores, univariate analysis, and multiple logistic regressions to find significant variables associated with good knowledge and practice scores. **Results:** About 75% had good knowledge score and 67% had good foot care practice score. Male gender (OR 2.36, 95% CI 1.16–4.79), poor education status (OR 2.40, 95% CI 1.19–4.28), and lesser duration of diabetes (OR 2.24, 95% CI 1.15–4.41) were significantly associated with poor knowledge on foot care. Poor knowledge was associated with poor foot care practices (OR 3.43, 95% CI 1.75–6.72). The prevalence of neuropathy was 47% (95% CI 40.14–53.85) and it was associated with longer duration of the disease (OR 2.18, 95% CI 1.18–4.04). **Conclusion:** There exist deficiencies in knowledge and practices regarding foot care. Male gender, low education, and lesser duration of diabetes are associated with poor knowledge scores. The prevalence of diabetic peripheral neuropathy is high.

**Keywords:** Diabetes, foot care, knowledge, neuropathy, practices

## Background

India is known as the “diabetes capital” of the world with more than 40 million people with diabetes.<sup>[1]</sup> Diabetes mellitus is a multifaceted disease and foot ulceration is one of its most common complications. The incidence of foot ulcers among people with diabetes ranges from 8% to 17%.<sup>[2]</sup> Foot ulcers can cause severe disability and hospitalization to patients and considerable economic burden to families and health systems.<sup>[3,4]</sup> Infection, occurring in about half of the diabetic foot ulcers, is a further complication.<sup>[5,6]</sup> About 85% of diabetes-related amputations are preceded by foot

ulcers, and it accounts for more than half of non-traumatic lower limb amputations.<sup>[5,7]</sup> Individuals who develop foot ulcers have a decreased health-related quality of life.<sup>[8,9]</sup>

Neuropathy, mechanical stresses, and angiopathy are the major aetiopathological factors in the development of foot ulcers in people with diabetes.<sup>[10]</sup> Diabetic peripheral neuropathy is a heterogeneous disorder that includes mononeuropathies, polyneuropathies, plexopathies, and radiculopathies.<sup>[11]</sup> As diabetic neuropathy frequently leads to foot ulcer, it is recommended to screen all individuals with diabetes at least annually.<sup>[12]</sup>

Of all the complications of diabetes, those that occur in the foot are considered the most preventable. Poor knowledge of foot

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care and poor foot care practices were identified as important risk factors for foot problems in diabetes.<sup>[13]</sup> Evidence suggests that consistent patient education with prophylactic foot care for those judged to be at highest risk may reduce foot ulceration and amputations.<sup>[14]</sup>

The objective of the current study was to assess the knowledge and practices regarding foot care and to estimate the proportion of people with peripheral neuropathy among people with diabetes attending a secondary care rural hospital in Tamil Nadu. The information gained on the knowledge and practices regarding foot care can aid health care providers and policy makers to develop targeted self-management education programs for people with diabetes.

## Materials and Methods

The study was conducted in Community Health and Development (CHAD) base hospital, a secondary level hospital run by the Community Health department of a medical college. The CHAD program serves a block with a population of about 100000 population. Many people in and around Vellore come to the CHAD base hospital seeking health care. The aim of the hospital is to provide good quality health care that is easily accessible, affordable, and culturally acceptable, and to serve as a model for training post-graduates in community medicine and family medicine. Average general out-patient department (OPD) attendance, including new and revisits, is around 200 per day. There is also a weekly diabetic clinic attended by approximately 40 patients each week.

A sample size of 212 was calculated using the prevalence of foot care knowledge as 32% with a relative precision of 20%.<sup>[15]</sup> Known cases of type 2 diabetes aged between 30 and 60 years, who had the disease for at least 6 months duration, attending the diabetic or general clinic of CHAD hospital were eligible to be included as participants in the study. Those with cognitive impairment and obvious disability that could affect the functions of the nervous system, affect independent self-care behavior, and those who had amputations of the lower limbs were excluded from the study. Two hundred and twelve consecutive people with diabetes attending the OPD, who were willing to participate, and gave informed consent were included in the study.

The questionnaire included demographic details, the knowledge questionnaire, and Nottingham assessment of functional foot care questionnaire. The knowledge questionnaire was developed based on a review of foot care knowledge questionnaires and was adapted to the local socio-cultural context. It had four components: Foot inspection, foot care, footwear, and nail care. The Nottingham assessment of functional foot care, which is a validated instrument for foot care practice, was used to assess the foot care practices.<sup>[16]</sup> The questionnaire was translated into the regional language and was back translated to check for consistency. It was pilot tested before use.

The Michigan Neuropathy Screening Instrument (MNSI), which had two components, the history and the physical assessment, was used to identify high risk feet.<sup>[17]</sup> The MNSI is designed to be used in an outpatient setting by primary care or other providers. The first part of the screening instrument consists of 15 self-administered “yes or no” questions on foot sensation including pain, numbness, and temperature sensitivity. A higher score (out of a maximum of 13 points) indicates more neuropathic symptoms. The second part of the MNSI is a brief physical examination involving 1) inspection of the feet for deformities, dry skin, hair or nail abnormalities, callous, or infection; 2) semi-quantitative assessment of vibration sensation at the dorsum of the great toe; 3) grading of ankle reflexes; and 4) monofilament testing. Patients screening positive on the clinical portion of the MNSI (greater than 2.5 points on a 10 point scale) were considered neuropathic. The sensitivity and specificity of MNSI with a cut-off values of 2.5 were 50% and 91%, respectively.<sup>[18]</sup>

The total and mean knowledge scores and practices scores were calculated. The study participants were categorized into two groups: Those who scored 50% or above as having good knowledge and good practices and those with less than 50% scores as having poor knowledge and poor practices. Those who scored more than 2.5 on the Michigan neuropathy screening instrument were considered as those with high risk feet. Analysis included descriptive analysis with frequency distribution for knowledge and practice scores, Chi-square test, and calculation of odds ratios by univariate analysis and multiple logistic regression to find significant variables which are associated with good knowledge and good foot care practices and the factors associated with high risk foot.

## Results

Of the study population, 61% (130/212) consisted of women. The mean age of the participants was 54.45 years (SD 6.1). Of the study participants, 25.5% (54/212) had not received any formal education. Housewives accounted for 45% (96/212) of the study participants, unskilled workers 17% (37/212) and farmers, shop owners, and clerical job holders 11.3% (24/212). The demographic details of the subjects are shown in Table 1.

The mean age at diagnosis of diabetes was 48.91 years (SD 5.4). The disease was diagnosed within the last 5 years for 54.7% (116/212) of the study participants. Of the study subjects, 81.6% (173/212) were on oral hypoglycemic agents (OHAs), 2.4% (5/212) on insulin, 1 on diet control alone and the rest were on combination of OHAs and insulin. Poor glycemic control (postprandial sugar > 180 mg/dl or HbA1C > 7.2 mmol) was noticed in 57.1% (121/212) of the subjects. Of all the study subjects, 82.1% (174/212) were regular on treatment with compliance more than 90% over the last month. Among them, 12.7% (27/212) had a history of foot ulcer. The details regarding the disease and treatment are shown in Table 2.

Of the study subjects, 74.5% (158/212) said that feet should be inspected daily and 49% (104/212) said that they should inspect the foot wear every time they wore it. The total possible maximum score for assessing knowledge was 25. The mean score obtained by the participants was 14.1 (SD 3.36). Among the participants, 75% (158/212) had score of  $\geq 50\%$ .

Of study subjects, 71.7% (152/212) said they inspected their feet once or more a day and 44.3% (94/212) said they inspected their foot wear each time they wore it. Of them, 87.3% (185/212) used

**Table 1: Demographic characteristics of the study population (N=212)**

| Demographic characteristics | Categories                                  | Number | Percentage |
|-----------------------------|---|--------|------------|
| Age                         | $\leq 45$ years                             | 48     | 22.6       |
|                             | 46-60 years                                 | 99     | 46.7       |
|                             | $>60$ years                                 | 65     | 30.7       |
| Gender                      | Male  | 82     | 38.7       |
|                             | Female                                      | 130    | 61.3       |
| Education                   | Nil   | 54     | 25.5       |
|                             | Up to 5 <sup>th</sup> grade                 | 50     | 23.6       |
|                             | 6 <sup>th</sup> to 10 <sup>th</sup> grade   | 90     | 42.5       |
|                             | 11 <sup>th</sup> and 12 <sup>th</sup> grade | 10     | 4.7        |
| Occupation                  | Graduate                                    | 8      | 3.8        |
|                             | Unemployed                                  | 2      | 0.9        |
|                             | Unskilled worker                            | 37     | 17.5       |
|                             | Semiskilled and Skilled                     | 32     | 15.1       |
|                             | Clerical, shop owner, farmer                | 24     | 11.3       |
|                             | Semi professional                           | 10     | 4.7        |
|                             | Housewife                                   | 96     | 45.3       |
| Retired                     | 11  | 5.2    |            |

**Table 2: Details regarding disease and treatment among the study population (N=212)**

| Demographic characteristics | Categories                                   | Number | Percentage |
|-----------------------------|--|--------|------------|
| Age at diagnosis            | 45 years or less                             | 86     | 40.6       |
|                             | More than 45 years                           | 126    | 59.4       |
| Duration of illness         | Less than 5 years                            | 116    | 54.7       |
|                             | 5 or more years                              | 96     | 45.3       |
| Medications                 | Only diet                                    | 1      | 0.5        |
|                             | Oral hypoglycemic drugs                      | 173    | 81.6       |
|                             | Insulin                                      | 5      | 2.4        |
|                             | Combined (oral drugs and insulin)            | 33     | 15.6       |
| Medication regularity       | Regular                                      | 174    | 82.1       |
|                             | Irregular (compliance $<90\%$ in last month) | 30     | 14.2       |
|                             | Defaulter (not taken in last month)          | 8      | 3.8        |
| Glycemic control            | Good control                                 | 91     | 42.9       |
|                             | Poor control                                 | 121    | 57.1       |
| Had/have foot ulcer         | Yes  | 27     | 12.7       |
|                             | No   | 185    | 87.3       |

to walk barefoot inside the house, while only 10.4% (22/212) said they did the same outside the house. Among the participants, 29.2% (62/212) said they regularly applied oil on their feet. The salient responses to knowledge and practices regarding foot care were shown in Table 3. The maximum possible score in foot care practice was 60 and the mean score obtained by the participants was 42.5 (SD 7.96). The proportion of people with good foot care practice ( $\geq 50\%$ ) was 67% (142/212).

The multiple logistic regression analysis showed that after adjusting for other variables, male gender (adjusted OR 2.36, 95% CI 1.16–4.79), poor education status (adjusted OR 2.40, 95% CI 1.19–4.28), and duration of diabetes less than 5 years (adjusted OR 2.24, 95% CI 1.15-4.41) were significantly associated with poor knowledge on foot care. The results are shown in Table 4.

Among the 142 participants who had good foot care practices, 11 had foot ulcers in the past (7.7%), while among the 70 participants who had poor foot care practices, 16 had foot ulcers in the past (22.9%). In the same group of 142 participants, 116 had good knowledge on foot care (81.7%), while among the other 70 participants, 42 had good knowledge on foot care (60.0%). After adjusting for age, gender, education, occupation, duration of illness, and previous history of having foot ulcers, the odds of having poor foot care practice was 3.43 times (95% CI 1.75–6.72) higher among those with poor knowledge on foot care as compared to those with good knowledge.

The maximum possible score by examination using MNSI was 10 and mean score in this study was 2.91 (SD 1.65). The prevalence of neuropathy (MNSI Score  $> 2.5$ ) was 47% (99/212) (95% CI 40.14-53.85) in the study group. After adjusting for other factors, the participants with the duration of diabetes more than 5 years have 2.18 times higher odds of having neuropathy (95% CI 1.18-4.04) as compared to those who had diabetes for less than 5 years.

## Discussion

Foot ulcers is a disabling complication and not uncommon among people with diabetes mellitus. The disability and possible progression to the amputation of digits and limbs make it a serious issue.

**Table 3: Salient responses regarding the knowledge and practices regarding foot care (N=212)**

| Question/response                                      | Number | Percentage |
|--|--------|------------|
| Feet should be inspected daily                         | 158    | 74.5       |
| Footwear should be inspected every time before wearing | 104    | 49.0       |
| Examined feet once a day or more                       | 152    | 71.7       |
| Checked foot wear before wearing them on each time     | 94     | 44.3       |
| Walk bare feet in the house often                      | 185    | 87.3       |
| Walk barefoot outside the house                        | 22     | 10.4       |
| Use oil on feet daily                                  | 62     | 29.24      |

**Table 4: Factors associated with the knowledge regarding foot care among the study participants**

| Characteristics      | Category                   | Poor (n=54) | Good (n=158) | OR (95% CI)      | Adjusted OR (95% CI) |
|----------------------|----------------------------|-------------|--------------|------------------|----------------------|
| Age                  | >=60 years                 | 25 (31.6)   | 54 (68.4)    | 1.66 (0.89-3.11) | 1.57 (0.81-3.04)     |
|                      | <60 years                  | 29 (21.8)   | 104 (78.2)   |                  |                      |
| Gender               | Male                       | 25 (30.5)   | 57 (69.5)    | 1.53 (0.82-2.86) | 2.36**(1.16-4.79)    |
|                      | Female                     | 29 (22.3)   | 101 (77.7)   |                  |                      |
| Education            | <=5 <sup>th</sup> standard | 32 (30.8)   | 72 (69.2)    | 1.74 (0.93-3.25) | 2.40**(1.19-4.82)    |
|                      | >5 <sup>th</sup> std.      | 22 (20.4)   | 86 (79.6)    |                  |                      |
| Occupation           | Unemployed/un/semi skilled | 22 (31.0)   | 49 (69.0)    | 1.53 (0.81-2.90) | 1.39 (0.65-2.98)     |
|                      | Others                     | 32 (22.7)   | 109 (77.3)   |                  |                      |
| Duration of diabetes | <5 years                   | 36 (31.0)   | 80 (69.0)    | 1.95*(1.02-3.72) | 2.24**(1.15-4.41)    |
|                      | ≥5 years                   | 18 (18.8)   | 78 (81.2)    |                  |                      |
| Had foot ulcer       | No                         | 47 (25.4)   | 138 (74.6)   | 0.97 (0.38-2.44) | 0.88 (0.30-2.56)     |
|                      | Yes                        | 7 (25.9)    | 20 (74.1)    |                  |                      |
| Age at diagnosis     | ≤45 years                  | 17 (19.8)   | 69 (80.2)    | 0.59 (0.31-1.14) | -                    |
|                      | >45 years                  | 37 (29.4)   | 89 (70.6)    |                  |                      |

\*Significant odds ratio from univariate analysis ( $P<0.05$ ),\*\*Significant odds ratio from multivariate analysis ( $P<0.05$ )

The important findings of the current study are as follows. About 75% had good knowledge score and 67% had good foot care practice score. Male gender (OR 2.36, 95% CI 1.16-4.79), poor education status (OR 2.40, 95% CI 1.19-4.28) and lesser duration of diabetes (OR 2.24, 95% CI 1.15-4.41) were significantly associated with poor knowledge on foot care. Poor knowledge was associated with poor foot care practices (OR 3.43, 95% CI 1.75-6.72). The prevalence of neuropathy was 47% (95% CI 40.14-53.85) among the study subjects.

In a study done in Chennai, only 33% of the patients obtained good scores (>50%) on knowledge regarding foot care.<sup>[15]</sup> Various studies from other developing countries like Nigeria and Iran also showed poor awareness regarding foot care.<sup>[19,20]</sup> The proportion of participants with good knowledge scores in the current study was 75%. This finding was consistent with a study done in Pakistan which showed 69.3% of the respondents had either good or satisfactory knowledge on foot care.<sup>[21]</sup>

On analysis of foot care practices, a majority (71%) of study subjects said they inspected their feet one or more times a day and this was in keeping with the similar knowledge question. This finding is similar to the study carried out in Chandigarh, where it was found that 63.3% of the patients with diabetes take care of their feet through regular washing.<sup>[22]</sup> However, many other studies from India revealed poor foot care practices.<sup>[14,23]</sup>

Thus, the level of awareness and good self-care practices is higher in the present study population compared to some other Indian studies and studies from developing countries. The possible reasons for the greater knowledge, awareness, and health behaviors could be many. Important among them could be the fact that the community health program has been giving multiple specific inputs to this cohort of diabetics being followed up in the hospital. The very participation of these patients in this focused diabetes care program could influence awareness, attitudes, and behavior. Since this is a clinic-based

study, the level of knowledge and practices do not reflect those of the community. Nevertheless, the level of awareness is much higher compared to other clinic-based studies in India indicating that the health education sessions, motivational counseling services, and good quality care provided to them as part of the program has influenced their awareness and behaviors. Another potential factor which could have biased the finding is that the instrument used in all these studies was not identical. Most of the studies used instruments generated for the purpose of the study, which was the case in the current study also and the issue of comparability with other studies is questionable.

There are some deficiencies in the knowledge and practices regarding foot care identified from this study. A vast majority (87.3%) said they walked bare foot at home. Walking bare foot at home is an age old cultural practice in most rural Indian households. In a study done in a specialized diabetic clinic in Mumbai, only 45% of patients with diabetes said they walked barefoot indoors.<sup>[14]</sup> Those study subjects were urban, and probably more educated which could explain the lower percentage of patients with diabetes walking barefoot indoors.

Poor educational status was associated with poor knowledge about foot care in this study. A hospital-based study done in Chennai also showed the association between poor education and poor knowledge on foot care.<sup>[15]</sup> Females have better knowledge regarding foot care in the current study. In rural areas, it is likely that men as bread winners of the family are less likely to spend time on hospital visits, as it also means loss of daily wages for that day. Greater duration of diabetes was associated with good knowledge on foot care. This can be attributed to multiple visits to the health care facility by people with longer duration of diabetes which would have exposed the subjects to more patient education.

The prevalence of peripheral neuropathy in the current study was 47%. The prevalence of peripheral neuropathy varied from

15% to 60% in different studies done in India.<sup>[24,25]</sup> The variations could be because of the variations in the instruments used to detect peripheral neuropathy. The current study used Michigan Neuropathy Screening Instrument. The MNSI is a rapid, simple and reliable test for screening diabetic peripheral neuropathy in both diabetes clinics and epidemiological surveys.<sup>[26]</sup> But it has to be kept in mind that MNSI is still just a screening test and electrophysiological studies are needed for a final diagnosis. Several other composite scoring instruments like the Neuropathy Impairment Score, the Clinical Neuropathy Examination score, and the Toronto Clinical scoring system have been developed and validated to screen and quantify peripheral neuropathy.<sup>[27-29]</sup>

This study highlights some areas of foot care knowledge and practice that are deficient in the rural population with diabetes. These findings can be used to guide a health education program on foot care for people with diabetes. Emphasis should be laid on these deficient areas during health education and misconceptions should be cleared. Some socio-demographic factors have been identified in this study which could influence good knowledge and practices. For example, male gender, low education and newly diagnosed people have been shown to have poor knowledge regarding foot care and so should be targeted for health education services in clinical practice. With the presence of high prevalence of peripheral neuropathy in the population, screening for neuropathy and foot complications is recommended in all patients on a regular basis. Periodic examination of the foot is a must in all patients with diabetes.

The strengths of the study include an adequate sample size and use of a good instrument to screen peripheral neuropathy. The study has several limitations. This is a clinic-based study, the level of knowledge and practices do not reflect those of the community. The knowledge instruments used in the study is not validated in this population.

Directions for future research include validating the knowledge instrument used in this study against preexisting tools and adapting it for routine use among patients to plan health education and support initiatives. Further studies are needed to assess the independent predictive value of all elements of patient history, physical signs, and diagnostic tests when assessing the risk of diabetic foot ulceration.

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