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Original Research Article

COMPARISON OF POST TRANSPORT TOPS SCORE WITH SNAPPE-II SCORE IN PREDICTING MORBIDITY AND MORTALITY IN NEONATES

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ABSTRACT

Background: Outborn neonates are at increased risk of morbidity and mortality because of delayed referral, inadequate stabilization, and transport-related physiological deterioration. Early identification of critically ill neonates using simple and reliable severity scoring systems is essential for timely intervention and optimal resource allocation. The Transport Risk Index of Physiologic Stability (TOPS) score provides a rapid post-transport assessment, whereas the Score for Neonatal Acute Physiology with Perinatal Extension-II (SNAPPE-II) offers a comprehensive evaluation of illness severity. However, evidence directly comparing the predictive performance of these scoring systems, particularly in resource-limited settings, remains limited. **Objective:** To compare the predictive accuracy of the post-transport TOPS score and SNAPPE-II score in determining morbidity and mortality among outborn neonates admitted to a tertiary care Neonatal Intensive Care Unit (NICU). **Materials and Methods:** This prospective observational study was conducted in a tertiary care NICU over 18 months. A total of 80 outborn neonates aged 0–28 days were enrolled. The TOPS score was assessed immediately upon admission, while SNAPPE-II was calculated within the first 24 hours of admission. The primary outcome was predischarge mortality, while secondary outcomes included morbidity assessed by duration of NICU stay and duration of respiratory support. Statistical analysis included comparison of mean scores, receiver operating characteristic (ROC) curve analysis, and estimation of sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy. **Results:** Of the 80 neonates, 60 (75%) survived and 20 (25%) expired. The mean TOPS score was significantly higher among expired neonates than survivors (5.70 ± 0.85 vs. 4.98 ± 1.12; $p < 0.001$). Similarly, the mean SNAPPE-II score was significantly higher in non-survivors compared with survivors (34.2 ± 31.2 vs. 21.3 ± 25.3; $p < 0.001$). The area under the receiver operating characteristic curve (AUC) for predicting mortality was 0.938 for TOPS and 0.917 for SNAPPE-II, indicating excellent discriminative ability for both scoring systems. At the optimal cut-off values, TOPS demonstrated 100% sensitivity and 85.0% specificity, whereas SNAPPE-II showed 95.0% sensitivity and 81.67% specificity. **Conclusion:** Both TOPS and SNAPPE-II are effective and reliable predictors of mortality among outborn neonates admitted to the NICU. While both scores demonstrated excellent diagnostic performance, SNAPPE-II showed superior ability to predict morbidity.

INTRODUCTION

The neonatal period, defined as the first 28 days of life, is a critical phase marked by rapid physiological adaptation as newborns transition from intrauterine to extrauterine life. This period carries the highest risk of morbidity and mortality, making neonatal survival a key indicator of the quality of maternal and child healthcare services.[1] Globally, approximately 2.6 million neonatal deaths occur each year, with nearly 7,000 deaths every day. India contributes a substantial proportion of these deaths, reporting nearly 640,000 neonatal deaths annually and a neonatal mortality rate (NMR) of approximately 25.3 per 1,000 live births.[2] Although the infant mortality rate has declined significantly over the past decades,

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neonatal mortality continues to account for a major share of infant deaths.[3]

The neonatal mortality rate is widely recognized as an important indicator of national health and socioeconomic development.[4,5] Nearly 40% of neonatal deaths occur during labour or within the first 24 hours after birth. Prematurity, neonatal infections, birth asphyxia, and congenital malformations remain the leading causes of neonatal mortality.[5] The first four weeks of life therefore represent a crucial window for timely identification and management of life-threatening conditions.

Neonatal sepsis and respiratory distress syndrome are among the commonest causes of admission to neonatal intensive care units (NICUs).[6] Many critically ill newborns require inter-facility transport during the early neonatal period, and studies have consistently demonstrated higher mortality among outborn neonates than inborn neonates.[7] Despite recommendations supporting regionalized neonatal care, standardized neonatal transport systems remain inadequate in many parts of India.[8] Efficient neonatal retrieval and stabilization services can substantially improve outcomes by reducing delays in definitive care.[9]

Clinical scoring systems offer a rapid, simple, and non-invasive alternative for evaluating disease severity and predicting neonatal outcomes. Among the available scoring systems, the TOPS score, based on Temperature, Oxygen saturation, Perfusion, and Blood Sugar, is a simple bedside tool that has demonstrated good predictive value for mortality in transported neonates.[7] The Score for Neonatal Acute Physiology–Perinatal Extension II (SNAPPE-II) is a more comprehensive scoring system that incorporates physiological and perinatal variables to estimate illness severity and mortality risk.[6,7] However, studies directly comparing the predictive performance of TOPS and SNAPPE-II are limited, particularly in the Indian setting. Considering the large number of critically ill outborn neonates admitted to tertiary care NICUs, identifying a reliable, rapid, and practical prognostic tool is essential. Therefore, the present study was undertaken to compare the effectiveness of TOPS and SNAPPE-II scores in predicting predischarge mortality among neonates admitted to a tertiary care NICU.

MATERIALS AND METHODS

A prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care teaching hospital in Mangalore over a period of 18 months following approval from the Institutional Ethics Committee. The study included outborn neonates aged 0–28 days who were referred and transported to the NICU for further management. All outborn neonates aged between 0 and 28 days admitted to the NICU during the study period and fulfilling the eligibility criteria were enrolled after obtaining written informed consent from their parents or legal guardians.

Inclusion and Exclusion Criteria

The study included all outborn neonates aged 0–28 days transported to the tertiary care hospital NICU. Neonates born at home, those with major congenital anomalies, and those in whom the Apgar score was unavailable were excluded from the study.

Data Collection

Data were collected using a predesigned and pretested proforma. Baseline demographic details, perinatal history, referral information, and clinical characteristics were recorded. Additional variables documented included gender, postnatal age, corrected gestational age, gestational age at birth, birth weight, place and mode of delivery, type of resuscitation at birth, Apgar score, maternal complications, referral hospital, duration of transport, indication for referral, prehospital stabilization, use of inotropes before transport, type and duration of respiratory support, and duration of hospital stay. All enrolled neonates were managed according to the standard NICU treatment protocol, and no study-related intervention influenced patient management.

Assessment of TOPS Score

The TOPS (Temperature, Oxygen Saturation, Perfusion, and Blood Sugar) score was assessed immediately upon admission to the NICU. Axillary temperature was measured using a digital thermometer, and a temperature below 36.5°C was considered hypothermia. Oxygen saturation was measured in the right upper limb using a pediatric pulse oximeter probe, with saturation below 90% considered hypoxemia. Peripheral perfusion was assessed by measuring capillary refill time over the sternum after applying gentle pressure for five seconds; a refill time greater than three seconds indicated poor perfusion. Blood glucose was measured using a glucometer from a heel-prick blood sample, and a value below 40 mg/dL was considered hypoglycemia. The TOPS score ranged from 0 to 4, with one point assigned for each abnormal parameter.

Assessment of SNAPPE-II Score

The Score for Neonatal Acute Physiology–Perinatal Extension II (SNAPPE-II) was calculated within the first 24 hours of admission using standard criteria. The variables included mean blood pressure, lowest temperature, PaO_2/FiO_2 ratio, serum pH, occurrence of multiple seizures, urine output, 5-minute Apgar score, birth weight, and small-for-gestational-age status. Based on the total score, neonates were categorized into mild (0–20), moderate (21–40), and severe (>40) illness groups.

Outcome Measures

The primary outcome was predischarge mortality. Secondary outcomes included morbidity assessed by the duration of NICU stay and duration of respiratory support. The relationship between TOPS and SNAPPE-II scores and these outcomes was evaluated.

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Sample Size

The sample size was calculated using the formula for estimation of sensitivity, considering a sensitivity of 87.5% and a prevalence of 81.6% reported in a previous study, with a 95% confidence interval (Z = 1.96). The minimum required sample size was calculated to be 80 neonates, all of whom were included in the study.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between categorical variables was assessed using the Chi-square test. The diagnostic performance of TOPS and SNAPPE-II scores was evaluated by calculating sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy. Receiver operating characteristic (ROC) curve analysis was performed to compare the predictive ability of the two scoring systems, and the area under the curve (AUC) was determined. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 80 outborn neonates were included in the study. Sixty (75%) survived until discharge, while 20 (25%) died during hospitalization. There was no significant association between mortality and demographic or perinatal characteristics such as sex, gestational age, age at admission, referral source, mode of delivery, or pre-transport stabilization.

Table 1: Baseline characteristics and outcome of study participants

Variable	Total (n=80)	Survived n (%)	Expired n (%)	p value
Male	45	33 (73.3)	12 (26.7)	0.299
Female	35	27 (77.1)	8 (22.9)	
Preterm	41	29 (70.7)	12 (29.3)	0.243
Term/Post-term	39	31 (79.5)	8 (20.5)	
Age <24 h	56	40 (71.4)	16 (28.6)	0.136
IV fluids before transport	39	31 (79.5)	8 (20.5)	0.366
Inotropes before transport	12	6 (50.0)	6 (50.0)	0.064
Government referral	5	2 (40.0)	3 (60.0)	0.097
Normal vaginal delivery	55	42 (76.4)	13 (23.6)	0.676

Baseline demographic and transport-related variables did not differ significantly between survivors and non-survivors.

Table 2: Comparison of TOPS and SNAPPE-II scores according to outcome

Score	Survived (Mean ± SD)	Expired (Mean ± SD)	p value
TOPS	4.98 ± 1.12	5.70 ± 0.86	<0.001
SNAPPE-II	21.3 ± 25.3	34.2 ± 31.2	<0.001

Both TOPS and SNAPPE-II scores were significantly higher among neonates who died than among survivors.

Table 3: Distribution of mortality according to TOPS and SNAPPE-II categories

Score category	Total	Mortality (%)	p value
TOPS			
Score 4	41	0 (0%)	<0.001
Score 5	10	0 (0%)	
Score 6	19	12 (63.2%)	
Score 7	10	8 (80.0%)	
SNAPPE-II			
<20	48	1 (2.1%)	<0.001
20–40	15	7 (46.7%)	
>40	17	12 (70.6%)	

Mortality increased significantly with increasing TOPS and SNAPPE-II scores.

Table 4: Individual parameters significantly associated with mortality

Scoring system	Significant parameter	p value
TOPS	Oxygen saturation	<0.001
	Perfusion	<0.001
	Blood glucose	<0.001
	Temperature	0.697
SNAPPE-II	Mean arterial pressure	<0.001

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	PaO_2/FiO_2 ratio	<0.001
	Serum pH	<0.001
	Urine output	<0.001
	Apgar score	0.002
	Multiple seizures	0.033
	Temperature	0.156
	Birth weight	0.280

Oxygen saturation, perfusion, and blood glucose were the strongest TOPS predictors of mortality. Within SNAPPE-II, hypotension, impaired oxygenation, metabolic acidosis, oliguria, low Apgar score, and seizures were significantly associated with mortality.

Table 5: Association of TOPS and SNAPPE-II scores with morbidity

Outcome	TOPS	SNAPPE-II
Duration of NICU stay	Not significant (p=0.359)	Significant (p=0.046)
Respiratory support	Higher requirement among non-survivors	Higher scores associated with prolonged respiratory support

SNAPPE-II showed better prediction of morbidity than TOPS, particularly regarding prolonged NICU stay.

Table 6: Diagnostic performance of TOPS and SNAPPE-II scores

Parameter	TOPS	SNAPPE-II
AUC	0.938	0.917
Sensitivity (%)	100	95
Specificity (%)	85.0	81.67
PPV (%)	68.96	63.33
NPV (%)	100	98.0
Accuracy (%)	88.75	85.00
p value	<0.001	<0.001

Both scoring systems demonstrated excellent diagnostic performance for predicting neonatal mortality. TOPS had slightly higher sensitivity, specificity, overall accuracy, and area under the ROC curve than SNAPPE-II.

DISCUSSION

The variations in mortality and morbidity among extramural neonates admitted to referral NICUs may indicate differences in the severity of illness within this population. These differences can be better understood by evaluating the severity of illness at the time of admission.

TOPS score is an objective score – temperature, oxygen saturation, perfusion (based on capillary refill time) and blood sugar are less prone to subjective variation. From our study, some babies have been treated before transportation, that could have altered the physiological status during Transportation.

Total babies included in the study were 80. Among them 60 (75%) survived and 20 (25%) expired. However, the mortality rate of extramural neonates not only depend on the quality of intensive neonatal care but also on the state of admission of neonate in a tertiary hospital.(10,11) From our study it is found that both TOPS and SNAPPE II has a better predictive value (AUC >0.9), with significant P values (<0.001) and both the scores are equally predicts mortality. From our study it is found that in predicting morbidity SNAPPE II score has a better predictive value with significant P value of (0.049) and TOPS score is not significant with P value of (0.359).

The most common cause for referral in our study was respiratory distress, preterm care asphyxia, neonatal convulsions. Derangements in TOPS score have significant association with mortality. In the present study Post transport TOPS score has a sensitivity, specificity and AUC ROC was 100%, 85% and 0.93%. While in the study done by Mathur et al,[12] shows sensitivity, specificity and AUC as 81.6%, 77.39% and 0.89, whereas in A study done by Ayesha Begum,[13] showed 71.9%, 80.8% and 0.764 respectively. TOPS score can be assessed easily at bedside, immediately after admission.

Hypothermia is common among newborns referred to tertiary care hospitals. In our study among 80 newborns only 5 newborns had hypothermia not significantly associated with mortality. This is in contrast to Mathur et al study,[12] where hypothermia is a strongest factor associated with mortality.

Tissue oxygen delivery depends on both perfusion and oxygen saturation. Skin perfusion, commonly assessed by capillary refill time, serves as an indicator of vital organ perfusion. In the early stages of shock, the body prioritizes blood flow to vital organs by redirecting circulation away from non-vital areas such as the skin. In our study in post transportation, both skin perfusion and oxygen saturation is found to have significant association with mortality. This finding is similar to that observed in Mathur et al study.[12]

In our study post transportation hypoglycemia at the time of receiving to our NICU has shown significant association with mortality. In the present study SNAP II PE score has been found to have significant association with mortality irrespective of gestational

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ages. The mean score in our study is 34.2 for expired and 21.3 for the alive. In a study by Harsha et al,[14] the mean SNAPPE-II score among expired babies was 45.72±18.68 and the survived ones had a score of 21.04±15.418.

In the present study SNAP II PE score of 24 and above were associated with higher mortality. In the present study Gestational age and age(hours of life) during referral has no significant relation to mortality In the present study prehospital stabilisation with iv fluids and inotropes and mode of delivery with p value of (0.366);(0.096) has no significant relation to mortality. In the present study SNAPPE II parameters like mean blood pressure,PO2/FIO2 ratio, urine output, APGAR shown statistical significance with p value 0.001.

CONCLUSION

Both Post transport TOPS and SNAPPE II scores have no significant difference in predicting mortality. When stratified analysis is done for mortality both post TOPS score and SNAP II PE have good predictive value and there is no statistical difference between the two scores. SNAPPE II Have good predictive value for morbidity compared to TOPS score.

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