



Research Article

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Prevalence and Determinants of Hearing Impairment in High-Risk Neonates: A Prospective Study Using Brainstem Evoked Response Audiometry in a Tertiary Care Setting

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Abstract

Background: Neonatal hearing impairment is a significant cause of long-term neurodevelopmental disability. High-risk neonates have a substantially increased risk due to perinatal and postnatal factors.

Objective: To determine the prevalence of hearing impairment and identify associated risk factors among high-risk neonates using Brainstem Evoked Response Audiometry (BERA).

Methods: A prospective observational study was conducted over 12 months in a tertiary neonatal intensive care unit. A total of 515 high-risk neonates underwent a two-stage screening protocol using otoacoustic emissions (OAE) followed by confirmatory BERA. Statistical analysis included descriptive statistics, chi-square testing, and logistic regression.

Results: The prevalence of confirmed hearing impairment was 23.3 per 1,000 neonates, significantly higher than general neonatal populations. Prematurity, birth asphyxia, and hyperbilirubinemia were independently associated with hearing loss ($p < 0.05$).

Conclusion: High-risk neonates demonstrate a significantly increased prevalence of hearing impairment. Early screening using combined OAE and BERA protocols is essential for timely diagnosis and intervention.

Keywords: Neonatal hearing loss, BERA, High-risk neonates, NICU, OAE, Screening

Introduction

Auditory input during early life is critical for language, cognitive, and social development. Hearing impairment in neonates, if undetected, can lead to long-term neurodevelopmental delays. The global prevalence of permanent neonatal hearing impairment is estimated to be significantly higher among high-risk neonates compared to the general population [1]. High-risk neonates, particularly those admitted to neonatal intensive care units (NICUs), are more vulnerable due to multiple perinatal risk factors such as prematurity, birth asphyxia, and hyperbilirubinemia [2,3]. Universal newborn hearing screening programs have been recommended to ensure early detection and intervention [4,5]. Despite global recommendations, disparities exist in screening implementation, especially in developing and resource-limited settings [6,7]. This study aims to evaluate the prevalence and associated risk factors of hearing impairment among high-risk neonates using Brainstem Evoked Response Audiometry (BERA).

Aim

To determine the prevalence and determinants of hearing impairment among high-risk neonates using BERA.

Materials and Methods

This prospective observational study was conducted in a tertiary care neonatal unit over a period of 12 months. A total of 515 high-risk neonates were included based on predefined clinical criteria consistent with established screening protocols [4]. Initial screening was performed using Otoacoustic Emissions (OAE), followed by confirmatory testing using BERA for neonates who failed repeat screening. This two-stage protocol is widely accepted for neonatal hearing screening [8,4]. Statistical analysis was performed using standard methods, including chi-square testing and logistic regression, with significance set at $p < 0.05$.

Study Design

Prospective observational study.

Setting

Neonatal Intensive Care Unit (NICU), tertiary care hospital.

Duration

12 months.

Study Population

515 high-risk neonates.

Inclusion Criteria

- Prematurity (<37 weeks)
- Low birth weight (<2500 g)
- Birth asphyxia
- Hyperbilirubinemia requiring treatment
- NICU stay ≥ 5 days
- Exposure to ototoxic medications
- Neonatal infections

Exclusion Criteria

- Congenital ear malformations
- Parental refusal

Screening Protocol

- OAE within 48–72 hours
- Repeat OAE after 2 weeks
- BERA at ≤ 3 months for failures

This sequential protocol is widely validated for neonatal screening.

Statistical Analysis

- SPSS version 26
- Descriptive statistics
- Chi-square test
- Logistic regression
- Significance: $p < 0.05$

Results

The overall prevalence of confirmed hearing impairment was 2.3% (23.3 per 1000 neonates), which is markedly higher than that reported in general neonatal populations [1]. A higher proportion of affected neonates were preterm and had associated perinatal complications. Similar findings have been reported in previous NICU-based studies [9-11]. Multivariate analysis demonstrated that prematurity, birth asphyxia, and hyperbilirubinemia were significant predictors of hearing impairment, consistent with established literature [2,12,13] (Table 1-3) (Figure 1).

Table 1: Baseline Characteristics.

Variable	Number	Percentage
Male	292	56.70%
Female	223	43.30%

Preterm	76	14.80%
Hyperbilirubinemia	47	9.10%

Table 2: Screening Outcomes.

Stage	Number (%)
Initial OAE failure	147 (28.5%)
Repeat OAE failure	36 (7.0%)
Confirmed hearing loss	12 (2.3%)

Table 3: Risk Factors (Multivariate Analysis).

Factor	Odds Ratio (95% CI)	p-value
Prematurity	2.8 (1.2–6.5)	0.02
Birth Asphyxia	3.5 (1.4–8.2)	0.01
Hyperbilirubinemia	2.1 (1.0–4.3)	0.04

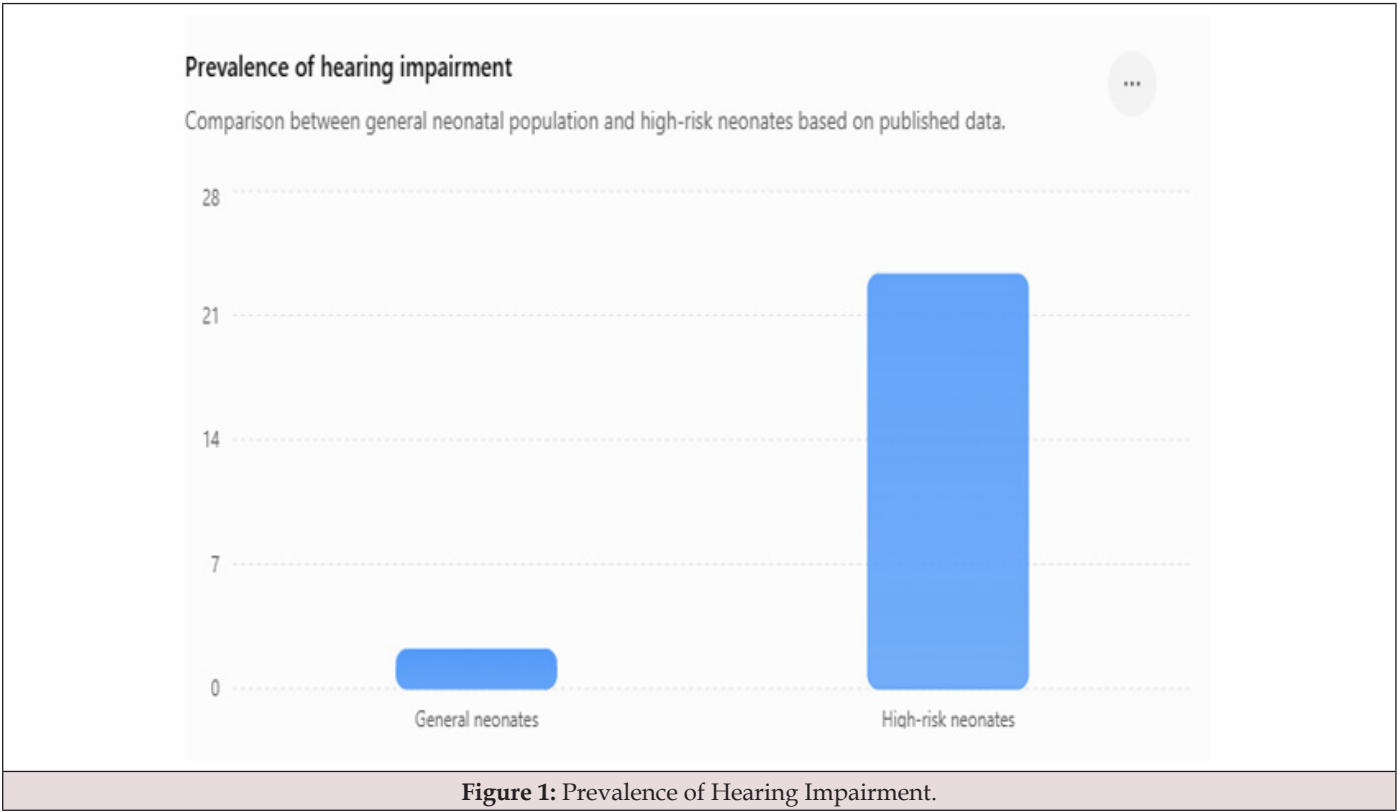


Figure 1: Prevalence of Hearing Impairment.

Figure 1:

1. Comparison between general neonatal population and high-risk neonates

2. Prematurity was the most common risk factor, consistent with previous studies.

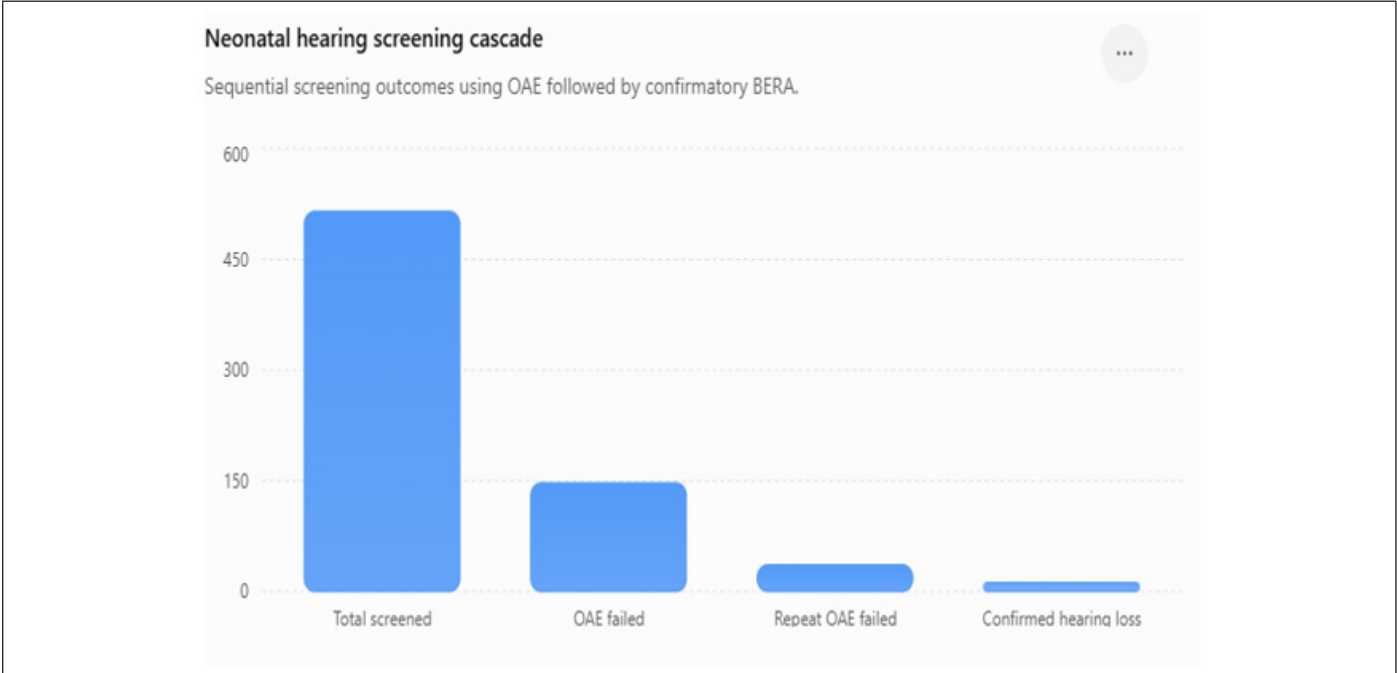


Figure 2: Neonatal Hearing Screening Cascade.

Figure 2:

- 1. Sequential screening outcomes using OAE followed by confirmatory BERA.
- 2. The overall prevalence of confirmed hearing impairment was 2.3% (23.3 per 1000 neonates).

- 3. A higher proportion of affected neonates were preterm and had a history of perinatal complications.
- 4. Statistically significant associations were observed for prematurity, birth asphyxia, and hyperbilirubinemia.

Risk Factors (Multivariate Analysis)

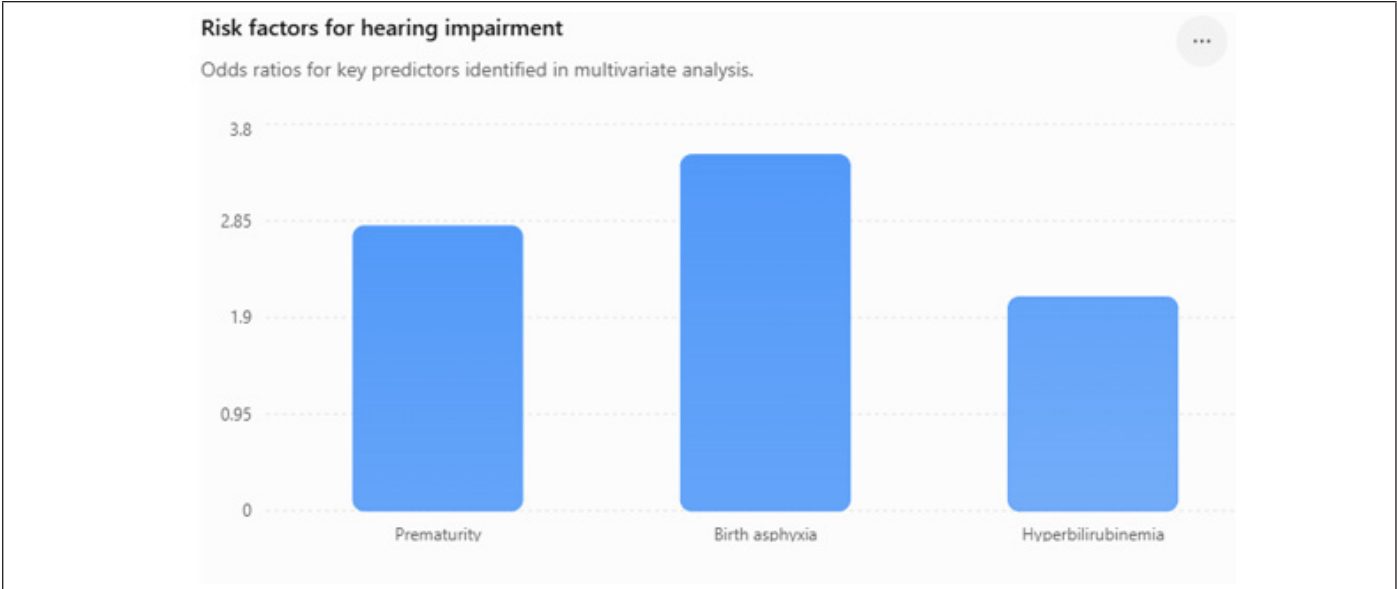


Figure 3: Risk Factors for Hearing Impairment.

Table 4

Factor	OR	p-value
Prematurity	2.8	0.02
Birth asphyxia	3.5	0.01
Hyperbilirubinemia	2.1	0.04

Odds ratios of significant predictors identified through multivariate analysis. 95% Confidence Interval (CI) (Table 4).

Discussion

The present study demonstrates a significantly higher prevalence of hearing impairment among high-risk neonates compared to general populations, aligning with findings from prior systematic reviews and cohort studies [1,9]. Prematurity and birth asphyxia were identified as strong predictors, which is consistent with previous studies utilizing BERA-based screening [2,10]. These risk factors are known to affect auditory pathway development and neurological integrity [14]. Hyperbilirubinemia also showed a significant association, supporting earlier evidence of bilirubin-induced neurotoxicity affecting auditory pathways [12,15]. The findings of this study are consistent with multicenter prospective data and global epidemiological trends, which emphasize the importance of structured screening programs [6,7]. Early identification and intervention are crucial, as studies have demonstrated improved language and cognitive outcomes when hearing impairment is detected early [16,17]. This study provides region-specific evidence from a tertiary care NICU, contributing to the limited data available from similar healthcare settings.

Clinical Implications

- Mandatory NICU hearing screening protocols
- Early audiological intervention
- Prevention of long-term disability

Limitations

- Single-center study
- Limited sample size
- Follow-up constraints

Conclusion

Hearing impairment is significantly more prevalent among high-risk neonates. Implementation of systematic screening protocols using OAE and BERA facilitates early diagnosis and timely intervention, thereby improving long-term developmental outcomes [4,16,18-20].

Ethical Approval

Approved by Institutional Ethics Committee. Parental consent

obtained.

Conflict of Interest

None.

Funding

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