Bangladesh Med J. 2025 Jan; 54(1)
DOI: https://doi.org/10.3329/bmj.v54i1.88086

Original Article

Neonatal Sequential Organ Failure Assessment (nSOFA) Score Predicts Mortality and Morbidity in Preterm Infants

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Abstract

Preterm infants are highly vulnerable to organ dysfunction and *death due to physiological immaturity and complications such as respiratory distress syndrome (RDS), sepsis, and intraventricular hemorrhage (IVH). The neonatal Sequential Organ Failure Assessment (nSOFA) score is an emerging tool for evaluating organ dysfunction. This cross-sectional study was conducted from January 2024 to December 2024 in the Department of Neonatology, Bangladesh Medical University (BMU). The study was designed to evaluate the role of the nSOFA score in predicting mortality and morbidity among 60 preterm infants admitted to the Neonatal Intensive Care Unit (NICU), BMU. An additional aim was to identify demographic and clinical factors associated with adverse outcomes in these preterm infants. Demographic, perinatal, and clinical data were collected. nSOFA scores comprising respiratory, cardiovascular, and hematologic components were calculated within 72 hours of birth. Infants were followed until discharge or death. Survivors and non-survivors were compared using independent t-test and chi-square test. Multivariate logistic regression identified independent predictors of mortality. Of the 60 infants, 86.7% survived, and 13.3% died. Non-survivors had significantly lower gestational age (32.8 ± 2.7 vs 34.9 ± 2.3 weeks; p = 0.041) and birth weight (1.8 ± 0.4 vs 2.2 ± 0.5 kg; p = 0.033). Sepsis (75.0% vs 30.8%; p = 0.025), RDS (75.0% vs 19.2%; p = 0.004), bronchopulmonary dysplasia (BPD) (50.0% vs 3.8%; p = 0.008), patent ductus arteriosus (37.5% vs 9.6%; p = 0.045), necrotizing enterocolitis (25.0% vs 3.8%; p = 0.049), and IVH (37.5% vs 7.7%; p = 0.031) were significantly more common among non-survivors. Mean cardiovascular (3.4 ± 1.1 vs 1.2 ± 0.8), respiratory (3.7 ± 0.9 vs 2.1 ± 1.0), hematologic (2.5 ± 0.6 vs 1.6 ± 0.7), and total nSOFA scores (8.1 ± 1.5 vs 4.9 ± 2.2) were significantly higher in non-survivors (all p ≤ 0.002). Multivariate analysis showed final nSOFA score (aOR 1.85; 95% CI 1.32–2.58; p < 0.001), sepsis (aOR 3.10; p = 0.030), BPD (aOR 4.50; p = 0.026), and IVH (aOR 4.20; p = 0.035) independently predicted mortality. The nSOFA score is a strong independent predictor of mortality in preterm infants. Higher early organ dysfunction scores, along with sepsis, BPD, and IVH, significantly increase death risk. Routine nSOFA assessment may support early risk stratification and targeted intervention in NICU settings.*

Keywords: *nSOFA scores, preterm infants, neonatal mortality, organ dysfunction.*

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INTRODUCTION

Preterm birth, defined as delivery before 37 completed weeks of gestation, remains a major global public health challenge and is a leading cause of neonatal morbidity and mortality. Complications of prematurity account for a substantial proportion of neonatal deaths worldwide, particularly in low and middle-income countries where access to advanced neonatal care may be limited. [1,2] Immaturity of the respiratory, cardiovascular, immune, and hematologic systems renders preterm infants highly vulnerable to respiratory distress syndrome (RDS), sepsis, intraventricular hemorrhage (IVH), and multi-organ dysfunction, all of which significantly increase the risk of death and long-term disability.[3, 4, 10]

RDS is one of the most common early complications of prematurity, resulting from surfactant deficiency and structurally immature lungs. It contributes to respiratory failure and often necessitates mechanical ventilation, which itself increases the risk of chronic lung disease such as

bronchopulmonary dysplasia (BPD).[4,12] Infectious morbidity, particularly neonatal sepsis, further compounds organ dysfunction through systemic inflammatory responses and hemodynamic instability.[3],[8] Neurological complications, including IVH, are also strongly associated with adverse outcomes and reflect the fragility of cerebral vasculature in preterm infants.[13] Together, these conditions often lead to progressive organ failure, underscoring the need for early, objective assessment of disease severity.

The Sequential Organ Failure Assessment (SOFA) score, widely used in adults to quantify organ dysfunction in sepsis, has been adapted for neonatal use as the neonatal SOFA (nSOFA) score.[5] The nSOFA incorporates respiratory support requirements, cardiovascular instability requiring vasoactive agents, and hematologic dysfunction measured by platelet counts.[5-7] Unlike single-parameter assessments, this composite score reflects the multisystem nature of critical illness in neonates. Several studies have demonstrated that higher nSOFA scores are associated with increased mortality in neonatal sepsis and late-onset infections, particularly among very low birth weight infants.[5,7,9] Cardiovascular and respiratory components of the score have shown especially strong predictive value.[6, 8]

Despite growing evidence supporting the prognostic utility of nSOFA, data focusing specifically on preterm infants remain limited. Preterm neonates differ physiologically from term infants and may exhibit distinct patterns of organ dysfunction due to developmental immaturity. [6,11] Furthermore, the burden of respiratory disease, chronic lung injury, and hemodynamic instability in this population may influence the predictive performance of organ dysfunction scores[12]. Understanding how nSOFA performs in preterm infants is therefore essential for improving early risk stratification and guiding clinical decision-making in neonatal intensive care units (NICUs).

MATERIALS AND METHODS

This cross-sectional study was conducted on 60 preterm infants from January 2024 to December 2024 in the Department of Neonatology, Bangladesh Medical University (BMU). Preterm infants born at <37 completed weeks of gestation and admitted within the study period with complete clinical records to the Neonatal Intensive Care Unit (NICU) of BMU were included in the study. Infants with major congenital anomalies, chromosomal abnormalities, or incomplete data were excluded.

Demographic and perinatal data were collected using a structured data collection form from medical records, clinical conditions/morbidity data were recorded in a checklist from bedside assessment, and assessment of organ dysfunction (nSOFA score) was noted in a scoring sheet.

Demographic and perinatal data included: Gestational age (weeks), Birth weight (kg), Sex, Mode of delivery (vaginal/caesarean section), Admission source (inborn/outborn), Antenatal steroid exposure, and APGAR score at 1 minute

Clinical morbidities recorded during hospitalization were: Sepsis, respiratory distress syndrome (RDS), bronchopulmonary dysplasia (BPD), patent ductus arteriosus (PDA), necrotizing enterocolitis (NEC), and intraventricular hemorrhage (IVH)

Organ dysfunction was assessed using the neonatal Sequential Organ Failure Assessment (nSOFA) score, calculated within the first 72 hours of life. The score includes three components: Respiratory component-requirement for mechanical ventilation, Cardiovascular component- need for vasoactive support, and Hematologic component- platelet count level. Each component was scored according to standard published thresholds, and the total nSOFA score was obtained by summing the component scores. Higher scores indicate more severe organ dysfunction.

Infants were followed from admission until discharge or death.

The primary outcome was in-hospital mortality. Infants were categorized into two groups based on outcome: Survivors (discharged alive), and non-survivors (died during hospitalization). Secondary outcomes included the association of nSOFA scores and major neonatal morbidities.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Continuous variables were tested for normality and presented as mean ± standard deviation (SD). Categorical variables were expressed as numbers and percentages. An independent t-test was used to compare continuous variables between survivors and non-survivors. Chi-square test or Fisher's exact test was used for categorical variables, as appropriate. Variables showing significant association in bivariate analysis were entered into a multivariate logistic regression model to identify independent predictors of mortality. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were reported. A p-value <0.05 was considered statistically significant.

Ethical approval was obtained from the Institutional Review Board (IRB) of the Bangladesh Medical University (BMU). Written informed consent (assent from parents or legal guardians) was obtained before enrollment. Confidentiality of patient information was strictly maintained throughout the study.

RESULTS

A total of 60 preterm infants admitted to the NICU during the study period were included in the analysis. Survival outcomes, demographic variables, clinical characteristics, nSOFA score components, and independent predictors of mortality were evaluated. Comparisons were made between survivors and non-survivors to identify differences in gestational age, birth weight, perinatal factors, and major neonatal morbidities. Organ dysfunction severity was assessed using nSOFA scores, and multivariate logistic regression was performed to determine variables independently associated with mortality among preterm infants.

Figure 1, the pie chart shows the survival status of preterm infants included in the study. Of the total 60 preterm infants, 52 (86.7%) survived, whereas 8 (13.3%) were non-survivors during the study period.

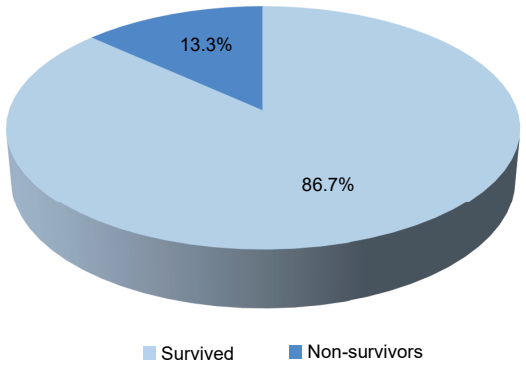

Figure 1: Survival outcomes among preterm infants (n=60)

Demographic Characteristics

Table I describes the demographic and birth-related characteristics of preterm infants according to survival outcome; values are presented as mean ± SD or number (%). Non-survivors had significantly lower gestational age (32.8 ± 2.7 vs 34.9 ± 2.3 weeks; p = 0.041) and lower birth weight (1.8 ± 0.4 vs 2.2 ± 0.5 kg; p = 0.033) than survivors. A higher proportion of non-survivors were male (75.0% vs 55.8%), delivered by caesarean section (62.5% vs 51.9%), and inborn (25.0% vs 65.4%), though these differences were not statistically significant (p = 0.456, 0.709, and 0.125, respectively). p-values were obtained using an independent t-test or chi-square test; *p < 0.05 was considered statistically significant.

Table I: Demographic and birth-related characteristics of preterm infants according to survival outcome

Demographic Variable	Survivors (n=52)	Non-Survivors (n=8)	p-value
Gestational Age (weeks)	34.9 ± 2.3	32.8 ± 2.7	0.041 *
Birth Weight (kg)	2.2 ± 0.5	1.8 ± 0.4	0.033 *
Sex (Male)	29 (55.8%)	6 (75.0%)	0.456
Mode of Delivery (C/S)	27 (51.9%)	5 (62.5%)	0.709
Admission Status (Inborn)	34 (65.4%)	2 (25.0%)	0.125

Table II presents the Clinical characteristics and neonatal morbidities among survivors and non-survivors; here, antenatal steroid exposure was more frequent among survivors than non-survivors (69.2% vs 50.0%; p = 0.297). Mean APGAR score at 1 minute was higher in survivors (6.8 ± 1.2) than non-survivors (6.2 ± 1.1; p = 0.120). Sepsis (75.0% vs 30.8%; p = 0.025), RDS (75.0% vs 19.2%; p = 0.004), BPD (50.0% vs 3.8%; p = 0.008), PDA (37.5% vs 9.6%; p = 0.045), NEC (25.0% vs 3.8%; p = 0.049), and IVH (37.5% vs 7.7%; p = 0.031) were significantly more common among non-survivors. Statistical comparisons used independent t-test, chi-square, or Fisher's exact test as appropriate; *p <0.05 indicates statistical significance.

Table II: Clinical characteristics and neonatal morbidities among survivors and non-survivors

Clinical Variable	Survivors (n = 52)	Non-Survivors (n = 8)	p-value
Antenatal Steroids	36 (69.2%)	4 (50.0%)	0.297
APGAR at 1 min	6.8 ± 1.2	6.2 ± 1.1	0.120
Sepsis	16 (30.8%)	6 (75.0%)	0.025 *
RDS	10 (19.2%)	6 (75.0%)	0.004 *
BPD	2 (3.8%)	4 (50.0%)	0.008 *
PDA	5 (9.6%)	3 (37.5%)	0.045 *
NEC	2 (3.8%)	2 (25.0%)	0.049 *
IVH	4 (7.7%)	3 (37.5%)	0.031 *

nSOFA Score Components and Final Score

Table III displays the comparison of nSOFA component scores and the total score between survivors and non-survivors, and the values are mean ± SD. Cardio- vascular score (3.4 ± 1.1 vs 1.2 ± 0.8; p < 0.001), respiratory score (3.7 ± 0.9 vs 2.1 ± 1.0; p < 0.001), and hematologic score (2.5 ± 0.6 vs 1.6 ± 0.7; p = 0.002) were all significantly higher among non-survivors. The final total nSOFA score was markedly elevated in non-survivors compared with survivors (8.1 ± 1.5 vs 4.9 ± 2.2; p < 0.001). Higher scores indicate more severe organ dysfunction. Independent t-tests were used; *p < 0.05 considered statistically significant.

Table III. Comparison of nSOFA component scores and total score between survivors and non-survivors

nSOFA Component	Survivors (n = 52)	Non-Survivors (n = 8)	p-value
Cardiovascular Score	1.2 ± 0.8	3.4 ± 1.1	<0.001*
Respiratory Score	2.1 ± 1.0	3.7 ± 0.9	<0.001*
Hematologic Score	1.6 ± 0.7	2.5 ± 0.6	0.002*
Final Total nSOFA	4.9 ± 2.2	8.1 ± 1.5	<0.001*

Multivariate Logistic Regression Analysis

Table IV states the multivariate logistic regression analysis of factors independently associated with mortality in preterm infants; adjusted odds ratios (aOR) with 95% confidence intervals (CI) are shown here. Final nSOFA score (aOR 1.85, 95% CI 1.32–2.58; p < 0.001), sepsis (aOR 3.10, 95% CI 1.12–8.59; p = 0.030), BPD (aOR 4.50, 95% CI 1.20–16.90; p = 0.026), and IVH (aOR 4.20, 95% CI 1.10–16.02; p = 0.035) were independently associated with increased mortality. RDS (aOR 2.20; p = 0.103), PDA (aOR 2.70; p = 0.095), and NEC (aOR 2.00; p = 0.210) showed elevated odds but did not reach statistical significance. Multivariate logistic regression was applied; *p < 0.05 indicates statistical significance.

Table IV. Multivariate logistic regression analysis of factors independently associated with mortality in preterm infants

Variable	aOR	95% CI	p-value
Final nSOFA Score	1.85	1.32 – 2.58	<0.001 *
Sepsis	3.10	1.12 – 8.59	0.030 *
BPD	4.50	1.20 – 16.90	0.026 *
RDS	2.20	0.85 – 5.68	0.103
IVH	4.20	1.10 – 16.02	0.035 *
NEC	2.00	0.68 – 5.89	0.210
PDA	2.70	0.85 – 8.56	0.095

DISCUSSION

This study demonstrates that the neonatal Sequential Organ Failure Assessment (nSOFA) score is a strong predictor of mortality and morbidity in preterm infants. Among 60 preterm neonates, mortality was 13.3% (8/60), which is consistent with reported mortality ranges among hospitalized preterm populations in low- and middle-income settings[1,2]. The significantly lower gestational age (32.8 ± 2.7 vs 34.9 ± 2.3 weeks; p = 0.041) and birth weight (1.8 ± 0.4 vs 2.2 ± 0.5 kg; p = 0.033) among non-survivors reinforce the well-established association between prematurity severity and neonatal death[10,11]. Organ immaturity predisposes these infants to respiratory failure, infection, and multi-organ dysfunction, explaining the higher vulnerability observed.

Non-survivors had markedly higher cardiovascular (3.4 ± 1.1 vs 1.2 ± 0.8), respiratory (3.7 ± 0.9 vs 2.1 ± 1.0), hematologic (2.5 ± 0.6 vs 1.6 ± 0.7), and total nSOFA scores (8.1 ± 1.5 vs 4.9 ± 2.2; all p ≤ 0.002). These findings align closely with studies validating nSOFA as a prognostic tool in neonatal sepsis and critical illness[8-9]. Wynn et al. demonstrated that rising nSOFA scores correlate with mortality risk in very low birth weight infants with infection[5], while subsequent multicenter evaluations confirmed that cardiovascular and respiratory components contribute most strongly to death prediction[6, 8]. The study results extend this evidence specifically to a preterm NICU population, where organ immaturity may amplify the impact of early organ failure.

The adjusted odds ratio for mortality per unit rise in final nSOFA score was 1.85 (95% CI 1.32–2.58; p < 0.001), making it the most robust independent predictor. This magnitude of association is comparable to previously reported odds ranging from 1.6–2.0 per score increment in neonatal cohorts[5, 7, 9].

Sepsis occurred in 75.0% of non-survivors compared with 30.8% of survivors (p = 0.025) and independently increased mortality risk (aOR 3.10). This supports established evidence that sepsis precipitates systemic inflammatory response and organ dysfunction, which nSOFA captures effectively[3, 5]. Studies in neonatal sepsis populations have consistently shown that organ failure scores outperform isolated laboratory markers in mortality prediction[6, 7].

Respiratory distress syndrome (RDS) was present in 75.0% of non-survivors versus 19.2% of survivors (p = 0.004). Although not statistically significant in multivariate

analysis (aOR 2.20; p = 0.103), RDS remains clinically critical. Similar findings have been reported in preterm cohorts where RDS is a primary driver of early mortality, particularly in resource-limited settings[4, 10]. The strong contribution of the respiratory component to the nSOFA score in our study underscores the importance of early ventilatory support.

Bronchopulmonary dysplasia (BPD) showed one of the strongest associations with death (50.0% vs 3.8%; p = 0.008; aOR 4.50). BPD reflects chronic lung injury and prolonged oxygen exposure, both linked to increased mortality and pulmonary hypertension in preterm infants[12].

Intraventricular hemorrhage (IVH) occurred in 37.5% of non-survivors versus 7.7% of survivors (p = 0.031; aOR 4.20). IVH is recognized as a major determinant of adverse outcomes, including death and neurodevelopmental disability[13]. The association observed here aligns with pathophysiological evidence that cerebral hemorrhage reflects hemodynamic instability and systemic illness severity.

PDA (37.5% vs 9.6%; p = 0.045) and NEC (25.0% vs 3.8%; p = 0.049) were more frequent in non-survivors but did not remain independent predictors. Their contribution may be mediated through systemic inflammatory and circulatory compromise, which is already captured within the nSOFA cardiovascular and hematologic components[6].

Integrating nSOFA scoring within 72 hours of birth offers an objective, bedside tool for early risk stratification. Identifying infants with scores ≥8 may prompt intensified monitoring, infection control, and organ support. This approach is particularly valuable in resource-limited NICUs, where early detection of deterioration may improve outcomes[7, 8].

CONCLUSION

The nSOFA score is a reliable and independent predictor of mortality in preterm infants. Non-survivors had significantly higher organ dysfunction scores (mean total nSOFA 8.1 vs 4.9), and each unit increase in score raised mortality odds by 85%. Sepsis, bronchopulmonary dysplasia, and intraventricular hemorrhage further amplified risk. Incorporating nSOFA assessment into routine NICU care may enhance early identification of high-risk infants and guide timely intervention. Larger multicenter studies using serial nSOFA measurements are recommended to validate its prognostic value across diverse neonatal settings.

Limitations:

This study was conducted at a single tertiary-care center with a relatively small sample size (n= 60), which may limit the generalizability of the findings to other NICU settings. This cross-sectional study design assessed nSOFA scores only within the first 72 hours of life; serial measurements over time might better reflect dynamic organ dysfunction and could improve predictive accuracy. Some potential confounders, such as maternal risk factors, timing of interventions, and detailed infection profiles, were not included in the regression model. The small number of deaths (n=8) may have reduced statistical power in multivariate analysis, possibly underestimating associations with conditions such as RDS, PDA, and NEC.

Acknowledgment

We extend our sincere thanks to the NICU medical team, nursing staff, and administrative personnel for their support.

Funding

No external funding was received for this study.

Conflict of Interest

The authors declare no conflicts of interest.

Contribution of authors

Shahana Akter and M. A. Mannan contributed to conception and data collection. Shahana Akter, Fatema Begum, Mohammad Golam Sadik and Ayesha Siddika contributed to data analysis, interpretation, and drafting the article. Rumpa Mani Chowdhury and M. A. Mannan contributed to critical revision and case management.

REFERENCES

1. Purisch SE, Gyamfi-Bannerman C. Epidemiology of preterm birth. Semin Perinatol. 2017;41(7):387–391. doi:10.1053/j.semperi.2017.07.009
2. Vogel JP, Chawanpaiboon S, Moller AB, Watananirun K, Bonet M, Lumbiganon P. The global epidemiology of preterm birth. Best Pract Res Clin Obstet Gynaecol. 2018;52:3–12. doi:10.1016/j.bpobgyn. 2018.04.003
3. Wynn JL. Defining neonatal sepsis. Curr Opin Pediatr. 2016;28(2):135–140. doi:10.1097/MOP. 0000 000000000315
4. Basnet S, Aryal S, Shrestha L. Incidence, outcome and predictors of mortality in respiratory distress syndrome: a prospective cohort study in Nepal. J Nepal Paediatr Soc. 2022;42(2):40–45.

5. Wynn JL, Polin RA. A neonatal sequential organ failure assessment score predicts mortality due to late-onset sepsis in preterm very low birth weight infants. Pediatr Res. 2020;88(1):85–90. doi:10.1038/s41390-019-0517-2

6. Nicolas L, Wynn JL, de la Cruz D. Utility of the neonatal and pediatric sequential organ failure assessment scores in critically ill term neonates. Front Pediatr. 2025;13:1546408. doi:10.3389/fped.2025.1546408

7. Mohamed MH, Mohamed FT, Shinkar DM. Neonatal sequential organ failure assessment score (nSOFA) as a mortality predictor in late-onset neonatal sepsis. Int J Pediatr Adolesc Med. 2024; 11(4):95–100. doi:10.4103/ijpam. ijpam_ 104_24

8. Al Gharaibeh FN, Liu S, Wynn JL, Aziz KB. The utility of neonatal sequential organ failure assessment in mortality risk in all neonates with suspected late-onset infection. J Perinatol. 2025. doi:10.1038/s41372-025-02304-2

9. Fliss N, et al. Evaluation of the neonatal sequential organ failure assessment and mortality risk in preterm infants with late-onset infection. JAMA Netw Open. 2021;4(2):e2036518. doi:10.1001/jamanetworkopen.2020.36518

10. Fanaroff AA, Stoll BJ, Wright LL, Carlo WA, Ehrenkranz RA, Stark AR, et al. Trends in neonatal morbidity and mortality for very low birthweight infants. Am J Obstet Gynecol. 2007;196(2): 147.e1–147.e8. doi:10.1016/j.ajog. 2006.09.014

11. Gupta A, BS S, Madhava KK. Neonatal outcomes as per gestational age in late preterm births: a retrospective study. Int J Contemp Pediatr. 2016 ;4(1):5–8. doi:10.18203/2349-3291.ijcp20164031

12. MacKenzie K, Cunningham K, Thomas S, Mondal T, El Helou S, Shah PS, Mukerji A. Incidence, risk factors, and outcomes of pulmonary hypertension in preterm infants with bronchopulmonary dysplasia. Paediatr Child Health. 2020;25(4):222–227. doi:10.1093/pch/pxz024

13. Ballabh P. Intraventricular hemorrhage in premature infants: mechanism of disease. Pediatr Res. 2010;67(1):1–8. doi:10.1203/PDR.0b013e3181c1b176