Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/17151
DOI URL: http://dx.doi.org/10.21474/IJAR01/17151

RESEARCH ARTICLE

EVALUATION OF MODIFIED SICK NEONATAL SCORE (MSNS) TO DETERMINE OUTCOME IN PRETERM BABIES ADMITTED TO A TERTIARY CARE NEONATAL INTENSIVE CARE UNIT

Dr. Aparna Gupta and Dr. Ranjit Ghuliani

Manuscript Info

Manuscript History
Received: 26 April 2023
Final Accepted: 31 May 2023
Published: June 2023

Abstract

Background: Various neonatal scoring systems have been developed and can be used to either estimate the severity of an illness or disease progression, such as the Clinical Risk Index for Babies (CRIB II) score and the Sick Neonate Score (SNS) score. This study was done to evaluate the applicability of modified sick neonatal score (MSNS), which is a simple scoring system that can be used to determine outcome in neonates in the resource-restricted settings, exclusively in preterm neonates.

Methods: This was a hospital based descriptive study, including a total of 45 preterm newborns admitted to the NICU. Modified Sick Neonatal Score was evaluated immediately after arrival in the NICU. All newborns were managed as per standard NICU protocols and were followed up until discharge or expiry. The score and its individual parameters were then correlated with the outcome (expired/discharged).

Results: Out of the 45 preterm neonates admitted to the NICU, 4 expired, and the rest were discharged. The mean score in the expired neonates was 8.2 and a cut-off score of 9.5 had a sensitivity of 100% (95% CI 39.76%-100.00%) and specificity of 90.24% (95% CI 76.87%-97.28%). The quality of respiratory effort was found to be the major determinant of mortality in the studied population, with a p-value = 0.001. Heart rate, axillary temperature and oxygen saturation also correlated well with the outcome, with p-values <0.05.

Conclusion: There was a direct correlation between the Modified Sick Neonatal Score and poor outcome in preterm neonates. A cut-off score of 9.5 could be used to predict mortality in this population.

Copy Right, IJAR, 2023,. All rights reserved.

Introduction:-

An estimated 25 million children are born every year in India, accounting for about 1/5th of the world's annual childbirths. Nearly 40 percent of neonatal deaths occur during labor or within the first 24 hours after birth. Prematurity, Neonatal Infections, Birth Asphyxia and Congenital Malformations accounting for about 35%, 33%, 20% and 9% respectively [1]. These are the major causes of newborn deaths in India. Hence, newborn population is of special interest since these neonates account for a significant portion of under 5 mortality rates from preventablefactors. The first 28 days of life are the biggest challenge for neonatal survival and there are several situations when a clinician, parent, nurse, manager, or researcher may wish to quantify the morbidity of a neonate in order to make informed decisions regarding the neonate.

Corresponding Author:- Dr. Aparna Gupta

Scoring systems for use in intensive care unit (ICU) patients allow an assessment of the severityof disease, and provide an estimate of in-hospital mortality and outcomes. Severity scores were first developed for adult intensive care units (ICUs) and subsequently, in 1988, the first specific pediatric score was published: the Pediatric Risk of Mortality (PRISM) score [2].

Scoring systems can broadly be divided into two categories.
1. Prognostic scores, which predict the risk of death at the time of entry into the Intensive Care Unit (ICU).
2. Descriptive or Outcome scores, which describe the course of illness after the admission into the ICU.

The Neonatal Mortality Rate (NMR) in India is 24.9 per thousand live births as per NHFS-5, which necessitates the use of reliable tools that can be used in resource limited settings to aid in assessment of disease severity and prognosis [3].

Several scoring systems have been described in the past for use in assessing neonatal mortality, afew of which are the CRIB score, SNAP score, SNAP-II score [4].

Modified Sick Neonatal Score (MSNS) is one such modality that can be used early during hospitalization to determine mortality risk in admitted neonates. This score is a modification of the Sick Neonate Score (SNS), another scoring system, utilized to predict mortality in neonates in resource-limited settings. MSNS differs from the SNS in that it uses two additional parameters - the birth weight and the gestational age and doesn't take into consideration the mean blood pressure [5][6].

SICK NEONATE SCORE

Variable	Score		
	0	1	2
Respiratory effort	Apnea or Grunting	Tachypnea (>60/min) with or without retractions	Normal (40–60/min)
Heart rate	Bradycardia/Asystole	Tachycardia (>160/min)	Normal (100–160/min)
Mean blood pressure (mmHg)	<30	30–39	>39
Axillary temperature (°C)	<36	36–36.5	36.5–37.5
Capillary filling time (s)	>5	3–5	<3
Random blood sugar (mg/dl)	<40	40–60	>60
SpO_2 (in room air)	<85 %	85–92 %	>92 %

MODIFIED SICK NEONATE SCORE

Parameter	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
Total		Maximum 16	

This study will evaluate the Modified Sick Neonatal Score (MSNS) to determine outcome exclusively in preterm babies admitted to a Tertiary Care NICU.

Materials And Methods:-

This was a descriptive cohort study performed at School of Medical Sciences & Research, Sharda University, Greater Noida. The study was conducted in the period of April 2021 to April 2022 and included preterm neonates (<37 weeks) delivered at Sharda Hospital requiring NICU admission. All term neonates (≥37 weeks; inborn or outborn) and neonates with major congenital anomalies were excluded from the study.

This was a hospital based descriptive study. A sample size of 56 neonates was needed for α-level 0.05 and for power 99% with 16% mortality rate (in reference to the previous study [6]). Out of the 56 neonates enrolled in the study, 11 subjects dropped out from the study. Hence, a total of 45 preterm neonates admitted to the NICU were included in the study. Informed consent was obtained from the guardians. Information collected included mode of delivery, maternal or fetal complications, APGAR score, gestational age, birth weight, clinical findings and diagnosis. Modified Sick Neonatal Score (as shown in the figure below) was evaluated immediately after arrival in the NICU. All newborns were managed as per standard NICU protocol and were followed up until discharge or expiry.

Parameter	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
Total		Maximum 16	

Results:-

In our study, 45 preterm neonates requiring NICU admission were studied. On admission, Modified Sick Neonatal Score (MSNS) was used to score the neonates based on their respiratory effort, heart rate, axillary temperature, capillary refill time, random blood sugar, oxygen saturation, birth weight and gestational age; the lowest score being 0 and the highest score being 16. This score with its individual parameters was then correlated with the outcome, i.e.discharged OR expired.

1. Overall mortality amongst the study group was 4 (8.9%) versus 16.2% in the study by Mansoor et al.
2. The quality of respiratory effort was found to be the major determinant of mortality in the studied population.
3. Heart rate, axillary temperature and oxygen saturation also correlated well with the outcome.
4. In our study, the area under the receiver operating curve was found to be 0.97 (95% CI: 0.93-1) versus the original MSNS study where the area under the curve was found to be 0.913 (95% CI: 0.879–0.946).
5. The cut-off value for MSNS for predicting mortality in preterm neonates in our study was 9.5 versus a cut-off value of 10 in the previous study of MSNS which included both term and preterm neonates.
6. The sensitivity and the specificity for a cut-off score of 9.5 in our study were 100% and 90.24% versus a sensitivity of 80% with specificity of 88.8% for a cut-off score of 10 in the previous study including both term and preterm neonates.

Baseline Characteristics Of Neonates Included (n=45)

	No.	%
Mode of delivery		
Vaginal delivery	10	22.2
LSCS	35	77.8
Gender		
Male	34	75.6
Female	11	24.4
Single/Multiple pregnancy		
Single	40	88.9
Twin	5	11.1
Gestational Age		
<32 weeks	14	31.1
32-36 weeks + 6/7 days	31	68.9
Birth Weight		
<1.5 kg	9	20
1.5-2.49 kg	29	64.4
2.5 kg or above	7	15.6

Outcome In Study Subjects (n=45)

Outcome	No.	%
Discharged	41	91.1
Expired	4	8.9

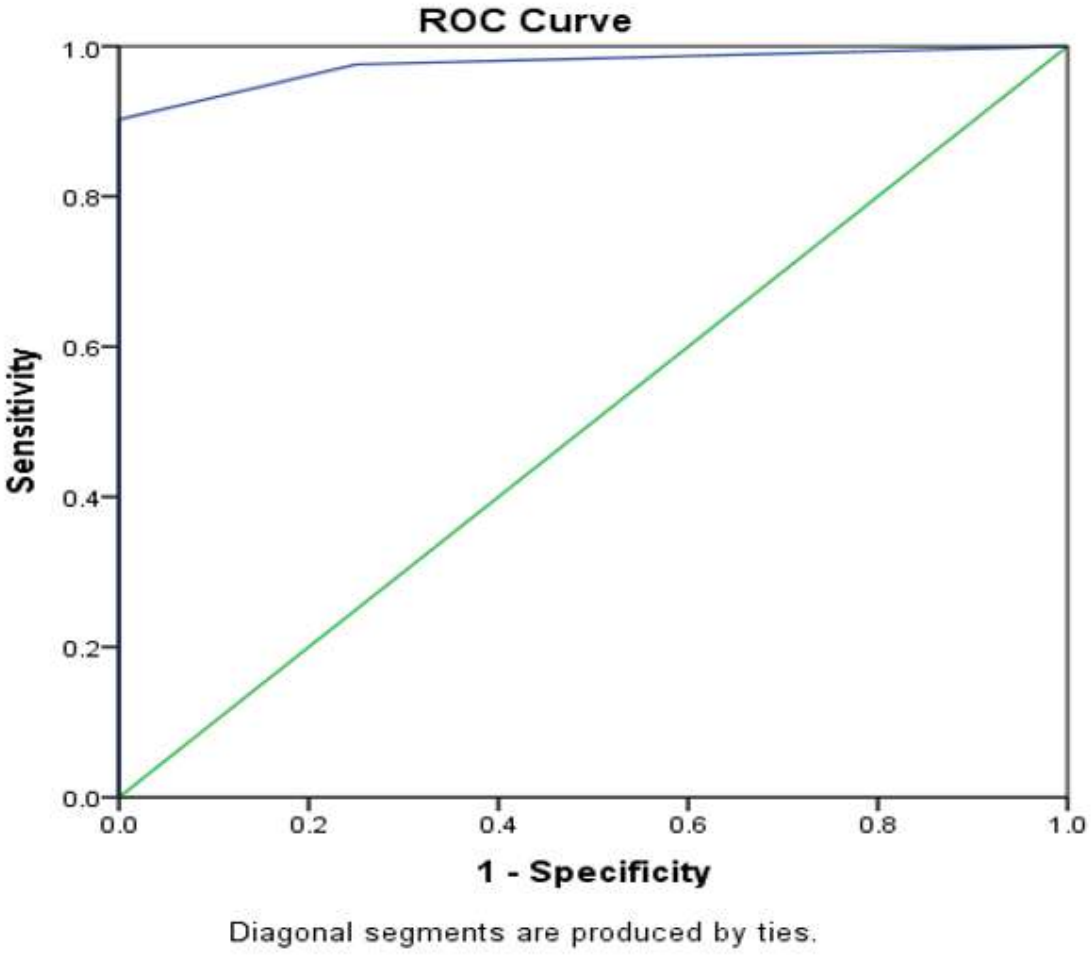
Parameters Of Modified Sick Neonate Score With Individual Scores (n=45)

	No.	%
Respiratory effort		
0	3	6.7
1	23	51.1
2	19	42.2
Heart rate		
0	0	0.0
1	3	6.7
2	42	93.3
Axillary temperature		
0	0	0.0
1	5	11.1
2	40	88.9
Capillary filling time		
0	0	0.0
1	4	8.9
2	41	91.1
RBS		
0	0	0.0
1	12	26.7
2	33	73.3
SpO2		
0	1	2.2
1	29	64.4
2	15	33.3
Gestational age		
0	14	31.1
1	31	68.9
2	0	0.0
Birth weight		
0	7	15.6
1	31	68.9
2	7	15.6

Assessment Of Each Subject As Per Msns (n=45)

	Discharged	Expired	P value
Respiratory effort			
0	1 (33.3%)	2 (66.7%)	**0.001**
1	21 (91.3%)	2 (8.7%)	
2	19 (100%)	0	
Heart rate			
1	1 (33.3%)	2 (66.7%)	0.01
2	40 (95.2%)	2 (4.8%)	
Axillary temperature			
1	3 (60%)	2 (40%)	0.05
2	38 (95%)	2 (5%)	
Capillary filling time			
1	3 (75%)	1 (25%)	0.32
2	38 (92.3%)	3 (7.3%)	
RBS			
1	10 (83.3%)	2 (16.7%)	0.28
2	31 (93.9%)	2 (6.1%)	
SpO2			
0	0	1 (100%)	<0.01
1	26 (89.7%)	3 (10.3%)	
2	15 (100%)	0	
Gestational age			
0	12 (85.7%)	2 (14.3%)	0.57
1	29 (93.5%)	2 (6.5%)	
Birth weight			
0	5 (71.4%)	2 (28.6%)	0.11
1	29 (93.5%)	2 (6.5%)	
2	7 (100%)	0	

Roc Curve Using Modified Sick Neonate Score (Msns) For Predicting Mortality



Diagnostic Value Of Modified Sick Neonate Score (Msns) For Predicting Mortality

		95% CI
AUC	0.97	0.93-1.0
P value	0.002	
Cut off value of MSNS	9.5	
Sensitivity	100.00%	39.76% to 100.00%
Specificity	90.24%	76.87% to 97.28%
Positive Likelihood Ratio	10.25	4.04 to 26.00
Positive Predictive Value	50.00%	28.27% to 71.73%
Negative Predictive Value	100.00%	
Accuracy	91.11%	78.78% to 97.52%

Discussion:-

A variety of scores are available in the NICU used for various purposes like the APGAR scores at birth, the Silverman Anderson scores and the Downe's score to grade respiratory distress, the Ballard score for estimation of gestational age, and so on. One of the very first scoring systems used in the adult ICUs was the APACHE (Acute Physiology and Chronic Health Evaluation) score, which was created in 1981 [7]. In the Pediatric Intensive Care Units, several prognostic scoring systems were developed overtime, such as the PIM (Pediatric Index for Mortality), PRISM (Pediatric Risk of Mortality), PELOD (Pediatric Logistic organ dysfunction), all of which kept evolving with time with the advent of new technology and equipment, enabling us to switch from a subjective view to a more objective one [8].

In this study, the Modified Sick Neonate Score, and its individual parameters were compared between 45 preterm neonates admitted to a tertiary care NICU. This study exclusively considered preterm neonates (<37 weeks) to assess the applicability of this score for these babies.

In our study, majority of the newborns were born via a lower segment caesarean section – 35 (77.8%) versus a vaginal delivery – 10 (22.2%). Out of the 45 enrolled neonates, 9 (20%) neonates weighed less than 1.5 kg, 29 (64.4%) weighed between 1.5 to 2.49 kg and only 7 (15.6%) weighed 2.5 kg or above (Table 1). Amongst the study group, 14 (31.1%) neonates were born before 32 weeks versus 31(68.9%) born between 32 to 36 weeks + 6/7 days.

Overall mortality amongst the study group was 4 (8.9%). Majority of the admissions were due to Hyaline Membrane Disease (HMD) – 13 (28.9%) and Early Onset Sepsis (EOS) – 13 (28.9%), followed by Transient Tachypnea of Newborn (TTNB) – 7 (15.6%) and Birth Asphyxia – 6 (13.3%). The quality of respiratory effort was found to be one of the major determinants of mortality in the studied population along with heart rate, oxygen saturation and axillary temperature with $P \leq 0.05$.

The area under the Receiver Operating Curve (ROC) was 0.97 (95% CI: 0.93-1). To predict mortality, the cut-off value was 9.5, for which the sensitivity and the specificity were 100% and 90.24%. The positive predictive value (PPV) and negative predictive value (NPV) were 100% and 50% respectively. The score had an accuracy of 91.11%.

The limitation of this study was the small sample size, and further studies involving preterm neonates need to be done to validate its use in that population. This study had a greater sensitivity and specificity than the previous studies - the SNS and the MSNS. However, it had a smaller sample size since it included only preterm neonates, unlike the previous two scoring systems.

In conclusion, it validates the use of MSNS in preterm neonates requiring admission to the NICU, owing to the high sensitivity and specificity. A total score of <9.5 could be used to predict mortality in preterm babies.

Conclusion:-

Our study of utility of MSNS in preterm neonates requiring NICU admission concluded that MSNS can be used to determine the outcome in this population. There was a strong correlation between the MSNS and the outcome, i.e. discharged or expired. There were no additional risk factors contributing to the poor outcome in expired neonates apart from those which are already known to occur in preterm births.

References:-

1. Newborn and child health. Available from: https://www.unicef.org/india/what-we-do/newborn-and-child-health
2. Pollack MM, Ruttimann UE, Getson PR. Pediatric risk of mortality (PRISM) score. CritCare Med. 1988;16(11):1110–6.
3. Rchiips.org. Available from: http://rchiips.org/nfhs/NFHS-5_FCTS/India.pdf
4. Payam &., Masoud &., Mohammad &., Gorji F. A comparison of CRIB, CRIB II, SNAP, SNAPII and SNAP-PE scores for prediction of mortality in critically ill neonates. Medical Journal of the Islamic Republic of Iran. 2011;24:193–9.
5. 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.
6. 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.
7. Akavipat P, Thinkhamrop J, Thinkhamrop B, Sriraj W. Acute physiology and chronic health evaluation (Apache) ii score - the clinical predictor in neurosurgical intensive care unit. Acta Clin Croat. 2019;58(1):50–6.
8. Ramazani J, Hosseini M. Comparison of the predictive ability of the pediatric risk of mortality III, pediatric index of mortality, and pediatric logistic organ dysfunction in medical and surgical intensive care units. J Compr Pediatr 2019.