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# The Silent Struggle: Diabetic Foot Ulcers in Rural and Urban Areas and Their Growing Prevalence

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## Abstract

Foot ulcers in diabetics are debilitating and are known to burden patients with high out-of-pocket expenditures. This study's objectives were to assess the occurrence of foot ulcers in individuals with diabetes mellitus and to study the characteristics of foot problems in diabetic patients. A longitudinal study was conducted in the outpatient department at the Rural and Urban Health and Training Centre. Necessary data were collected from 108 study participants who fulfilled the inclusion criteria using a pre-tested semi-structured questionnaire. Data entered in a Microsoft Excel spread sheet were analysed using Statistical Package for Social Sciences version 16. The study included 108 diabetic patients, with a mean age of 54.6±9.8 years, and a female predominance (63%). The prevalence of diabetic foot ulcers (DFUs) was 5.6% while 4 of them had sore or blisters at the time of data collection. About 1% had a history of amputation and 2% had history of sore. More than 60% of them had the habit of inspecting foot regularly; had felt tightness, heaviness, or cramps in the feet or legs; had experienced numbness, tingling, pins and needles or itching in foot and had developed callus in the foot Strengthening community-based foot-care programs, expanding access to podiatric services, and encouraging adherence to diabetes management protocols can collectively help reduce diabetic foot ulcers (DFU) prevalence and associated complications. A multidisciplinary approach involving health care providers, educators, and policymakers will be instrumental in improving the quality of life for diabetic patients' .Insights from ABUAD serve as a model for other institutions aiming to cultivate thriving entrepreneurial ecosystems.

**Keywords:** Chronic Ulcers, Diabetic Foot Ulcers (DFU), Diabetes Mellitus, Rural Health, Training Centre.

## Introduction

"Prevention is better than the treatment of the disease"(1). This timeless wisdom resonates deeply when examining diabetic foot ulcers, one of the most preventable yet devastating complications of diabetes mellitus (1). Today's global health landscape reveals an alarming diabetes epidemic, with developing nations like India facing unprecedented challenges (2). The International Diabetes Federation's latest data paints a concerning picture of diabetes as a 21st-century public health crisis (2). Current trends suggest that millions more people will develop diabetes in the coming decades, straining healthcare systems worldwide, with this burden falling disproportionately on countries where medical infrastructure struggles to meet basic healthcare needs (2, 3). Most deaths in India are due to non-communicable diseases (4). With 77 million adults aged 18 and above living with Type 2 Diabetes and an additional 25 million in the prediabetic stage, the country houses one of the world's largest diabetic populations (3). Multiple factors drive this epidemic: rapid urbanization, sedentary lifestyles, processed food consumption, aging population, socioeconomic disparities, and genetic predisposition (2). What makes India's situation unique is the stark contrast between urban and rural diabetes patterns. While cities have long grappled with lifestyle-related diabetes, rural areas now face similar challenges as traditional agricultural communities adopt more sedentary occupations, with profound implications for diabetes prevention and management, particularly regarding serious complications like foot ulcers (1, 3). Perhaps most troubling is the hidden nature of this epidemic. Over half of all diabetics remain unaware of their elevated blood sugar levels, leading to delayed diagnosis and preventable complications (3). Healthcare researchers have identified this delay occurring at three distinct levels: patient, physician, and healthcare system - collectively termed "Clinical Inertia". Patients may ignore symptoms or lack access to screening, physicians



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might delay treatment intensification, and healthcare systems often lack coordinated care protocols (5). The consequences of uncontrolled diabetes extend far beyond elevated blood sugar. Patients inevitably develop either micro vascular complications affecting small blood vessels or macro vascular complications involving major arteries, ranging from kidney disease and vision problems to heart attacks and strokes, fundamentally altering patients' quality of life (6). Among these complications, neuropathy stands out as particularly prevalent across both urban and rural India (7). This nerve damage, especially in the feet, creates a dangerous cascade of problems where patients lose sensation, making them vulnerable to injuries they cannot feel, while poor circulation hampers healing. When neuropathy meets poor circulation, foot ulcers become almost inevitable (6). These wounds, often starting from minor trauma, resist healing and become breeding grounds for infection. Without proper care, what begins as a small cut can progress to deep tissue infection, bone involvement, and ultimately amputation (8). The lifetime risk statistics are sobering: between 19% and 34% of diabetics will develop foot ulcers (8, 9). Diabetic foot ulcers exact a heavy toll beyond physical health. They significantly impact patients' quality of life, creating financial hardship and psychological distress (10). The amputation risk looms large, making diabetic foot complications the leading cause of non-traumatic limb loss. This devastating outcome carries mortality rates comparable to many cancers, yet receives far less attention in prevention efforts (11). From an economic perspective, diabetic foot ulcers impose crushing financial burdens. A recent study in south India found that medications, dressing changes, and wound care accounted for 79.26% of direct medical costs (12). The rural-urban divide adds another layer of complexity, with urban centers offering specialized wound care services while rural communities face significant barriers including limited healthcare infrastructure, fewer trained professionals, and geographic isolation (7).

The compelling need for this study emerges from several critical knowledge gaps in diabetic foot ulcer management within India's diverse healthcare landscape. Currently, most research focuses on global patterns, leaving substantial gaps in understanding how rural versus urban environments influence foot ulcer development and outcomes. India's unique healthcare challenges demand location-specific solutions. The dramatic differences in healthcare access, lifestyle factors, and socioeconomic conditions between rural and urban areas suggest that one-size-fits-all approaches may be inadequate. Economic considerations add urgency to this research, as the financial burden of diabetic foot ulcers varies significantly based on geographic location and available treatment options.

Early detection and prevention strategies require deep understanding of how foot ulcers present differently across populations. The phenomenon of clinical inertia manifests differently across healthcare settings, with rural areas facing system-level challenges while urban centers might struggle with patient-level barriers.

Finally, with diabetes prevalence rising in both rural and urban India, the window for prevention is rapidly closing. The silent nature of diabetes progression, where patients remain unaware of their condition while complications develop, necessitates comprehensive screening and prevention programs tailored to different population groups and healthcare environments.

Therefore, preventing and detecting foot ulcers early is crucial in alleviating the heavy toll on both patients and healthcare systems (13). This study aims to provide the crucial baseline data needed to develop effective diabetic foot care programs and reduce the burden of this devastating complication (13). This study's objectives were to assess the occurrence of foot ulcers in individuals with diabetes mellitus and to study the characteristics of foot problems in diabetic patients.

## Methodology

A longitudinal study was conducted among diabetes patients attending the outpatient department at the Rural Health and Training Centre (RHTC) and Urban Health and Training Centre (UHTC) of Sri Ramachandra Institute of Higher Education and Research for 6 months from April 2024 to September 2024. The Sample size was computed based on the literature review where the proportion of patients with a minimum of one clinical manifestation related to DFU was 54.5% (14). The sample size was derived to be 96 considering an absolute error of 10% at a 95% confidence interval and 80% power (15). Further,

adding a 12% non-response rate, the sample size was 108. Study participants included all people known to have been diagnosed with Diabetes Mellitus (DM) attending the RHTC and UHTC of Sri Ramachandra Institute of Higher Education and Research (SRIHER) who have provided consent for the study in writing and those who were not able to communicate were excluded from the study.

Data required for the study was collected after briefly explaining the purpose of the study, data collection procedure, study outcome and ethics followed in the process of the research using a Participant Information Sheet (PIS). Then, a pre-tested semi-structured questionnaire was administered to collect data regarding basic demographic details, presence of chronic illness and medications taken for those conditions, past medical and surgical history and personal history including diet, lifestyle and sleep pattern. Data relevant to the history of current foot or leg problems were collected using a Diabetes foot care questionnaire with written informed consent from the participants. Foot ulcers were classified using the Wagner's grading system. Data entry was done using a Microsoft Excel spread sheet and Statistical Package for Social Sciences (SPSS) version 16.0. Qualitative data were expressed in proportions and graphically represented in bar graphs while quantitative data were presented in mean and standard deviation.

The research study commenced after obtaining approval from the Institutional Ethics Committee of Sri Ramachandra Institute of Higher Education and Research. There were no ethical issues involved. The study comprised administering a short questionnaire and no interventions were done. Data were collected only after obtaining consent by writing from the participants. The information collected from the participants was confidential and will be maintained the same way.

## Results

Data was collected from 108 participants enrolled in the study. Mean age of the study participants was 54.6±9.8 years. Most of the participants belonged to the 56 to 65 years age group (36.1%, n=39), 46 to 55 years age group (27.8%, n=30) and 66 to 75 years age group (22.2%, n=24). Females predominated in the study group. About 35.2% (n=38) of them were illiterates and the same proportion were employed. The majority of them (54.6%, n=59) belonged to the upper lower class according to Modified B.G. Prasad's Socioeconomic status class for December 2024. The most common type of family was nuclear (65.7%, n=71) with less than 4 family members residing in a rural locality (51.9%, n=56). A family history of non-communicable diseases was present in 25% (n=27) of participants, Table 1.

**Table 1**: Study Participant's Demographic Particulars and Medical History (n=108)

| Characteristics | Total | |
|---|---|---|
| | n (108) | % (100) |
| **Age** | | |
| <35 years | 2 | 1.9 |
| 36-45 years | 9 | 8.3 |
| 46-55 years | 30 | 27.8 |
| 56-65 years | 39 | 36.1 |
| 66-75 years | 24 | 22.2 |
| >75 years | 4 | 3.7 |
| **Sex** | | |
| Female | 68 | 63.0 |
| Male | 40 | 37.0 |
| **Education** | | |
| Illiterate | 38 | 35.2 |
| Literate | 70 | 64.8 |
| **Occupation** | | |
| Unemployed | 70 | 70 |
| Employed | 38 | 38 |
| **Socioeconomic Status** | | |
| Upper class | 3 | 2.8 |

| | | |
|---|---|---|
| Upper middle class | 5 | 4.6 |
| Lower middle class | 10 | 9.3 |
| Upper lower class | 59 | 54.6 |
| Lower class | 31 | 28.7 |
| **Type of Family** | | |
| Nuclear | 71 | 65.7 |
| Joint | 37 | 34.3 |
| **Number of Family Members** | | |
| <4 | 85 | 78.7 |
| >4 | 23 | 21.3 |
| **Family History of NCD** | | |
| Yes | 27 | 25 |
| No | 81 | 75 |
| **Residence** | | |
| Rural | 56 | 51.9 |
| Urban | 52 | 48.1 |

*Modified B.G. Prasad's socioeconomic status classification for December 2024

On probing the history of drug abuse, it was found that nearly 17.6% of the study participants (n=19) were using tobacco currently or in the past, of which nearly 80% of them (n=15) had been smoking tobacco. Around 18.5% (n=20) of the study participants had the habit of alcohol consumption, and all of them were male. To our surprise, about 76.9% (n=83) of the study participants admitted that they had not been involved in any kind of moderate physical activity in the past month. But only 39 (36.1%) of them were obese, Table 2.

**Table 2:** Drug Abuse and Fitness among Study Participants (n=108)

| Characteristics | Total | |
|---|---|---|
| | n (108) | % (100) |
| **Tobacco Use** | | |
| Yes | 19 | 17.6 |
| No | 89 | 82.4 |
| **Smoking Habit in the Past or Present*** | | |
| Yes | 15 | 13.9 |
| No | 93 | 86.1 |
| **Alcohol Use** | | |
| Yes | 88 | 81.5 |
| No | 20 | 18.5 |
| **Moderate Physical Activity** | | |
| Yes | 83 | 76.9 |
| No | 25 | 23.1 |
| **Obesity** | | |
| Present | 39 | 36.1 |
| Absent | 69 | 63.9 |

About 40.8% (n=44) of the study participants had hypertension as a co-morbidity. In contrast, nearly 63 Participants (58.3%) had no co-morbidity. Only one patient (0.9%) had undergone amputation in the past. And unpredictably, six patients (5.6%) had foot ulcers either at the time of the interview or in the past, Table 3.

Figure 1 shows that 2% (n=2) of the study participants had suffered from a cut or sore which took more than two weeks to heal. Nearly 6% (n=6) of them had foot ulcer and 1% (n=1) had undergone amputation of toe in the past.

Figure 2 depicts that more than 60% of the study participants had the habit of inspecting foot regularly, had experienced tightness, heaviness, pain or cramps in the feet or legs, had felt some numbness, tingling, pins and needles or itching in foot and had got callus in foot.

**Table 3:** Medical Profile of the Study Participants (n=108)

| Characteristics | Total | |
|---|---|---|
| | n (108) | % (100) |
| **Associated Medical Condition** | | |
| Nil 0 | 63 | 58.3 |
| Hypertension | 44 | 40.8 |
| Hypothyroidism | 1 | 0.9 |
| **Medication Use** | | |
| Metformin | 19 | 17.6 |
| Metformin and Amlong | 37 | 34.3 |
| Metformin and Glynase | 52 | 48.1 |
| **Past History of Surgery** | | |
| Amputation | 1 | 0.9 |
| Other surgeries | 40 | 37.1 |
| Nil | 67 | 62 |
| **Foot Ulcer in Past or Present** | | |
| Yes | 6 | 5.6 |
| No | 102 | 94.4 |

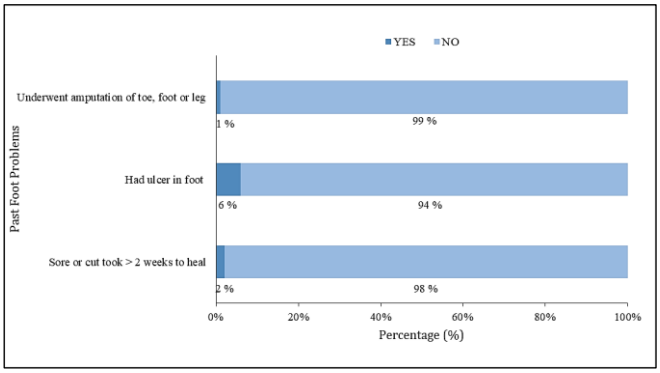


**Figure 1:** Past foot Problems in Study Participants (n=108)

Only one person had found blood or pus stains in the socks while four of them had ulcer, sore or blister in the foot.

Bivariate analysis was performed to assess the association between the presence of diabetic foot ulcers and various factors including age, sex, socio-economic status, type of family, smoking history and presence of hypertension. Of these factors, belonging to socio-economic class 4 and 5 were found to be 86% protective from developing foot ulcer which was statistically significant shows in Table 4.

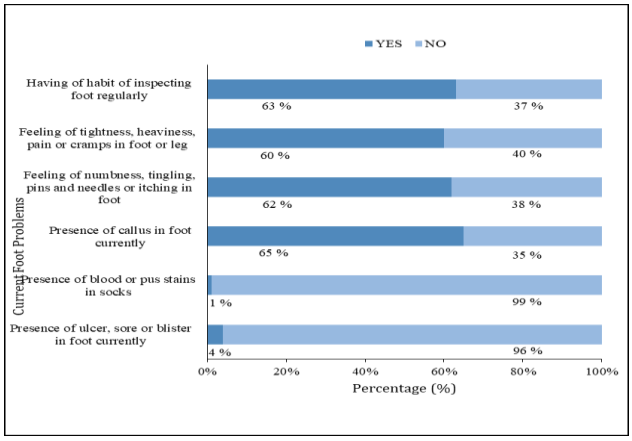


**Figure 2:** Current Foot Problems among the Study Participants (n=108)

**Table 4:** Factors Associated with Occurrence of Foot Problems among the Study Participants (n=108)

| Variables | Foot ulcer | | Crude Odd's Ratio (95 % CI) | p value | Adjusted Odd's Ratio (95 % CI) | p value |
|---|---|---|---|---|---|---|
| | Present (n=6) | Absent (n=102) | | | | |
| **Age** | | | | | | |
| Above 45 years | 5 (83.3) | 92 (90.2) | 0.543 (0.58- | 0.594 | 0.46(0.036-5.843) | 0.546 |
| Below 45 years | 1 (16.7) | 10 (9.8) | 5.126) | | | |
| **Sex** | | | | | | |
| Female | 5 (83.8) | 63 (61.8) | 3.095 (0.349- | 0.311 | 2.70(0.276-26.29) | 0.394 |
| Male | 1 (16.7) | 39 (38.2) | 27.487) | | | |
| **Socio-economic Status** | | | | | | |
| Class 4 and 5 | 3 (50) | 87 (85.3) | 0.172 (0.032- | 0.042 | 0.13 (0.019- | 0.041 |
| Class 1,2 and 3 | 3 (50) | 15 (16.7) | 0.936) | | 0.922) | |
| **Type of Family** | | | | | | |
| Nuclear family | 4 (66.7) | 67 (65.7) | 1.045 (0.182- | 0.961 | 0.77(0.109- | 0.797 |
| Joint family | 2 (33.3) | 35 (34.3) | 5.988) | | 5.480) | |
| **Smoking** | | | | | | |
| Yes | 0 | 1 (1) | 3.423 (0.569- | 0.179 | 1.45(0.194- | 0.717 |
| No | 6 (100) | 101 (99) | 20.592) | | 10.815) | |
| **Hypertension** | | | | | | |
| Yes | 4 (66.7) | 40 (39.2) | 3.100 (0.542- | 0.203 | 4.43(0.584- | 0.150 |
| No | 2 (33.3) | 62 (60.8) | 17.720) | | 33.619) | |

# Discussion

DFUs pose a significant health challenge, leading to increased morbidity, financial burdens, and diminished quality of life among diabetic patients. In our study, the DFU prevalence was observed to be 5.6%, aligning closely with the 6.2% prevalence reported in the meta-analysis (16). However, compared to hospital-based studies (7.5%) and community-based estimates (2.5%), our findings indicate an intermediate prevalence level (16). This variation may be due to differences in healthcare access, awareness, and self-care practices. Moreover, differences in access to medical care, foot hygiene practices, levels of education, work-related exposures, and the type or condition of footwear worn can all significantly impact the development and outcomes of diabetic foot ulcers. Incorporating these contextual factors can offer a more complete understanding of why the prevalence of diabetic foot ulcers may vary between different populations and settings. Discussing these broader systemic factors such as disparities in healthcare infrastructure, economic constraints, and health literacy is essential to understanding the root causes of inequities and identifying scalable, sustainable interventions.

A research study highlighted that nearly 15–20% of diabetics develop DFUs during their lifetime, reinforcing the importance of early preventive measures (17). An interesting aspect of our findings was the gender-based difference in DFU prevalence. While our study recorded a female predominance (63%), other observed higher DFU rates among males (16, 18). This contrast could be due to differences in healthcare-seeking behaviour, socio-cultural norms, and variations in sample demographics. Further, past literature identified poor glycaemic control (HbA1c 9.44 ± 9.02) as a major DFU risk factor, while our study focused on demographic and lifestyle-related determinants (18).

Among modifiable lifestyle factors, our study found that 17.6% of participants reported tobacco use, 18.5% consumed alcohol, and a significant 76.9% lacked regular physical activity. These lifestyle patterns are well-documented contributors to DFU development. Similar findings like addiction, prolonged diabetes duration, and irregular follow-ups were identified as critical risk factors in past research (19). Interestingly, in our study, bivariate analysis did not reveal any significant association between diabetic foot ulcer occurrence and demographic or clinical variables such as age, sex, presence of hypertension or history of smoking. But belonging to lower socio-economic class was found to be a protective factor. This could be attributed to their physically active working environment (heavy workers) as most of them were daily wage workers.

Researchers found that about 54.5% of diabetic individuals exhibited at least one foot-related complication, with heel fissures (29.4%) and calluses (5.2%) being the most common (14).

Although our study did not directly assess foot-care knowledge, the fact that 35.2% of participants were illiterate suggests a potential link between education and DFU risk. This observation is consistent with other studies where 79% of participants lacked proper foot-care awareness (19).

The role of poor foot-care knowledge in DFU development was studied, highlighting the necessity of structured education programs (20). Similarly, inappropriate foot-care habits, high body mass index (BMI), and prolonged diabetes duration were identified as major DFU risk factors, all of which can be mitigated through lifestyle modifications (17). Strengthening foot-care education and encouraging routine screenings could play a crucial role in reducing DFU prevalence.

Another crucial aspect of DFU management is infection control. Staphylococcus aureus (26.9%) and Pseudomonas aeruginosa (20.9%) were the most commonly isolated pathogens in DFU cases, exhibiting high antibiotic resistance (21). While our study did not conduct microbiological assessments, these findings highlight the importance of early infection management. Other researchers have stressed the need for effective infection control strategies, reporting a higher DFU prevalence of 16% in their study (22).

Our findings underscore the necessity for early intervention, structured patient education, and lifestyle modifications to mitigate DFU risks. The prevalence of modifiable risk factors, such as tobacco use, sedentary lifestyles, and inadequate foot-care awareness, calls for community-driven prevention strategies. Estimated that nearly 100,000 lower limb amputations occur annually in India, with 75% being preventable through proper intervention (17). Implementing multidisciplinary foot-care programs could significantly reduce DFU-related complications. Future research should focus on enhancing foot-care education, integrating microbiological evaluations, and conducting longitudinal studies to develop comprehensive DFU prevention strategies.

Strengths: By including participants from both rural and urban settings, the research provides a more comprehensive understanding of foot problems among diabetic patients. The use of a pre-tested semi-structured questionnaire ensured consistency in data collection, while the analysis of both modifiable and non-modifiable risk factors offered actionable insights for DFU prevention.

Limitations: The relatively small sample size may limit the generalizability of the findings to larger diabetic populations. As a cross-sectional study, it captures data from a single point in time, restricting the ability to establish causal relationships between risk factors and DFU development. Further, the reliance on self-reported data also introduces the possibility of recall bias, which may impact the accuracy of information regarding lifestyle practices and past foot complications. The longitudinal study may give more details about the diabetic ulcer and its association factors.

# Conclusion

This study highlights the significant burden of diabetic foot ulcers and the need for timely, preventive interventions. Modifiable risk factors such as poor foot hygiene, lack of physical activity, and inadequate awareness highlight the importance of community-level education and behavioural change. Key practices include regular foot inspections, proper footwear use, early treatment of foot injuries, and structured patient education on foot care.

Strengthening podiatric services at primary care facilities and integrating foot care into national diabetes programs are essential policy measures. Additionally, adopting global diabetic foot care guidelines and implementing region-specific screening and awareness initiatives can help reduce the incidence and complications of DFUs. A multidisciplinary, patient-centered approach remains crucial to improving outcomes and quality of life for individuals living with diabetes. Future research with a larger sample size and longitudinal design would further clarify risk factors and enhance preventive strategies.

## Abbreviations

BMI: Body Mass Index, DFU: Diabetic Foot Ulcer, DM: Diabetes Mellitus, MBGP: Modified Brahm Govind Prasad, RHTC: Rural Health and Training Centre, SRIHER: Sri Ramachandra Institute of Higher Education and Research.

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## Author Contributions

Balachander NC: Concept, design, definition of intellectual content, literature search, data acquisition, data analysis, manuscript preparation, manuscript editing and manuscript review, Pankaj B Shah: Concept, design, definition of intellectual content, data analysis, manuscript preparation, manuscript editing, manuscript review.

## Conflict of Interest

There was no conflict of interest in the study.

## Ethics Approval

Institutional Ethics Committee of Sri Ramachandra Institute of Higher Education and Research. REF NO: CSP-MED/24/MAR/101/113 on 03.04.2024.

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