



Original Clinical Research Article

The Role of the Dengue Severity Scale in Predicting Prognosis in Patients Admitted to the Medicine Wards of a Tertiary Care Hospital during an Epidemic

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Abstract

Background: *Dengue is most rapidly spreading mosquito-borne viral disease in the world with approximately 1 million cases reported annually. Ko-Chang et al developed a clinical scoring system to predict dengue severity, based on clinical characteristics and laboratory investigations. The WHO 1997 classification of Dengue is considered as the golden standard.*

Objectives

- i. *To classify patients with dengue into uncomplicated and severe dengue using the Dengue Severity Scale & WHO Classification.*
- ii. *To determine the sensitivity, specificity, positive predictive value & negative predictive value of Dengue Severity Scale.*

Methodology: *This is a cross sectional study done in May - June 2017. Consenting patients admitted with proven dengue (NS1 antigen positive) who fulfilled the study selection criteria were enrolled in the study. Sample size calculated for a confidence level of 95% and precision of 5% was 130 patients to find the sensitivity of the Dengue Severity Scale for predicting the prognosis of dengue.*

The socio-demographic and clinical data was collected, and patients were classified to Group A (mild) and B (severe) using the Dengue Severity Scale (DSS) and the traditional WHO Scale (WHOS). In the DSS, the cut-off value is 6. Maximum score is 15. The DSS scores were compared to the gold standard, the WHOS and the sensitivity, specificity and positive predictive value (PPV) and the negative predictive values (NPV) were obtained.

Results: *Of the 130 patients recruited to the study, 73 (56.2%) were male and 57(43.8%) were female. Most of the participants 114 (87.7%) belonged to the lower middle or lower socio-economic group.*

The DSS scoring system had a sensitivity of 91.70%, specificity of 4.80%, PPV of 83.30% and NPV of 10.00% In the DSS, 120(92.3%) patients were in the severe dengue group and 10 (7.7%) were in the

uncomplicated dengue group. The upper limit of the DSS score was 13 and the lower limit was 4.

By the WHO Scale, of the 130 patients who had dengue, there were 21 (16.2%) in the uncomplicated or mild dengue group and 108 (83.4%) patients were in the severe dengue group.

Conclusions: *From this study we see male patients had a greater risk of developing severe dengue. Greater number of patients were grouped as severe dengue in the DSS compared to the WHOS, making the probability of detecting severe dengue higher with the DSS Score. The DSS scale has a higher sensitivity so it is useful in detecting severe cases of dengue but as the specificity is low it may not be as useful in ruling out other types of fever. We hope this study will evolve into a good screening tool for detecting patients who may have severe dengue so that focussed care and monitoring may be given to them.*

Keywords: *Dengue fever, Dengue Severity Scale, DSS, WHO Scale, Predicting prognosis.*

Introduction

Dengue is the most rapidly spreading mosquito-borne viral disease in the world with approximately one million cases being annually reported to the World Health Organization.^[1] In the last 50 years, incidence has increased thirty-fold with increasing geographic expansion to new countries and, in the present decade, from urban to rural settings.^[1] Approximately 2.5 billion people live in dengue-risk regions with about 100 million new cases each year worldwide. The dengue disease burden has attained an unprecedented proportion in recent times with sharp increase in the size of human population at risk.^[2]

In India, the first epidemic of clinical dengue-like illness was recorded in Madras (now Chennai) in 1780 and the first virologically-proven epidemic of dengue fever occurred in Calcutta (now Kolkata) and the eastern coast of India in 1963-1964.^[3]

The 2002 World Health Assembly resolution (WHA55.17) urged greater commitment to dengue by WHO and its members. Dengue has a wide spectrum of clinical presentation often with unpredictable clinical evolution and outcome.^[1] It is also an emergent condition requiring prompt diagnosis and quick treatment before patients enter into the states of bleeding or shock. The 1997 WHO guidelines classified symptomatic dengue virus infections were grouped into three categories: undifferentiated fever, dengue fever and dengue haemorrhagic fever. Experiences with this classification system has exposed several limitations. It is based on clinical data in Thai children, which may not be representative of dengue following its expansion to additional

tropical regions and older age groups. A range of clinical tests requiring repetition is also needed which can be difficult for countries with limited source to perform regularly.^[4] The WHO Scale of 2009 classifies dengue fever into two groups: uncomplicated and severe, though the 1997 WHO classification is still widely used.^[4]

The 2009 WHO criteria classifies dengue according to levels of severity: dengue with or without warning signs; (abdominal pain, persistent vomiting, mucosal bleeding, lethargy, hepatomegaly, increasing hematocrit with decreased platelets); and severe dengue (with severe plasma leakage, severe bleeding, organ failure)^[5]

Most of the prediction systems in the past focused on clinical outcomes of the disease. There are few studies that focused directly on infection severity.^[6] Ko-Chang et al developed a simple clinical scoring system to predict dengue infection severity, based on patient clinical characteristics and routine laboratory investigations. The scoring system had a sensitivity of 90.67%, a specificity of 86.89%, a positive predictive value (PPV) of 81.4%, and a negative predictive value (NPV) of 93.63% for prediction of dengue fever among febrile patients.^[7] An ROC curve, which plotted the false-positive rate against the true-positive rate for each possible cut-off for a diagnostic test, had an area under the curve of 0.958 for the dengue score.

Dengue fever is an important public health problem. The dengue fever scoring system based on epidemiological information and clinical signs or symptoms, which might be useful in detecting the dengue fever very early prior to laboratory

results.^[7] This classification also identifies patients with low risk who may be discharged safely and attention given to patients with high risk who should be admitted for close monitoring. The sooner dengue is diagnosed, the sooner the treatment can be started, therefore a dependable scoring system can differentiate patients requiring close monitoring in the emergency room.^[7]

This study was planned to study the role of the Dengue Severity Scale (DSS) in predicting prognosis compared to the traditionally used WHO Scale for dengue during an epidemic. We wanted to classify patients with proven dengue fever, admitted to the wards of this tertiary care hospital into uncomplicated and severe dengue using the Dengue Severity Scale Dengue and WHO classification and to determine the sensitivity, specificity, positive predictive value and negative predictive value of the Dengue Severity Score as a tool for predicting the prognosis of Dengue fever.

Materials & Methods

This is a cross-sectional study to find the sensitivity, specificity, positive predictive value and negative predictive value of the DSS in early diagnosis of dengue fever. We would like to know how effective is the DSS in grading the severity of Dengue so that it can become a guidance tool to predict the prognosis of the dengue fever.

Clinically suspected dengue fever was defined as the presence of fever and any two of the following symptoms: headache, myalgia, poly arthralgia, skin rash, nausea and vomiting, or haemorrhagic manifestations with Dengue NS1, Ag or IgM antibody present.

After receiving permission to undertake the study from the medical superintendent and approval from the Institutional Review Board and Ethics committee, consenting patients with Dengue fever were consecutively enrolled to the study if they fulfilled selection criteria. Adult patients over the age of 18 years admitted to the medicine wards of this institution were included if they were serologically positive for Dengue fever during the

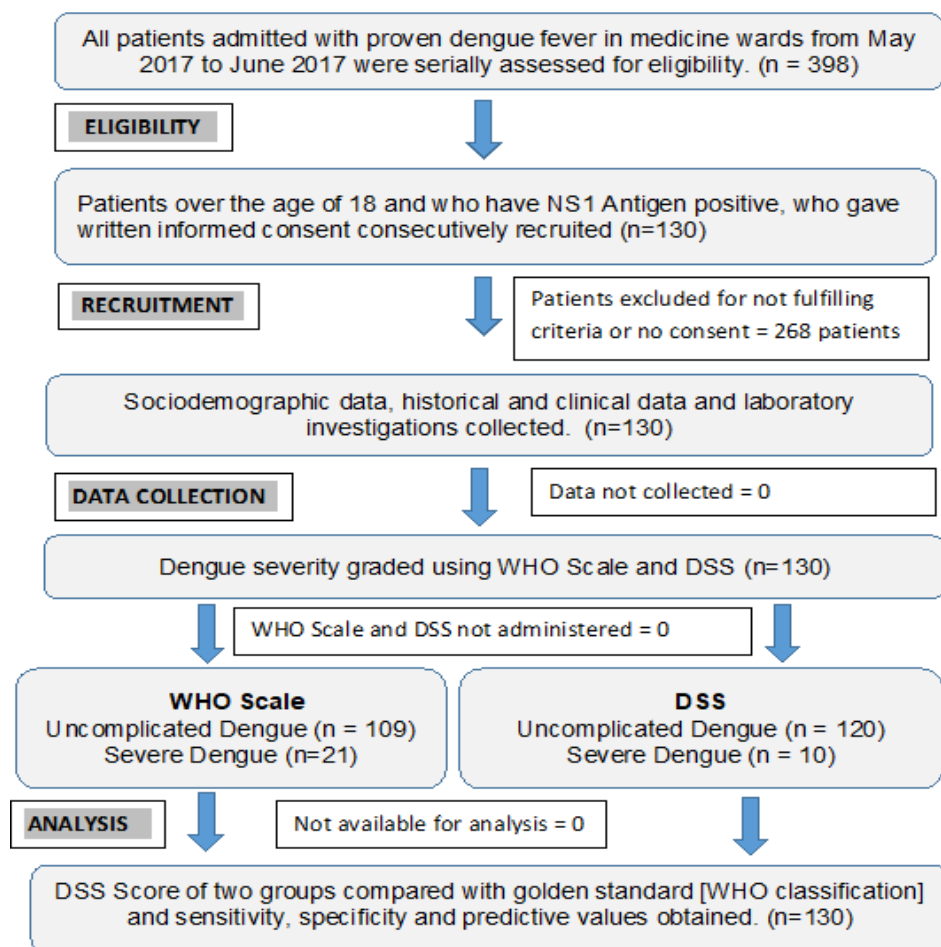
period May to June 2017 and gave written informed consent.

Socio-demographic and clinical data will be collected from all consenting patients admitted to the medicine ward during an epidemic. The historical and demographic data was collected and the socio-economic status was obtained using the Kuppaswamy scale^[8] Patients serially recruited into the study were classified based on the DSS and WHOS into Group A: Uncomplicated (mild) dengue fever and Group B.: Severe dengue fever After a thorough clinical examination, the hepatic and renal functions will be investigated using aspartate aminotransferase (AST) formerly called Serum Glutamate Oxaloacetate Transaminase (SGOT) and alanine aminotransferase (ALT) formerly called serum glutamate pyruvate Transaminase (SGPT) and serum creatinine and the patients classified into Group A (Uncomplicated Dengue) and Group B. (Severe Dengue). The data will be recorded in the case study form after confirmation with the clinicians treating the patient.

The Sample size was calculated for the sensitivity of a test using nMaster Sample Size calculation computer software with an expected sensitivity of 90.67% based on the study by Ko-Chang et al who found the sensitivity of the DSS for predicting the prognosis of dengue to be 90.67%.^[10] The Sample size calculated for a confidence level of 95% and precision of 5% was 130 patients diagnosed to have Dengue fever. All data was maintained confidentially and handled only by the investigator and authorised personnel. The demographic and clinical variables in the two groups were compared using the Chi square test and entered into the baseline table. The WHOS and the DSS scores will be used to obtain the the severity of the disease. The sensitivity, specificity and predictive values of the DSS were obtained. The study Flow diagram according to Strobe guidelines is given in Figure 1.

Figure 1 Study Flow Diagram

Study Flow Diagram



Results

Table 1 Baseline Characteristics of participants

Variables		Uncomplicated Dengue (n=10)	Severe Dengue (n=120)	Total (n=130)
Gender	Male	6 (8.2%)	67 (91.8%)	73 (56.2%)
	Female	4 (7.0%)	53 (93.0%)	57 (43.8%)
Age in years	18 - 30 years	6 (13.0%)	40 (87.0%)	46 (35.4%)
	31 – 50 years	2 (4.3%)	44 (95.7%)	46 (35.4%)
	51 – 75 years	2 (5.3%)	36 (94.7%)	38 (29.2%)
Socio-economic Status	Upper middle income	1 (6.3%)	15 (93.8%)	16 (12.3%)
	Lower middle income	1 (5.0%)	19 (95%)	20 (15.4%)
	Upper lower income	8 (8.5%)	86 (91.5%)	94 (72.3%)
Symptomatology	Fever	10 (7.7%)	120 (92.3%)	130 (100 %)
	Rash	0 (0.0%)	20 (100%)	20 (15.4%)
	Headache	10 (7.7%)	120 (92.3%)	130 (100%)
	Myalgia	10 (7.7%)	120 (92.3%)	130 (100%)
	Cough	0 (0.0%)	8 (100%)	8 (6.2%)
	Bleeding signs	0 (0.0%)	10 (7.7%)	10 (7.7%)
Co-morbidities	Hypertension	0 (0.0%)	3 (100 %)	3 (2.3 %)
	Diabetes mellitus	1 (12.5%)	7 (87.5%)	8 (6.2 %)
	Other diseases	3 (18.8%)	13 (94.2 %)	16 (12.3 %)
	No co-morbidities	6 (5.8%)	97 (94.2%)	103 (79.2 %)
Hospital stay	Hospital stay 4 or < 4 days	9 (12.2 %)	65 (87.8%)	74 (56.9%)
	Hospital stay > 4 days	1 (1.8%)	55 (98.2%)	56 (43.1 %)

Figure 2. Comparison of WHO Scale and the Dengue Severity Scale

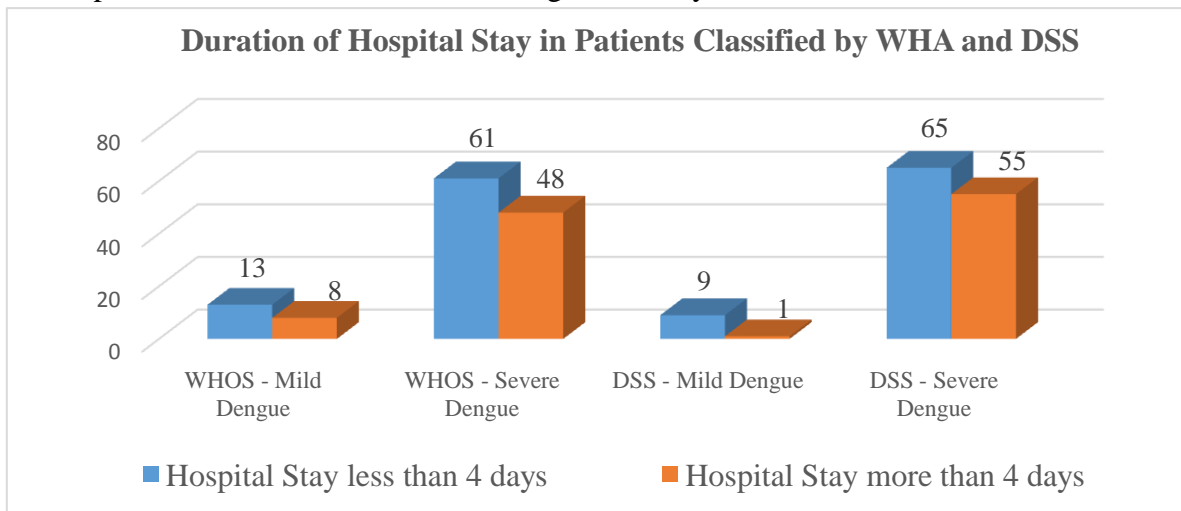


Figure 2. Legend: The Dengue Severity Scale identified more patients with severe dengue who were more likely to have a longer hospital stay and fewer patients of uncomplicated dengue, most of whom stayed less than 4 days in the hospital. (p=.0.023)

Table 2. Two by Two Table Comparing WHOS and DSS Scores

	Dengue Severity Scale Scores		Total WHOS Scores
	Uncomplicated Dengue	Severe Dengue	
Mild Dengue	9	20	109
Severe Dengue	1	100	21
Total DSS Scores	10	120	130

The DSS scoring system had a sensitivity of 91.70%, specificity of 4.80%, PPV of 83.30% and NPV of 10.00%. By the DSS, 120 (92.3%) were in the severe dengue group and 10 (7.7%) in the uncomplicated dengue group. The upper limit of the DSS score was 13 and the lower limit was 4.

By the WHO Scale, of the 130 patients who had dengue, there were 21 (16.2%) patients in the uncomplicated or mild dengue group and 108 (83.4%) patients in the severe dengue group.

Table 3 Investigations in the Uncomplicated and Severe Dengue Groups

DSS Classification	Uncomplicated (Mild) Dengue (n=10) Mean (SD)	Severe Dengue (n=120) Mean	Significance(p value) (Student t-test)
Serum Creatinine	1 (0) g/dl	0.96 (0.24) g/dl	0.381
Haemoglobin	12.9 (1.45) mg/dl	13.44 (1.65)mg.dl	0.485
	Median (IQR)	Median (IQR)	Significance (p value) (Mann Whitney U test)
Platelet count	52500 (25000 – 66000)	54000 (30500 – 85000)	0.038
SGOT (AST)	39 (36 - 69) IU	128.5 (69 -184) IU	0.000
SGPT (ALT)	35 (31 - 39) IU	80.5 (55.5 - 141) IU	0.000

There was no significant difference in the serum creatinine and haemoglobin of patients with uncomplicated and severe dengue. The Platelet count was significantly higher in patients with severe dengue (p<0.05) while the difference in

SGOT (AST) and SGPT (ALT) between the two groups was highly significant (p<0.001).

Discussion

Dengue is a common communicable disease spreading in epidemic proportions in our country and in many parts of the world. It commonly occurs in our part of the country during the monsoon months. Out of 130 patients enrolled in this study 73 (56.2%) were males and 57 (43.8%) were females showing that dengue was more prevalent in males than females and also both uncomplicated and severe dengue. As we recruited only patients admitted in the ward, we found a greater number who had severe dengue. More patients, 94(72.3%), belonged to the upper lower socio-economic group of the Kupusamy scale followed by 20 (15.4%) patients in the lower middle class group and in each class. There were also more patients, 105 (80.8%) in these two classes who had severe dengue.

The patients recruited to the study were all between the ages of 18 and 75 years. Most of the patients 92 (70.8 %), who were admitted for dengue, were below the age of 50 years, 38 (29.2%) were over the age of 50 years and 46 (35.4%) were below 30 years of age. The mean age of patients in the uncomplicated dengue group was 35.9 (SD 8.9) years and in the severe dengue group, it was 41(SD 15) years.

Clinical features like fever, myalgia, and headache were present in all patients (100%) of both categories. Only 20 (15.4%) had a rash and all were in the severe dengue group. Respiratory symptoms of cough and cold were present only in 8(6.2%) patients, again in the severe dengue group. Bleeding signs were present only in 10 (7.7%) patients, all of whom had uncomplicated dengue. They mainly gave a history of petechial haemorrhages and menorrhagia.

Of the 130 patients in the study, 103(79.2%) had no co-morbidities or any history of past illness. There were only 3 (2.3%) diabetics and 8 (6.2%) patients with hypertension, however 16 (12.3%) had other conditions like rheumatoid arthritis, hypothyroidism and cardiac disease.

The higher limit of the DSS score in the study population was 13 and lower limit value was 4. In

the uncomplicated dengue group, the mean creatinine value was 1 mg/dl and in the severe group it was 0.9 mg/dl. The mean haemoglobin level in uncomplicated group was 12.9 g/dl and it was 13.4 g/dl in the severe group. There was no significant difference in these values between the two groups. The median platelet count (54000) in the severe group was significantly higher than in the uncomplicated group (52000). The median values for SGOT were 39 IU and 128.5 IU in the uncomplicated and severe dengue groups. The median SGPT value was 35 IU in uncomplicated group and 80.5 IU in severe group. The difference in the median values for SGOT (AST) and SGPT (ALT) between the two groups was highly significant (p value <0.001).

Good outcome was measured by healthy discharge from hospital and duration of hospital stay less than 4 days. All the 130 patients without exception were discharged healthy from the hospital. Hospital duration was found to be prolonged in patients who were classified as severe by the DSS and by the WHO scale. Of the 120 classified as severe dengue by the DSS, 55 (45.8%) patients spent more than 4 days in hospital. Only one of the uncomplicated cases of dengue stayed longer than 4 days and that person had diabetes mellitus. Of the 109 patients classified by the WHO scale as severe dengue 48 (44.0%) patients stayed in the hospital for more than 4 days while 8 (38.1%) patients out of the 21 classified as mild dengue also stayed for more than 4 days, indicating that some cases of severe dengue may have been missed by the WHO scale.

The limitations of our study were that we studied only 130 patients of the total 398 patients as they did not all fulfil the criteria. Many of them did not have the antigen test. Some patients were not willing to be part of the study. Also as patients are anxious because they are admitted, here are chances for exaggeration of their symptoms may present, thereby increase in the DSS score may present

However the DSS scoring system correctly classified the severe cases with 91.70% sensitivity

which is nearly equal to the study conducted by Ko Chang et al [90.67%]. Also the clinical features like fever, head ache, myalgia etc. is seen among all patients. There was no significant difference in mean serum creatinine and haemoglobin values in the two groups but platelet count, SGOT and SGPT were significantly raised in the severe dengue group. By using the DSS scoring system, the clinician can get an idea regarding the severity and he can start appropriate treatment in order to prevent poor prognosis.

Clinicians can play an important role in early diagnosis of dengue patients and help public health workers to conduct appropriate control measures at earlier stages. Patients with low risk may be discharged safely and attention given to patients with high risk who should be admitted for close monitoring. This scoring system could be useful in diagnosis by less experienced physicians, especially when rapid diagnostic tests are not available, thus severe dengue fever can be recognized early, which allows appropriate therapy and prevention strategies to be implemented

Conclusion

The Dengue severity scale is a valid tool for predicting prognosis. It has great value in detecting patients with severe infection so that additional care and attention can be paid to monitoring these patients during an epidemic.

The study shows that male patients with a high DSS score are likely to have a poorer prognosis with a longer duration of hospital stay. The DSS scale has a higher sensitivity so it will be helpful to detect the severe cases of dengue. However the specificity is low and so it cannot be used for ruling out other types of fevers. Early detection and prompt control are the two pillars for successful infection control.

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