

Prediction of outcome in individuals with diabetic foot ulcers based on diabetic ulcer severity score (DUSS) in a tertiary care hospital, south india: A longitudinal study

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Abstract

Background: In an effort to better categorise ulcers and enable comparison of the results of standard management, a number of classification schemes for foot ulcers have been developed. One of the most recent classification systems for wounds is the DUSS (Diabetic Ulcer Severity Score), which still needs to be validated in order to evaluate the results of diabetic foot ulcers. So, using the diabetic ulcer severity score, we conducted this study to ascertain the prognosis of diabetic foot ulcers (DUSS) **Methods:** Total of 100 Diabetic patients attending surgical outpatient clinic or admitted into the tertiary care hospital with diabetic foot ulcers from January 2018 to June 2019 were included in the study. Sociodemographic data along with information related to diabetes were collected using a pretested semi structured questionnaire and the DUSS score was calculated for each patient and analysed using STATA version 14. **Results:** The mean age of the study participants with Diabetic foot was 57.2 (11.7). Males were commonly affected by Diabetic foot ulcers accounting to 77%. Most commonly ulcers were of DUSS Score of 1 followed by Score 0. Major amputation was done for 12% of patients, minor amputation was done in 16% of patients in our study. Patients with raised DUSS score has more probability of having amputation when to patients with lower score. **Conclusion:** The DUSS scoring system offers a simple diagnostic tool for estimating the likelihood of healing or amputation. This scoring system is very simple and straightforward, requires no sophisticated investigation tools, and is simple to use even in busy OPDs.

Keywords: Diabetes, foot ulcer, DUSS, primary healing, amputation

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Introduction

The world health organization (WHO) defines the diabetic foot as an infection, ulceration or destruction of deep tissue associated with neurological abnormalities and various degrees of peripheral vascular disease in the lower limb.¹ The diabetic foot is a syndrome rather than a disease. In India 30 million people are diabetic and by the year 2025 predicted to have 57 million. Presently India is known as the diabetic capital of the world. Every year 3 to 7 % of

diabetics suffer from foot lesion for the first time.² Foot ulcers occur in approximately 15% of diabetic peoples, which accounts for 25% of all hospital admissions. Foot ulcers are a common complication of diabetic patients and represent a major source of morbidity. More than 60% of lower extremity amputations are seen in diabetes and 70% of healed ulcers are estimated to reoccur in next 5 years.³ In the year 2002 globally 82,000 diabetes has undergone amputations. Therefore, by taking simple precautionary measures in diabetic peoples, foot complications can be prevented. If the person has already developed an ulcer recognizing it at the earliest and by proper treatment of the ulcer the limb can be saved.⁴

Foot is an integrated complex of bones arranged in beautiful arches. An aponeurosis nicely bow stringing the arches, long tendons traversing the leg that guy-rope the foot and the long nerves and artery that branch and reach every miniscule of the foot. The foot and its arch help one walk with grace and maintain the equilibrium of the biped man. In diabetic foot this foot arch is lost and thus the equilibrium.⁵ Peripheral neuropathy, peripheral vascular disease, abnormal plantar pressure load, and infection are accepted as the main risk factors for the development of diabetic foot ulcers and amputations. Since diabetic foot wounds and amputations account for a significant part of diabetic related health care costs, several attempts have been made to establish classification systems that help assess the severity of the disease.⁶

Various scoring systems and classification of foot ulcer exists. Different parameters are incorporated in these scoring systems such as ulcer depth, site of ulcer, depth of the ulcer, infection, neuropathy, arterial insufficiency. All these scoring systems are complex and do not predict long term outcome in the patients. Diabetic ulcer severity score is easy enough to be applied in day to day clinical practice and it is one of the latest wound based classification which needs to be validated in our setup. Moreover there is a scarce published literature on assessing the outcome of diabetic ulcer based on Diabetic ulcer severity score (DUSS) from urban part of southern India. Hence, this hospital-based study was conducted to predict the outcome in individuals with Diabetic Foot Ulcers based on Diabetic ulcer severity score (DUSS).

Materials and methods

This was a longitudinal, follow-up study, conducted at a tertiary care hospital in South India. Based on the feasibility and the expected number of participants that would be available during the study period (January 2018 to June 2019), and with a non-response rate of 10%, our final sample size came out to be 100. We included only those patients who were a) between the ages of 40 to 70 years, b) diagnosed case of diabetes mellitus based on WHO criteria⁷ and c) diabetic patients with foot ulcers irrespective of the duration. We excluded those patients with the following a) ulcers located above the ankle, b) non-diabetic foot ulcers, c) venous stasis ulcers with diabetes and d)ulcer with evidence of gangrene.

A pre-tested semi-structured questionnaire was used to collect information on sociodemographic details and other variables related to diabetes and foot ulcer which was followed by careful clinical examination and regular follow-up. Those who underwent surgery were noted separately. We used Diabetic ulcer severity score (DUSS) as shown in table 1 to calculate the severity of the diabetic foot ulcer and followed up the patients to assess the outcome based on their severity.⁸

Standard treatment care was given to all these patients, which included oral hypoglycaemic or insulin for good control of diabetes, health education, antibiotics and regular wound care. Healing was defined as complete epithelisation or healing after skin grafting. Amputation rate was defined as the percentage of patients undergoing either minor or major amputation within the observation period. Toe or forefoot amputations were taken as minor amputation and below or above amputation were taken as major amputation. Dressings were done every day

for in patients and patients who were discharged are followed up in the surgical outpatient clinic for DUSS scoring (table 1) once in fortnight for 1st month, then once in a month till the ulcer healed or for a minimum period of up to 6 months. Ulcer healing was assessed as mentioned earlier.

Table 1: DUSS scoring system

S.No	Variables	Score 0	Score 1
1.	Palpable pedal pulse	Presence	Absence
2.	Probing to bone	No	Yes
3.	Ulcer site	Toes	Foot
4.	Ulcer number	Single	Multiple

Statistical analysis

Data entry was done in Epi info 7.0 and analysed in STATA 14.0.⁹ Shapiro-Wilk test was performed to assess the distribution (parametric/non-parametric) of the variables. Continuous variables were described using mean \pm SD and categorical variables in frequency and percentage. Pie and bar charts were used to visualise the categorical data. Chi-square test was performed to find the association between categorical variables and a p-value of less than 0.05 is considered as statistically significant.

Results

Out of 112 approached, 100 agreed to participate in this study. Of which 23 were females and 77 were males. The age group of the participants ranged between 40 to 78 and the mean age was 57.2 (11.7). Most of the participants were daily wager by occupation followed by farmers. Majority of the participants were educated up to secondary school followed by middle school. Almost 68% of them were smokers and half of them (51%) were alcoholic. Majority of the participants were type 2 diabetes mellitus and were diabetic for more than 10 years as shown in table 2.

Table 2: Distribution of participants based on sociodemographic variables and diabetes status

S.No	Characteristic		Frequency	Percentage (%)
1.	Age (in years)	40-49	28	28
		50-59	27	27
		60-69	41	41
		≥ 70	4	4
2.	Sex	Male	77	77
		Female	23	23
3.	Occupation	Carpenter	3	3
		Clerk	4	4
		Daily wager	39	39
		Farmer	19	19
		Housewife	10	10
		Mechanic	1	1
		Unemployed	19	19
4.	Education	Watchman	5	5
		Illiterate	14	14
		Primary school	15	15
		Middle school	19	19

		Secondary school	24	24
		High school	19	19
		Graduates	9	9
5.	Smoking status	Smoker	68	68
		Non-smoker	32	32
6.	Alcohol user	Yes	51	51
		No	49	49
7.	Type of diabetes	Type I DM	8	8
		Type II DM	92	92
8.	Duration of diabetes (in years)	≤ 5	15	15
		6-10	26	26
		11-15	38	38
		16-20	21	21

Based on the DUSS score, one fourth of the patients belong to score 1 and 0 as shown in figure 1.

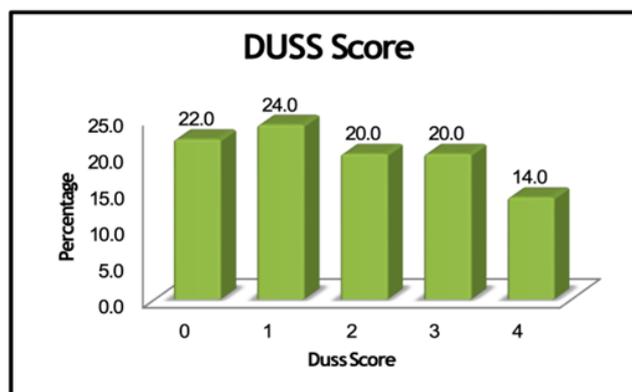


Figure 1: Distribution of participants based on DUSS score

More than half of the participants (58%) had primary healing, 14% under split thickness skin grafting (SSG), 16% had minor amputation and 12% had major amputation as shown in Table 3.

Table 3: Outcome distribution of the study participants

S.No	Characteristic	Frequency	Percentage (%)
1.	Primary healing	58	58
2.	Split thickness skin graft	14	14
3.	Minor amputation	16	16
4.	Major amputation	12	12

The association between DUSS with various outcomes like primary healing (χ^2 - 48.6, p-value <0.05), Split thickness Skin Graft (χ^2 -8.7, p-value <0.05), minor amputation (χ^2 -8.7, p-value <0.05) and major amputation (χ^2 -20.2, p-value <0.05) showed statistically significant results as shown in Figure 2. We observed that as the severity of the DUSS increases the primary healing decreased, whereas the other outcomes like SSG, minor and major amputation increased as the severity score increases. Hence, DUSS score is good in predicting the outcomes of the diabetic ulcers among diabetic patients.

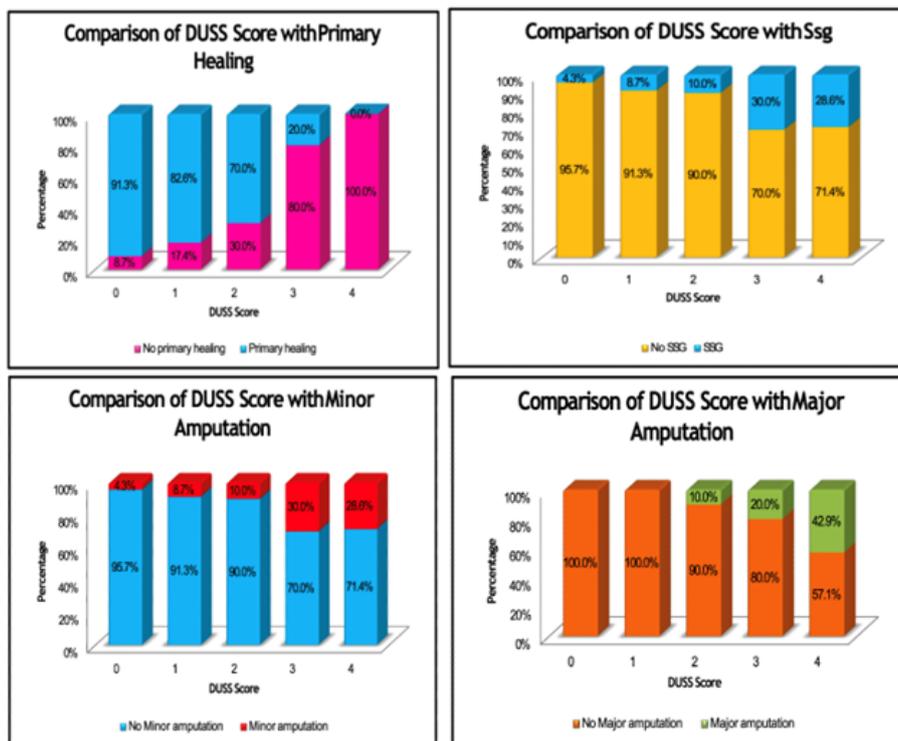


Figure 2: Distribution of participants based on the comparison of DUSS score with various outcomes

Discussion

We included a total of 100 diabetic patients with foot ulcers irrespective of duration of ulcers attending surgical outpatient clinic or admitted in Madras Medical College and hospital were studied based on the inclusion and exclusion criteria mentioned earlier. Almost half of the study participants belong to the age group of 60 and 69 years, with the mean age of 57.2 (11.7) years. A study conducted during the year 2004 through the 2002 National Hospital discharge survey, evaluated 275,000 in patient records from 500 hospitals from 1996 onwards. This study showed that elderly diabetic patients had twice the risk of developing a foot ulcer, three times the risk of developing a foot abscess and four times the risk of developing osteomyelitis.¹⁰

In our study male population were commonly affected around 77% and female were 23%. Based on occupation daily wages are commonly affected by diabetic foot ulcers with 39% , next being the farmers with 19%, smoking increases the risk of developing diabetic foot ulcers, in our study 68% of the smokers and 32% of the non- smokers developed foot ulcers. Around 51% of the diabetics who are taking alcohol and 49% of the non-alcoholics developed diabetic foot ulcer in our study. Patients having diabetes for long duration are prone to develop diabetic foot ulcers. In our study diabetes duration between 11 and 15 years are commonly affected by diabetic foot ulcers and was 28%. Approximately 55% of the patients who are taking treatment for diabetes both oral hypoglycaemic agents and human insulin developed diabetic foot ulcers in our study and 45% of the patients who are not taking treatment for diabetes developed foot ulcers.

Among study population out of 100, 58 patients with foot ulcers, the wound was healed primarily, and 14 patients underwent split thickness skin grafting. Toe amputation accounts for the majority of the diabetes related lower limb amputation. The age adjusted lower extremity amputation rate in the year 2002 among persons with diabetes was highest for toe level amputation (2.6 per 1000 persons) and followed by below knee amputation (1.6 per 1000 persons) Generally the lower extremity amputation rate is 15 to 40 times higher in

diabetic versus non-diabetic population. Amputation rate is 50% higher in men compared to women. In our study minor amputation like toe amputation and fore foot amputation was done in 16% of the study population and major amputations like above knee and below knee amputation were done in 12% of the study population.

The most common ulcers were of score 1 followed by score 0, which is similar to another study conducted in south India by Shashikala et al.¹¹ When the DUSS score was compared with primary healing 91.3% of the patients with score 0, 82.6% of the patients with score, 70% of the patients with score 2, 20% of the patients with score 3 and 0% of the patients with score 4, the wound underwent primary healing after wound dressing regularly. This rate is similar to other studies conducted in similar study setting.¹²⁻¹⁴

By comparing the DUSS score with split thickness skin grafting, none of the patients with score 0, 8.7% of the patients with score 1, 10% of the patients with score 2, 30% of the patients with score 3 and 28.6% of the patients with score 4 underwent split thickness and skin grafting. On comparing minor amputation with DUSS scoring, 4.3% of the patients with score 0, 8.7% of the patients with score 1, 10% of the patients with score 2, 30% of the patients with score 3 and 28.6% of the patients with score 4, underwent minor amputation for diabetic foot ulcer.

On comparing the DUSS score with major amputation, none of the patients with score 0 and 1, 10% of the patients with score 2, 20% of the patients with score 3 and 42.9% of the patients with score 4 underwent major amputation. In our study none of the patients with score 0 and 1 underwent major amputation. This finding is similar to another study conducted in south India in similar study setting.¹⁵ Major amputation increases in the patients with DUSS score of 3 and 4. A similar study conducted by Parisi et al., shows that around 12% of the study participants underwent major amputation, which is similar to our study.¹⁶ Another study by Beckert et al.¹² also found similar results. Hence, lower score is strongly associated with primary healing and higher score with amputations. Similar results were found in others studies as well.^{12,15}

The high response rate in our study encourages us to extrapolate our findings in other similar study setting. We have selected the study participants based on a well laid inclusion and exclusion criteria, thereby no or minimal selection bias. The assessment of exposure and the outcome were obtained based on objectively prepared standardized and universally accepted scoring criteria and hence minimal information bias. Our study also has some limitations. The sample size is low and we did not take into account the other confounding factors that might have a role in the outcome of the diabetic patients like control status of the diabetes and duration of diabetes, number of oral hypoglycaemic drugs taken by the diabetic patient at the time of recruitment etc.

Conclusion

Diabetic ulcer severity scoring (DUSS) system provides an easy diagnostic tool for prediction of outcomes of diabetic ulcers by combining four clinical assessable wound based parameters. In order to provide a straightforward, streamlined approach in a clinical setting without the need for an advanced investigative tool, study groups can be stratified based on the severity of the ulcers. However, this does not change the process of wound management. In this study, patients with lower DUSS scores didn't need any major amputations, whereas those with higher scores needed major amputations as part of their management. The results of this study corroborate with similar studies performed with DUSS scores in other centre. Therefore DUSS score is a simple and easily reproducible that can be used in patients with diabetic foot ulcers in routine surgical practice.

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