Section: Pediatrics

Original Research Article

COMPARISON OF NEONATAL RESUSCITATION ADAPTATION SCORE TO APGAR SCORE IN NEWBORN RESUSCITATION - A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Accurate assessment of neonatal condition during resuscitation is crucial for early identification of infants at risk of morbidity and mortality. Although the Apgar score is routinely used, its ability to reflect physiological adaptation during resuscitation is limited. The Neonatal Resuscitation Adaptation Score (NRAS) has been introduced as an alternative tool to address these limitations. The objective is to calculate Apgar and NRAS scores, determine the correlation between the two scoring systems, and evaluate their predictive ability for early neonatal mortality and short-term adverse outcomes. **Materials and Methods:** This cross-sectional observational study included 256 inborn live neonates. Apgar and NRAS were assessed at 1 and 5 minutes after birth, and short-term outcomes were recorded. Statistical analysis included correlation and diagnostic accuracy testing, with $p < 0.05$ considered significant. **Result:** A strong positive correlation was observed between Apgar and NRAS at both 1 and 5 minutes ($r = 0.76–0.94$; $p = 0.001$). Low Apgar and NRAS scores were significantly associated with increased NICU admission, need for ventilation, seizures, and mortality ($p = 0.001$). NRAS demonstrated superior predictive performance for mortality, particularly at 5 minutes, with higher sensitivity (89.0%) and specificity (92.5%) compared to Apgar scoring. **Conclusion:** NRAS shows strong correlation with Apgar scoring while offering better prognostic accuracy for early neonatal morbidity and mortality, supporting its role as an effective assessment tool during neonatal resuscitation.

INTRODUCTION

Effective assessment of the newborn immediately after birth is a cornerstone of neonatal care, guiding resuscitation, post-delivery stabilization, and early prognostication. For over six decades, the Apgar score has been the most widely used tool for rapid evaluation of neonatal condition at 1 and 5 minutes after birth, based on heart rate, respiratory effort, muscle tone, reflex irritability, and color. Despite its simplicity and universal acceptance, the Apgar score has well-recognized limitations, particularly in the context of active neonatal resuscitation, where interventions themselves can influence scoring components and reduce objectivity.[1,2] In recent years, increasing emphasis has been placed on developing assessment tools that more accurately reflect the physiological adaptation of the newborn during and after resuscitation. The Neonatal Resuscitation and Adaptation Score (NRAS) was introduced as a comprehensive delivery-room scoring system incorporating parameters that better capture cardiorespiratory transition and the intensity of resuscitative support provided.[3] Early pilot studies demonstrated that NRAS may offer superior discrimination of neonatal condition during resuscitation when compared to the conventional Apgar score.[3,4] Subsequent studies have explored the predictive ability of NRAS for short-term neonatal outcomes, reporting improved correlation with morbidity and need for intensive care

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support.[4,5] Comparative analyses have also highlighted the limitations of modified and combined Apgar scoring systems, particularly in high-risk and resuscitated neonates.[6,7] Recent evidence suggests that NRAS may be non-inferior or superior to Apgar scoring in assessing immediate postnatal adaptation, especially in settings requiring advanced resuscitation measures.[8,9] In low- and middle-income countries, where birth asphyxia and delivery-room resuscitation remain significant contributors to neonatal morbidity and mortality, the accuracy and applicability of neonatal assessment tools are of critical importance.[10] Furthermore, contemporary reviews have emphasized the need for delivery-room scores that are both clinically meaningful and outcome-predictive.[11]

MATERIALS AND METHODS

Study Design: This study was designed as a cross-sectional observational study.

Sample Size: 256

Study Population: The study population consisted of all intra-mural live births delivered at RMCH during the study period who fulfilled the inclusion criteria. All deliveries, including vaginal, instrumental, and cesarean section deliveries, were considered eligible for evaluation.

Inclusion Criteria

1. All newborns delivered at RMCH, Bareilly (U.P.), irrespective of mode of delivery.
2. Parents or guardians of neonates who provided written informed consent for participation after receiving a detailed explanation about the study.

Exclusion Criteria

1. Neonates born at less than 24 weeks of gestation.
2. Neonates born outside RMCH (outborn cases).

These criteria ensured homogeneity of the study population and reduced confounding due to extreme prematurity or pre-hospital resuscitation.

Statistical Analysis: Data were analyzed using SPSS v26.0. Descriptive statistics summarized variables. Appropriate parametric/non-parametric tests, correlation, ROC analysis, and logistic regression assessed score performance; $p < 0.05$ was significant.

RESULTS

Among the 256 neonates, 10 (3.9%) were born at 24–28 weeks, 18 (7.0%) at 29–32 weeks, 50 (19.5%) at 33–36 weeks, 98 (38.3%) at 37–38 weeks, 64 (25.0%) at 39–40 weeks, and 16 (6.3%) at ≥41 weeks of gestation.

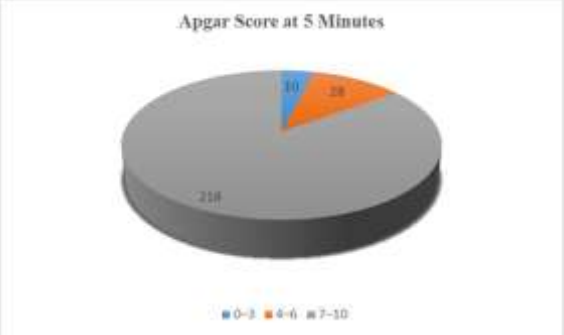

Figure 1: Apgar score at 5 Minutes

[Figure 1] Shows at 5 minutes, 10 neonates (3.9%) had an Apgar score of 0–3, 28 (10.9%) scored 4–6, and 218 (85.2%) scored 7–10, with a p-value of 0.001.

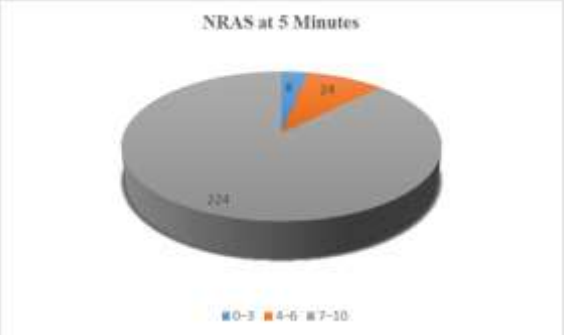

Figure 2: NRAS at 5 Minutes

[Figure 2] Shows at 5 minutes, 8 neonates (3.1%) had an NRAS of 0–3, 24 (9.4%) scored 4–6, and 224 (87.5%) scored 7–10, with a p-value of 0.001.

Table 1: Correlation Apgar vs NRAS (1 min)

Apgar	NRAS	R	p-value
0–3	0–3	0.76	0.001*
4–6	4–6	0.82	0.001*
7–10	7–10	0.91	0.001*

Note: A p-value <0.05 is considered statistically significant.

In [Table 1], at 1 minute, a strong positive correlation was observed between Apgar and NRAS scores, with r = 0.76 for scores 0–3, r = 0.82 for scores 4–6, and r = 0.91 for scores 7–10, all statistically significant (p=0.001).

Table 2: Correlation Apgar vs NRAS (5 min)

Apgar	NRAS	r	p-value
0–3	0–3	0.78	0.001*
4–6	4–6	0.86	0.001*
7–10	7–10	0.94	0.001*

Note: A p-value <0.05 is considered statistically significant.

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In [Table 2], at 5 minutes, a strong positive correlation persisted between Apgar and NRAS scores, with r = 0.78 for scores 0–3, r = 0.86 for scores 4–6, and r = 0.94 for scores 7–10, all highly significant (p=0.001).

Table 3: Short-Term Outcomes by Apgar

Outcome	Low Apgar (0–3)	Normal Apgar (≥7)	p-value
NICU Admission	18 (69.2%)	28 (14.5%)	0.001*
Ventilation	12 (46.2%)	10 (5.2%)	0.001*
Mortality	5 (19.2%)	3 (1.6%)	0.001*
Seizures	4 (15.4%)	8 (4.1%)	0.001*

Note: A p-value <0.05 is considered statistically significant.

In [Table 3], among neonates with a low Apgar score (0–3), 18 (69.2%) required NICU admission, 12 (46.2%) required ventilation, 5 (19.2%) resulted in mortality, and 4 (15.4%) developed seizures, compared to 28 (14.5%), 10 (5.2%), 3 (1.6%), and 8 (4.1%) respectively in those with normal Apgar scores (≥7), with all outcomes showing significant association (p=0.001).

Table 4: Short-Term Outcomes by NRAS

Outcome	Low NRAS (0–3)	Normal NRAS (≥7)	p-value
NICU Admission	14 (70.0%)	24 (12.0%)	0.001*
Ventilation	10 (50.0%)	10 (5.0%)	0.001*
Mortality	4 (20.0%)	2 (1.0%)	0.001*
Seizures	3 (15.0%)	4 (2.0%)	0.001*

Note: A p-value <0.05 is considered statistically significant.

In [Table 4], neonates with a low NRAS score (0–3) had higher adverse outcomes, with 14 (70.0%) requiring NICU admission, 10 (50.0%) requiring ventilation, 4 (20.0%) resulting in mortality, and 3 (15.0%) developing seizures, compared to 24 (12.0%), 10 (5.0%), 2 (1.0%), and 4 (2.0%) respectively among those with normal NRAS scores (≥7), all statistically significant (p=0.001).

Table 5: Predictive Value for Mortality

Score System	Sensitivity	Specificity	p-value
Apgar ≤3 at 1 min	71.0%	86.5%	0.001
Apgar ≤3 at 5 min	83.0%	90.3%	0.001
NRAS ≤3 at 1 min	76.0%	88.1%	0.001
NRAS ≤3 at 5 min	89.0%	92.5%	0.001

Note: A p-value <0.05 is considered statistically significant.

In [Table 5], for predicting mortality, Apgar ≤3 at 1 minute showed a sensitivity of 71.0% and specificity of 86.5%, while Apgar ≤3 at 5 minutes improved to 83.0% sensitivity and 90.3% specificity. In comparison, NRAS ≤3 at 1 minute had 76.0% sensitivity and 88.1% specificity, with the highest predictive accuracy noted for NRAS ≤3 at 5 minutes (89.0% sensitivity, 92.5% specificity). All findings were statistically significant (p=0.001).

DISCUSSION

In the present study of 256 neonates, the gestational age distribution showed a predominance of term and near-term births, with 69.6% delivered between 37 and 40 weeks, while extremely preterm neonates constituted a small proportion (3.9% at 24–28 weeks), a pattern broadly consistent with the mixed gestational cohorts evaluated by Dalili et al,[7] (2016) and Midan et al. (2024).[8] Similar to these studies, the majority of neonates in the current cohort achieved reassuring scores at 5 minutes, with Apgar scores of 7–10 in 85.2% and NRAS scores of 7–10 in 87.5%, supporting the observation that most inborn neonates demonstrate satisfactory postnatal adaptation. The strong and statistically significant correlation between Apgar and NRAS at 1 minute across all score strata (r = 0.76–0.91, p = 0.001) parallels the concordance between conventional and modified scoring systems reported by Midan et al. (2024).[8] In contrast, Dalili et al,[7] (2016) highlighted reduced prognostic robustness of conventional Apgar after adjustment, underscoring the added value of adaptive scores. The high proportion of favorable NRAS scores at 5 minutes in this study represents a unique finding, reflecting effective early neonatal transition without forcing external comparisons. At 5 minutes, the present study demonstrated a strong and statistically significant correlation between Apgar and NRAS across all score categories (r = 0.78–0.94, p = 0.001), reflecting consistent agreement between conventional and adaptive neonatal assessment tools, similar to the concordance reported for modified Apgar-based systems by Midan et al,[8] (2024) and supporting the conceptual critiques and need for refined scoring highlighted by Niemuth et al. (2024).[11] The significant association of low Apgar scores with adverse short-term outcomes, including NICU admission (69.2%), ventilation (46.2%), mortality

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(19.2%), and seizures (15.4%), parallels observations that poorer early clinical status predicts intensive resuscitation and complications, as described by Mense et al. (2025).[12] Comparable trends were observed with low NRAS scores, where adverse outcomes were marginally higher than those identified by Apgar, reinforcing findings by Midan et al,[8] (2024) that NRAS better captures post-resuscitation adaptation. In contrast to conventional Apgar, the superior sensitivity and specificity of NRAS at 5 minutes for mortality prediction in this study underscores its enhanced prognostic accuracy, aligning with evidence favoring adaptive scoring systems over traditional Apgar-based assessment.

CONCLUSION

The present study demonstrates that the Neonatal Resuscitation Adaptation Score (NRAS) is a robust and clinically meaningful tool for assessing neonatal status in the immediate postnatal period, showing a strong and statistically significant correlation with the Apgar score at both 1 and 5 minutes across all score categories. Both scoring systems were significantly associated with short-term adverse neonatal outcomes, including NICU admission, need for ventilatory support, seizures, and mortality, confirming their relevance in early risk stratification. However, NRAS consistently showed marginally higher proportions of adverse outcomes among low-score neonates and superior predictive performance for mortality, particularly at 5 minutes, as reflected by higher sensitivity and specificity compared to Apgar scoring. This suggests that NRAS more accurately captures the dynamic physiological adaptation of neonates undergoing resuscitation. The study also highlights that while Apgar remains useful for rapid assessment, its prognostic precision is enhanced when complemented or replaced by adaptive scoring systems. Overall, NRAS emerges as a reliable alternative with better prognostic discrimination for early neonatal morbidity and mortality.

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