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ASSESSMENT OF MODIFIED SICK NEONATAL SCORE FOR PROGNOSTICATION OF OUTCOMES IN NEONATES ADMITTED AT NICU CMH MULTAN

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ABSTRACT
Aim: The aim of this study was to evaluate the prognostic value of the Modified Sick Neonatal Score (MSNS) in predicting outcomes among neonates admitted to the Neonatal Intensive Care Unit (NICU) at CMH Multan.
Methodology: This prospective validation study was conducted in the Department of Pediatrics, CMH Multan over a period of six months, from October 2025 to March 2026. Total 207 neonates aged 0–28 days admitted to the NICU were included using a non-probability consecutive sampling technique. The Modified Sick Neonatal Score was calculated at the time of admission using eight clinical parameters: respiratory rate, heart rate, axillary temperature, capillary refill time, random blood sugar, oxygen saturation, gestational age, and birth weight. The neonates were followed until the final outcome, which was recorded as discharge after recovery or death.
Results: The mean gestational age of neonates was 34.5 ± 3.2 weeks, and the mean birth weight was 2200 ± 600 g. The mean MSNS score was 9.2 ± 3.4. Among the study participants, 58% were male and 42% were female. Most neonates (93%) were discharged after recovery, whereas 7% died during hospitalization. At a cutoff score of ≤10, MSNS showed 86% sensitivity, 55% specificity, 90% positive predictive value, 40% negative predictive value, and 82% diagnostic accuracy. ROC curve analysis showed an area under the curve of up to 0.81, indicating good predictive ability.
Conclusion: The Modified Sick Neonatal Score is a simple and reliable bedside scoring system that can effectively predict neonatal outcomes and assist in early identification of high-risk neonates in NICU settings.
KEYWORDS: *Modified Sick Neonatal Score (MSNS), Neonatal Intensive Care Unit (NICU), Neonatal outcome, Neonatal mortality, Prognostic scoring system, Neonatal morbidity.*

INTRODUCTION

Although significant advances have been made in mother and child health care, neonatal mortality remains a serious public health problem. Around 2.3 million babies die every year within the first 28 days of life, most of them in low and middle-income countries (LMICs) [1–4]. The main causes of neonatal deaths are prematurity, birth asphyxia, neonatal infections and congenital anomalies [5,6]. The period of neonatal life is more susceptible to physiological changes from intrauterine to extrauterine life. Respiratory distress, hypothermia, sepsis, metabolic disorders and prematurity are common complications and often lead to admission to a Neonatal Intensive Care Unit (NICU) [7–10]. Therefore, the timely identification of critically ill neonates is crucial to achieve timely intervention, proper resource allocation and better survival rates.

There are several neonatal illness severity scoring systems developed which predict neonatal outcomes, such as the Clinical Risk Index for Babies (CRIB), Score for Neonatal Acute Physiology and SNAP-Perinatal Extension II (SNAP-P II) [11, 12]. The systems, however, are usually complex and can need arterial blood gas measurement, biochemical studies, and complex calculations, which make them inaccessible in resource-limited environments [13, 14]. The Modified Sick Neonatal Score (MSNS) is a tool that uses 8 parameters that are routinely measured at the bedside: respiratory rate, heart rate, axillary temperature, capillary refill time, random blood glucose, oxygen saturation, gestational age and birth weight [15–18]. It has a total score of 0–16; the lower the score the more severe the illness and the higher the risk of death.

MSNS has previously been shown to be a useful prognostic indicator. The cutoff score of ≤10 was used to calculate 83% sensitivity and 78% specificity by Padar et al. [19] and they found significant difference between survivors and non-survivors by Meshram et al. [20]. Singh et al. also reported significantly increased mortality in neonates with low MSNS score [21]. Reddy et al. reported an AUC value of 0.91 [22] while Naithani et al. reported 85.11% sensitivity, 75.76% specificity, and AUC value of 0.859 [23]. Thus this study was conducted to evaluate the predictive value of MSNS in predicting outcomes of admitted neonates in NICU of CMH, Multan.

MATERIALS & METHODS

This was a prospective study in the Department of Pediatrics, Combined Military Hospital (CMH), Multan after obtaining study synopsis and ethical clearance from the hospital ethical review committee for a period of six months, from October 2025 to March 2026. This study was designed to evaluate the prognostic value of the Modified Sick Neonatal Score (MSNS) for outcomes of neonates admitted to Neonatal Intensive Care Unit (NICU). A sample size of 207 neonates was determined by applying the Buderer formula for diagnostic accuracy studies, with assumed sensitivity of 80%, specificity of 58%, prevalence of neonatal mortality of 30.7%, 95% confidence level and 10% margin of error [24]. The participants were sampled using non-probability consecutive sampling, until the desired number of participants was reached. Only neonates (0-28 days old) of both genders admitted to NICU, who had written informed consent from parents/guardians and who were assessed using MSNS at admission were included. Major congenital anomalies that may affect survival on their own and neonates with GA < 28 weeks were not included. A predesigned proforma was used to gather data which included clinical data: gestational age, birth weight, mode of delivery and five-minute Apgar score, and demographic data: age, sex, place of birth, maternal education and socioeconomic status. The principal investigator or a trained pediatric registrar estimated the MSNS at admission based on eight routinely measured parameters: respiratory rate, heart rate, axillary temperature, capillary refill time, random blood glucose, oxygen saturation, gestational age, and birth weight. A score was given from 0 to 2 on each of the parameters, giving a total score ranging from 0 to 16, with lower scores reflecting higher severity of illness. Neonates were handled according to the standard NICU care without any study related intervention and were followed until they recovered or died in the NICU. SPSS version 25 was used to analyze the data. The quantitative data were presented as mean and standard deviation and the qualitative data were presented as frequencies and percentages. MSNS's diagnostic accuracy was evaluated using sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy. A receiver operating characteristic curve was drawn to find the best MSNS cut-off for predicting mortality. Subgroup analyses by gestational age, sex, birth weight and mode of delivery/admission were also conducted to assess the score's consistency across clinically important subgroups.

RESULTS

A total of 207 neonates were evaluated. As shown in Table 1, the mean gestational age was 34.5 ± 3.2 weeks, mean birth weight was 2200 ± 600 g, mean five-minute Apgar score was 7.5 ± 1.3, and mean MSNS was 9.2 ± 3.4. Table 2 indicates that 58% of the neonates were male, 67.5% were from urban areas, 45.5% were middle SES and 67.5% of the neonates were delivered vaginally. Overall, 192 (93%) neonates recovered from their disease and were discharged alive and 15 (7%) neonates died in hospital. Table 3 showed that a cutoff value of ≤10 for MSNS had an 86% sensitivity, 55% specificity, 90% positive predictive value, 40% negative predictive value and 82% diagnostic accuracy. Table 4 and Figure 1 show the ROC analysis, with a cut-off of ≤11.5 yielding the highest AUC of 0.81 and 80% sensitivity and 61% specificity. Stratified results presented in Table 5 indicated relatively consistent diagnostic performance across all four groups; gestational age, sex, birth weight, and delivery mode. Finally, Table 6 demonstrated an overall efficacy of 82%, with neonates <34 wks gestation and low-birth neonates having the highest efficacy (88% and 83%, respectively).

Table 1: Descriptive Statistics for Quantitative Data

Variable	Mean (SD)	Minimum	Maximum
Gestational Age (weeks)	34.5 (3.2)	28	42
Birth Weight (g)	2200 (600)	1500	4000
APGAR Score at 5 min	7.5 (1.3)	2	10
Respiratory Rate (RR)	52 (14)	30	90
Heart Rate (HR)	118 (18)	90	180
Axillary Temperature (°C)	36.7 (0.4)	35.6	37.9
Capillary Refill Time (CRT)	2.3 (0.6)	1	4
Random Blood Sugar (RBS)	87 (22)	40	160
Oxygen Saturation (SpO2)	91% (4.3)	80%	98%
MSNS Score	9.2 (3.4)	0	16

Table 2: Frequency Table for Qualitative Data

Variable	Category	Frequency (N)	Percent (%)
Gender	Male	120	58
Gender	Female	87	42
Residential Status	Urban	140	67.5
Residential Status	Rural	67	32.5
Socioeconomic Status	Low	78	37.5
Socioeconomic Status	Middle	95	45.5
Socioeconomic Status	High	34	17

Maternal Education	Illiterate	58	28
Maternal Education	Primary Education	82	39
Maternal Education	Secondary/Higher	67	33
Mode of Delivery	Normal Vaginal Delivery	140	67.5
Mode of Delivery	Cesarean Section	67	32.5
Study Outcome	Discharged	192	93
Study Outcome	Expired	15	7

Table 3: Diagnostic Performance of MSNS

Cutoff Score	Sensitivity (%)	Specificity (%)	Positive Predictive Value (PPV) (%)	Negative Predictive Value (NPV) (%)	Diagnostic Accuracy (%)
≤ 10	86	55	90	40	82
≤ 11.5	80	61	85	42	78
≤ 8	89	48	83	58	81

Table 4: ROC Curve Analysis for MSNS Cutoff Score

Cutoff Score	Sensitivity (%)	Specificity (%)	AUC (Area Under Curve)	95% Confidence Interval (CI)
10	86	55	0.78	0.74 - 0.82
11.5	80	61	0.81	0.77 - 0.85
8	89	48	0.76	0.72 - 0.80

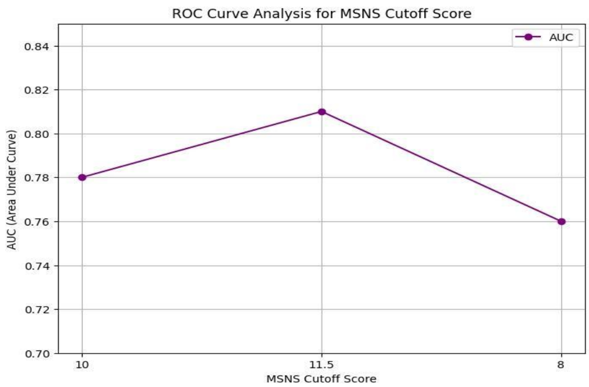

Figure 1: ROC Curve

Table 5: Stratification Analysis for Confounding Factors

Stratification Factor	MSNS Cutoff	Sensitivity (%)	Specificity (%)	Diagnostic Accuracy (%)
Gestational Age	≤ 10	85	55	81
Male Neonates	≤ 10	84	58	79
Female Neonates	≤ 10	88	51	80
Low Birth Weight	≤ 10	87	53	80
High Birth Weight	≤ 10	85	57	82
Normal Vaginal Delivery	≤ 10	86	54	79
Cesarean Section	≤ 10	84	56	81

Table 6: Efficacy for Stratified Groups

Factor	Efficacy (%)
Overall (All Neonates)	82
Gestational Age < 34 weeks	88
Gestational Age ≥ 34 weeks	75
Male Neonates	81
Female Neonates	79
Low Birth Weight	83
High Birth Weight	80
Normal Vaginal Delivery	79
Cesarean Section	82

DISCUSSION

The current prospective validation research assessed the utility of the Modified Sick Neonatal Score (MSNS) to forecast neonatal outcomes in patients admitted to the NICU at CMH Multan. The mean gestational age in this study was 34.5 + 3.2 weeks and mean birth weight was 2200 + 600 g, which implies that the population under study was composed mainly of preterm and low birth weight new-borns, which are characterized as being vulnerable to morbidity and mortality. Mean score of MSNS was 9.2 ± 3.4, which is moderate level of illness in the admitted neonates. These results emphasize the significance of severity assessment at an early stage of NICU admissions to detect neonates who need high-intensive monitoring and care.

The demographic results of the current research revealed that 58 percent of neonates were male and 42 percent were female, which pointed to a low percentage of the male dominance in NICU admissions. Jahan et al. [25] also indicated similar results and a higher percentage of male neonates among the participants in the study who assessed the Modified Sick Neonatal Score in a tertiary care hospital. The authors have proposed that male newborns might be more susceptible to neonatal issues, and this could be the reason why they dominate the NICU admissions.

The outcome analysis of the present research showed that 93 per cent of the neonates were discharged with recovery and 7 per cent died during hospitalization. The same observation was made by Twanbasu et al. [26], who reported that the majority of the neonates admitted to NICU survived after receiving relevant medical care. The diagnostic performance analysis of MSNS in the current study indicated that with cutoff score of 10, the scoring system had 86% sensitivity, 55% specificity and overall diagnostic accuracy of 82%. Pandey [27] also found comparable results when the utility of MSNS was evaluated in NICU admissions and the researcher found that neonates with low scores on MSNS showed a high mortality risk.

The current research also exhibited good predictive performance by ROC curve analysis in which the area under the curve (AUC), varied between 0.76 and 0.81 with an optimally functioning cutoff of 11.5 or less. The same outcome was found by Kumar et al. [28] who assessed the results of NICUs based on MSNS and noted that reduced MSNS scores were significantly correlated with increased mortality and extended hospitalization. The authors reached the conclusion that MSNS may be successfully used to rank neonates by the severity of diseases.

Stratified analysis was also performed in the current research, which revealed that MSNS was specifically effective in the babies with a low birth weight and those babies who were born prematurely, with a sensitivity of 88 and 87 respectively. Other similar results were also observed by Chethan et al. [29) who compared the prognostic predictive accuracy of the Extended Sick Neonatal Score which revealed that systems based on the severity of illness, which do rely on clinical parameters, are good predictors of neonatal mortality and morbidity in NICU.

Similarly, Shirwaikar et al. [30] highlighted that the scoring systems for the severity of neonatal illness are vital to predict the mortality of critically ill neonates and to guide them to receive intensive care treatment, given the high risk associated with them. They conclude that simple bedside scores such as MSNS can play a helpful role in clinical decision making. Another study by Akhila et al. [31] used various neonatal severity scoring systems (NSSS) like CRIB II and ESNS to conclude that scores of illness severity is a good predictor of in-hospital mortality (IHM) of preterm infants. They have found that standardised scoring systems will improve their prognostic ability in the NICU setting, and have highlighted these as an area of focus.

Similarly, Adane et al. [32] developed and tested a prediction model for neonatal death in NICU admissions and found that clinical scoring systems provided good early stratification of risk for predicting neonatal death, which significantly improved prediction. The authors also emphasized the importance of using these scoring systems to identify the neonates that are critically ill and to take appropriate action. Furthermore, Sri Ram et al. [33] validated the Neonatal Sequential Organ Failure Assessment (nSOFA) and physiological based severity scoring systems and determined that this was an excellent predictor of neonatal mortality from critical illness. The results further validate the significance of the simple clinical scores such as MSNS in neonatal intensive care.

This study had some limitations, however. It was conducted in a single health care centre and included a limited number of respondents which may limit generalizability of findings. Therefore, further multicenter studies with an increased sample size are recommended to validate MSNS' predictive capacity and to explore further roles for its implementation in improving quality of neonatal care and outcomes.

CONCLUSION

The Modified Sick Neonatal Score (MSNS) was used in this prospective validation study to predict outcome in neonate admitted in the NICU at CMH Multan. The results indicated that MSNS is useful and feasible bedside report card for severity evaluation at admission. It is used without the need for complicated laboratory investigations because of its measured clinical parameters. The score showed good predictive value in both preterm and term neonates and is thus useful in the identification of risk, clinical decision making and better care of neonates, especially in resource poor communities.

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