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ORIGINAL RESEARCH

MODIFIED SICK NEONATAL SCORE(MSNS), A NOVEL NEONATAL DISEASE SEVERITY SCORE FPR CLINICAL ASSESSMENT AND MORTALITY PREDICTION IN RESOURCE – CONSTRAINED SETTINGS

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ABSTRACT

Background: As the mortality observed could be adjusted to the severity of the disease of admitted newborns, they are used to create standardized comparisons between the performances of various units To evaluate modified sick neonatal (MSNS), a novel neonatal disease severity score designed for resource constrained settings.

Methods: A facility based prospective observational study. Present study was done for duration of 1 year i.e, from 06-03- 2021 to 05-03-2022, was done in SNCU, Sri Venkateswara Ramnarain Ruia Government General Hospital (SVRRGGH), Tirupati. Newborns Admitted in SNCU, SVRRGGH, Tirupati. A sample size of 565 neonates is required, assuming 90% sensitivity and specificity and an absolute accuracy of 0.035 at 95% confidence level.

Results: In terms of MSNS and result, 66.5% of neonates with scores between 0 and 8 expired, followed by 30.7% with scores between 9 and 12, and 2.8% with scores between 13 and 16. The MSNS scores of expired neonates were substantially lower. When individual parameters were connected with outcome, the lower score in each MSNS parameter significantly increased the risk of mortality.

Conclusion: In conclusion, as compared to earlier scoring systems, the MSNS employed in this study is simple to use, has good sensitivity and specificity, could be used early in the hospitalization process, and could be used for both term and preterm babies. Therefore, in light of their admission profile and resource availability, SNCUs would benefit more from using the MSNS neonatal illness severity score.

Keywords: Modified sick neonatal score, Gestational age, Vitals, Mortality and Morbidity.

INTRODUCTION

In neonatal intensive care units, rating systems for neonatal disease severity are widely utilised. As the mortality observed could be adjusted to the severity of the disease of admitted newborns, they are used to create standardised comparisons between the performances of various units. Additionally, they assist in providing parents of specific newborns receiving treatment in the units with prognostic information. They also make it possible to spot trends in results over time.

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Numerous scoring methods include elements like pH, SpO2/FiO2 ratio, and base excess that call for more examination. In environments when resources are scarce, it is challenging to achieve these values.

The neonatal mortality rate (NMR) in urban India is 15 and in rural India is 31 per 1000 live births.42

The differences between the two are striking. Government-established Special Newborn Care Units (SNCUs) in district and sub-district hospitals serve the rural population and play a significant part in lowering the infant mortality rate there.

There is a need for a proper illness severity grading system in order to compare the performance of SNCUs and to encourage early referral of specific infants with a more severe condition to centres that are better equipped. Consequently, it was intended for this study to assess the Modified Sick Neonatal Measure (MSNS), an novel neonatal disease severity score created for settings with limited resources.

AIM AND OBJECTIVES OF THE STUDY

Aim

To evaluate a new neonatal disease severity score – Modified Sick Neonatal Score (MSNS) for resource-constrained settings.

Objective of The Study

To evaluate modified sick neonatal (MSNS), a novel neonatal disease severity score designed for resource constrained settings

MATERIALS & METHOD

Study Design: A facility based prospective observational study.

Study Duration: Present study was done for duration of 1 year i.e, from 06-03- 2021 to 05-03-2022.

Study Setting: Present Study was done in SNCU, Sri Venkateswara Ramnarain Ruia Government General Hospital (SVRRGGH), Tirupati.

Study Subjects: Newborns Admitted in SNCU, SVRRGGH, Tirupati.

Sample Size: A sample size of 565 neonates is required, assuming 90% sensitivity and specificity and an absolute accuracy of 0.035 at 95% confidence level. (In rural India, NMR is 31 per 1000 live births, compared to 15 per 1000 in urban India).42

Inclusion Criteria: Newborns between 0-28 days who were admitted in Special Newborn Care Unit (SNCU) were included in this study and selected using simple randomized technique.

Exclusion Criteria:

Those newborns on ventilatory support

Those newborns discharged against medical advice.

Those newborns whose.

Methodology

This facility based prospective observational study was conducted in SNCU of SVRRGGH, Tirupati after the approval of Institutional Ethics Committee of SV

Medical College, Tirupati. The parents of the included sample provided signed, informed consent

In the semi-structured proforma, demographic information, gestational age, birth weight, significant clinical findings with investigations, and diagnoses were documented. Following each baby until discharge, the results were recorded. At the time of admission, the disease severity was evaluated and rated using the Modified Sick Neonatal Score (MSNS), as shown in Table 1.

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MSNS contains eight criteria and assigns scores between 0 and 2. Actually, it is a modified version of the Sick Neonate Score (SNS) with 7 parameters, another proven scoring system. Six of the eight parameters are directly adopted from SNS.
Scores 0 and 2 indicate the poorest and optimal clinical settings, respectively, for each metric. Birth weight and gestational age are two additional indicators that are scored in the MSNS since they are crucial factors in a newborn's survival.

Table 1. MSNS Parameters with Scoring

PARAMETER	SCORE 0	SCORE 1	SCORE 2
Respiratory effort	Apnea or grunt	RR ≥60/min with or without retractions	RR 40-60/min
Heart rate	Bradycardia or asystole	HR≥160	HR 100-160
Axillary temp(ºC)	≤36	36-36.5	36.5-37.5
CFT(s)	≥5	3-5	≤3
RBS (mg/dL)	≤40	40-60	≥60
SPO2 (room air)	≤85	85-92	≥92
Gestational Age	≤32 weeks	32-36±6/7 days	≥37
Birth weight(kg)	≤1.5	1.5-2.49	≥2.5

Total score: (Maximum:16)

Statistical Analysis

Data entry was done using Microsoft Excel 2013 and analysed using SPSS V 16. Results were expressed as mean with SD, median with interquartile ranges and percentages using appropriate tables. Chi square test is used to depict the association between the individual parameters and outcome. ROC (Receiver Operating Characteristic) curve is generated with MSNS as the test variable to predict mortality. Bar Diagrams & Pie-charts were used to represent the data. P value of < 0.05 was considered statistical significant.

Ethical Considerations:

1. Informed written consent will be obtained from the parent of the subject.
2. No financial burden imposed.
3. No conflict of interest

RESULTS

This is a prospective observational study done in 565 study subjects in SNCU, SVRRGGH, Tirupati.

Table 1: Gender Distribution of study subjects

Gender	Frequency	Percentage
Male	213	37.7%
Female	352	62.3%
Total	565	100%

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Table 2: Gestational Age of Newborn at delivery

Gestational age	Frequency	Percentage
23 – 28	42	7.4%
29 – 32	84	14.9%
33 – 36	115	20.4%
37 – 42	324	57.3%
Total	565	100%
Mean Gestational Age	35.76 ± 3.76	

Table 3: Birth Weight of Newborn in kgs

Birth weight	Frequency	Percentage
<1.5 kg	105	18.7%
1.5 – 2.5	219	38.9%
2.5 – 3.5	221	39.3%
>3.5	18	3.2%
Total	565	100%
Mean Birth weight in Kg	2.29 ± 0.74	

Table 4: Mode of Delivery in study subjects

Mode of delivery	Frequency	Percentage
LSCS	223	39.5%
NVD	316	56%
Vaccum	26	4.5%
Total	565	100%

Table 5: Indication for Admission in study subjects

Indication	Frequency	Percentage
Apnea / Gasping	2	0.4%
Hyperthermia >37.5C	1	0.2%
Hypoglycemia <45 mg%	1	0.2%
Low birth weight <1800 gm	21	3.7%
Meconium aspiration	7	1.2%
Neonatal convulsions	17	3%
Neonatal jaundice	50	8.8%
Perinatal asphyxia	142	25.1%
Prematurity <34 weeks	85	15%
Refusal to feed	40	7.1%
Respiratory distress syndrome (Rate >60 or Grunt/ retractions)	199	35.2%

Table 6: Descriptive Analysis of Variables in MSNS

		Frequency	Percentage
	Apnea	150	26.5%

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Respiratory effort	RR ≥60/min with or without retractions	228	40.4%
	RR 40-60/min	187	33.1%
Heart rate	Bradycardia or asystole	27	4.8%
	HR≥160	97	17.2%
	HR 100-160	441	78.1%
Axillary temp(ºC)	≤36	126	22.3%
	36-36.5	301	53.3%
	36.5-37.5	138	24.4%
CFT(s)	≥5	52	9.2%
	3-5	205	36.3%
	≤3	308	54.5%
RBS(mg/dL)	≤40	86	15.2%
	40-60	310	54.9%
	≥60	169	29.9%
SPO2 (room air)	≤85	192	34.0%
	85-92	185	32.7%
	≥92	188	33.3%
Gestational Age	≤32 weeks	132	23.4%
	32-36±6/7 days	115	20.4%
	≥37	318	56.3%
Birth weight(kg)	≤1.5	101	17.9%
	1.5-2.49	201	35.6%
	≥2.5	254	45.0%

Table 7: Variables and Outcome of study subjects

Parameter		Discharged	Death	P value
Respiratory effort	Apnea	48	38	0.01*
	RR ≥60/min with or without retractions	182	128	
	RR 40-60/min	120	49	
Heart rate	Bradycardia or asystole	3	24	0.0001*
	HR≥160	45	52	
	HR 100-160	302	139	
Axillary temp(ºC)	≤36	40	86	0.0001*
	36-36.5	209	92	
	36.5-37.5	101	37	
CFT(s)	≥5	7	45	0.0001*
	3-5	108	97	
	≤3	235	73	
RBS(mg/dL)	≤40	48	38	

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	40-60	182	128	0.01*
	≥60	120	49	
SPO2 (room air)	≤85	56	136	0.0001*
	85-92	144	41	
	≥92	150	38	
Gestational Age	≤32 weeks	34	98	0.0001*
	32-36±6/7 days	82	33	
	≥37	234	84	
Birth weight(kg)	≤1.5	24	77	0.0001*
	1.5-2.49	139	71	
	≥2.5	187	67	

ROC graph

Prognostic Significance of MSNS score in predicting outcome

ROC constructed to identify the mortality cutoff with the highest level of sensitivity and specificity. This ROC graph shows the score calculated as above using the parameters and applied to 565 neonates. The diagnostic test is not regarded as significant, according the ROC, if the area under the curve was less than 0.5. The test is deemed significant if the curve is higher than the diagonal and more to the left.

Area under the curve in this study is 0.878, indicating that the score has a stronger importance in predicting death. AUC of the ROC graph

Area under the ROC curve (AUC)	0.885
Standard Error [a]	0.0148
95% Confidence interval [b]	0.855 to 0.910
z statistic	26.039
Significance level P (Area=0.5)	<0.0001

[a] DeLong *et al*., 1988

[b] Binomial exac

	Cut off	Sensitivity	Specificity	PPV	NPV
MSNS	<9	79.53%	82.86%	74.06%	86.80%

Table 8: Modified sick neonatal Score and Outcome

	Discharged		Expired		Total
Score	N	%	N	%	N (%)
0 – 8	28	8.0%	143	66.5%	171 (30.3%)
9 – 12	197	56.3%	66	30.7%	263 (46.5%)
13 – 16	125	35.7%	6	2.8%	131 (23.2%)
Total	350	100.0%	215	100.0%	565 (100%)
Chi square test= 231.65, p=0.0001*, Statistically significant					

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DISCUSSION

The first seven days of life are thought to be when 75% of newborn deaths take place.To reduce mortality and morbidity in critical care settings, prompt illness severity diagnosis and response are essential.

In the current study, MSNS parameters of 565 neonates admitted to the SNCU, of which 37.7% were males and 62.3% were females, were recorded in the current study. Where as in another study by Padar et al., 2022, 262 neonates were admitted out of which Male were 140 (56%), Female 108 (44%).

57.30% of the patients in this study were between 37 and 42 weeks, followed by 20.40% in the 33 to 36 weeks, 14.90% in the 29 to 32 weeks, and 7.40% in the 23 to 28 weeks. A 35.76 ± 3.76 gestational age is the average. As opposed to this, in a different study from 2019 by Mansoor et al., 41% of patients were preterm (precise gestational age was not given), and 84.1% weighed less than 2,500 grams.

In the current study, the weight distribution was as follows: 39.30% with 2.5- 3.5kg, 38.90% with 1.5-2.5kg, 18.70% with >3.5kg. The average newborn weighs about 2.29 ± 0.74 kgs. In terms of admittance type, 50.10 % were extramural and 49.9 % were intramural. 56.0% of babies are delivered via normal vaginal delivery, followed by 39.5% by LSCS, and then 4.50% by vacuum assisted delivery.

Regarding admissions criteria, in the current study, the most frequent reason for admission is RDS (35.2%), which is followed by perinatal asphyxia (25.10%), and apnea and hypoglycemia (0.2 0.4%), which are the least frequent reasons. Results of the study's subjects is as follows, 61.9% were discharged and 38.10% expired. Where as in the research by Mansoor et al., 2019, Discharged were 490 (83.8%) and Expired were 95 (16.2%).

In terms of MSNS and result, 66.5% of neonates with scores between 0 and 8 expired, followed by 30.7% with scores between 9 and 12, and 2.8% with scores between 13 and 16. The MSNS scores of newborns that died were much lower. The lower score in each MSNS parameter was highly connected with mortality when individual parameters were correlated with outcome. In contrast, in the study by Mansoor et al., 2019, MSNS, mean (SD) score, among discharged patients was

13.4 and among those who had passed away was 8.22 (2.96) (2.14).4

The importance of MSNS, a cutting-edge method for determining the severity of newborn diseases in environments with constrained resources, is illustrated by this SNCU-based study. MSNS demonstrated a sensitivity of 80% and a specificity of 88.8% for predicting mortality with an ideal cutoff score of 10.

In the current study, AUC was 0.885 (95% Confidence interval: 0.855 to 0.910). with Significant P level of <0.0001, which is comparable to that results obtained by using SNAP-II, a widely reported neonatal disease severity score. The details of the study are as follows,.

Table 9 Comparison of scores in mortality prediction among various studies

	MSNS (current study)	SNS (Rathod D *et al.,* 2016)	SNAP (Maiya *et al*., 2001)	MSNS + delta MSNS (Padar *et al*., 2022)
Score	<9	≤8	>15	10
Sensitivity	79.53 %	58.3 %	63 %	88.24 %

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Specificity	82.86 %	52.7 %	95 %	95.2 %

Advantages of MSNS:

1) In this score, we use vital basic clinical parameters
2) Applicable in both term and preterm for mortality prediction
3) Simple non invasive scoring system
4) It can be used in basic health care centres to tertiary care centers
5) Score is time bound (scored at time of admission) but non time consuming
6) Doesn't require special training for scoring
7) Doesn't need special apparatus in scoring
8) Aids while counselling parents in explaining the prognosis
9) Helps in early referral for centers with better resources

Limitations

The MSNS scoring method has a drawback in that concerns such chorioamnionitis, labour and delivery complications, maternal diabetes, hypertension, adequate prenatal care, and antenatal steroid use have not been taken into account. A low MSNS score, however, may also be linked to the existence of such risk factors. Serial scoring might have revealed more information because the scoring was only done once, at admission. Furthermore, among neonates with higher MSNS scores at admission, variables such nosocomial infections may have increased mortality. The score's propensity to anticipate these could have been impacted. The study was also conducted in a single location and requires thorough confirmation before being put into practise. Additionally, more research is required to confirm applicability in various contexts.

SUMMARY

The main aim of the present facility-based prospective observational study was to evaluate a new neonatal disease severity score – Modified Sick Neonatal Score (MSNS) for resource-constrained settings.

In the current study, the MSNS, all the parameters of 565 neonates admitted to the SNCU (Special Newborn Care Unit), with a gender distribution of 37.7% males and 62.3% females, were recorded.

57.30% of the patients in this study were between 37 and 42 weeks, followed by 20.40% in the 33 to 36 week range, 14.90% in the 29 to 32 week range, and finally 7.40% in the 23 to 28 week range. It is 35.76 weeks gestational age on average. The distribution of weights was as follows: 18.70% with more than 3.5kg, 39.30% with 1.5-2.5kg, and 38.90% with 2.5-3.5kg. A newborn weighs 2.29 0.74 kg on average. 50.10 percent of admissions were extramural, and 49.9 percent were intramural.. 56.0% of babies are born in this study via normal vaginal delivery, followed by 39.5% by LSCS, and then 4.50% by vacuum assisted delivery.

Regarding admissions criteria, in the current study, the most frequent reason for admission is RDS (35.2%), which is followed by perinatal asphyxia (25.10%), and apnea and hypoglycemia (0.2-0.4%), which are the least frequent reasons of the study's subjects. In this study, 61.9% were released and 38.10% passed away. Overall, 16.2% of the study participants passed away. According to reports, the overall mortality rate for SNCUs in India is 10.5%, with hospitalised babies weighing less than 2,500 grams in 51% of cases and being 46% preterm. Our study population's mortality rate is greater than the national average as a result of variances in disease severity among hospitalised newborns.

In terms of MSNS and result, 66.5% of neonates with scores between 0 and 8 expired, followed by 30.7% with scores between 9 and 12, and 2.8% with scores between 13 and 16. The MSNS

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scores of expired neonates were substantially lower. When individual parameters were connected with outcome, the lower score in each MSNS parameter significantly increased the risk of mortality. In contrast, the MSNS mean (SD) score in the study by Mansoor et al., from 2019 was 8.22 (2.96) for those who had passed away and 13.4 for those who had been discharged (2.14).
This SNCU-based study demonstrates the value of MSNS, a cutting-edge approach for assessing the severity of newborn diseases in environments with limited resources. With an ideal cutoff score of 10, MSNS showed a sensitivity of 80% and a specificity of 88.8% for predicting mortality. Overall MSNS is an easy- to-use bedside scoring system that requires minimal training and no invasive procedures. In terms of predicting mortality and length of hospital stay, it has demonstrated good sensitivity

CONCLUSION

In conclusion, as compared to earlier scoring systems, the MSNS employed in this study is simple to use, has good sensitivity and specificity, could be used early in the hospitalization process, and could be used for both term and preterm babies. Therefore, in light of their admission profile and resource availability, SNCUs would benefit more from using the MSNS neonatal illness severity score.
The MSNS score for neonatal illness severity is practical and was created with district level SNCUs and other resource-constrained situations in mind. Mortality could be predicted with a total score of less than 10.
Furthermore, the calculation of the Delta score served the same purpose. Delta MSNS may be more useful than MSNS as a predictor of death, according to future studies.

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