The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 7, 2025

PREDICTIVE ACCURACY OF CRIB-II AND SNAPPE-II SCORES FOR MORTALITY RISK IN PRETERM NEONATES

Dr. Muhammad Usman Ali[*1], Dr. Mahnoor Fatima[*2], Dr. Muhammad Asim[*3], Dr. Muhammad Ahsan[*4]

[*1] *MBBS, PGR Pediatrics, Benazir Bhutto Hospital, Rawalpindi.*
[*2] *MBBS, PGR Psychiatry, Benazir Bhutto Hospital Rawalpindi, Rawalpindi Medical University*
[*3] *MBBS, FCPS, Benazir Bhutto Hospital Rawalpindi, Rawalpindi Medical University*
[*4] *MBBS, PGPN, PGD General Hospital, Faisalabad*

DOI: https://doi.org/10.5281/zenodo.18205262

Keywords
Predictive Value of Tests, ROC Curve, Infant, Newborn, Gestational Age

Article History
Received on 18 July 2025
Accepted on 20 July 2025
Published on 21 July 2025

Corresponding Author: *
Dr. Muhammad Usman Ali

Abstract

Objective: *To evaluate and compare the diagnostic performance of the CRIB-II and SNAPPE-II scoring systems in predicting mortality among preterm neonates.*

Study Design: *Cross sectional Validation study.*

Study Setting: *Department of Pediatrics, Benazir Bhutto Hospital, Rawalpindi.*

Study Duration: *Six Months (February to 14 July, 2025).*

Methodology: *This study included preterm neonates with a gestational age of less than 32 weeks and a birth weight below 1500 grams, selected through non-probability consecutive sampling. Both CRIB-II and SNAPPE-II scores were calculated within 12 hours of admission. Mortality risk was classified using cutoff values of ≥8.5 for CRIB-II and ≥27.5 for SNAPPE-II. Neonatal outcomes were monitored for 28 days. Diagnostic indicators such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), likelihood ratios, and the area under the receiver operating characteristic curve (AUC) were determined.*

Results: *Of the 122 neonates enrolled, 15 (12.3%) did not survive. The CRIB-II scores correctly identified 11 deaths, with a sensitivity of 73.33%, specificity of 79.44%, PPV of 33.33%, NPV of 95.51%, accuracy of 78.69%, and an AUC of 0.925. SNAPPE-II identified 12 deaths, demonstrating a sensitivity of 80.00%, specificity of 84.11%, PPV of 41.38%, NPV of 96.77%, accuracy of 83.61%, and an AUC of 0.952.*

Conclusion: *Both scoring systems demonstrated reliable diagnostic value for early mortality prediction in preterm neonates. In this cohort, SNAPPE-II exhibited superior overall performance.*

INTRODUCTION

Preterm birth remains a leading cause of neonatal mortality and long-term neurodevelopmental morbidity worldwide, primarily due to the immaturity of vital organ systems, including the lungs, brain, gastrointestinal tract, and immune system. Despite significant advances in perinatal and neonatal care, preterm infants continue to face a high burden of life-threatening complications such as respiratory distress syndrome, sepsis, intraventricular hemorrhage, and necrotizing enterocolitis. These conditions often necessitate prolonged neonatal intensive care and highly individualized management strategies.[1,2]

Early identification of neonates at increased risk of mortality is essential for guiding timely life-saving interventions, optimizing monitoring intensity, and

ensuring efficient utilization of neonatal intensive care unit (NICU) resources. To support this, several risk prediction models have been developed, most notably the Clinical Risk Index for Babies II (CRIB-II) and the Score for Neonatal Acute Physiology with Perinatal Extension II (SNAPPE-II), both of which stratify neonates based on objective clinical and laboratory parameters obtained during the first hours of life. CRIB-II is valued for its simplicity and incorporates birth weight, gestational age, admission temperature, base deficit, and sex.[3,4] In contrast, SNAPPE-II provides a more comprehensive physiological assessment, including mean arterial pressure, serum pH, body temperature, oxygenation status, five-minute Apgar score, urine output, seizure activity, and growth status.[5,6]

Previous comparative studies have reported inconsistent findings regarding the superiority of these tools. Hao et al. demonstrated a higher predictive accuracy for SNAPPE-II (AUC 0.82) compared with CRIB-II (AUC 0.79), while Dalili et al. reported greater sensitivity for SNAPPE-II.[7,8] Conversely, Vardhelli et al. and Nyamathi et al. highlighted the practicality of CRIB-II, noting comparable predictive performance, particularly in resource-limited clinical settings.[9,10]

Given the variability in neonatal populations, healthcare infrastructure, and clinical practices, external validation of these scoring systems in specific settings remains essential. Therefore, this study aimed to evaluate and compare the diagnostic performance of CRIB-II and SNAPPE-II in predicting 28-day mortality among preterm neonates admitted to a tertiary care NICU, with the goal of generating local evidence to support data-driven and context-appropriate clinical decision-making.

METHODOLOGY:

This cross-sectional validation study was conducted at the Department of Pediatrics, Benazir Bhutto Hospital, Rawalpind. The study utilized non-probability consecutive sampling to recruit a total of 122 preterm neonates. This sample size was determined based on an anticipated mortality prevalence of 41.7%, a 95% confidence interval, 10% precision, and the expected sensitivity and specificity of the SNAPPE-II tool. Informed consent was obtained for all participants before enrollment.

The inclusion criteria targeted neonates with a gestational age of less than 32 weeks and a birth weight below 1,500 grams, regardless of gender. Conversely, the study excluded neonates with congenital anomalies, those lacking a documented Apgar score at birth, and those whose guardians chose to discharge them against medical advice within the first 24 hours of admission. Comprehensive demographic and clinical data were collected for each infant, including gender, type of pregnancy, and mode of delivery. Birth weights were obtained using calibrated digital scales, while admission temperatures were recorded rectally using digital thermometers.

Both the CRIB-II and SNAPPE-II scores were calculated within the first 12 hours of admission. The CRIB-II score was derived from five variables: gestational age, birth weight, gender, admission temperature, and base deficit, using a threshold of ≥8.5 to classify mortality risk. The SNAPPE-II score incorporated nine physiological parameters—including mean arterial pressure, serum pH, and urine output—with a cutoff of ≥27.5 utilized to indicate increased risk. Neonatal outcomes were then monitored for a total of 28 days.

Statistical analysis was performed using SPSS version 26.0, where all data were documented via a standardized proforma. The predictive accuracy of both scoring systems was assessed using 2×2 contingency tables and Receiver Operating Characteristic (ROC) curves. These methods allowed for the determination of key diagnostic indicators, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), likelihood ratios, and the area under the curve (AUC)

RESULTS:

Among the 122 preterm neonates included, the mean gestational age was 27.71 ± 2.01 weeks, and the mean birth weight was 1116.58 ± 214.31 g. Sixty neonates (49.2%) were male and 62 (50.8%) were female. Cesarean section was the mode of delivery in 68 cases (55.7%), while 54 neonates (44.3%) were delivered vaginally. Fifteen infants (12.3%) died within the 28-day observation period, whereas 107

(87.7%) survived. The mean CRIB-II score was 6.03 ± 2.41, and the mean SNAPPE-II score was 21.47 ± 7.11. Using predefined cut-off values, CRIB-II (≥8.5) classified 33 neonates (27.0%) as high-risk, while SNAPPE-II (≥27.5) identified 29 neonates (23.8%) as high-risk. Receiver operating characteristic analysis demonstrated excellent discriminative ability for both models, with an AUC of 0.925 for CRIB-II and 0.952 for SNAPPE-II.

Using a CRIB-II cut-off of ≥8.5, 11 of 15 deaths were correctly identified (true positives), and 85 of 107 survivors were correctly classified (true negatives). Twenty-two neonates were falsely labeled high-risk (false positives), and four deaths were missed (false negatives). This corresponded to a sensitivity of 73.33% (95% CI: 44.90%–92.21%) and a specificity of 79.44% (95% CI: 70.54%–86.64%). The positive predictive value was 33.33% (95% CI: 23.60%–44.73%), and the negative predictive value was 95.51% (95% CI: 90.13%–98.02%). The positive likelihood ratio was 3.57 (95% CI: 2.20–5.77), the negative likelihood ratio was 0.34 (95% CI: 0.14–0.78), and the overall diagnostic accuracy was 78.69% (95% CI: 70.35%–85.58%).

For SNAPPE-II at a cut-off of ≥27.5, 12 of 15 deaths were correctly predicted, while 90 of 107 survivors were accurately classified. Seventeen survivors were misclassified as high-risk, and three deaths were not identified. SNAPPE-II demonstrated a sensitivity of 80.00% (95% CI: 51.91%–95.67%) and a specificity of 84.11% (95% CI: 75.79%–90.46%). The positive predictive value was 41.38% (95% CI: 29.89%–53.89%), and the negative predictive value was 96.77% (95% CI: 91.57%–98.81%). The positive likelihood ratio was 5.04 (95% CI: 3.04–8.34), and the negative likelihood ratio was 0.24 (95% CI: 0.09–0.66). The overall diagnostic accuracy of SNAPPE-II was 83.61% (95% CI: 75.82%–89.69%).

TABLE 1: BASELINE DEMOGRAPHIC AND CLINICAL CHARACTERISTICS (N=122)

Characteristic	Value (Mean ± SD) or n (%)
Gestational Age (weeks)	27.71 ± 2.014
Birth Weight (grams)	1116.58 ± 214.310
Gender	
- Male	60 (49.2%)
- Female	62 (50.8%)
Mode of Delivery	
- Cesarean Section	68 (55.7%)
- Vaginal Delivery	54 (44.3%)
28-Day Neonatal Outcome	
- Survived	107 (87.7%)
- Expired	15 (12.3%)

TABLE 2: COMPARATIVE DIAGNOSTIC PERFORMANCE FOR MORTALITY PREDICTION

Performance Metric	CRIB-II (Cutoff ≥8.5)	SNAPPE-II (Cutoff ≥27.5)
Sensitivity (95% CI)	73.33% (44.90%–92.21%)	80.00% (51.91%–95.67%)
Specificity (95% CI)	79.44% (70.54%–86.64%)	84.11% (75.79%–90.46%)
PPV (95% CI)	33.33% (23.60%–44.73%)	41.38% (29.89%–53.89%)
NPV (95% CI)	95.51% (90.13%–98.02%)	96.77% (91.57%–98.81%)
Diagnostic Accuracy	78.69%	83.61%
AUC (ROC)	0.925	0.952
Positive Likelihood Ratio	3.57	5.04
Negative Likelihood Ratio	0.34	0.24

TABLE 3: CLASSIFICATION OF STUDY COHORT BASED ON SCORING THRESHOLDS

Parameter	CRIB-II (n)	SNAPPE-II (n)
True Positives (Correctly Predicted Deaths)	11	12
True Negatives (Correctly Predicted Survivors)	85	90
False Positives (Survivors Misclassified)	22	17
False Negatives (Deaths Missed)	4	3

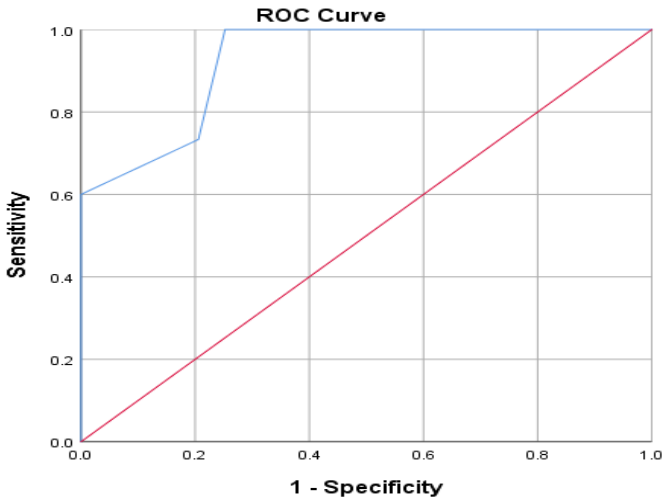

FIGURE I: ROC CURVE FOR CRIB-II SCORING SYSTEM (N=122)

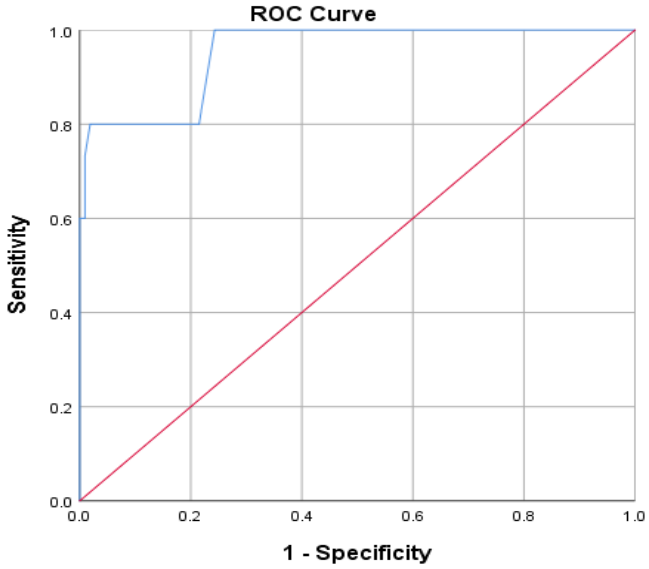

FIGURE II: ROC CURVE FOR SNAPPE-II SCORING SYSTEM (N=122)

DISCUSSION:

Both CRIB-II and SNAPPE-II effectively predicted 28-day mortality in preterm neonates in our cohort; however, SNAPPE-II demonstrated superior overall performance, with higher sensitivity, specificity, diagnostic accuracy, and AUC. These findings support the utility of both models for early risk stratification, while favoring SNAPPE-II for more precise mortality prediction.

Our results are consistent with Hao et al., who reported higher predictive accuracy for SNAPPE-II compared with CRIB-II (AUC 0.82 vs. 0.79), along with greater sensitivity.[7] Similarly, Dalili et al. found both scores reliable but observed higher sensitivity for SNAPPE-II, supporting its stronger discriminatory ability.[8] The high AUC (0.952) and excellent NPV (96.77%) observed in our study further emphasize SNAPPE-II's strength in ruling out mortality risk, which is clinically valuable for triaging and resource allocation in NICUs.

In contrast, some studies have favored CRIB-II due to its simplicity and practicality. Nyamathi et al. and Vardhelli et al. reported comparable or slightly better performance of CRIB-II, particularly in high-mortality or multicenter settings.[9,10] The superiority of SNAPPE-II in our study may be explained by our standardized single-center design, lower disease severity, and the inclusion of broader physiological variables, which likely enhanced discrimination in a relatively stable preterm population.

Our CRIB-II performance is comparable to Akhila et al. and Sotodate et al., who also reported high AUC values, confirming its continued relevance as a simplified risk tool.[11,12] Differences in sensitivity, specificity, and PPV across studies, including those by Qasim et al. and Rehman et al., likely reflect variations in mortality prevalence, gestational age distribution, illness severity, and score cut-off values.[13,17] The lower PPV observed in our cohort is plausibly attributable to the relatively low mortality rate, a well-recognized effect in diagnostic modeling.

Studies focusing on disease-specific populations, such as necrotizing enterocolitis or persistent pulmonary hypertension, have shown variable performance of SNAPPE-II, highlighting that score accuracy may shift depending on clinical context and outcome definitions.[14,18] Our findings reinforce SNAPPE-II's strength as a general early mortality predictor rather than a condition-specific prognostic tool.

CONCLUSION:

SNAPPE-II demonstrated superior predictive accuracy compared to CRIB-II for identifying mortality risk in preterm neonates. This enhanced performance is likely due to its comprehensive assessment of hemodynamic, respiratory, metabolic, and neurological parameters.

LIMITATIONS:

Both CRIB-II and SNAPPE-II scores were derived from clinical and laboratory data obtained within the first 12 hours of admission, which may not account for subsequent changes in the neonates' clinical status. The use of fixed cutoff values for each scoring system may not reflect variations in population characteristics or differences in clinical practices across diverse healthcare settings, potentially limiting the generalizability of the results.

REFERENCE:

1. Lalani S, Premji SS, Shaikh K, Sulaiman S, Yim IS, Forcheh N, et al. Individual and collective contribution of antenatal psychosocial distress conditions and preterm birth in pakistani women. PLoS One. 2023;18(3):e0282582.10.1371/journal.pone.0282582
2. Ohuma EO, Moller AB, Bradley E, Chakwera S, Hussain-Alkhateeb L, Lewin A, et al. National, regional, and global estimates of preterm birth in 2020, with trends from 2010: A systematic analysis. Lancet. 2023;402(10409):1261-71.10.1016/S0140-6736(23)00878-4
3. Machado JS, Ferreira TS, Lima RCG, Vieira VC, Medeiros DS. Premature birth: Topics in physiology and pharmacological characteristics. Rev Assoc Med Bras (1992). 2021;67(1):150-5.10.1590/1806-9282.67.01.20200501
4. Veloso FCS, Barros CRA, Kassar SB, Gurgel RQ. Neonatal death prediction scores: A systematic review and meta-analysis. BMJ

Paediatr Open. 2024;8(1):e003067.10.1136/bmjpo-2024-003067
5. Ali A, Ariff S, Rajani R, Khowaja WH, Leghari AL, Wali S, et al. Snappe ii score as a predictor of neonatal mortality in nicu at a tertiary care hospital in pakistan. Cureus. 2021;13(12):e20427.10.7759/cureus.20427
6. Bhandekar H, Bansode Bangartale S, Arora I. Evaluating the clinical risk index for babies (crib) ii score for mortality prediction in preterm newborns: A prospective observational study at a tertiary care hospital. Cureus. 2024;16(4):e58672.10.7759/cureus.58672
7. Hao Q, Chen J, Chen H, Zhang J, Du Y, Cheng X. Comparing nsofa, crib-ii, and snappe-ii for predicting mortality and short-term morbidities in preterm infants </=32 weeks gestation. Ann Med. 2024;56(1):2426752.10.1080/07853890.2024.2426752
8. Dalili H, Farrokhzad N, Kavyani Z, Sahebi L, Habibelahi A, Ashrafzade M, et al. Determination of predictive power of crib-ii and snappe-ii in mortality risk of neonates with low gestational age or birth weight admitted to the neonatal intensive care unit. Iran J Neonatol. 2020;11(4):74-80.10.22038/ijn.2020.42513.1704
9. Vardhelli V, Murki S, Tandur B, Saha B, Oleti TP, Deshabhotla S, et al. Comparison of crib-ii with snappe-ii for predicting survival and morbidities before hospital discharge in neonates with gestation </= 32 weeks: A prospective multicentric observational study. Eur J Pediatr. 2022;181(7):2831-8.10.1007/s00431-022-04463-2
10. Nyamthi SO, Dhavaleshwar A, Soans S. Comparison between snappe-ii and crib-ii scoring methods in predicting neonatal mortality in the nicu. Perinatology. 2024;25(2):102-8.10.1080/07853890.2024.2426752
11. Akhila G, Choudhury J, Krishnegowda VK, Nanda D. Comparison of clinical risk index for babies (crib) ii score and extended sick neonatal score (esns) as a predictor of in-hospital mortality in premature neonates with gestational age </= 32 weeks. Indian Pediatr. 2025:1-5.10.1007/s13312-025-00107-4
12. Sotodate G, Oyama K, Matsumoto A, Konishi Y, Toya Y, Takashimizu N. Predictive ability of neonatal illness severity scores for early death in extremely premature infants. J Matern Fetal Neonatal Med. 2022;35(5):846-51.10.1080/14767058.2020.1731794
13. Qasim S, Zahid S, Islam A, Anwar M, Siddique S, Rafique A. Clinical risk index score (crib ii) as a predictor of neonatal mortality among premature babies. Pakistan Journal of Medical & Health Sciences. 2022;16(08):70-.10.53350/pjmhs2216870
14. Fijas M, Vega M, Xie X, Kim M, Havranek T. Snappe-ii and mdas scores as predictors for surgical intervention in very low birth weight neonates with necrotizing enterocolitis. J Matern Fetal Neonatal Med. 2023;36(1):2148096.10.1080/14767058.2022.2148096
15. Alshafei A, Zawam E, Galal M, Khan A, El Saba Y, Hassan M. Validity of the mean platelet volume and revised clinical risk index for babies (crib-ii) score to assess mortality risk in preterm infants. New Emirates Medical Journal. 2024;5(1):e040923220679.10.2174/0250688205666230904104508
16. Kumar D, Kumar D, Irfan U, Yadav YS, Yadav RK, Kanti V, et al. Predictive values and correlation of crib score ii and perfusion index in assessment of severity of illness in sick preterm neonates: An observational study. J Neonatal Perinatal Med. 2024;17(5):723-30.10.3233/NPM-240084
17. Rehman A, Hamid MH. Accuracy of crib ii score in predicting the neonatal mortality in very preterm babies. Pakistan Journal of Medical & Health Sciences. 2022;16(03):564-.10.53350/pjmhs22163564
18. Pakhathirathien P, Maneenil G, Thatrimontrichai A, Dissaneevate S, Praditaukrit M. Mortality prediction in

newborns with persistent pulmonary hypertension: A comparison of four illness severity scores. Pediatr Pulmonol. 2025;60(1):e27484.10.1002/ppul.27484
19. Madabhushi S, Naik SA, Shah MH. Clinical risk index of babies-ii versus score for neonatal acute physiology-ii in predicting mortality and morbidity in preterm babies. Int J Contemp Pediatr. 2022;9:247-52.10.18203/2349-3291.ijcp20220378
20. Bayen A, Sk MH, Chaudhuri S, Saha B. Comparison of crib-ii with snappe-ii as a predictor of mortality and neurodevelopmental outcome at 12 months of age for newborns≤ 32 weeks of gestational age. Journal of Neonatology. 2025;39(2):104-12.10.1177/09732179241258250
21. Zeng Z, Shi Z, Li X. Comparing different scoring systems for predicting mortality risk in preterm infants: A systematic review and network meta-analysis. Front Pediatr. 2023;11:1287774.10.3389/fped.2023.1287774