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Original Research Article

A Descriptive Study to Assess the Effects of Loud Noise on the Physiological and Behavioural Responses of Premature Neonates in a NICU

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Abstract:

Background: Premature neonates admitted to the NICU are consistently exposed to environmental noise levels that surpass recommended limits. Excessive noise can disturb physiological stability, alter behavioural responses, and interfere with neurodevelopment.

Objective: To assess the effects of loud noise on physiological and behavioural responses among premature neonates admitted to a quaternary care NICU.

Methods: A descriptive observational study was conducted among 60 stable preterm neonates (29–36+6 weeks) using non-probability convenience sampling. Physiological parameters—heart rate, respiratory rate, and oxygen saturation—and behavioural responses based on autonomic, motor, state, attention/interaction, and self-regulation cues were recorded using validated tools. Noise levels were measured with a decibel meter during morning (08:30–09:30) and night (01:30–02:30) shifts. Data were analysed using descriptive statistics and paired t-tests.

Results: Morning noise levels were significantly higher (54.0 dB) than night levels (43.1 dB) ($p < 0.001$). Higher morning noise was associated with increased heart rate (150.9 vs 141.1 bpm), higher respiratory rate (54.0 vs 50.5/min), and lower SpO_2 (95.9% vs 98.1%) (all $p < 0.001$). Behavioural stress signs increased by a mean of 4.67 points during periods of loud noise ($p < 0.05$).

Conclusion: Loud noise in the NICU exerts a significant adverse impact on both physiological stability and behavioural organization of premature neonates. Implementation of noise-reduction policies and staff sensitization is essential to promote a developmentally supportive NICU environment.

Keywords: NICU noise, Premature neonates, Physiological responses, Behavioural stress, Oxygen saturation, Heart rate.

Introduction

Premature infants who require admission to a neonatal intensive care unit encounter a sensory environment that differs sharply from the quiet, protective setting of the womb. The NICU is filled with essential clinical activity—monitoring devices, alarms, conversations, and movement of staff—all of which contribute to continuous background noise. For infants born before maturity of their auditory and neurological pathways, such exposure may become a source of physiological strain. Although professional bodies recommend that sound levels in neonatal units remain well below levels typically encountered in clinical practice, numerous assessments have shown that noise frequently exceeds recommended limits. In many centres, including Indian NICUs, routine care results in prolonged periods where ambient noise is higher than what fragile infants can comfortably tolerate [1,2].

In early life, preterm neonates have limited capacity to manage environmental stimuli because many of their regulatory mechanisms are still developing. Sudden or persistent sound can interfere with vital processes such as breathing, heart rate control, and oxygenation. Even modest increases in noise may interrupt sleep patterns, provoke instability, or trigger stress responses. Behaviourally, these infants may show signs of discomfort, difficulty settling, or

reduced ability to maintain calm states. Since the immediate postnatal period is critical for brain growth, any disturbance that affects physiological stability or behavioural organization may have consequences beyond the NICU stay [3,4].

Despite long-standing awareness of these risks, noise control remains one of the least consistently implemented aspects of developmental care. Much of the sound in NICUs comes from everyday actions—equipment handling, bedside discussions, or routine patient care—suggesting that many contributors are preventable. Units that have attempted structured noise-management approaches, such as optimizing alarms or modifying staff behaviour, have reported measurable improvements. However, such strategies are not universally practiced, and the cumulative effect of routine noise continues to challenge efforts to provide a developmentally supportive environment to the smallest and most vulnerable patients [5,6].

In the Indian healthcare context, where neonatal units often function under demanding workloads and spatial constraints, understanding how noise influences preterm infants is particularly important. Evidence that directly links sound levels with physiological and behavioural changes can guide realistic and effective interventions. The present study was designed to examine this relationship by comparing premature neonates' responses during periods of differing noise exposure in a quaternary-care NICU. By evaluating how fluctuations in sound relate to heart rate, respiratory rate, oxygen saturation, and behavioural cues, this study aims to support practical, evidence-based strategies that contribute to a quieter, safer, and more developmentally attuned NICU environment [7,8].

Methods

Study Design and Setting: A descriptive, non-experimental observational study was conducted in the neonatal intensive care unit of a quaternary care hospital in New Delhi.

Population and Sampling: The study included 60 premature neonates admitted to the NICU. A non-probability convenience sampling technique was used.

Inclusion Criteria:

- Stable premature neonates with gestational age 29–36+6 weeks.

Exclusion Criteria:

- Critical illness, neurological disorders, neonates on antibiotic therapy, or parental refusal.

Variables

- **Independent variable:** Loud noise exposure (>45 dB).
- **Dependent variables:**
    - Physiological: Heart rate (HR), respiratory rate (RR), and oxygen saturation (SpO_2).
    - Behavioural: Autonomic, motor, state, attention/interaction, and self-regulatory responses based on Synactive Theory.

Tools and Measurements

- Noise levels were measured using a calibrated decibel meter during two time periods:
    - Morning: 08:30–09:30
    - Night: 01:30–02:30
- Physiological data were obtained through standard NICU monitors.
- Behavioural responses were recorded using a structured behavioural assessment tool developed from validated neonatal frameworks.

Procedure: Each neonate underwent two sets of observations—morning and night. Physiological parameters and behaviour were recorded simultaneously with noise levels.

Data Analysis: Data were analysed using descriptive statistics (mean, standard deviation, percentage). Paired t-tests were performed to compare morning and night values. A p-value < 0.05 was considered statistically significant.

Results

A total of 60 premature neonates were included in the study. The majority were male (53.3%), and nearly half (43.3%) had a birth weight between 1.5–2 kg. More than half (51.6%) belonged to the gestational age group of 32–34+6 weeks.

Noise Levels: Noise measurements demonstrated a significant difference between the two observation periods. The mean morning noise level was 54.0 dB, substantially higher than the night level of 43.1 dB. This indicates that routine morning clinical activities contributed to elevated sound exposure.

Physiological Responses: During periods of increased noise exposure (morning), neonates exhibited clear physiological signs of stress. The mean heart rate was higher in the morning (150.9 bpm) compared to night (141.1 bpm). A similar trend was observed in respiratory rate, rising from 50.5/min at night to 54.0/min in the morning. Oxygen saturation decreased from 98.1% at night to 95.9% during higher noise.These differences were statistically significant, suggesting a strong association between loud noise and physiological instability.

Behavioural Responses: Premature neonates demonstrated a marked increase in stress-related behavioural cues when exposed to loud noise. There was a mean increase of 4.67 behavioural stress signs, including irritability, tremors, startle responses,

disrupted sleep states, and reduced self-regulation. This highlights heightened sensitivity of premature infants to environmental disturbances.

Table 1: Physiological and Noise Level Comparison (Morning vs Night)

Parameter	Morning	Night
Noise level (dB)	54.0	43.1
Heart Rate (bpm)	150.9	141.1
Respiratory Rate (breaths/min)	54.0	50.5
SpO_2 (%)	95.9	98.1

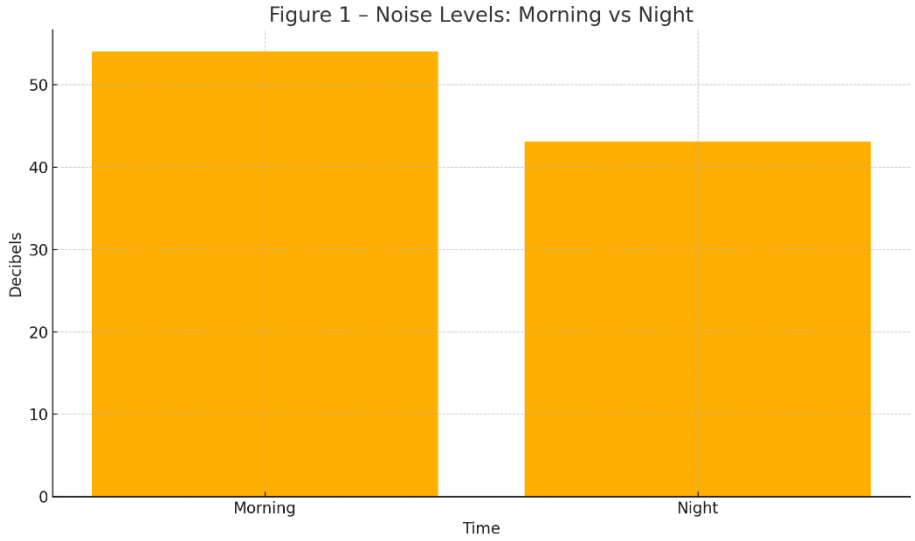

Figure 1: Noise Levels (Morning vs Night)

Discussion

The present study brings to attention how routine NICU activity influences the physiological steadiness of premature neonates. The consistent rise in noise during morning hours was mirrored by measurable shifts in vital parameters, suggesting that infants responded promptly to changes in their surroundings. Such differences between morning and night readings reflect the operational rhythm of the unit rather than isolated events. For preterm infants, even minor fluctuations in their environment can act as stressors, and the trends observed here indicate that their systems react visibly under these circumstances. These findings support the clinical understanding that preterm infants function within narrow physiological margins and show instability when exposed to external strain [9,10].

The rise in heart rate and respiratory rate recorded during noisier periods highlights that environmental sound may trigger heightened autonomic activity. These changes may not seem dramatic individually, but taken together, they point to increased biological effort. For infants who are still developing cardiorespiratory coordination, repeated exposure to such stimuli may contribute to cumulative strain. The lowering of oxygen saturation during noisy intervals adds another layer of concern, as even short declines in SpO_2 can disrupt metabolic balance in infants with immature lungs. Similar patterns have been documented in earlier studies, strengthening the interpretation that noise can interfere with physiological equilibrium in a predictable manner [11,12].

The behavioural findings further reinforce the sensitivity of premature infants to auditory variations. The increase in stress cues, noted through posture, state changes, and autonomic signs, indicates that the infants were not merely physiologically affected but also behaviourally unsettled. Behavioural shifts provide important information about how neonates cope with environmental challenges. A rise in stress-related signals during louder intervals suggests that the infants were struggling to maintain organization. These manifestations serve as early indicators of overload and help clinicians gauge when the infant's adaptive capacity is being exceeded [13].

A notable aspect of these behavioural observations is their potential influence on other areas of care. When an infant exhibits difficulty in maintaining a stable behavioural state, it may affect feeding tolerance, sleep continuity, and the ability to interact during caregiving. Repeated interruptions in behavioural organization can delay progression through developmental milestones that depend on stable periods of rest and regulated activity. Previous

research describing irritability, fragmented sleep, and diminished regulation during noisy conditions aligns closely with the present findings. Such evidence collectively suggests that noise, though often overlooked, plays a significant role in shaping day-to-day neonatal functioning [14,15].

Another dimension emerging from this study relates to the NICU ecosystem itself. The morning–night contrast in recordings points towards modifiable practices within the care environment. A significant portion of NICU noise originates from routine tasks—opening drawers, moving equipment, adjusting monitors, and verbal communication among staff. Recognizing these contributors opens opportunities for structured interventions. Units that have implemented staff education, adjusted alarm settings, or reorganized workflow have shown measurable reductions in noise. These interventions demonstrate that improvements can be made without compromising clinical efficiency [16,17].

Incorporating noise reduction into routine practice also aligns with broader goals of individualized and development-oriented care. Strategies such as pacing clinical interactions, using soft-closing equipment, encouraging mindful communication, and planning quieter intervals during the day can create a more stable therapeutic environment. Parental involvement is equally important; families can be guided to understand how infant cues reflect overstimulation and how their own interactions may help or hinder regulation. These approaches collectively support the infant's physiological and behavioural organization by reducing unnecessary environmental load [18].

While this study did not evaluate longer-term developmental outcomes, the short-term disturbances observed here emphasize the importance of consistent environmental stewardship. Research from other centres suggests that prolonged exposure to high ambient noise may influence hearing, behaviour, and sensory processing as the child grows. These possibilities strengthen the argument for establishing clear noise-control policies and ongoing monitoring in NICUs. The findings from this study underline that reducing environmental noise is not simply an aesthetic improvement but a clinical necessity. By addressing modifiable aspects of the care setting, NICUs can significantly improve the stability and comfort of premature infants, thereby supporting more favourable early developmental patterns.

Conclusion

In this descriptive study, elevated noise levels within the NICU were associated with measurable disturbances in both physiological and behavioral stability among premature neonates. Higher morning noise coincided with increased heart and respiratory rates and reduced oxygen saturation, indicating heightened autonomic stress. Concurrently, infants demonstrated more frequent stress-related behaviors, suggesting difficulty maintaining regulated states under louder environmental conditions. These findings highlight the sensitivity of preterm infants to routine auditory fluctuations and underscore the relevance of environmental control as part of developmental and neuroprotective care. Because many noise sources stem from modifiable clinical practices, implementing structured noise-reduction strategies—including staff awareness, optimized alarm management, and workflow adjustments—may substantially improve the care environment. Although long-term developmental outcomes were not assessed, the immediate physiological and behavioral changes observed warrant prioritizing sound regulation as an essential component of NICU practice to promote stability and support healthier developmental trajectories in this vulnerable population.

References

1. Harrison W, Goodman D. Epidemiologic trends in neonatal intensive care, 2007–2012. JAMA Pediatr. 2015;169(9):855–62.
2. Environmental Protection Agency. Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety. Washington, DC: Government Printing Office; 1974.
3. American Academy of Pediatrics Committee on Environmental Health. Noise: a hazard for the fetus and newborn. Pediatrics. 1997; 100(4): 724–7.
4. American National Standards Institute. Specification for personal noise dosimeters. ANSI/ASA S1.25. Washington, DC: Office of the Federal Register; 1991.
5. White RD, Smith JA, Shepley MM. Recommended standards for newborn ICU design: eighth edition. J Perinatol. 2013; 33(S1): S2–16.
6. Zahr LK, Balian S. Responses of premature infants to routine nursing interventions and noise in the NICU. Nurs Res. 1995;44(3):179–85.
7. Cardoso SM, Kozlowski LC, de Lacerda AB, Marques JM, Ribas A. Newborn physiological responses to noise in the neonatal unit. Braz J Otorhinolaryngol. 2015;81(6):583–8.
8. Capriolo C, Viscardi RM, Broderick KA, Nassebeh S, Kochan M, Solanki NS, et al. Assessment of NICU sound exposure using a smartphone application. Am J Perinatol. 2022; 39(2):189–94.
9. Casey L, Fucile S, Flavin M, Dow K. A two-pronged approach to reduce noise levels in the NICU. Early Hum Dev. 2020; 146:105073.

10. Philbin MK, Gray L. Changing levels of quiet in an intensive care nursery. J Perinatol. 2002; 22(6):455–60.
11. Graven SN. Sound and the developing infant in the NICU: conclusions and recommendations. J Perinatol. 2000;20(8 Pt 2):S88–93.
12. Livera MD, Priya B, Ramesh A, Rao PN, Swarnarekha B, Dominic M, et al. Spectral analysis of noise in the neonatal intensive care unit. Indian J Pediatr. 2008;75(3):217–22.
13. Milette IH. Nursing interventions to reduce NICU noise. Neonatal Netw. 2010;29(6):353–62.
14. Rao S, Patole S, Warren R, Nathan E, Simmer K. Maintaining reduced noise levels in a resource-constrained NICU by operant conditioning. Indian J Pediatr. 2012;79(5):624–8.
15. Bhat RY, Rao A, Murthy D. Noise levels in a tertiary neonatal intensive care unit in India. Indian Pediatr. 2018;55(9):753–6.
16. Chawla D, Natarajan G. Environmental sound levels in Indian neonatal intensive care units. Indian Pediatr. 2014;51(6):515–7.
17. Sankar MJ, Agarwal R, Deorari AK, Paul VK. Noise levels in a NICU in Delhi, India. Indian Pediatr. 2012;49(8):741–5.
18. Zahr LK, de Traversay J. Premature infants' responses to noise-reduction by earmuffs: a pilot study. J Perinatol. 1995;15(6):448–53.
19. Peng NH. Environmental stressors and stress biobehavioural responses of preterm infants in NICUs. J Nurs Res. 2008;16(4):231–9.
20. Patel K, et al. Physiological stress markers in neonates due to NICU noise. Int J Pediatr. 2020;5(2):80–4.