

## A Study of Diabetic Foot Ulcers in Relation to Duration of Diabetes and Ulcer Severity Scores

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### Abstract

**Introduction:** The present study explores the relationship between the duration of diabetes and the severity of diabetic foot ulcers using the Diabetic Ulcer Severity Score (DUSS) in a tertiary care setting. By examining ulcer characteristics and healing outcomes, the study aims to identify key factors impacting ulcer severity and treatment outcomes among middle-aged and elderly diabetic patients.

**Material and Methods:** This prospective observational study was conducted over one year in the Department of General Surgery at a tertiary care hospital, focusing on 50 diabetic foot ulcer patients. Data, including demographic and clinical parameters, were collected and analyzed with SPSS to examine the association between ulcer severity scores (DUSS) and healing outcomes. Patients received comprehensive treatment and follow-up care, with ulcers assessed for depth, infection, and other severity indicators, allowing for targeted interventions based on severity and diabetes duration.

**Results:** In this study of 50 diabetic foot ulcer patients, males represented 76.71% of the cohort, with most patients being middle-aged (41-60 years, 48.0%) or seniors (61-70 years, 28.0%). Diabetes duration influenced ulcer severity, with 53.42% of patients having diabetes for under 6 years, while none had it beyond 15 years. Healing outcomes varied: 47.95% achieved healing by primary intention, 17.81% required skin grafting, and 34.25% underwent amputation. DUSS scores showed that moderate ulcers (Score 2) were most common (34.0%), with both genders similarly affected. Healing outcomes also varied by gender, with primary intention healing highest in males (47.37%) and females (50.0%), while amputation rates were consistent across gender and age groups, underscoring the complexity of advanced ulcer cases.

**Conclusion:** Diabetic foot ulcer outcomes are significantly impacted by diabetes duration, ulcer severity, and patient demographics, with early intervention being crucial to minimize complications and amputation rates. Tailored management strategies are essential to improve healing and patient quality of life.

**Keywords:** Diabetes Duration, Ulcer Severity, Healing Outcomes, DUSS Score.

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### Introduction

Diabetic foot ulcers (DFUs) are a major complication of diabetes mellitus, posing a significant burden on both patients and healthcare systems. [1] They are associated with high morbidity, prolonged hospital stays, and a considerable risk of lower extremity amputation, affecting patients' quality of life and increasing healthcare costs. The global prevalence of diabetic foot ulcers ranges from 4% to 10% among people with diabetes, and in India, it is notably high, given the increasing prevalence of diabetes and related complications. [2] Identifying and managing DFUs at an early stage is crucial to improve patient

outcomes and reduce the risk of severe consequences. [3]

The Diabetic Ulcer Severity Score (DUSS) has been developed to assess the severity of DFUs based on wound characteristics, helping healthcare professionals to predict healing outcomes and optimize management strategies. [4] The score evaluates critical parameters, such as ulcer depth, location, presence of infection, and peripheral arterial disease, which are essential factors influencing wound healing. [5] Accurate severity assessment is vital for implementing appropriate treatment plans, monitoring patient progress, and identifying those at risk for poor outcomes, such as

amputations. [6] However, there is a need for more evidence on the utility and effectiveness of DUSS in diverse patient populations, especially in resource-limited settings. [7] This study aims to evaluate the application and reliability of the Diabetic Ulcer Severity Score in predicting the prognosis of diabetic foot ulcers at a tertiary care hospital.

### Material and Methods

This study was a prospective observational study conducted at the Department of General Surgery, [insert name of hospital], a tertiary care hospital. The study spanned over a 1-year duration and focused on patients presenting with diabetic foot ulcers. Patients were recruited from the surgical outpatient department and those admitted to the surgical ward, ensuring a comprehensive data set for analysis. Ethical approval was secured from the institutional review board, and all participants provided written informed consent.

The source of data for this study included diabetic patients with foot ulcers attending the surgical outpatient department or admitted to the hospital. Data were collected and analyzed using GraphPad Prism, a statistical tool to ensure rigorous data analysis. This software was employed to compute descriptive and inferential statistics, including comparisons of ulcer healing outcomes and the association of severity scores with clinical parameters.

Patients included in the study were those diagnosed with diabetes mellitus as per WHO criteria (symptoms of diabetes with random blood sugar >200 mg/dL or fasting blood sugar >126 mg/dL and 2-hour postprandial glucose level >200 mg/dL) and were older than 15 years of age. Participants with diabetic foot ulcers of varying types, such as cellulitis, abscess, and neuropathic ulcers, were eligible, irrespective of the duration of diabetes or the ulcer itself, provided they consented to participate and complete follow-up.

A total of 50 diabetic patients with foot ulcers, regardless of ulcer duration and diabetes duration, were enrolled based on inclusion and exclusion criteria. Baseline demographic data, including age, gender, occupation, educational status, comorbidities, personal habits, socioeconomic status, and diabetes management history, were collected. Relevant investigations, including fasting blood glucose, postprandial blood glucose, HbA1c, hemoglobin, total leukocyte count, renal function tests, serum electrolytes, and foot X-rays, were performed. All patients were managed with oral hypoglycemic agents (OHA) or insulin to optimize blood glucose control, as guided by physicians.

The diabetic foot ulcers were meticulously examined to document their location (toes or foot),

number (single or multiple), and the presence of palpable pedal pulses. Wound depth was assessed using a sterile blunt probe to determine probing to bone, with foot X-rays used to evaluate osteomyelitis when bone involvement was suspected. Ulcers with purulent discharge were swabbed for culture and sensitivity testing. Each ulcer was assigned a Diabetic Ulcer Severity Score (DUSS) by evaluating the four key parameters: palpable pedal pulses, probing to bone, ulcer location, and ulcer number. Ulcers were treated with debridement, disarticulation, or amputation as necessary, along with systemic antibiotics based on culture results and adequate pain management.

**Diabetic Ulcer Severity Score (DUSS) and Ulcer Grading:** The DUSS was calculated based on observations: palpable pedal pulses (present or absent), probing to bone (absent or present), ulcer location (toes or foot), and ulcer number (single or multiple). The depth of ulcers was graded from Grade 1 (dermis involvement) to Grade 5 (bone involvement) using a sterile blunt probe. Osteomyelitis was assessed as necessary, and wounds were managed using standard care practices, including glucose control, antibiotics, and regular wound care. Healing was defined as complete epithelialization or healing after skin grafting. Amputation rates were recorded for both minor and major procedures performed within the observation period.

Patients were followed up regularly in the surgical outpatient department for up to six months or until healing or amputation, whichever occurred first. Surgical interventions and wound healing progress were documented. Ulcer healing was classified as complete healing without surgical intervention, healing requiring surgical procedures other than amputation, or healing resulting in amputation. Patients who did not complete the six-month follow-up or whose ulcers remained unhealed were excluded from the final analysis.

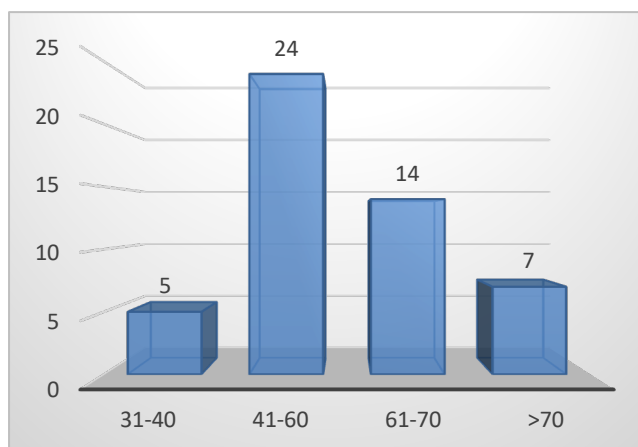
Statistical analysis was conducted using SPSS 21.2 to determine the association between DUSS scores and healing outcomes. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were presented as mean  $\pm$  standard deviation, and categorical variables as frequencies and percentages. A p-value of <0.05 was considered statistically significant.

### Results

In our study, we analyzed 50 patients with diabetic foot ulcers, highlighting significant gender disparities and ulcer characteristics. The majority of the study population were male, with 38 patients (76.71%) compared to 12 females (23.29%), indicating a higher prevalence of diabetic foot ulcers among men. The majority of patients with

diabetic foot ulcers were middle-aged, with 48.0% in the 41-60 years group. Seniors aged 61-70 years

accounted for 28.0%, while only 10.0% were younger (31-40 years), and 14.0% were over 70.



**Figure 1: Age Distribution (n)**

The duration of diabetes also played a crucial role, with 27 patients (53.42%) having diabetes for less than 6 years, and 23 patients (46.58%) within the 6-15 years duration bracket, highlighting the absence of cases beyond 15 years. The healing outcomes demonstrated varied results: 24 patients (47.95%)

achieved healing through primary intention, 9 patients (17.81%) required skin grafting, and a significant 17 patients (34.25%) underwent amputations, underscoring the severity and complications associated with advanced diabetic ulcers.

**Table 1: DUSS Score Distribution**

DUSS Score	Number	Percentage (%)
Score 0	0	0.0
Score 1	13	26.0
Score 2	17	34.0
Score 3	10	20.0
Score 4	5	10.0
Score 5	5	10.0

In our study, ulcer healing outcomes showed that 47.37% of males and 50.0% of females healed with primary intention, with similar rates for amputation (34.21% in males and 33.33% in females). The DUSS score distribution revealed that most patients had moderate scores, with Score 2 being the most prevalent among both genders (34.2% in males, 33.3% in females).

**Table 2: Gender-wise Ulcer Healing Rates with Total**

Outcome	Male (N=38)	Female (N=12)
Primary Intention	18 (47.37%)	6 (50.0%)
Skin Grafting	7 (18.42%)	2 (16.67%)
Amputation	13 (34.21%)	4 (33.33%)
<b>Total</b>	<b>38 (100%)</b>	<b>12 (100%)</b>

**Table 3: Gender-wise DUSS Score Distribution**

DUSS Score	Male (N=38)	Female (N=12)
Score 0	0 (0.0%)	0 (0.0%)
Score 1	10 (26.3%)	3 (25.0%)
Score 2	13 (34.2%)	4 (33.3%)
Score 3	8 (21.1%)	2 (16.7%)
Score 4	4 (10.5%)	1 (8.3%)
Score 5	3 (7.9%)	2 (16.7%)
<b>Total</b>	<b>38 (100%)</b>	<b>12 (100%)</b>

Age-wise, primary intention healing was highest in the 41-60 age group (50.0%), while amputation rates remained significant across all age groups, emphasizing the need for effective management across demographics. (Table 4)

**Table 4: Age-wise Ulcer Healing Rates**

Age Group	Primary Intention	Skin Grafting	Amputation
31-40	2 (40.0%)	1 (20.0%)	2 (40.0%)
41-60	12 (50.0%)	4 (16.67%)	8 (33.33%)
61-70	7 (50.0%)	2 (14.29%)	5 (35.71%)
>70	3 (42.86%)	1 (14.29%)	2 (28.57%)
<b>Total</b>	<b>24 (48.0%)</b>	<b>9 (18.0%)</b>	<b>17 (34.0%)</b>

## Discussion

In our study, we analyzed 50 patients with diabetic foot ulcers, highlighting significant gender disparities and ulcer characteristics. The majority of patients with diabetic foot ulcers were middle-aged, with 48.0% in the 41-60 years group. Seniors aged 61-70 years accounted for 28.0%, while only 10.0% were younger (31-40 years), and 14.0% were over 70. Age-wise, our findings align with several other studies, which also report a high prevalence of diabetic foot ulcers among middle-aged and older adults. Pemayun et al. [8] observed a similar age distribution in a tertiary care hospital setting in Indonesia, where the mean patient age was 54.3 years, indicating that middle-aged to senior individuals are particularly affected by diabetic foot ulcers. Kalaiselvi et al. [9] reported a mean age of 57.2 years among diabetic foot ulcer patients, corroborating the increased prevalence of foot ulcers in older adults. These findings suggest that as patients age, they are more likely to experience complications such as neuropathy and vascular disease, which heighten the risk of developing foot ulcers. This correlation of age with ulcer incidence highlights the need for preventive interventions targeting middle-aged and older adults to reduce the burden of diabetic foot ulcers.

In our study, we observed a significant male predominance in diabetic foot ulcer cases, with 76.71% of the cohort being male, a trend similarly noted in several other studies. Anand et al. [10] reported a male-to-female ratio of 3.5:1, suggesting that males may be more susceptible to diabetic foot complications due to lifestyle factors, increased physical activity levels, and higher exposure to foot trauma. Saraswat et al. [11] similarly found that 76.71% of patients with diabetic foot ulcers were male, aligning closely with our data. Kalaiselvi et al.<sup>9</sup> also noted that 77% of their diabetic foot ulcer patients were male, underscoring this pattern across different populations. This gender disparity suggests that men may face higher risks related to smoking, prolonged undiagnosed diabetes, and other factors contributing to foot ulcer development. These findings underscore the importance of targeted awareness and preventive

programs, particularly for men who appear to be at a higher risk for diabetic foot complications.

Age-wise, our study found that nearly half (48.0%) of the cases were in the 41-60 age group, with seniors aged 61-70 accounting for 28.0%.

In our study, the Diabetic Ulcer Severity Score (DUSS) distribution shows that the majority of patients presented with moderate to severe ulcer severity, with 34.0% at Score 2 and 26.0% at Score 1. This distribution aligns with findings from Kalaiselvi et al. [9], where moderate DUSS scores were similarly prevalent, indicating a substantial need for focused care among middle-to-high severity cases. Saraswat et al. [11] also reported that most diabetic foot ulcer cases fell within mid-range DUSS scores, emphasizing a high risk of complications if ulcers progress without timely intervention. Additionally, a small but significant portion of our patients were classified under Scores 4 and 5 (10.0% each), reflecting advanced ulcer stages requiring intensive treatment, a trend noted by Pemayun et al. [8], where severe ulcers accounted for a noticeable fraction of cases in tertiary settings. The absence of Score 0 patients, as observed in both our study and those by Anand et al. [10] and Saraswat et al. [11], underscores that nearly all patients in clinical settings present with some degree of ulcer severity, reinforcing the need for early-stage screening and proactive intervention to prevent escalation to higher DUSS scores.

The duration of diabetes significantly influenced ulcer severity and healing outcomes in our study, with 53.42% of patients having diabetes for less than 6 years and 46.58% within the 6-15 year range, while no cases extended beyond 15 years. This trend aligns with findings from Saraswat et al.<sup>11</sup>, where shorter diabetes duration was common among ulcer cases, suggesting that even earlier stages of diabetes pose risks for ulcer development if not well-managed. Kalaiselvi et al. [9] similarly observed a concentration of cases within the first 15 years of diabetes, underscoring the need for early interventions to mitigate ulcer risks.

Healing outcomes in our study showed varied results, with 47.95% of patients achieving healing through primary intention, 17.81% requiring skin

grafting, and a notable 34.25% undergoing amputations. Comparable outcomes were observed in the study by Pemayun et al. [8], which reported significant amputation rates in severe ulcer cases, emphasizing the complications associated with advanced diabetic ulcers. Kalaiselvi et al. [9] also noted a substantial proportion of amputations among patients with longer diabetes duration, reflecting the compounded risks from unmanaged diabetes and ulcer progression. These findings highlight the importance of early and effective management strategies to prevent severe outcomes, such as amputations, particularly for those in the mid-range diabetes duration who are at elevated risk for advanced ulcer complications.

A limitation of our study is the relatively small sample size, which may limit the generalizability of findings across broader populations. Additionally, the absence of cases with diabetes duration beyond 15 years restricts our understanding of long-term ulcer risks.

### Conclusion

In conclusion, our study highlights that diabetic foot ulcers predominantly affect middle-aged and older men, with moderate to severe cases common among those with shorter diabetes duration. The high rate of amputations underscores the need for early screening and focused management to prevent severe outcomes. These findings emphasize the importance of timely intervention and tailored preventive strategies to reduce the burden of diabetic foot complications and improve patient outcomes.

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