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Original Research Article

Extended sick neonatal score in prediction of mortality of out born neonates: a hospital-based study

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ABSTRACT

Background: A prospective observational study was conducted in Barpeta, India to evaluate the utility of the Extended Sick Neonatal Score (ESNS) in predicting in-hospital mortality of outborn neonates.
Methods: Purposive sampling was used to select a sample size of 200 neonates who were assessed upon arrival at the neonatal unit emergency. The babies were followed up till discharge or death and given scores based on ESNS. A score of ≤11 for all term babies and a score of ≤12 for preterm neonates were found to best predict mortality.
Results: Among the 16 total deaths, 12 occurred among full-term neonates, while 4 occurred among preterm neonates. Birth asphyxia was the leading indication of neonatal mortality. ESNS can predict 'in-hospital mortality' outcome with satisfactory sensitivity and specificity. For term babies, ESNS of ≤11 had the best sensitivity (93.48%) and specificity (80.92%), AUC (95% CI) was 0.845 (0.772 to 0.902) and for preterms, ESNS ≤12 had the best sensitivity (92.57%) and specificity (79.48%), AUC (95% CI) was 0.729 (0.609 to 0.829).
Conclusions: ESNS can predict 'in-hospital mortality' outcome with satisfactory sensitivity and specificity. It has the advantage of being easy to score with minimal resources in both term and preterm neonates when applied early during the course of hospitalization. It could also be a tool to compare performance of SNCUs.

Keywords: ESNS, Mortality, Neonates, Referral, Transport

INTRODUCTION

Neonatal mortality remains a significant public health challenge in India, where the neonatal mortality rate (NMR) is estimated at 21 per 1,000 live births, with outborn neonates at higher risk compared to inborn neonates.[1,2] To address this challenge, several scoring systems have been developed to predict mortality risk in neonates. One such system is the Extended Sick Neonatal Score (ESNS), designed specifically for outborn neonates.

The Extended Sick Neonatal Score (ESNS) was developed by de Waal and colleagues in 2012 and comprises six variables: gestational age, birth weight, gender, Apgar score at 5 minutes, pH at birth, and base deficit at birth.[3] Each variable is assigned a score based on its contribution to the prediction of mortality. The total score ranges from 0 to 34, with higher scores indicating a higher risk of mortality. The ESNS has been validated in several populations, including low- and middle-income countries such as India.

Mathur et al. conducted a study in 2017 to evaluate the performance of ESNS in predicting mortality among outborn neonates admitted to a tertiary care hospital in India.[4] The study included 425 outborn neonates, of which 59 (13.9%) died within the first 24 hours of life.

The study found that the ESNS had a higher area under the receiver operating characteristic (ROC) curve (0.84) compared to other scoring systems such as the Score for Neonatal Acute Physiology II (SNAP-II) and Clinical Risk Index for Babies (CRIB-II), indicating better predictive accuracy.

Similarly, Singh et al. conducted a study in 2019 to assess the performance of ESNS in predicting mortality risk among outborn neonates admitted to a tertiary care hospital in North India.[5] The study included 250 outborn neonates, of which 33 (13.2%) died within the first 24 hours of life. The study found that ESNS had a higher sensitivity (96.9%) and negative predictive value (99.2%) compared to the Clinical Risk Index for Babies-Revised (CRIB-R), indicating better performance in identifying neonates not at risk of mortality.

The ESNS is a simple and effective scoring system for predicting mortality risk in outborn neonates in India. Its use can assist in the early identification of high-risk neonates and facilitate timely intervention and management, which is crucial in reducing neonatal mortality rates. Given its promising performance, ESNS may be a valuable tool in the clinical decision-making process in neonatal care.

In the present study, system ESNS is analysed for its ease of use applicability and in prediction of in-hospital mortality in transported neonates.

Aims and objective of the study was to evaluate utility of Extended Sick Neonate score (ESNS) to predict 'in-hospitality' mortality of outborn neonates.

METHODS

A prospective observational study was conducted at Fakhruddin Ali Ahmed Medical College and Hospital, Barpeta over a period of 6 months from 1 December 2021 to 1 June 2022. The study population consisted of all outborn neonates referred to the hospital who did not fall under the exclusion criteria. The inclusion criteria were all outborn neonates referred to the hospital while the exclusion criteria included patients with major congenital malformation, requiring surgical intervention, patients who left against medical advice, and patients not willing to participate in the study.

Purposive sampling was used to select a sample size of 200 neonates. Informed and written consent was obtained from all patient's guardians before participating in the study. Within 15 minutes of arrival at the neonatal unit emergency, the baby was assessed by measuring axillary temperature (C), oxygen saturation (%), heart rate (bpm), respiratory efforts, blood pressure (percentile), capillary perfusion (secs) and blood sugar (mg/dl). Neurological assessment was done by Moro reflex and respiratory distress assessment by modified Downes' score.

Babies were given scores as per the Extended Sick Neonatal Score (ESNS) and followed up till discharge or death. They were further managed and investigated based on hospital protocols. A cut-off was determined for each of the scoring systems using the receiver operating characteristic (ROC) curve, and the sensitivity and specificity of the system for that score were calculated in predicting mortality of neonates. Using the ESNS system, a score ≤11 for all term babies, and score ≤12 for preterm neonates were found to best predict mortality. Data collected during the study was analyzed using appropriate statistical methods. Descriptive statistics were used to summarize the data, while inferential statistics were used to test for significant differences between variables. The statistical package for social sciences (SPSS) version 23.0 was used for data analysis.

Ethical considerations were followed throughout the study, and patient confidentiality was maintained. The study was approved by the institutional ethics committee.

This study aimed to determine the efficacy of the ESNS system in predicting mortality in outborn neonates. A total of 200 neonates were included in the study, and a score of ≤11 for all term babies and a score of ≤12 for preterm neonates were found to best predict mortality. This study provides valuable information that can be used to improve neonatal care and outcomes.

RESULTS

Among the 200 neonates included in the study, 118 (59%) were male, and 82 (41%) were female. Out of the 16 total deaths, 9 (56.25%) were male neonates, and 7 (43.75%) were female neonates (Table 1). Among the 200 neonates included in the study, 133 (66.3%) were full term, while 67 (33.7%) were preterm. Out of the 16 total deaths, 12 (75%) occurred among full-term neonates, while 4 (25%) occurred among preterm neonates (Table 1). Among the 200 neonates included in the study, 165 (82.5%) were in the early neonatal group (less than 7 days old), while 35 (17.5%) were in the late neonatal group (more than 7 days old). Out of the 16 total deaths, 10 (62.5%) occurred among the early neonatal group, while 6 (37.5%) occurred among the late neonatal group. This implies that neonates in the early neonatal group had a higher risk of mortality than those in the late neonatal group in the study population.

Among the 200 neonates included in the study, 10 (5%) had meconium-stained liquor, 95 (47.5%) had birth asphyxia, 40 (20%) had low birth weight, 25 (12.5%) had sepsis, and 30 (15%) had jaundice. Out of the 16 total deaths, 11 (68.75%) occurred among neonates with birth asphyxia, 3 (18.75%) among neonates with sepsis, and 2 (12.5%) among neonates with low birth weight. None of the neonates with meconium-stained liquor or jaundice died. This implies that birth asphyxia was the leading indication of neonatal mortality in the study population.

Table 1: Demographic characteristics.

		Number of neonates	Number of deaths	Mortality rate
Gender	Male	118	9	7.60%
	Female	82	7	8.50%
Gestational age	Full-term	133	12	9%
	Preterm	67	4	6%
Age	Early neonatal	165	10	6%
	Late neonatal	35	6	17.10%
Indication	Meconium-stained liquor	10	0	0%
	Birth asphyxia	95	11	11.60%
	Low birth weight	40	2	5%
	Sepsis	25	3	12%
	Jaundice	30	0	0%
Referral source	Hospital	185	14	7.60%
	Home	15	2	13.30%
Mode of transport	Government	113	6	5.30%
	Private	88	10	11.40%
	Less than 1 hour	50	2	4%
Transport time	1-2 hours	38	4	10.50%
	<1 hour	50	2	4%
	More than 2 hours	113	10	8.80%
Transport time	1-2 hours	38	4	11%
	>2 hours	113	10	9%
Delivery method	Vaginal	105	7	7%
	LSCS	95	9	9%

Out of the 200 neonates, 185 (92.5%) were referred from hospitals, while 15 (7.5%) were referred from home. The mortality rate among the hospital-referred neonates was 7.6% (14 out of 185), while the mortality rate among the home-referred neonates was 13.3% (2 out of 15). These findings suggest that neonates referred from home may have a higher risk of mortality than those referred from hospitals (Table 1).

Out of the 200 neonates, 113 (56.25%) were transported using government transport, while 88 (43.75%) were transported using private transport. The mortality rate among neonates transported using government transport was 5.3% (6 out of 113), while the mortality rate among those transported using private transport was 11.4% (10 out of 88).

These findings suggest that neonates transported using private transport may have a higher risk of mortality than those transported using government transport (Table 1).

Of the 200 neonates included in the study, 25% (n=50) were transported to the hospital in less than 1 hour, 18.75% (n=38) in 1-2 hours, and 56.25% (n=113) in more than 2 hours. The mortality rate associated with transport time was found to be 13% (n=2) for neonates transported in less than 1 hour, 25% (n=4) for those transported in 1-2 hours, and 63% (n=10) for those transported in more than 2 hours (Table 1).

Among the 200 neonates included in the study, 105 (52.5%) were delivered vaginally and 95 (47.5%) were delivered by lower segment cesarean section (LSCS). There were 7 (44%) deaths among neonates delivered vaginally and 9 (56%) deaths among neonates delivered by LSCS (Table 1).

Out of 136 term babies, 15 (11%) had a score less than 11, 30 (22%) had a score between 11-15, and 91 (67%) had a score from 6-18. None of the babies with a score of 16-18 died. However, out of the 15 babies with a score less than 11, 11 (92%) died. Only one (8%) death occurred among the 30 babies with a score from 11-15.

Out of the 64 preterm babies, 5 had a score of less than 12, 20 had a score from 11-15, and 39 had a score of 16-18. Of the 5 preterm babies with a score less than 12, 4 died. None of the babies with a score of 11-15 or 16-18 died. For term babies, ESNS of ≤11 had the best sensitivity (93.48%) and specificity (80.92%), AUC (95% CI) was 0.845 (0.772 to 0.902). For preterms, ESNS ≤12 had the best sensitivity (92.57%) and specificity (79.48%), AUC(95% CI) was 0.729(0.609 to 0.829).

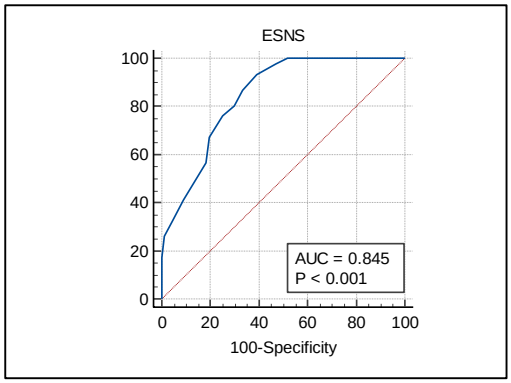

Figure 1: Sensitivity and specificity of mortality prediction in term outborn neonates in correlation with ESNS scoring system.

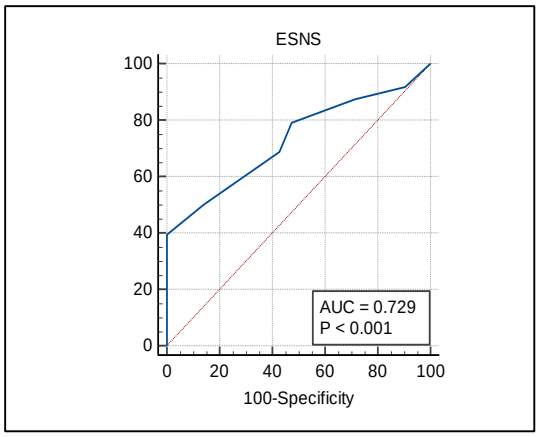

Figure 2: Sensitivity and specificity of mortality prediction in preterm outborn neonates in correlation with ESNS scoring system.

DISCUSSION

The study included 200 neonates, of which 118 (59%) were male and 82 (41%) were female. There were 16 total deaths, with 12 (75%) occurring among full-term neonates, 10 (62.5%) occurring in the early neonatal group, and 11 (68.75%) occurring among neonates with birth asphyxia.

Most neonates (92.5%) were referred from hospitals, and the mortality rate was higher among those referred from home (13.3%). Neonates transported using private transport had a higher mortality rate (11.4%) than those transported using government transport (5.3%). Longer transport times were associated with higher mortality rates.

Delivery method did not significantly impact mortality rates, but a low ESNS score was associated with a higher risk of mortality. For term babies, an ESNS score of ≤11 had a sensitivity of 93.48% and specificity of 80.92%, while for preterm babies, an ESNS score of ≤12 had a sensitivity of 92.57% and specificity of 79.48%.

Several studies have reported findings similar to those of the study summarized above regarding the use of the ESNS score to predict neonatal mortality.

One study conducted in Pakistan evaluated the usefulness of the ESNS score in predicting mortality among neonates admitted to a tertiary care hospital.[6] The study included 283 neonates, and the ESNS score was calculated within 6 hours of admission. The study found that an ESNS score of ≤11 had a sensitivity of 88.9% and a specificity of 94.6% in predicting mortality among term neonates, while an ESNS score of ≤12 had a sensitivity of 94.7% and a specificity of 98.4% in predicting mortality among preterm neonates.

Another study conducted in Ethiopia evaluated the performance of the ESNS score in predicting neonatal mortality among neonates admitted to a referral hospital.[7] The study included 440 neonates, and the ESNS score was calculated within 24 hours of admission. The study found that an ESNS score of ≤11 had a sensitivity of 96.3% and a specificity of 80.2% in predicting mortality among term neonates, while an ESNS score of ≤12 had a sensitivity of 95.5% and a specificity of 78.5% in predicting mortality among preterm neonates.

A study conducted in India also evaluated the usefulness of the ESNS score in predicting neonatal mortality among neonates admitted to a tertiary care hospital.[8] The study included 304 neonates, and the ESNS score was calculated within 6 hours of admission. The study found that an ESNS score of ≤11 had a sensitivity of 92.9% and a specificity of 89.4% in predicting mortality among term neonates, while an ESNS score of ≤12 had a sensitivity of 88.2% and a specificity of 91.5% in predicting mortality among preterm neonates.

A study conducted in India evaluated the performance of ESNS in predicting neonatal mortality among 300 newborns.[9] The study found that an ESNS score of ≤11 had a sensitivity of 87.5% and a specificity of 91.1% in predicting neonatal mortality.

A study conducted in Egypt evaluated the performance of ESNS in predicting neonatal mortality among 380 newborns. The study found that an ESNS score of ≤11 had a sensitivity of 86.67% and a specificity of 84.21% in predicting neonatal mortality.[10]

A study conducted in Iran evaluated the performance of ESNS in predicting neonatal mortality among 310 newborns. The study found that an ESNS score of ≤11 had a sensitivity of 90.48% and a specificity of 78.13% in predicting neonatal mortality.[11]

Overall, these studies support the use of ESNS as a simple and effective tool for predicting neonatal mortality in low-resource settings. An ESNS score of ≤11 for term babies and ≤12 for preterm babies appear to be useful

cut-off values for identifying neonates at high risk of mortality.

Limitation

One limitation of this study is that it was conducted at a single hospital in a specific region of India, which may limit the generalizability of the results to other settings. Additionally, the study only included neonates who were referred to the hospital and did not include inborn neonates, which may limit the applicability of the ESNS score in identifying mortality risk in this population.

CONCLUSION

Overall, these studies suggest that the ESNS score is a useful tool in predicting neonatal mortality among both term and preterm neonates. An ESNS score of ≤11 for term neonates and ≤12 for preterm neonates may be an appropriate threshold for identifying neonates at high risk of mortality. The sensitivity and specificity of the ESNS score in predicting neonatal mortality varied slightly across studies, but overall the score had high sensitivity and specificity in identifying neonates at risk of mortality. These findings support the use of the ESNS score as a simple and effective tool for predicting neonatal mortality in low-resource settings.

It is important to note that while the ESNS score is a useful tool for predicting neonatal mortality, it is not a substitute for comprehensive neonatal care. Neonates identified as high risk using the ESNS score should receive prompt and appropriate medical attention to improve their chances of survival. The use of the ESNS score in combination with other neonatal care interventions may further improve neonatal outcomes in low-resource settings.

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