International Journal of Contemporary Pediatrics
Shivaramakrishnababji N et al. Int J Contemp Pediatr. 2022 Jan;9(1):53-57
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20214938

Original Research Article

Validation of modified sick neonatal score, a simple clinical score for assessment of severity of illness and outcome in new-borns for resource poor settings

N. Shivaramakrishna Babji[1], Cheruku Rajesh[1], Aparajitha Mekala[2]*, Bharathi Rani Siddani[3]

[1]Department of Pediatrics, Mamata Medical College and Hospital, Khammam, Telangana, India
[2]Department of Pediatrics, Chettinad Health and Research Centre, Kelambakkam, Tamil Nadu, India
[3]Department of Opthamology, The Eye Foundation, Coimbatore, Tamil Nadu, India

Received: 16 December 2021
Accepted: 01 January 2021

***Correspondence:**
Dr. Aparajitha Mekala,
E-mail: dr.aparajitha@gmail.com

ABSTRACT

Background: India contributes to 25% of the neonatal deaths worldwide each year. Neonatal disease severity scoring systems are needed to make standardized comparison between performances of different units and also give prognostic information. Existing scoring systems are unsuitable for resource-limited settings which lack investigations like pH, pO_2/FiO_2 ratio and base excess. Modified sick neonatal score (MSNS) is based on eight routinely measured clinical variables in NICUs namely respiratory effort, heart rate, axillary temperature, capillary refill time, random blood sugar, pulse oximeter saturation, gestational age and birth weight found to be useful in resource poor settings. The aim of the study was to validate MSNS score for its clinical utility in predicting mortality.
Methods: This was a cross sectional study done at NICU of Mamata Medical College Hospital. The parameters required for the score were recorded immediately at admission in NICU from 1 January 2020 to 1 January 2021 and scored using Modified sick neonatal score (MSNS). The total score was calculated and outcome was noted. The data collected were coded and analzed using SPSS Statistics for Windows, v21.0 Chi square test, Mann-Whitney U test and ROC analysis.
Results: Total of 355 neonates got discharged, while 45 neonates expired. For a cutoff score of ≤10, sensitivity and specificity were 85.9% and 51.1%, respectively. Positive predictive value and negative predictive value were 93.3% and 31.5%, respectively. The Area under the curve (AUC) was 0.811 (95%CI: 0.788-0.835), which indicates the accuracy of 81.1%.
Conclusions: MSNS is a better suited neonatal disease severity score for resource poor settings.

Keywords: MSNS, Scoring systems, Mortality

INTRODUCTION

The number of neonatal deaths in India is about 25% of the total neonatal deaths worldwide, which accounts for 1 million neonatal deaths every year.[1] The Neonatal mortality rate (NMR) in urban India with good tertiary care centers is 15, while in rural India with smaller hospitals, Special newborn care units (SNCU) is 31 per 1000 live births.[2] Thus, there is obvious discrepancy between the twoareas.[3] To bring down neonatal mortality, we need to improve the care of newborn in rural areas of India with resource poor settings.

Neonatal disease severity scoring systems help in making standardized comparison between performances among different units, i. e., well-equipped centers in urban areas and resource poor settings in rural areas.[3] They also help in assessing the prognosis, which is especially useful for prioritizing care in resource poor settings more commonly in rural areas and in early referral of sick neonates which

cannot be managed in peripheries.[4] There are several scoring systems like Clinical risk index for babies (CRIB), CRIB 2, Score for neonatal acute physiology (SNAP), Score for neonatal acute physiology-perinatal extension (SNAPPE), SNAP 2, SNAP-PE2, Neurobiological risk score (NBRS), Neonatal mortality prognosis index (NMPI) which were evaluated. Currently evaluated scoring systems predominantly depend on investigations like pH, pO_2/FiO_2 ratio, and base excess making them unsuitable for resource limited settings.[5]

Neonatal therapeutic intervention scoring system (NTISS) is based on the treatment received by the newborns admitted in Neonatal intensive care units, which varies depending on the unit policy and does not help in assessing prognosis of individual babies admitted.[5,6]

Though Sick neonatal score (SNS), Extended sick neonatal score (ESNS) are very effective scoring systems, the accurate measurement of non-invasive blood pressure in neonates requires advanced equipment. This may not be readily available at resource-restricted settings.

An ideal scoring system should be easy to use with ability to apply at admission, should reliably predict mortality among neonates.[7,8] Mansoor et al devised a score named Modified sick neonatal score (MSNS) based on eight routinely measured variables in NICUs namely respiratory effort, heart rate, axillary temperature, capillary refill time. random blood sugar, pulse oximeter saturation, gestational age and birth weight.[3] This score was essentially a modification of another validated scoring system, SNS with 7 parameters.[3] MSNS score was evaluated for prognostication at SNCU of one district and was found to be promising. We tried to validate this score in a tertiary care center in Telangana.

Aim and objectives

The aim and objective of this study were (a) to validate MSNS in neonates admitted in NICU; (b) to correlate total score with the outcome; and (c) to correlate each variable in the score with the outcome.

METHODS

This cross-sectional study was done in NICU of Mamata Medical College and Hospital from 01 January 2020 to 01 January 2021 (1 year). Institutional Ethics Committee approved the study.

All the neonates admitted in NICU during study period were included in the study. Convenient sampling was used in this study. Refusal of consent by parents, newborns with surgical conditions and syndromes were excluded from the study. Newborns referred to higher centers and discharged against medical advice were also excluded from the study.

Demographic details, gestational age, gender, birth weight, important clinical findings with investigations and diagnosis were recorded in the semi-structured proforma. The parameters required for the score were recorded as part of newborn assessment protocol in our NICU. The disease severity was assessed immediately at admission using MSNS as depicted in Table 1 and the total score was calculated. The final outcome was noted.

Statistical analysis

The data collected was coded and analyzed using SPSS Statistics for Windows, v21.0. Descriptive statistics was used to present the important parameters recorded in the study. Chi-square test was used to determine the association between the individual parameters and the outcome. Mann-Whitney U test was used to compare the score of each individual parameter in relation to the outcome. Receiver operating characteristics was done to analyze the accuracy of a MSNS scoring system in predicting mortality by using the total score as the test variable and outcome as the event variable. The optimum cut-off value that was obtained from the ROC curve was used to calculate sensitivity, specificity, positive predictive value and negative predictive values.

RESULTS

A total of 446 neonates were admitted during study period, of which 46 were excluded as per exclusion criteria. Of 400 neonates, 23. 7% were preterm and the rest were term. 230 neonates (57.5%) were male and the rest were females. 233 neonates (58.3%) were inborn and 167 neonates (41.75%) were outborn. Base line characteristics of the included neonates were described in Table 2. The mean (SD) age of neonates at the time of admission was 4.11 (5.33) days.

Total of 355 neonates (88.75%) were discharged, while 45 neonates (11.25%) expired. Assessment was done for each individual parameter with the outcome. All the parameters included in the score, when found abnormal were significantly associated with mortality with p value being significant as in Table 3. The mean (SD) of the total MSNS scores for neonates who expired and discharged respectively was 9.93 (2.26) and 14.06 (1.67), the difference being statistically significant p value<0.0001. The optimum cutoff value obtained for prediction of mortality was 10.

The lower the score, the higher the probability of mortality. For a cutoff score of ≤10, sensitivity and specificity were 85.9% and 51.1%, respectively, in predicting mortality. Positive predictive value and negative predictive value were 93.3% and 31.5%, respectively. On ROC analysis, the AUC was 0.811 (95%CI:0.788-0.835), which indicates the prediction accuracy of 81.1% (Figure 1).

Table 1: Baseline characteristics of the included neonates.

Parameters	Score 0	Score 1	Score 2
Respiratory effort	Apnea or grunt	Tachypnea (respiratory rate >60/min) with or without retractions	Normal (respiratory rate 40-60/min)
Heart rate	Bradycardia or asystole	Tachycardia (>160/min)	Normal (100-160/min)
Axillary temperature (°C)	<36	36-36.5	36.5-37.5
Capillary refilling time (s)	>5	3-5	<3
Random blood sugar (mg/dl)	<40	40-60	>60
SpO_2 (in room air)	<85	85-92	>92
Gestational age (in weeks)	<32 weeks	32 to 36 weeks+6/7 days	37 weeks and above
Birth weight (kg)	<1.5	1.5-2.49	2. 5 or above

Table 2: Baseline characteristics of the study population.

Parameter	N	%
Gestational age		
Preterm	95	23. 7
Term	293	73. 3
Post term	12	3. 0
Gender		
Male	230	57. 5
Female	170	42. 5
Referral		
Inborn	233	58. 3
Referred	167	41. 7
Birth weight (kg)		
<2.5	177	44. 3
>2.5	223	55. 7
Outcome		
Discharged	355	88. 7
Expired	45	11. 3

Table 3: Individual parameter Scores of MSNS in relation to the outcome (expired and discharged).

MSNS parameters	Score	Discharged		Expired		P value
		N	%	N	%	
Respiratory effort	0	06	1.7	03	6.7	<0.0001*
	1	75	21.1	26	57.8	
	2	274	77.2	16	35.5	
Heart rate	0	01	0.3	02	4.4	0.003*
	1	44	12.4	9	20	
	2	310	87.3	34	75.6	
Axillary temperature	0	01	0.3	0	0	0.001*
	1	89	25.1	23	51.1	
	2	265	74.6	22	48.9	
Capillary refilling time	0	02	5.7	0	0	<0.0001*
	1	16	4.5	11	24.4	
	2	337	94.9	34	75.5	
Random blood sugar	0	05	1.4	5	11.1	<0.0001*
	1	86	24.2	21	46.7	
	2	264	74.4	19	42.2	
SpO2 (in room air)	0	03	0.8	13	28.9	<0.0001*
	1	34	9.6	20	44.4	
	2	318	89.6	12	26.7	
Gestational age	0	12	3.4	23	51.1	<0.0001*

Continued.

MSNS parameters	Score	Discharged		Expired		P value
		N	%	N	%	
	1	110	31	12	26.7	
	2	233	65.6	10	22.2	
Birth weight	0	35	9.9	25	55.6	<0.0001*
	1	106	29.9	11	24.4	
	2	214	60.2	09	20	

Note: NS= not significant; *= significant.

Table 4: Mean SD scores among discharged vs expired neonates.

Outcome	MSNS score mean (SD)	P value
Discharged	14.06 (1.67)	<0.0001
Expired	9.93 (2.26)	

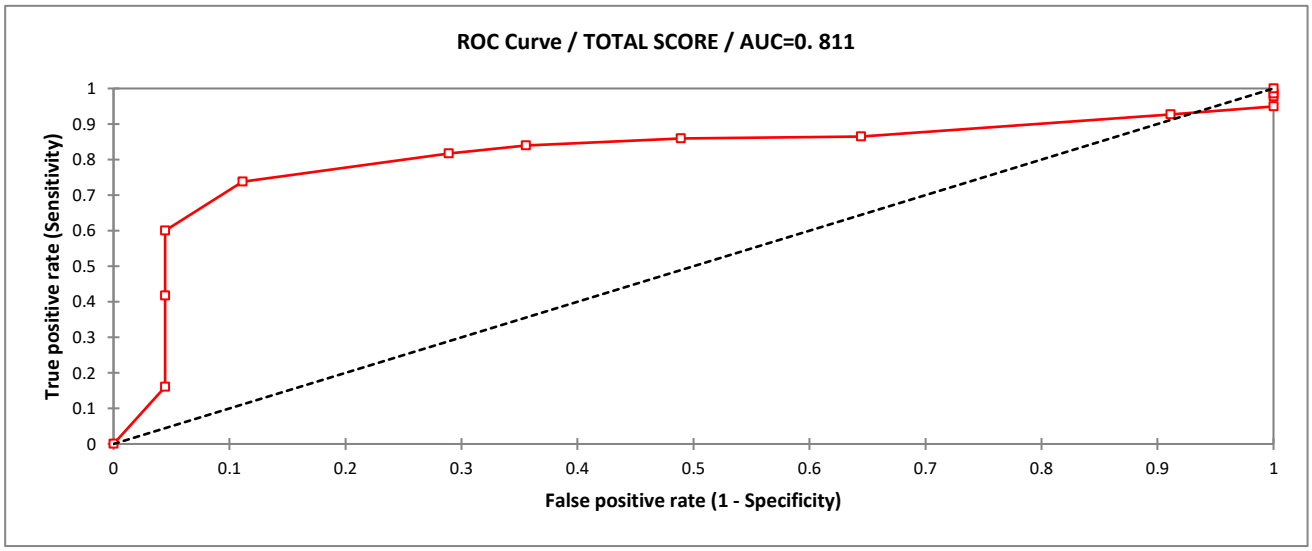

Figure 1: ROC analysis for prediction of accuracy of MSNS score.

DISCUSSION

Scoring systems like SNAP, SNAP-II, SNAPPE, and SNAPPE-II are found to be useful in various settings.[9-14] SNAP score has 28 variables to score, while SNAP-II score is much simplified version consisting of only 6 items.[3] As even this score includes investigations like serum pH and pO_2/FiO_2 ratio making it unsuitable for use in SNCU.[5] SNS is an ideal primary scoring system from which MSNS score was devised.[3] SNS was studied only in transported babies.[15]

Ray et al devised ESNS based on SNS with parameters of respiratory effort, heart rate, mean BP, axillary temperature, capillary refill time, random blood sugar, pulse oximeter saturation, Moros reflex and modified down score.[4] In their study, ESNS had better sensitivity and specificity to predict mortality than SNS.[4] To score ESNS, there is requirement of mean BP which needs sophisticated equipment to measure.

Hence MSNS score was devised with simple clinical variables which neither requires investigations nor costly sophisticated equipment. We tried to validate this score in our NICU.

At a cutoff score ≤8, SNS had sensitivity of 58. 3% and specificity of 52.7%.[3] MSNS had a better sensitivity (86.9%) and specificity (51.1%) at a cutoff score ≤10, as compared to the original SNS score. In ESNS study for the cut off score of ≤11, sensitivity was 85.9% and specificity was 89.8%.

Limitation

The small sample size was one of the limitation of this study. The calculation of inter observer variability was also not done. Further, the study being a single-center study needs extensive validation before implementation. We recommend multicentric studies involving larger samples studies to confirm applicability across different settings.

CONCLUSION

MSNS is easy to use, can be applied at admission. At a cut off score ≤10, it has good sensitivity, specificity and

predictive ability. Moreover, it can be applied, both in preterm as well as term neonates. Thus, MSNS is a better suited neonatal disease severity score for resource poor settings, SNCU in view of their admission profile and resource availability.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. M. A. M. Siddiq and Dr. G. Somaiah, Department of Pediatrics, Mamata Medical College for manuscript editing and inputs in analysis.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Lawn JE, Cousens S, Zupan J, Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: when? Where? Why?. Lancet. 2005;365(9462):891-900.
2. NITI Aayog. Neonatal Mortality Rate, 2018. Available at: http://niti. gov. in/content/neo-natalmortality-rate-nmr-1000-live-births. Accessed on 09 December 2021.
3. Mansoor KP, Ravikiran SR, Kulkarni V, Baliga K, Rao S, Bhat KG, et al. Modified Sick Neonatal Score (MSNS): A Novel Neonatal Disease Severity Scoring System for Resource-Limited Settings. Crit Care Res Pract. 2019;2019:9059073.
4. Ray S, Mondal R, Chatterjee K, Samanta M, Hazra A, Sabui TK. Extended Sick Neonate Score (ESNS) for Clinical Assessment and Mortality Prediction in Sick Newborns referred to Tertiary Care. Indian Pediatr. 2019;56(2):130-3.
5. Dorling JS, Field DJ, Manktelow B. Neonatal disease severity scoring systems. Arch Dis Child Fetal Neonatal Ed. 2005;90(1):11-6.
6. Aluvaala J, Collins GS, Maina M, Berkley JA, English M. A systematic review of neonatal treatment intensity scores and their potential application in low-resource setting hospitals for predicting mortality, morbidity and estimating resource use. Syst Rev. 2017;6(1):248.
7. Mathur NB, Arora D. Role of TOPS (a simplified assessment of neonatal acute physiology) in predicting mortality in transported neonates. Acta Paediatr. 2007;96(2):172-5.
8. Muktan D, Singh RR, Bhatta NK, Shah D. Neonatal mortality risk assessment using SNAPPE- II score in a neonatal intensive care unit. BMC Pediatr. 2019;19:279.
9. Shrestha D, Dhoubhadel BG, Parry CM, Prajapati B, Ariyoshi K, Mahaseth C. Predicting deaths in a resource-limited neonatal intensive care unit in Nepal. Trans R Soc Trop Med Hyg. 2017;111(7):287-93.
10. Harsha SS, Archana BR. SNAPPE-II (Score for Neonatal Acute Physiology with Perinatal Extension-II) in Predicting Mortality and Morbidity in NICU. J Clin Diagn Res. 2015;9(10):10-2.
11. Richardson DK, Corcoran JD, Escobar GJ, Lee SK. SNAP-II and SNAPPE-II: Simplified newborn illness severity and mortality risk scores. J Pediatr. 2001;138(1):92-100.
12. Radfar M, Hashemieh M, Fallahi M, Masihi R. Utilization of SNAP II and SNAPPE II Scores for Predicting the Mortality Rate Among a Cohort of Iranian Newborns. Arch Iran Med. 2018;21(4):153-7.
13. Ramirez MN, Godoy LE, Barrientos E. SNAP II and SNAPPE II as Predictors of Neonatal Mortality in a Pediatric Intensive Care Unit: Does Postnatal Age Play a Role?. Int J Pediatr. 2014;2014:298198.
14. Richardson DK, Shah BL, Frantz ID, Bednarek F, Rubin LP, McCormick MC. Perinatal risk and severity of illness in newborns at 6 neonatal intensive care units. Am J Public Health. 1999;89(4):511-6.
15. Rathod D, Adhisivam B, Bhat BV. Sick Neonate Score--A Simple Clinical Score for Predicting Mortality of Sick Neonates in Resource Restricted Settings. Indian J Pediatr. 2016;83(2):103-6.

Cite this article as: Shivaramakrishnababji N, Rajesh C, Mekala A, Siddani BR. Validation of modified sick neonatal score, a simple clinical score for assessment of severity of illness and outcome in new-borns for resource poor settings. Int J Contemp Pediatr 2022;9:53-7.