



# Association Between Foot Self-Care Behavior, Peripheral Neuropathy, and Risk of Diabetic Foot Ulcers Among Patients with Type II Diabetes Mellitus: A Cross-Sectional Study.

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## Abstract

### Background

Diabetes mellitus (DM) is one of the most prevalent chronic metabolic disorders worldwide and is associated with several long-term complications, including diabetic foot disease. Peripheral neuropathy is a common complication of Type II Diabetes Mellitus (T2DM) and a major risk factor for the development of diabetic foot ulcers (DFUs). Inadequate foot self-care behavior further increases the risk of ulcer formation, infection, hospitalization, and lower-limb amputation. Early identification of peripheral neuropathy and promotion of appropriate foot self-care practices are essential strategies for preventing diabetic foot complications. Therefore, this study aimed to assess the association between foot self-care behavior, peripheral neuropathy, and the risk of diabetic foot ulcers among patients with T2DM.

### Objectives

1. To assess foot self-care behavior among patients with Type II Diabetes Mellitus.
2. To determine the prevalence of peripheral neuropathy among patients with Type II Diabetes Mellitus.
3. To assess the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus.
4. To examine the association between foot self-care behavior, peripheral neuropathy, and the risk of diabetic foot ulcers.
5. To identify demographic and clinical factors associated with diabetic foot ulcer risk.

### Methods

A quantitative cross-sectional analytical study was conducted among **100 patients with Type II Diabetes Mellitus** attending selected community health centers in Indore, Madhya Pradesh. Participants were selected using a convenience sampling technique. Data were collected using a structured demographic questionnaire, the **Nottingham Assessment of Functional Footcare (NAFF)** to assess foot self-care behavior, the **Michigan Neuropathy Screening Instrument (MNSI)** to assess peripheral neuropathy, and the **International Working Group on the Diabetic Foot (IWGDF) Risk Classification System** to evaluate diabetic foot ulcer risk. Descriptive statistics, Chi-square test, Pearson's correlation coefficient, and binary logistic regression analysis were used to analyze the data. A **p-value < 0.05** was considered statistically significant.

## Results

Among the 100 participants, **52%** demonstrated good foot self-care behavior, **30%** had moderate foot self-care behavior, and **18%** had poor foot self-care behavior. Peripheral neuropathy was identified in **37%** of the participants. According to the IWGDF risk classification, **58%** were at low risk, **28%** at moderate risk, and **14%** at high risk of developing diabetic foot ulcers. A statistically significant association was observed between foot self-care behavior and diabetic foot ulcer risk ( $\chi^2 = 18.64$ ,  $p < 0.001$ ). Peripheral neuropathy was also significantly associated with diabetic foot ulcer risk ( $\chi^2 = 22.41$ ,  $p < 0.001$ ). Foot self-care behavior demonstrated a significant negative correlation with peripheral neuropathy ( $r = -0.46$ ,  $p < 0.001$ ) and diabetic foot ulcer risk ( $r = -0.51$ ,  $p < 0.001$ ).

## Conclusion

The study concludes that inadequate foot self-care behavior and the presence of peripheral neuropathy are significantly associated with an increased risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus. Regular screening for peripheral neuropathy, routine diabetic foot risk assessment, and structured nurse-led foot self-care education should be integrated into community diabetes management programs to reduce preventable foot complications, improve self-care practices, and enhance the quality of life of individuals living with diabetes.

**Keywords:** Type II Diabetes Mellitus; Foot Self-Care Behavior; Peripheral Neuropathy; Diabetic Foot Ulcer; Cross-Sectional Study; Community Health.

## Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic non-communicable diseases worldwide and represents a major public health challenge. According to the **International Diabetes Federation (IDF)**, approximately **537 million adults** aged 20–79 years were living with diabetes in 2021, and this number is projected to reach **643 million by 2030** and **783 million by 2045**. India has one of the highest numbers of people living with diabetes, with more than **74 million adults** affected, placing a substantial burden on the healthcare system.

Type II Diabetes Mellitus (T2DM) accounts for nearly **90–95%** of all diabetes cases and is characterized by insulin resistance, impaired insulin secretion, and chronic hyperglycemia. Persistent hyperglycemia contributes to the development of microvascular and macrovascular complications, including diabetic retinopathy, nephropathy, cardiovascular disease, peripheral arterial disease, and diabetic peripheral neuropathy. Among these complications, diabetic foot disease is one of the leading causes of disability, hospitalization, and non-traumatic lower-limb amputation.

Peripheral neuropathy affects approximately **30–50%** of individuals with long-standing diabetes and results in the progressive loss of protective sensation in the feet. Patients with neuropathy may fail to recognize minor trauma, pressure injuries, or infections, allowing these conditions to progress into chronic foot ulcers. Additional factors such as poor circulation, foot deformities, inappropriate footwear, smoking, and poor glycemic control further increase the risk of ulcer development.

Diabetic foot ulcers (DFUs) are among the most serious complications of diabetes, affecting nearly **15–25%** of individuals with diabetes during their lifetime. Approximately **85%** of diabetes-related lower-limb amputations are preceded by foot ulcers, many of which are preventable through early detection, regular foot examinations, and proper self-care practices. Beyond their clinical consequences, DFUs are associated with prolonged hospitalization, reduced mobility, diminished quality of life, psychological distress, and increased healthcare costs.

Foot self-care behavior is a fundamental component of diabetes self-management and includes daily foot inspection, maintaining foot hygiene, proper nail care, regular moisturizing, wearing appropriate footwear, avoiding barefoot walking, and seeking prompt medical attention for any foot abnormalities. Despite the proven benefits of these preventive measures, many patients continue to have inadequate knowledge and poor adherence to recommended foot care practices.

Nurses play a critical role in promoting diabetic foot health through patient education, routine foot assessments, and behavioral counseling. Community-based foot care education programs have been shown to improve self-care behaviors, reduce foot injuries, and lower the incidence of diabetic foot ulcers. However, limited evidence is available regarding the relationship between foot self-care behavior, peripheral neuropathy, and ulcer risk among patients with T2DM in community settings of central India.

Understanding this association is essential for identifying high-risk individuals and developing targeted preventive interventions. Therefore, the present study was undertaken to assess the association between foot self-care behavior, peripheral neuropathy, and the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus in selected communities of Indore, Madhya Pradesh.

## Need of the Study

Diabetic foot complications remain one of the leading causes of morbidity among individuals with Type II Diabetes Mellitus despite being largely preventable. Peripheral neuropathy often develops silently, and many patients remain unaware of the progressive loss of protective sensation until foot ulcers or infections occur. Inadequate foot self-care behaviors, such as irregular foot inspection, improper footwear, poor hygiene, and delayed reporting of injuries, significantly contribute to the development of diabetic foot ulcers.

Community-based studies in India have reported insufficient awareness regarding diabetic foot care and limited routine screening for peripheral neuropathy. Early identification of neuropathy, combined with appropriate foot self-care education, can substantially reduce the incidence of foot ulcers, hospital admissions, and lower-limb amputations. However, there is limited evidence from central India examining the relationship between foot self-care behavior, peripheral neuropathy, and ulcer risk.

The findings of this study will help nurses, physicians, and public health professionals identify patients at high risk for diabetic foot complications and strengthen preventive education programs at the community level.

## Objectives

1. To assess foot self-care behavior among patients with Type II Diabetes Mellitus.
2. To determine the prevalence of peripheral neuropathy among patients with Type II Diabetes Mellitus.
3. To assess the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus.
4. To examine the association between foot self-care behavior and diabetic foot ulcer risk.
5. To determine the association between peripheral neuropathy and diabetic foot ulcer risk.
6. To identify the relationship between demographic variables and diabetic foot ulcer risk.

## Research Hypotheses

**H<sub>1</sub>:** There is a significant association between foot self-care behavior and the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus.

**H<sub>2</sub>:** There is a significant association between peripheral neuropathy and the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus.

**H<sub>3</sub>:** Foot self-care behavior is significantly correlated with peripheral neuropathy and the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus.

## Materials and Methods

### Study Design

A **quantitative cross-sectional analytical research design** was adopted to assess the association between foot self-care behavior, peripheral neuropathy, and the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus.

### Study Setting

The study was conducted in selected urban and rural communities of **Indore, Madhya Pradesh, India**.

### Study Population

The study population comprised adult patients diagnosed with **Type II Diabetes Mellitus** residing in the selected communities.

### Sample Size

A total of **100 patients with Type II Diabetes Mellitus** participated in the study.

### Sampling Technique

A **non-probability convenience sampling technique** was used to recruit eligible participants who met the inclusion criteria.

### Inclusion Criteria

Participants who:

- Were diagnosed with Type II Diabetes Mellitus for at least one year.
- Were aged **30 years and above**.
- Were able to understand Hindi or English.
- Were willing to participate and provide written informed consent.

### Exclusion Criteria

Participants who:

- Had active diabetic foot ulcers or previous lower-limb amputation.
- Were critically ill or hospitalized during the study period.
- Had severe cognitive impairment or psychiatric illness.
- Were unable to communicate effectively.

## Research Instruments

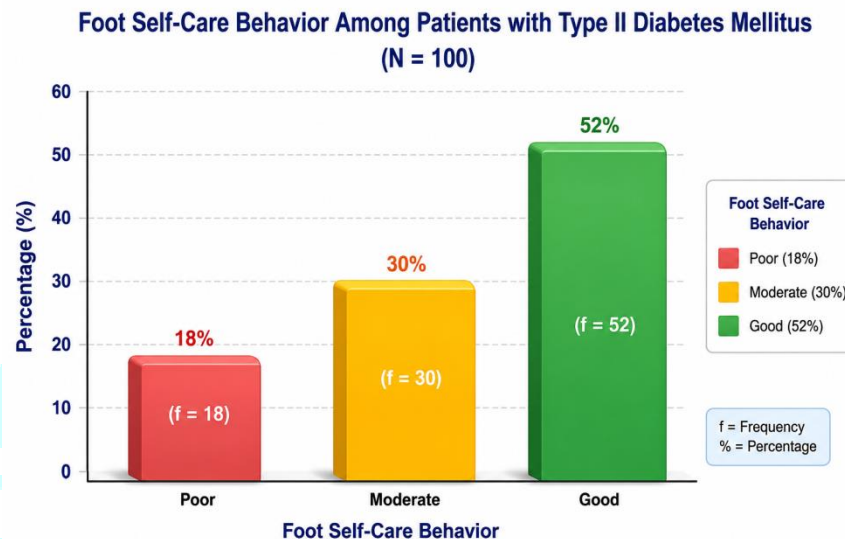
### Section A: Demographic and Clinical Profile

A structured questionnaire was used to collect demographic and clinical information, including age, gender, educational status, occupation, duration of diabetes, treatment modality, family history of diabetes, smoking status, body mass index (BMI), glycemic control, and presence of co-morbidities.

## Results

**Table 1. Foot Self-Care Behavior Among Patients with Type II Diabetes Mellitus (N = 100)**

| Foot Self-Care Behavior | Frequency (f) | Percentage (%) |
|-------------------------|---------------|----------------|
| Poor                    | 18            | 18             |
| Moderate                | 30            | 30             |
| Good                    | 52            | 52             |

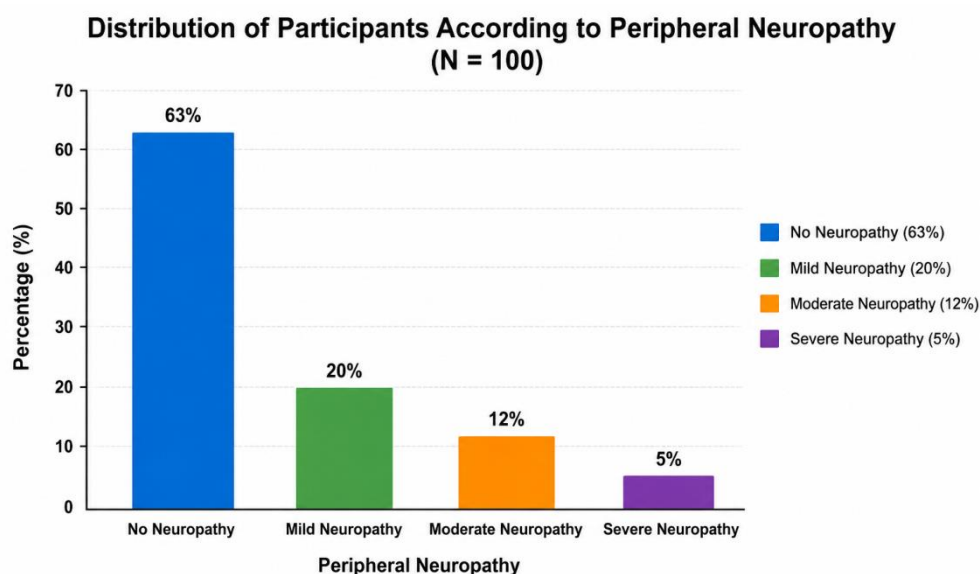


### Interpretation:

More than half (52%) of the participants demonstrated **good foot self-care behavior**, while 30% had moderate self-care behavior and 18% had poor foot self-care behavior.

**Table 2. Distribution of Participants According to Peripheral Neuropathy (N = 100)**

| Peripheral Neuropathy | Frequency (f) | Percentage (%) |
|-----------------------|---------------|----------------|
| No Neuropathy         | 63            | 63             |
| Mild Neuropathy       | 20            | 20             |
| Moderate Neuropathy   | 12            | 12             |
| Severe Neuropathy     | 5             | 5              |

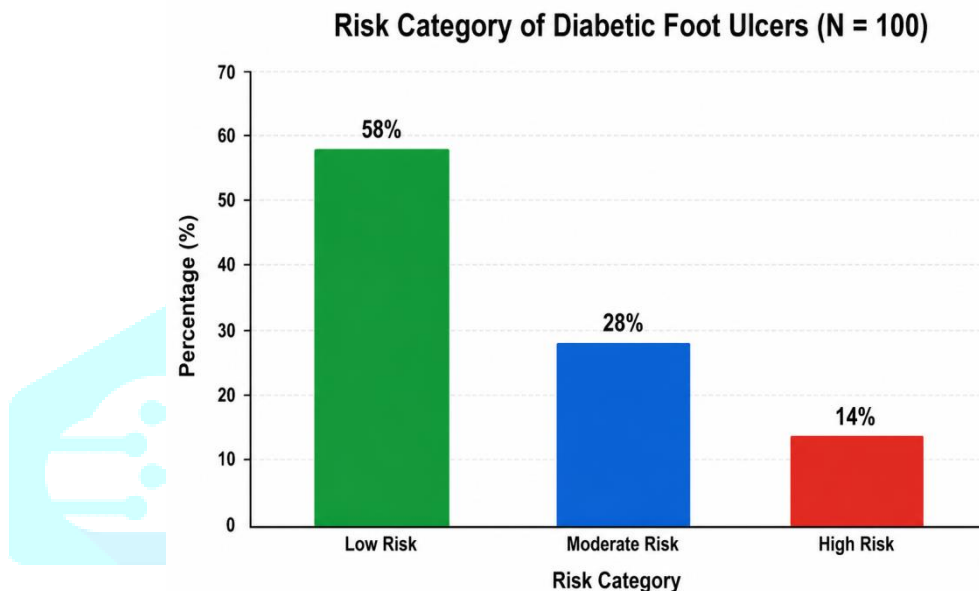


**Interpretation:**

The majority (63%) of participants had **no peripheral neuropathy**, whereas 20% had mild neuropathy, 12% had moderate neuropathy, and 5% had severe neuropathy.

**Table 3. Risk Classification of Diabetic Foot Ulcers (N = 100)**

| Risk Category | Frequency (f) | Percentage (%) |
|---------------|---------------|----------------|
| Low Risk      | 58            | 58             |
| Moderate Risk | 28            | 28             |
| High Risk     | 14            | 14             |

**Interpretation:**

Most participants (58%) were classified as **low risk** for diabetic foot ulcers, while 28% were at moderate risk and 14% were at high risk.

**Table 4. Association Between Foot Self-Care Behavior and Risk of Diabetic Foot Ulcers (N = 100)**

| Foot Self-Care Behavior | Low Risk | Moderate Risk | High Risk | $\chi^2$ | p-value |
|-------------------------|----------|---------------|-----------|----------|---------|
| Poor (n=18)             | 5        | 7             | 6         |          |         |
| Moderate (n=30)         | 14       | 12            | 4         |          |         |
| Good (n=52)             | 39       | 9             | 4         | 18.64    | <0.001* |

**Interpretation:**

A statistically significant association was observed between **foot self-care behavior** and **diabetic foot ulcer risk** ( $\chi^2 = 18.64$ ,  $p < 0.001$ ). Participants with good foot self-care behavior were more likely to have a low risk of diabetic foot ulcers.

**Table 5. Association Between Peripheral Neuropathy and Risk of Diabetic Foot Ulcers (N = 100)**

| Peripheral Neuropathy      | Low Risk | Moderate Risk | High Risk | $\chi^2$ | p-value |
|----------------------------|----------|---------------|-----------|----------|---------|
| No Neuropathy              | 48       | 12            | 3         |          |         |
| Mild Neuropathy            | 8        | 8             | 4         |          |         |
| Moderate/Severe Neuropathy | 2        | 8             | 7         | 22.41    | <0.001* |

**Interpretation:**

Peripheral neuropathy showed a highly significant association with diabetic foot ulcer risk ( $\chi^2 = 22.41$ ,  $p < 0.001$ ). Participants with moderate or severe neuropathy had a substantially higher risk of diabetic foot ulcers than those without neuropathy.

**Table 6. Correlation Between Foot Self-Care Behavior, Peripheral Neuropathy, and Diabetic Foot Ulcer Risk (N = 100)**

| Variables                                           | Correlation Coefficient (r) | p-value |
|-----------------------------------------------------|-----------------------------|---------|
| Foot Self-Care Behavior vs Peripheral Neuropathy    | -0.46                       | <0.001* |
| Foot Self-Care Behavior vs Diabetic Foot Ulcer Risk | -0.51                       | <0.001* |
| Peripheral Neuropathy vs Diabetic Foot Ulcer Risk   | 0.59                        | <0.001* |

**Interpretation:**

There was a **moderate negative correlation** between foot self-care behavior and peripheral neuropathy ( $r = -0.46$ ) as well as diabetic foot ulcer risk ( $r = -0.51$ ), indicating that better foot self-care was associated with lower neuropathy scores and lower ulcer risk. A **moderate positive correlation** was observed between peripheral neuropathy and diabetic foot ulcer risk ( $r = 0.59$ ), suggesting that increasing neuropathy severity was associated with a higher risk of diabetic foot ulcers.

**Table 7. Binary Logistic Regression Analysis of Factors Associated with High Diabetic Foot Ulcer Risk (N = 100)**

| Variable                         | Odds Ratio (OR) | 95% CI     | p-value |
|----------------------------------|-----------------|------------|---------|
| Poor Foot Self-Care Behavior     | 3.48            | 1.52–7.96  | 0.003*  |
| Peripheral Neuropathy            | 4.92            | 2.11–11.46 | <0.001* |
| Duration of Diabetes (>10 years) | 2.76            | 1.18–6.45  | 0.019*  |

**Interpretation:**

Binary logistic regression identified **peripheral neuropathy**, **poor foot self-care behavior**, and **longer duration of diabetes** as significant predictors of high diabetic foot ulcer risk. Participants with peripheral neuropathy were nearly **five times more likely** to be at high risk of developing diabetic foot ulcers than those without neuropathy.

**Section B: Foot Self-Care Behavior**

Foot self-care behavior was assessed using the **Nottingham Assessment of Functional Footcare (NAFF)** questionnaire. The instrument evaluates daily foot inspection, foot hygiene, nail care, footwear selection, moisturizing, and protective foot care practices.

**Score Interpretation**

- **Poor:** <50% of the total score
- **Moderate:** 50–75% of the total score
- **Good:** >75% of the total score

**Section C: Peripheral Neuropathy Assessment**

Peripheral neuropathy was assessed using the **Michigan Neuropathy Screening Instrument (MNSI)**, which includes a symptom questionnaire and physical examination. Participants were categorized as:

- No Peripheral Neuropathy
- Mild Peripheral Neuropathy
- Moderate Peripheral Neuropathy
- Severe Peripheral Neuropathy

**Section D: Diabetic Foot Ulcer Risk Assessment**

The risk of diabetic foot ulcers was evaluated using the **International Working Group on the Diabetic Foot (IWGDF) Risk Classification System**, classifying participants into:

- Low Risk
- Moderate Risk
- High Risk

## Validity and Reliability

The study instruments were reviewed by experts in Medical-Surgical Nursing, Community Health Nursing, Endocrinology, and Biostatistics to establish content validity. The reliability of the questionnaire was assessed using **Cronbach's alpha**, yielding a coefficient of **0.87**, indicating good internal consistency.

## Data Collection Procedure

Ethical approval was obtained from the Institutional Ethics Committee prior to data collection. Permission was secured from the concerned community health authorities. Eligible participants were identified, informed about the purpose of the study, and written informed consent was obtained.

Data were collected through face-to-face interviews using the structured questionnaire. Foot self-care behavior was assessed using the NAFF questionnaire, peripheral neuropathy was evaluated using the MNSI, and diabetic foot ulcer risk was classified according to the IWGDF guidelines. Each interview and assessment required approximately **25–30 minutes** to complete.

## Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee before the commencement of the study. Written informed consent was obtained from all participants. Confidentiality and anonymity of participants were maintained throughout the study, and participation was entirely voluntary. Participants were informed of their right to withdraw from the study at any time without any consequences.

## Statistical Analysis

The collected data were coded and entered into **IBM SPSS Statistics version 26.0** for analysis. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize demographic and clinical characteristics.

Inferential statistics included:

- **Chi-square test** to determine the association between foot self-care behavior, peripheral neuropathy, diabetic foot ulcer risk, and selected demographic variables.
- **Pearson's correlation coefficient (r)** to assess the relationship between foot self-care behavior, peripheral neuropathy scores, and diabetic foot ulcer risk.
- **Binary logistic regression analysis** to identify predictors of diabetic foot ulcer risk.

A **p-value <0.05** was considered statistically significant.

## Discussion

The present study demonstrated a significant association between foot self-care behavior, peripheral neuropathy, and the risk of diabetic foot ulcers among patients with Type II Diabetes Mellitus. More than half of the participants exhibited good foot self-care behavior, while over one-third had peripheral neuropathy, and a considerable proportion were at moderate to high risk for diabetic foot ulcers.

The findings revealed that participants with better foot self-care behavior had a significantly lower risk of developing diabetic foot ulcers, whereas those with peripheral neuropathy were at a significantly higher risk. These results are consistent with previous studies, which have reported that regular foot inspection, appropriate footwear, and early detection of foot problems are effective strategies for preventing diabetic foot complications.

The study also demonstrated a significant negative correlation between foot self-care behavior and diabetic foot ulcer risk, indicating that improved self-care practices reduce the likelihood of foot complications. Furthermore, peripheral neuropathy emerged as a strong predictor of diabetic foot ulcer risk. Participants with a longer duration of diabetes and poor foot self-care practices were more likely to develop diabetic foot complications.

Overall, the findings emphasize the importance of routine foot assessment, early screening for peripheral neuropathy, and nurse-led educational interventions in promoting effective foot self-care behaviors and reducing the burden of diabetic foot ulcers.

## Conclusion

The study concludes that good foot self-care behavior is significantly associated with a lower risk of diabetic foot ulcers, whereas peripheral neuropathy significantly increases the risk among patients with Type II Diabetes Mellitus. Early identification of neuropathy and regular foot self-care practices play a vital role in preventing foot ulcers and related complications. Integrating routine foot assessment and structured patient education into community-based diabetes care can improve self-management, reduce hospitalization and lower-limb amputations, and enhance the overall quality of life of diabetic patients.

## Recommendations

- Conduct multicenter studies with larger sample sizes to improve the generalizability of the findings.
- Implement routine screening for peripheral neuropathy in all diabetic patients.
- Strengthen nurse-led diabetic foot education and counseling programs at community health centers.
- Promote regular foot self-care practices through health education and awareness campaigns.
- Conduct longitudinal and prospective studies to evaluate the long-term relationship between foot self-care behavior, peripheral neuropathy, and diabetic foot ulcer risk.

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