

# ASSESSMENT OF DIABETIC FOOT ULCER USING DIABETIC ULCER SEVERITY SCORE (DUSS) IN PATIENTS PRESENTING TO VMKV HOSPITAL

Dr. C. Rajasekaran, MS <sup>1</sup>, Dr. Abhiram Kanth J R <sup>2</sup>  
Dr. Roshakhi Sultana <sup>3</sup> and Dr. Mukesh Raj <sup>4\*</sup>

<sup>1</sup> Professor & Unit Chief, Department of General Surgery,  
Vinayaka Mission's Kirupananda Variyar Medical College & Hospital, Salem.  
Email: drcraja@gmail.com

<sup>2</sup> Post Graduate, Department of General Surgery,  
Vinayaka Mission's Kirupananda Variyar Medical College & Hospital, Salem.  
Email: abhiram.kanth490@gmail.com, ORCID ID: 0009-0006-6301-3417

<sup>3</sup> Post Graduate, Department of General Surgery,  
Vinayaka Mission's Kirupananda Variyar Medical College & Hospital, Salem.  
Email: roshakhi.shaik@gmail.com, ORCID ID: 0009-0005-8752-8063

<sup>4</sup> Vinayaka Mission's Kirupananda Variyar Medical College & Hospital, Salem.  
\*Corresponding Author Email: mukeshrajcool@yahoo.com

DOI: 10.5281/zenodo.11066300

## Abstract

**Introduction:** Diabetes mellitus is a chronic endocrine illness which manifesting with raised blood glucose levels subsequent from an absolute or relative lack of insulin and is laden with complications alike retinopathy, nephropathy, macroangiopathy and the diabetic foot ulcers<sup>1</sup>. **Materials and Methods:** Total of 60 Diabetic patients with diabetic foot ulcers, attending surgical outpatient clinic or admitted into the hospital (VMKV) irrespective of their duration of illness were recruited into the study based on the inclusion and exclusion criteria. The baseline demographic data which included age, gender, duration of illness, occupation, education status, habits, socioeconomic status and treatment history were taken. **Results:** Most commonly affected age group with Diabetic foot was between 51-60 years. Mean age group is 52.3 years. Males were commonly affected in our study group contributing to 61%. In this study group around 20 % of the population were found to be both smoker and alcoholic, around 11.7% were smokers. 45% of the people are without any harmful habits. DUSS score with 3 and 4 had majority of amputation among the study population. Amputation major was around 100% in score 4. **Conclusion:** DUSS scoring system provides a simple diagnostic tool by integrating four clinically determinable wound-based parameters for anticipating probability of healing or amputation of diabetic foot ulcers. By categorizing the patients with diabetic ulcers with DUSS scoring depending upon the severity of the ulcers, we can help in implementing efficient and simplified approach. By using this method, we can minimize the need of any advanced and invasive investigations which can be time consuming. This tool can be used in both outpatient setting and bedside setting which is cost effective.

**Keywords:** Diabetes mellitus, retinopathy, nephropathy, macroangiopathy, DUSS scoring system.

## INTRODUCTION

Diabetes mellitus is a chronic endocrine illness which manifesting with raised blood glucose levels subsequent from an absolute or relative lack of insulin and is laden with complications alike retinopathy, nephropathy, macroangiopathy and the diabetic foot ulcers <sup>1</sup>.

Foot infections are a prevalent and deliberate problem in persons with diabetes. Diabetic foot infections (DFIs) frequently begin in an ulcer, nearly often a neuropathic ulceration. Whilst all wounds are colonized with microorganisms, the existence of infection is defined by  $\geq 2$  classical findings of inflammation or suppuration.<sup>2</sup>

Infections are then divided into mild (superficial and limited in size and depth), moderate (deeper or more extensive), or severe (accompanied by systemic signs or metabolic perturbations). This classification system, adjacent with a vascular assessment, helps to figure out which patients to be in hospital, which may requiring special imaging procedures or surgical management, and which will be requiring amputation.<sup>3</sup>

15% of diabetics patients land up foot ulcers in their life time with notable health related problems preeminent to depreciate in quality of life and utilization of a great deal of healthcare resources<sup>4</sup>.

Foot ulcer incidence in diabetes are around 2% per year<sup>4</sup>. A number of foot ulcer classification systems for example, the Wagner system and the University of Texas (UT) systems have been concluded in an attempt to categorize ulcers more effectively and thereby, allow efficient comparison of the outcome of routine management in different centers and treatment modalities.<sup>5</sup>

**AIM:** To calculate the “Diabetic Ulcer Severity Score” (DUSS) and Assessment of the score with patient outcomes like healing and amputation.

## OBJECTIVES

- To study the progression of ulcer healing status in diabetic patients.
- To study various techniques of surgical management involved in treatment of non healing diabetic foot ulcer.
- To study the incidence rate of amputation in patients having diabetic foot ulcer.

## MATERIALS AND METHODS

Total of 60 Diabetic patients with diabetic foot ulcers, attending surgical outpatient clinic or admitted into the hospital (VMKV) irrespective of their duration of illness were recruited into the study based on the inclusion and exclusion criteria. The baseline demographic data which included age, gender, duration of illness, occupation, education status, habits, socioeconomic status and treatment history were taken.

Ulcers were labeled infected if a purulent discharge was present with two of the local signs mentioned below. Wound depth was evaluated using a sterile blunt probe. The ability to probe to bone with the presence of local inflammation (warmth, erythema, lymphangitis, lymphadenopathy, edema, pain) or signs of systemic infection and suggestive radiological features provided a clinical diagnosis of osteomyelitis. Peripheral vascular disease was clinically detected by the absence of both pedal pulses. Then patients were categorized into groups having either single or multiple ulcerations on the same foot. The wound with the highest grading was selected for analysis for patients with multiple ulcers. For larger wounds identical grading was chosen.

Unhealed ulcers were followed up for a minimum period of 6 months. Once the ulcer had healed completely either by primary healing or skin grafting or amputation performed, the outcome was noted and the patient was deemed to have completed the study.

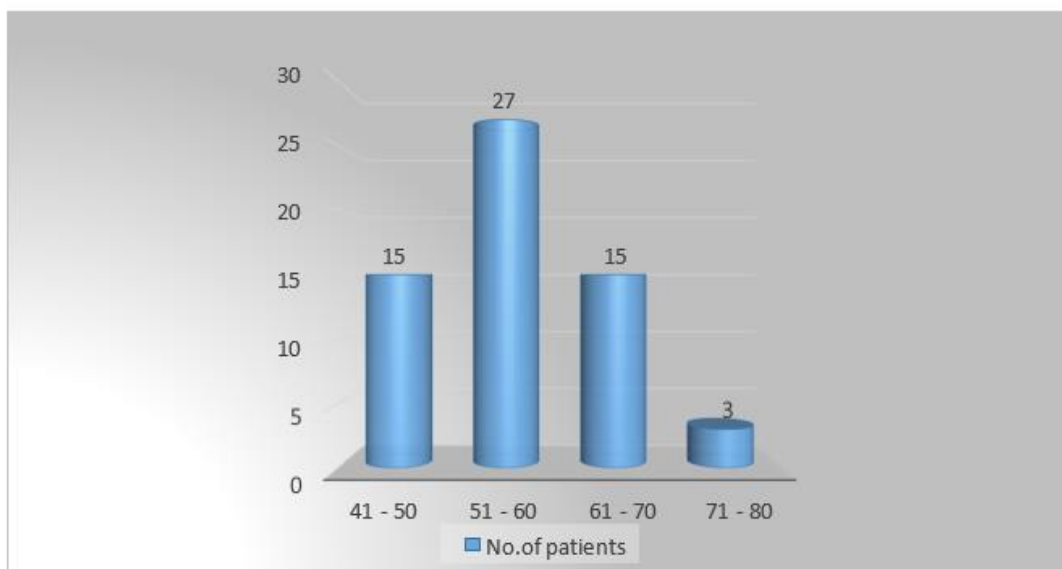
## RESULTS

**Statistical Analysis:** The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis is done with the help of computer by using SPSS 20 software. By using this software mean, SD, percentage will be calculated.

Using this software, '**p**' values are calculated through **One way ANOVA test** for raw data (continuous variables) and **chi square test** for consolidated data to test the significance of difference between variables. A 'p' value less than 0.05 is taken to denote significant relationship.

**Table 1: Age wise Distribution of Study Population**

AGE DISTRIBUTION OF STUDY POPULATION		
Age in years	No. of patients	Percentage (%)
41 - 50	15	25
51 - 60	27	45
61 - 70	15	25
71 - 80	3	5
Total	60	100

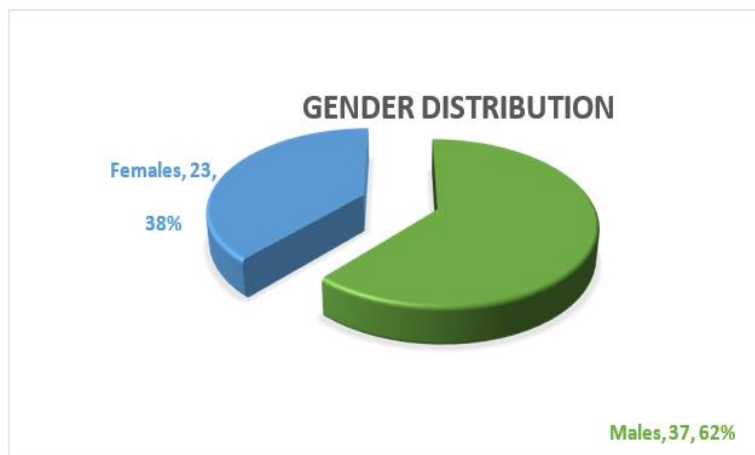


**Figure 1: Bar diagram showing Age Wise Distribution of study Population**

Most commonly affected age group with Diabetic foot was between 51-60 years. Mean age group is 52.3 years.

**Table 2: Gender wise distribution among study population**

GENDER WISE DISTRIBUTION OF STUDY POPULATION		
Gender	No. of patients	Percentage (%)
Males	37	61.7
Females	23	38.3
Total	60	100

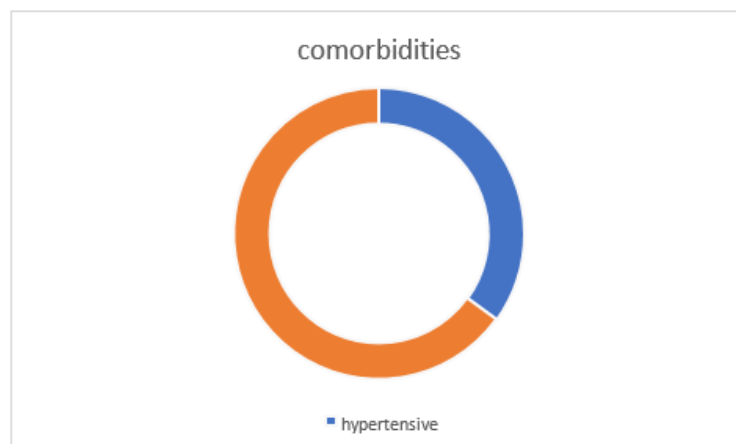


**Figure 2: Pie chart showing Gender wise distribution among study population**  
 Males were commonly affected in our study group contributing to 61%.

**Table 3: Distribution of Comorbidities among the study population**

DISTRIBUTION OF CO-MORBIDITIES		
Comorbidities	No. of patients	Percentage (%)
Hypertensive	21	35.0
No Comorbidity	39	65.0
TOTAL	60	100.0

In this study 65% has no comorbidities, around 35% were hypertensives.



**Figure 3: Pie chart showing Distribution of Comorbidities among the study population**

**Table 4: Distribution of personal habits among the study population**

DISTRIBUTION OF PERSONAL HABITS		
PERSONAL HABITS	No. of patients	Percentage (%)
SMOKER	7	11.7
BEETLE NUT CHEWER	7	11.7
ALCOHOLIC	7	11.7
SMOKER, ALCOHOLIC	12	20
NIL	27	45
TOTAL	60	100



**Figure 4: Pie chart showing distribution of personal habits among study population**

In this study group around 20 % of the population were found to be both smoker and alcoholic, around 11.7% were smokers. 45% of the people are without any harmful habits.

**Table 5: Distribution of DUSS score among the study population**

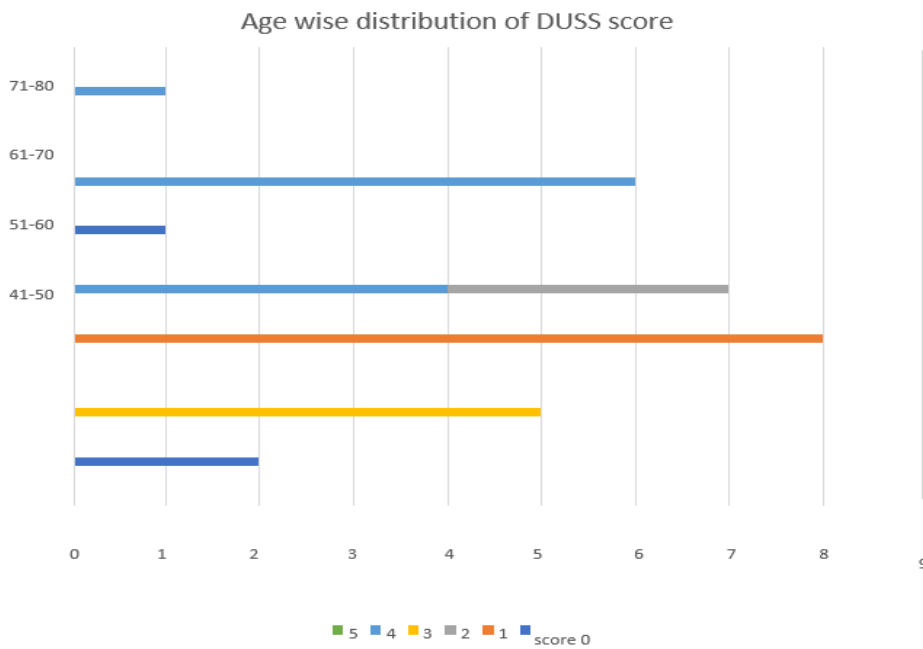
DISTRIBUTION OF DUSS SCORE		
DUSS score	No. of patients	Percentage (%)
SCORE 0	7	11.7
1	11	18.3
2	18	30.0
3	13	21.7
4	11	18.3
Total	60	100

Most common ulcers were in the score of 2 followed by 3 in this study population. Mean score was 2.83.

**Table 6: Age Wise distribution of DUSS score among study population**

AGE	DUSS SCORE 0	1	2	3	4	Total
41-51	2 (13.3%)	3 (20%)	5 (33.3%)	5 (33.3%)	0 (0%)	15 (100%)
51-60	4 (14.8%)	8 (29.6%)	7 (25.9%)	4 (14.8 %)	4 (14.8 %)	27(100%)
61-70	1 (6.6%)	0 (0%)	5 (33.3%)	3 (20%)	6 (40%)	15 (100%)
71-80	0 (0%)	0 (0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	3 (100%)
TOTAL	7	11	18	13	11	60 (100%)

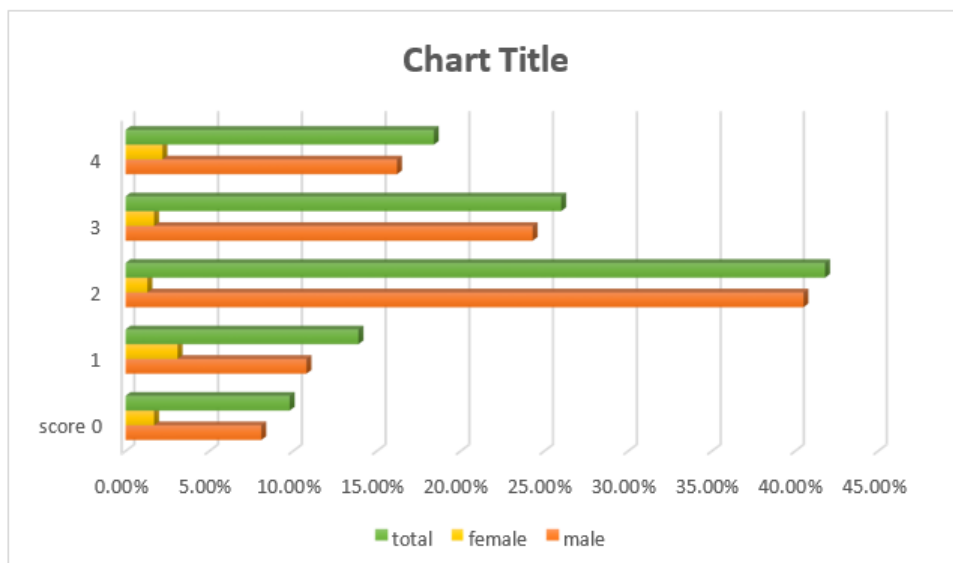
Among age wise distribution in total of 15 from 41-50 years, 33.3 % for score 2, 3 and 20 % for score 2 and 13.3. % for score 1. From 51-60 years, 29.6%, 25.9 % for score 1 and 2 respectively and for score 0,3,4 its 14.8%. Among the age group 61-70 years 40%, 33.3% and 20% for score 4, 2, 3 respectively. From 71-80years 33.3% for score 2, 3, 4.



**Figure 6: Bar diagram of Age Wise Distribution of DUSS score among the study population**

**Table 7: Gender wise distribution of DUSS score among study population**

GENDER	MALE	FEMALE	TOTAL
DUSS SCORE 0	3 (8.1%)	4 (1.7%)	7 (11%)
1	4 (10.8%)	7 (3.1%)	11 (18%)
2	15(40.5%)	3 (1.3%)	18 (30%)
3	9 (24.3%)	4 (1.7%)	13 (21%)
4	6 (16.2%)	5 (2.2%)	11 (18%)
TOTAL	37 (100%)	23 (100%)	60 (100%)



**Figure 7: Bar diagram of Gender wise distribution of DUSS score among study population**

In DUSS score 0, around 8% males, 1.7% females. In DUSS score 1, around 10.8% are males, 3.1% females. Maximum number of males are in DUSS score 2 around 40.5 % and score 3, 4, 1 and 0 in descending order wise. In females' maximum number is in score 1 (3.1%).

**Table 8: Treatment Outcome Distribution among study population**

TREATMENT OUTCOME DISTRIBUTION		
OUTCOME	No. of patients	Percentage (%)
PRIMARY HEALING	6	10.0
SSG	15	25.0
TOE AMPUTATION	5	8.3
FOOT AMPUTATION	8	13.3
BKA	12	20.0
AKA	14	23.3
DEATH DUE TO SEPSIS	2	3.3

SSG contributes as the major outcome among the study population then amputation which is above knee amputation, below knee amputation then foot amputation.

**Table 9: Distribution of DUSS Score among Study Population with Wound Debridement**

DUSS SCORE VS WOUND DEBRIDEMENT		
DUSS score	Wound Debridement	Percentage (%)
SCORE 0	7	11.7
1	11	18.3
2	2	3.3
3	1	1.7
4	0	0.0
Total	21	35.0

In wound debridement score 1 contributes around 18.3 %, score 0 around 11.7% and follows score 2, 3 and 4.

**Table 10: Distribution of DUSS score among study population undergone amputation**

DUSS SCORE VS AMPUTATION			
DUSS Score	AMPUTATION MAJOR	AMPUTATION MINOR	AMPUTATION TOTAL
SCORE 0	0 (0%)	0 (0%)	0 (0%)
1	0 (0%)	0 (0%)	0 (0%)
2	4 (25%)	12 (75%)	16 (100%)
3	11 (91.7%)	1 (8.3%)	12 (100%)
4	11 (100%)	0	11 (100%)
Total	26	13	39

DUSS score with 3 and 4 had majority of amputation among the study population. Amputation major was around 100% in score 4.

**Table 11: Distribution of Amputation major in study population**

TREATMENT - AMPUTATION - MAJOR		
TREATMENT	No. of patients	Percentage (%)
AMPUTATION - MAJOR	26	43.3 %

In this table it shows that amputation major was around 43.3% in the given population aged between 41-80 years.

**Table 12: Distribution of Amputation minor in study population**

TREATMENT – AMPUTATION – MINOR		
TREATMENT	No. of patients	Percentage (%)
AMPUTATION – MINOR	13	21.7 %

In this given study population aged between 41- 80 years around 21.7% went for minor amputation.

**Table 13: Wound Debridement distribution among study population**

TREATMENT - WOUND DEBRIDEMENT		
TREATMENT	No. of patients	Percentage (%)
Wound Debridement	21	35

In this given study population aged between 41-80 years 35 % went in for wound debridement as the mode of treatment.

**Table 14: Gender distribution of amputation major in study population**

AMP MAJOR	BKA	AKA	Total Percentage (%)
MALE	7 (58.3%)	10 (71.4%)	17 (65.3%)
FEMALE	5 (41.6%)	4 (28.5%)	9 (34.6%)
<b>TOTAL</b>	12(46.1%)	14 (53.8%)	26 (100%)

46.1% of them has undergone below knee amputation in 43.3% of the total amputation major population. Around 58.3 % who are male has undergone below knee amputation. Females are 34.6% who has undergone amputation major. Bar diagram shows the gender distribution of amputation major which is males contributing around 58.3 and 71.4 in below knee amputation and above knee amputation respectively.

**Table 15: Gender distribution of amputation minor in study population**

AMPUTATIONMINOR	FOOT	TOE	Total Percentage (%)
MALE	6 (75%)	4 (80%)	10 (76.9%)
FEMALE	2 (25%)	1 (20%)	3 (23%)
<b>TOTAL</b>	8 (61.5%)	5 (38.4%)	13 (100%)

21.7% of the population has undergone foot amputation minor in that 61.5% have undergone foot amputation and 34.8% toe amputation. Around 21.7 % of the population underwent amputation minor in that males were 76.9% and females were 23%.

**Table 16: Comparison of DUSS score with FBS**

DUSS SCORE VS FBS MEAN		
DUSS score	FBS mean	SD
SCORE 0	154.4	24.3
1	168.5	26.9
2	181.6	25.9
3	232.1	38.8
S 4	285.0	40.9
p value	<0.001 Significant	

In this given study population, the mean level of fasting blood glucose level which is recorded for score 0 is 154.4, score 1 is 168.5, for score 2 is 181.6, for score 3 is 232.1 and for score 4 is 285. The p value is <0.001 which is significant.



**Table 17: Comparison of Duss Score with PPBS**

DUSS SCORE VS PPBS		
DUSS score	PPBS Mean	SD
SCORE 0	239.6	33.0
1	272.1	45.8
2	302.9	58.0
3	376.0	73.5
4	493.0	62.2
P value	<0.001 significant	

In this given study population, the mean level of postprandial blood glucose level which is recorded for score 0 is 239.6, score 1 is 272.1, for score 2 is 302.9, for score 3 is 376 and for score 4 is 493. The p value is <0.001 which is significant.

**Table 18: Comparison of DUSS score with Amputation major and minor in study population**

DUSS SCORE VS AMPUTATION MINOR + MAJOR			
DUSS score	AMPUTATION MINOR+ MAJOR	Others	Total
SCORE 0	0 (0%)	7 (100%)	7
1	0 (0%)	11 (100%)	11
2	16 (88.9%)	2 (11.1%)	18
3	12 (92.3%)	1 (7.7%)	13
4	11 (100%)	0 (0%)	11
Total	39	21	60
P VALUE	< 0.001 Significant		

This bar diagram represents around 88.9 % in score 2 went in for amputation and 92.3% went in score 3 and 100% of them in score 4, p value is also significant.

**Table 19: Comparison of DUSS score with amputation minor**

DUSS SCORE VS AMPUTATION MINOR			
DUSS Score	AMPUTATION MINOR	Others	Total
SCORE 0	0 (0%)	7 (100%)	7
1	0 (0%)	11 (100%)	11
2	12 (66.6%)	6 (33.4%)	18
3	1 (7.7%)	12 (92.3%)	13
4	0 (0%)	11 (100%)	11
Total	13	47	60
P VALUE	< 0.001 Significant		

**Table 20: Comparison of DUSS score with amputation major**

DUSS SCORE VS AMPUTATION MAJOR			
DUSS score	AMPUTATION MAJOR	others	Total
SCORE 0	0 (0%)	7 (100%)	7 (100%)
1	0 (0%)	11 (100%)	11 (100%)
2	4 (22.2%)	14 (77.8%)	18 (100%)
3	11 (84.6%)	2 (15.4%)	13 (100%)
S 4	11 (100%)	0 (0%)	11 (100%)
Total	26	34	60
P VALUE	< 0.001 Significant		

This bar diagram represents around 100% in score 4, 84.6 % in score 3 and 22.2% in score 2 went in for amputation, p value is also significant.

**Table 21: Outcome distribution among the study population**

OUTCOME DISTRIBUTION		
OUTCOME	NO. OF CASES	PERCENTAGE
DEATH	2	3.33 %
ALIVE	58	96.67 %
<b>TOTAL</b>	60	100.00 %

The Mortality of the study population is 3.33% due to sepsis.

## DISCUSSION

Based on the inclusion and exclusion criteria mentioned before, total of 60 patients with Diabetic foot ulcer who were attending surgical outpatient clinic or admitted into VMKVMCH were recruited in this study.

This study was conducted after obtaining informed consent from patients. The Most commonly affected age group with Diabetic foot was between 51-60 years. Mean age group is 52.3 years. Second group between 41-50 and 61-70 years of age. Among study population males were more commonly affected than females. Males were affected around 61.7 % and females were 38.3%. In this study 65 % had no comorbidities and 35% had Hypertension along with Diabetic. In this study 55% of the study population had additive personal habits which includes smoking, alcohol consumption, beetle-nut chewing. Regarding the additive personal habits of study population 11.7% are smoker, 20% of them are both smoker and alcoholic.<sup>6</sup>

In this study maximum number of patients were in score 2 around 30 %. Among the gender distribution in DUSS score males were more affected in score 2 around 40.5%, females in score 1 around 3.2%. The most common management in this study population is SSG around 25%. Primary healing without any major intervention occurred around 10 % of the population. Major amputation occurred in 43.3% of the population and 21.7% underwent minor amputation. In that total of 21.7% minor amputation group 76.9% were male and 23% females. Around 43.3% population underwent Major amputation in which males are more accounting to 65.3% and females are 34.6%.<sup>7</sup>

In score 0 and 1, all of the population underwent conservative management. In score 2 around 88.9% underwent amputation either in the form of minor or major, others 11.1% had conservative management. DUSS score with 3 and 4 had majority of amputation among the study population. Amputation major was around 100% in score 4.<sup>8</sup>

Pattern of ulcer healing with score 0 is started to heal or show improvement at second visit to maximum of 5 follow up visits. For score 0 and 1 only conservative management. As the score increases the rate of amputation increases. Mortality rate of this study is 3% due to sepsis otherwise most of them had conservative management or amputation.<sup>9</sup> Study population in score 0, 1 had almost primary healing of the ulcer. Study population in score 2, 3 had primary healing, SSG and amputation also. With scores 3 and 4 most of the patients went in for amputation. Management changed from one treatment to another in few patients as the score increases. Males had more amputation compared to females. As the score increases, the incidence of amputation among diabetic foot ulcer patients also increases. Difference in the DUSS score among the study population was found to be statistically significant ( $P < 0.001$ ).<sup>10</sup>

## CONCLUSION

DUSS scoring system provides a simple diagnostic tool by integrating four clinically determinable wound-based parameters for anticipating probability of healing or amputation of diabetic foot ulcers. By categorizing the patients with diabetic ulcers with DUSS scoring depending upon the severity of the ulcers, we can help in implementing efficient and simplified approach. By using this method, we can minimize the need of any advanced and invasive investigations which can be time consuming. This tool can be used in both outpatient setting and bedside setting which is cost effective.

## References

- 1) Igbinovia E. Diabetic foot ulcers: current trends in management. *Journal of Postgraduate Medicine* 2009;130-138.
- 2) Clinical practice guidelines for the diagnosis and treatment of diabetic foot infections, 2012 *Infectious Disease Society Of America*; 54(12):132-173
- 3) Wieman TJ. Principles of management: the diabetic foot. *American Journal of Surgery* 2005;190:295-299.
- 4) Ramsey SD, Newton K, Blough D, Sandhu N. *Diabetes care* 1999 Mar;22(3):382-7
- 5) Beckert S, Witte M, Wicke C, Koenigsrainer A, Coerper S. A new wound-based severity score for diabetic foot ulcers. *Diabetes Care* 2006;29:988 –992.
- 6) Sabiston's Text book of surgery, 19<sup>th</sup> edition, pg 257.
- 7) McKeown KC. History of the diabetic foot. *The Foot* 1992;2:179-182.
- 8) Joslin EP. The menace of diabetic gangrene. *The New England Journal of Medicine* 1934 July;16:20.
- 9) Most RS, Sinnock P. The epidemiology of lower extremity amputations in diabetic individuals. *Diabetes Care* 1983 January;6:87-91.
- 10) Ward JD. The cost of diabetic foot problems. *Pharmaco Economics* 1995;8(Suppl.1):55-57.