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Evaluation of hearing impairment in neonatal intensive care unit (NICU) admitted newborns using otoacoustic emissions (OAE) and brainstem evoked response audiometry (BERA): A prospective observational study"

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Abstract

Background

Hearing impairment in neonates, particularly those admitted to Neonatal Intensive Care Units (NICUs), is a major cause of delayed speech, language, and cognitive development if not diagnosed and addressed early. The prevalence of hearing loss increases significantly among NICU-admitted infants due to risk factors such as prematurity, very low birth weight (VLBW), hyperbilirubinemia, sepsis, and ototoxic medication exposure.

Aim

To assess the incidence and risk factors of hearing impairment in NICU-admitted newborns using Otoacoustic Emissions (OAE) and Brainstem Evoked Response Audiometry (BERA).

Methods

This prospective observational study was conducted in the NICU of Hitech Medical College & Hospital, Bhubaneswar, from October 2022 to October 2024. One hundred NICU-admitted neonates underwent a three-stage auditory screening: OAE1 on Day 3, OAE2 at 6 weeks, and diagnostic BERA at 3 months. Demographic and clinical data were collected, including key risk factors.

Results

The incidence of REFER results was 16% on OAE1, 14% on OAE2, and 8% confirmed by BERA. A significant association was found between hearing loss and VLBW, hyperbilirubinemia ≥20 mg/dL, sepsis, mechanical ventilation, and ototoxic medication use. OAE2 showed strong concordance with BERA ($p<0.001$), supporting its reliability as a screening tool.

Conclusion

Sequential screening using OAE and BERA is effective in early detection of hearing impairment in NICU-admitted neonates. High-risk infants, particularly those with VLBW, sepsis, or hyperbilirubinemia, require prioritized auditory evaluation. Early diagnosis and intervention are essential to ensure optimal neurodevelopmental outcomes. Integrating structured hearing screening into NICU protocols is strongly recommended.

Recommendations

This study recommends routine OAE screening with confirmatory BERA for all NICU-admitted newborns, structured follow-up for high-risk infants, and integration of universal screening with counseling, staff training, and early rehabilitation into neonatal care.

Keywords: *Neonatal hearing loss, Otoacoustic Emissions (OAE), Brainstem Evoked Response Audiometry (BERA), Neonatal Intensive Care Unit, Very Low Birth Weight (VLBW)*
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Introduction

Hearing is a fundamental sense for language development, communication, and social integration in infants. Congenital hearing loss, if undetected and untreated, can lead to significant delays in speech, cognitive, emotional, and academic development. Globally, approximately 1 to 3 per 1000 live-born infants are affected by some form of hearing impairment. This prevalence increases dramatically to 40 to 60 per 1000 among newborns requiring admission to Neonatal Intensive Care Units (NICUs) due to associated risk factors such as prematurity, low birth weight, hyperbilirubinemia, ototoxic medication use, birth asphyxia, and neonatal infections.1

The early months of life—especially the first 6 months—constitute a critical period for auditory stimulation and neural plasticity required for language acquisition. If hearing loss is identified and addressed before this window closes, affected infants have a significantly higher chance of developing normal language skills and achieving optimal developmental outcomes.2

Traditionally, hearing loss in children was diagnosed late—often around 2.5 years of age—when speech and language delays became apparent. This delay in diagnosis results in missed opportunities for timely intervention. The advent of objective and non-invasive auditory tests like Otoacoustic Emission (OAE) and Brainstem Evoked Response Audiometry (BERA) has revolutionized early hearing detection and intervention programs. OAE detects cochlear (outer hair cell) function, whereas BERA assesses neural conduction along the auditory pathway, enabling comprehensive screening and diagnosis of hearing loss even in neonates.3

Several international and national health organizations, including the Joint Committee on Infant Hearing (JCIH), advocate for universal newborn hearing screening (UNHS) with a "1-3-6" goal: screening by 1 month, diagnosis by 3 months, and intervention by 6 months. Despite these recommendations, universal implementation remains inconsistent, particularly in resource-constrained settings.4

In India, hearing loss is the second most common cause of disability, and early detection remains a challenge due to a lack of awareness and screening infrastructure. NICU-admitted neonates, who are at higher risk, warrant targeted evaluation.5

Given this context, the present study was undertaken to assess the incidence of hearing impairment among NICU-admitted newborns using a two-stage screening protocol involving OAE and BERA, and to evaluate the association between various neonatal risk factors and hearing outcomes. The findings aim to highlight the need for structured hearing screening programs in high-risk neonatal populations to ensure early diagnosis and timely intervention.

Aim

To assess the incidence and risk factors of hearing impairment in NICU-admitted newborns using OAE and BERA.

Objectives

To determine the incidence of hearing impairment in NICU-admitted neonates using OAE and BERA.
To evaluate the association of various neonatal risk factors with hearing impairment.
To assess the correlation between OAE and BERA results.

Materials and Methods

Study Design

Cross-sectional study

Duration

The study was conducted from 01 October 2022 to 31 October 2024, over a period of two years."

Setting

NICU, Department of Pediatrics, Hitech Medical College & Hospital, Bhubaneswar. The attached teaching hospital is a 500-bedded tertiary care facility, which includes approximately 400 teaching beds and about 20 high-tech neonatal intensive care unit (ICU) beds.

Study participants

This cross-sectional study enrolled neonates admitted to the Neonatal Intensive Care Unit (NICU) of Hi-Tech Medical College & Hospital, Bhubaneswar, between 01 October 2022 and 31 October 2024. The study population consisted only of NICU-admitted newborns; neonates who were never admitted to the NICU were outside the target population and therefore not eligible for inclusion.

Sampling methods

Consecutive sampling was used: all neonates who met the inclusion criteria and were admitted to the NICU during the study period were approached for enrolment.

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Inclusion criteria

Neonates (≤28 days of life) admitted to the NICU during the study period.
Parental/guardian written informed consent for participation and follow-up.

Exclusion criteria

Parent(s) or legal guardian refused or did not provide written informed consent (resulting in non-enrolment).
Neonates with congenital ear anomalies that preclude reliable OAE/BERA testing (e.g., external ear malformations).
Neonates transferred out of the hospital before the initial hearing screen could be performed.

Selection methods

Consecutive NICU admissions meeting the inclusion criteria were screened daily by the study team.
Eligible neonates whose parents provided written consent were enrolled and underwent Otoacoustic Emissions (OAE) screening, with Brainstem Evoked Response Audiometry (BERA) performed as indicated.
Reasons for non-enrolment (e.g., parental refusal, immediate transfer/discharge, or anatomical contraindications to testing) were recorded in a screening log and reported in the manuscript.

Sample Size

The sample size can be calculated as per the prevalence of hearing impairment. As per a previous study, the prevalence of hearing impairment among NICU-admitted neonates was 6% (p = 0.06) — based on a recent hospital study of high-risk neonates using OAE/BERA.(as per study by Deeksha Chawla et al) Confidence level: 95% (Z = 1.96). Desired absolute precision (margin of error): ±5% (d = 0.05) — chosen to give a reasonably precise estimate for a low prevalence. Calculated sample size is 87, Anticipated non-response / lost to follow-up: 10% we had taken 100 sample size.
Bias minimisation: Bias was minimized through consecutive sampling of all NICU admissions, use of standardized OAE and BERA protocols by trained audiologists, and blinding of BERA interpreters. Key confounders were documented and adjusted for, while screening logs, repeat testing, systematic follow-up, and double data entry reduced selection, attrition, and data errors.

Data Collection Procedure

In this prospective observational study, data collection was systematically organized to assess hearing function in NICU-admitted newborns using a structured, tiered protocol. After obtaining informed written consent from parents, a detailed demographic and clinical history was recorded for each neonate, including perinatal events, birth weight, gestational age, Apgar scores, and any postnatal complications. Special attention was given to identifying potential risk factors for hearing impairment, such as prematurity, very low birth weight (VLBW), neonatal hyperbilirubinemia (≥20 mg/dL), use of ototoxic medications (notably aminoglycosides), birth asphyxia, need for mechanical ventilation, and neonatal sepsis.
All enrolled neonates underwent an otoscopic examination to rule out structural ear anomalies or obstruction of the external auditory canal (e.g., vernix or cerumen), which could interfere with accurate hearing assessments.
The initial hearing screening, OAE1, was conducted on Day 3 of life using Transient Evoked Otoacoustic Emissions (TEOAE). The test was performed in a quiet environment, preferably during natural sleep, and results were reported as "PASS" or "REFER." Infants with a "PASS" result were considered to have normal cochlear function, whereas those with a "REFER" result were suspected to have a potential hearing issue and scheduled for further testing.
A second-stage screening, OAE2, was performed at 6 weeks of age on all available infants regardless of their initial OAE1 result. This allowed reassessment of those who had REFER results in OAE1 and ensured detection of any new or persistent cochlear dysfunction. This step also helped minimize the number of false positives due to transient factors like middle ear effusion, debris, or vernix.
Infants who had a REFER result in OAE2, along with a proportion of those who passed both OAEs, were scheduled for Brainstem Evoked Response Audiometry (BERA) testing at 3 months of age. BERA was conducted in a soundproof room using surface electrodes placed on the forehead and mastoid regions to record electrical activity in response to auditory stimuli. This electrophysiological test provided objective information about neural conduction along the auditory pathway from the cochlea to the brainstem.
Thus, through this three-stage approach—OAE1, OAE2, and BERA—hearing status was thoroughly evaluated, and correlation with documented neonatal risk factors was established for each subject. Data were subsequently

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analyzed using statistical software to determine the incidence and predictors of neonatal hearing impairment.

Statistical Analysis:

Data analysis was performed using SPSS version 26.0. Descriptive statistics were used to summarize baseline characteristics and risk factor distribution among the neonates. To assess the relationship between various neonatal risk factors and hearing impairment detected by OAE and BERA, the Chi-square test was applied for categorical variables. In order to evaluate the strength and direction of these associations, Odds Ratios (ORs) with corresponding 95% Confidence Intervals (CIs) were calculated. These statistical measures helped determine whether the presence of specific risk factors significantly increased the likelihood of hearing loss. A p-value of less than 0.05 was considered statistically significant, indicating that the observed associations were unlikely to have occurred by chance.

Results

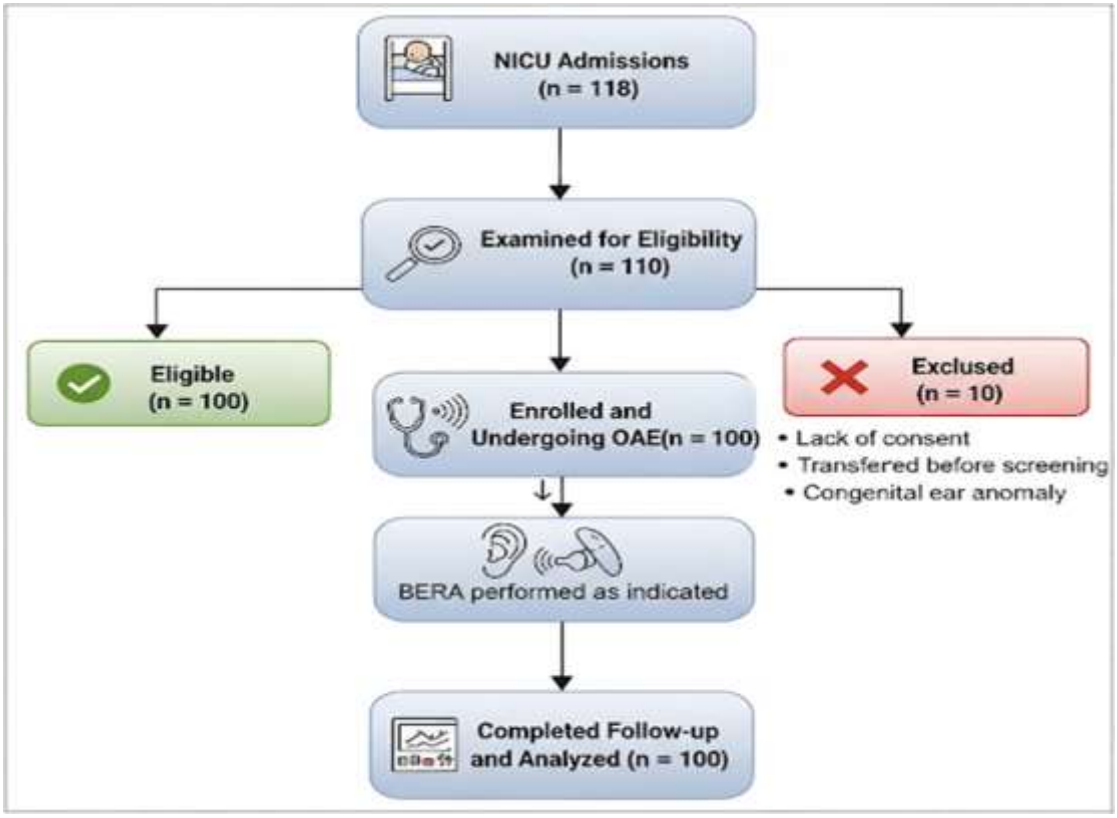

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Table 1. Demographic and Clinical Characteristics of Study Neonates (n = 100)

Variable	Frequency (n)	Percentage (%)
Sex		
Male	56	56%
Female	44	44%
Gestational age		
Preterm (<37 weeks)	32	32%
Term (37–41 weeks)	64	64%
Post-term (≥42 weeks)	4	4%
Birth weight		
<2500 g (low birth weight)	38	38%
≥2500 g	62	62%
Risk factors		
Neonatal jaundice	28	28%
Sepsis	22	22%
Hypoxic-ischemic encephalopathy	14	14%
Ototoxic drug exposure	18	18%
Mechanical ventilation required	20	20%
Family history of hearing loss	5	5%

Of the 100 NICU-admitted neonates included in the study, 56% were male and 44% female. The majority (64%) were term babies, with 32% preterm and 4% post-term. Low birth weight (<2500 g) was observed in 38% of neonates. Among clinical risk factors, neonatal jaundice (28%) and sepsis (22%) were most common, followed by mechanical ventilation requirement (20%), ototoxic drug exposure (18%), and hypoxic-ischemic encephalopathy (14%). A family history of hearing loss was present in 5% of neonates.

Tab 2: Prevalence of Hearing Impairment Based on Tests

Test	Normal (PASS)	Abnormal (REFER)	Incidence of Hearing Impairment (%)
OAE1 (Day 3)	84	16	16.0%
OAE2 (6 Weeks)	86	14	14.0%
BERA (3 Months)	92	8	8.0%

The prevalence of hearing impairment among NICU-admitted newborns decreased across the sequential testing stages. On initial screening with OAE1 at Day 3, 16% showed a REFER result, which slightly reduced to 14% on repeat OAE2 at 6 weeks, likely due to the resolution of transient middle ear conditions. Diagnostic BERA conducted at 3 months confirmed hearing impairment in 8% of the neonates, indicating that early screening followed by confirmatory testing effectively identifies true cases of neonatal hearing loss.

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Table 3: Risk Factor Profile and Association with Hearing Loss

Risk Factor	No. of Babies	OAE2 REFER (%)	Abnormal BERA (%)
Prematurity	51	13 (25.49%)	7 (13.7%)
VLBW (<1500g)	13	8 (61.53%)	5 (38.5%)
Ototoxic Med	40	12 (30%)	7 (17.5%)
Hyperbilirubinemia (≥20)	22	10 (45.45%)	7 (31.8%)
Sepsis	14	7 (50%)	6 (42.9%)
Birth Asphyxia	20	6 (30%)	5 (25%)
Mechanical Ventilation	5	4 (80%)	3 (60%)

Analysis of risk factors revealed a strong association between specific neonatal conditions and hearing impairment. Very low birth weight (VLBW), mechanical ventilation, sepsis, and hyperbilirubinemia (≥20 mg/dL) were the most significant contributors, with REFER rates on OAE2 ranging from 45% to 80% and abnormal BERA rates from 31.8% to 60%. Prematurity and ototoxic medication use also showed notable associations. These findings highlight that neonates with these high-risk conditions are more susceptible to hearing loss and should be prioritized for early auditory screening and follow-up.

Table 4: Association of OAE1 vs OAE2 Results

OAE1 Result (Day 3)	OAE2 PASS (6 Weeks)	OAE2 REFER (6 Weeks)	Total
PASS	84	2	86
REFER	2	12	14
Total	86	14	100

The comparison between OAE1 and OAE2 results shows strong consistency across the two screening stages. Of the 86 neonates who passed OAE1, 97.7% (84) continued to pass OAE2, while only 2 showed a change to REFER. Conversely, among the 14 who were REFER on OAE1, 85.7% (12) remained REFER on OAE2, indicating persistent auditory concerns. This supports the reliability of initial OAE screening and reinforces the importance of repeat testing at 6 weeks to confirm persistent cases and reduce false positives due to transient conditions.

Table 5: Association of BERA vs OAE2 Correlation

OAE2 Result (6 Weeks)	BERA Normal	BERA Abnormal	Total
PASS	84	2	86
REFER	8	6	14
Total	92	8	100

A significant correlation was observed between OAE2 results and BERA outcomes. Among the 14 neonates who had a REFER result on OAE2, 42.9% (6) were confirmed to have abnormal BERA findings, indicating true hearing impairment. In contrast, only 2 out of 86 neonates (2.3%) who passed OAE2 had abnormal BERA results. This strong association suggests that a REFER result on OAE2 is a reliable predictor of confirmed hearing loss, reinforcing the effectiveness of OAE2 as a screening tool prior to diagnostic BERA testing.

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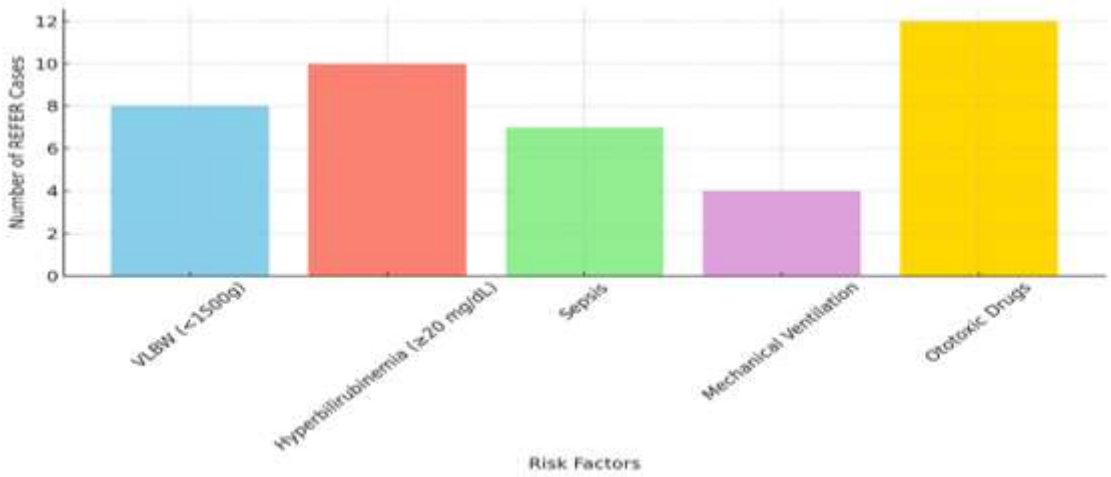
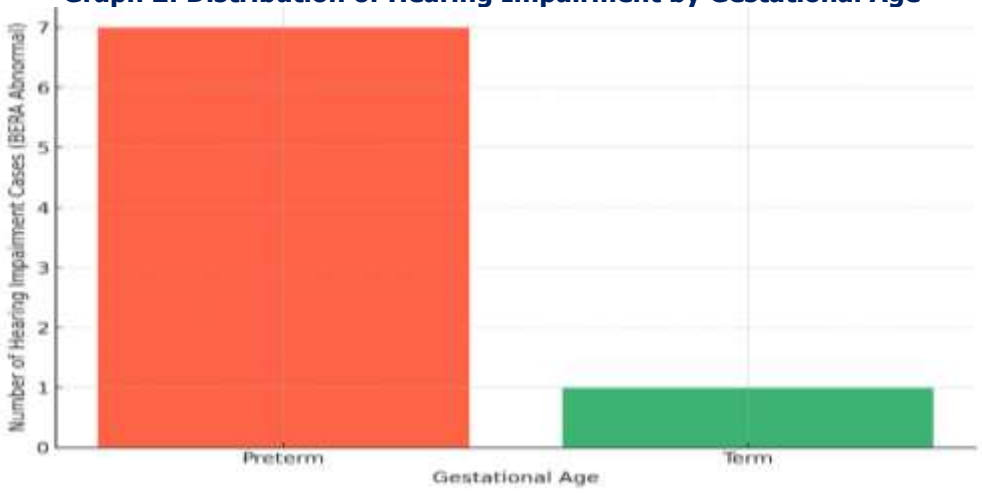
Graph 1: Risk Factor Frequency Among REFER OAE2 Cases



Graph 1 depicts the frequency of key risk factors among neonates who had a "REFER" result on OAE2. Ototoxic drug exposure and hyperbilirubinemia were the most frequently associated risk factors, followed by VLBW, sepsis, and mechanical ventilation.

Graph 2: Distribution of Hearing Impairment by Gestational Age



Graph 2 shows the distribution of hearing impairment by gestational age. The graph highlights a significantly higher number of BERA-confirmed hearing impairment cases in preterm neonates compared to term neonates, indicating prematurity as a major risk factor.

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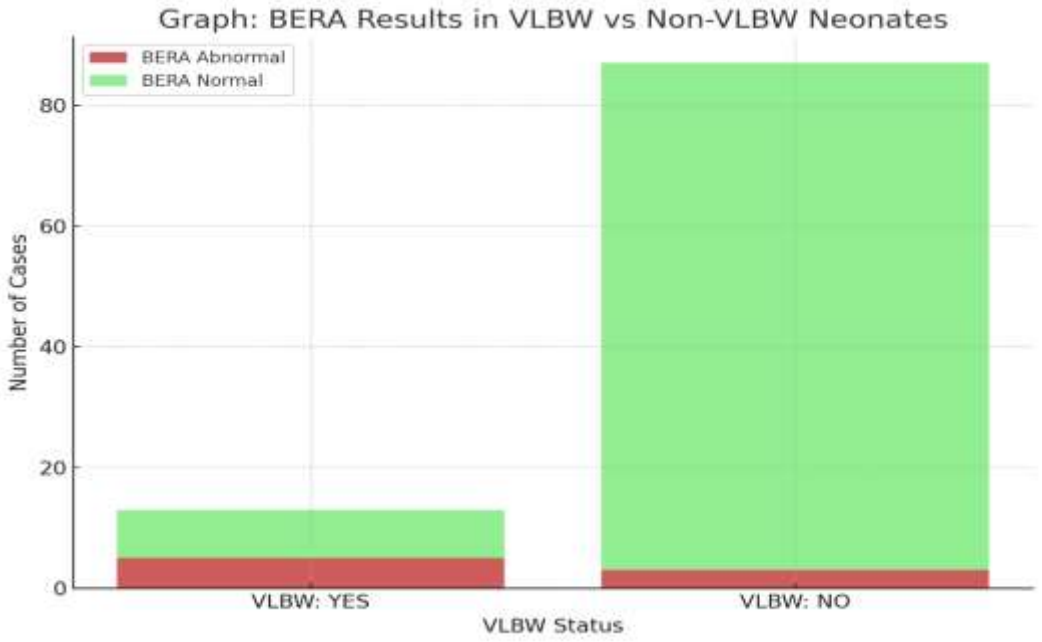
Graph 3: BERA results in VLBW vs non-VLBW neonates



The graph clearly demonstrates that neonates with Very Low Birth Weight (VLBW, <1500g) had a significantly higher proportion of abnormal BERA results compared to their non-VLBW counterparts. Specifically, out of 13 VLBW neonates, 5 (38.5%) had abnormal BERA findings, while among 87 non-VLBW neonates, only 3 (3.4%) were BERA abnormal. This stark contrast emphasizes that VLBW is a strong risk factor for hearing impairment. The calculated odds ratio of 17.5 and a p-value of 0.000 further confirm a statistically significant association, indicating that VLBW neonates are at considerably higher risk of developing auditory dysfunction requiring early screening and intervention.

Discussion

In our study, 56% of neonates were male, 32% preterm, and 38% low birth weight, with jaundice (28%) and sepsis (22%) being the most common risk factors, followed by ventilation, ototoxic exposure, and HIE. Similar risk profiles were reported by Vohr et al (6, who highlighted higher morbidity among NICU infants compared to well-baby units, and by Lima et al (7, who found prematurity and critical illness strongly associated with abnormal hearing screens. Pourarian et al.8 also noted significant links between hearing loss, prematurity, antibiotic/oxygen therapy, and sepsis. These concordant findings emphasize that both preterm and term neonates in NICUs face elevated risks due to perinatal complications, while differences in prevalence across studies reflect variations in case mix, screening methods, and timing of assessment.

In our study, the prevalence of hearing impairment decreased from 16% on initial OAE screening at Day 3 to 14% on repeat OAE at 6 weeks, with confirmatory BERA at 3 months identifying true impairment in 8% of neonates. This stepwise reduction is consistent with the findings of Pourarian et al (8, who reported higher initial OAE refer

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rates that declined on repeat testing, attributing early failures to transient middle ear conditions. Similarly, Meyer et al.9 observed that repeat screening reduced false-positive rates, improving specificity before confirmatory ABR. Lima et al.7 also highlighted that combining OAE with diagnostic BERA enhances accuracy in detecting permanent hearing loss. These parallels suggest that early OAE screening, followed by staged retesting and confirmatory BERA, is effective in distinguishing transient conductive issues from true sensorineural impairment, aligning our findings with previous NICU-based studies.

The present study demonstrated that VLBW, mechanical ventilation, sepsis, and severe hyperbilirubinemia were strongly associated with higher REFER rates on OAE2 (45–80%) and abnormal BERA findings (31.8–60%), with prematurity and ototoxic drug exposure also contributing significantly. These results align with Pourarian et al.8, who identified prematurity, antibiotic therapy, and oxygen supplementation as major predictors of neonatal hearing loss, and with Yoshikawa et al.10, who reported hypoxia, infection, and ototoxic drugs as significant etiological factors. Similarly, Fakhraee et al.11 found sepsis and hyperbilirubinemia to be strongly linked to ABR abnormalities. The consistency across studies underscores that both perinatal complications and therapeutic exposures synergistically increase auditory vulnerability in NICU populations, reinforcing the need for targeted screening and close follow-up in these high-risk groups.

In the present study, 97.7% of neonates who passed OAE1 continued to pass OAE2, while 85.7% of those referred on OAE1 remained REFER, confirming the reliability of early OAE and the value of repeat testing in identifying persistent cases. Similar results were reported by Rhodes et al, 3, who found high consistency between sequential OAE tests and emphasized repeat screening to minimize false positives. Meyer et al9) also observed that staged OAE screening reduced unnecessary referrals by distinguishing transient middle ear conditions from true impairment. Likewise, Finckh-Kramer et al2 highlighted that repeat OAE in high-risk neonates improved diagnostic accuracy and reduced parental anxiety from initial REFER results. These concordant findings support the use of sequential OAE protocols to enhance specificity and ensure that only infants with persistent auditory concerns proceed to confirmatory BERA.

In this study, 42.9% of neonates with a REFER on OAE2 were confirmed to have abnormal BERA, while only 2.3% of those who passed OAE2 showed abnormalities, demonstrating a strong predictive value of OAE2 for confirmed hearing loss. This finding is consistent with Bilgen et al.12, who reported that REFER results on OAE had a high likelihood of correlating with ABR-confirmed impairment in high-risk neonates. Similarly, Mathur and Dhawan13 emphasized that OAE followed by BERA is an effective strategy for screening in tertiary hospitals, as persistent OAE failures strongly predict true auditory deficits. Pourarian et al.8 also found a significant association between OAE and ABR results, highlighting the reliability of repeat OAE as a precursor to confirmatory testing. Collectively, these studies support our observation that OAE2 serves as a robust screening step, efficiently identifying infants who truly require diagnostic BERA.

In the present study, neonates with a REFER result on OAE2 most frequently had ototoxic drug exposure and hyperbilirubinemia, followed by very low birth weight, sepsis, and mechanical ventilation, highlighting these as the leading contributors to persistent auditory dysfunction. Similar patterns were reported by Yoshikawa et al.10, who found hypoxia, infection, and ototoxic medications to be major etiological factors in neonatal hearing loss, while Fakhraee et al.11 demonstrated strong associations between hyperbilirubinemia, sepsis, and abnormal ABR findings. Pourarian et al.8 likewise emphasized that prematurity, antibiotic therapy, and oxygen support significantly increased the risk of hearing impairment among NICU infants. These consistent observations across studies reinforce that both neonatal illness and therapeutic exposures contribute substantially to auditory risk, explaining why neonates with these conditions are disproportionately represented among those failing repeat OAE.

The present study showed that BERA-confirmed hearing impairment was significantly higher among preterm neonates compared to term neonates, underscoring prematurity as a major risk factor. This finding is consistent with Pourarian et al.8, who reported that preterm infants had a markedly increased prevalence of hearing loss compared to term neonates in NICU populations. Similarly, Lima et al.7 observed that prematurity and low gestational age were strongly associated with abnormal auditory screening outcomes. Meyer et al.9 also identified prematurity as an independent predictor of neonatal hearing impairment in high-risk infants. The biological plausibility lies in the vulnerability of the immature auditory system to hypoxia, metabolic instability, infection, and ototoxic therapies. Thus, our results align with prior research emphasizing that

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preterm neonates are disproportionately affected and should be prioritized for early auditory screening and long-term follow-up.

The present study found that 38.5% of VLBW neonates (<1500 g) had abnormal BERA results compared to only 3.4% of non-VLBW neonates, with an odds ratio of 17.5 (p = 0.000), confirming VLBW as a strong risk factor for hearing impairment. Similar findings were reported by Vohr et al6, who demonstrated significantly higher rates of auditory dysfunction in VLBW infants, attributing it to immaturity of the auditory system and increased exposure to NICU-related complications. Pourarian et al.8 likewise identified low birth weight as an independent predictor of abnormal hearing screening outcomes in high-risk neonates. Meyer et al9) also highlighted that infants with very low birth weight had a greater incidence of confirmed hearing loss, often compounded by prematurity and prolonged intensive care interventions. These consistent results across studies reinforce that VLBW neonates represent a particularly vulnerable group, warranting targeted early screening, close follow-up, and timely intervention to prevent long-term auditory and developmental delays.

Generalisability

The findings of this study are generalisable primarily to NICU-admitted neonates in similar tertiary care settings with comparable risk factor profiles. While the results underscore the utility of combined OAE and BERA screening in early detection of hearing impairment, generalisability to the broader neonatal population may be limited due to the selective inclusion of high-risk NICU newborns. Larger multicentric studies including both NICU and healthy neonates would enhance external validity and applicability of the findings to universal newborn hearing screening programs.

Conclusion

This study highlights the significant burden of hearing impairment among NICU-admitted neonates and underscores the effectiveness of sequential auditory screening using OAE and confirmatory BERA. High-risk factors such as very low birth weight, hyperbilirubinemia, sepsis, mechanical ventilation, and ototoxic drug exposure were strongly associated with hearing loss. Early identification through OAE at birth and follow-up BERA at 3 months enables timely diagnosis and intervention, which is crucial for optimal speech, language, and cognitive development. Integrating targeted hearing screening into NICU protocols is essential to improve long-term outcomes in this vulnerable population.

Limitations

The study was limited by a small sample size, a single-center design, and a lack of a healthy control group. Loss to follow-up and exclusion of genetic or long-term outcome data also affected the completeness of findings.

Recommendations

This study recommends routine OAE screening with confirmatory BERA for all NICU-admitted newborns, structured follow-up for high-risk infants, and integration of universal screening with counseling, staff training, and early rehabilitation into neonatal care.

Acknowledgement

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Funding

The study did not receive any external funding.

Conflict of interest

"All authors declare that they have no conflict of interest related to this study."

Abbreviation

BERA – Brainstem Evoked Response Audiometry
HIE – Hypoxic-Ischemic Encephalopathy
ICU – Intensive Care Unit
NICU – Neonatal Intensive Care Unit
OAE – Otoacoustic Emissions
UNHS – Universal Newborn Hearing Screening

Author Biographies

Dr. Aparna Aradhana is an Associate Professor in the Department of Pediatrics at IMS and SUM Hospital, Bhubaneswar. With extensive experience in neonatal and pediatric care, her research interests include neonatology, pediatric infectious diseases, and developmental pediatrics.

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Bhubaneswar. His academic and clinical work focuses on neonatal intensive care, growth and nutrition in children, and early childhood health interventions.

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Dr. Nitish Jena is an Assistant Professor in the Department of Pediatrics at IMS and SUM Hospital, Bhubaneswar. His clinical expertise lies in pediatric emergencies and neonatology, with academic contributions in neonatal hearing, child growth, and developmental screening.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. To protect patient confidentiality, individual-level data have not been made publicly accessible.

Author Contributions

Dr. Aparna Aradhana: Conceptualization, study design, supervision, and critical revision of the manuscript.

Dr. Bighneswar Senapati: Data collection, patient recruitment, and drafting of the initial manuscript.

Dr. Suchismita Panda: Data analysis, interpretation of results, and manuscript editing.

Dr. Nitish Jena: Methodology, data validation, preparation of figures/tables, and corresponding author responsibilities, including manuscript submission and communication.

Referencing

1. World Health Organization. Global estimates on the prevalence of hearing loss, mortality, and burden of diseases, and prevention of blindness and deafness. Geneva: WHO; 2012;2(1): 2-3.
2. Finckh-Kramer U, Gross M, Bartsch M, Kewitz G, Versmold H, Hess M. Hearing screening of high-risk newborn infants. HNO. 2000;48(3):215-20. https://doi.org/10.1007/s001060050035
3. Rhodes MC, Margolis RH, Hirsch JE, Napp AP. Hearing screening in the newborn intensive care nursery: comparison of methods. Otolaryngol Head Neck Surg. 1999;120(6):700-8. https://doi.org/10.1016/S0194-5998(99)70317-7
4. Stelmachowicz PG, Gorga MP. Audiology: early identification and management of hearing loss. In: Cummings CW, Fredrickson JM, Harker LA, Krause CJ, Schuller DE, Richardson MA, editors. Otolaryngology head and neck surgery. 3rd ed. Vol. 5. London: Mosby; 1998;3(5):401-8.
5. Hayes D, Thomson V. The Colorado newborn hearing screening project: screening for hearing loss and otitis media in children. 2001;2(1):210-7.
6. Vohr BR, Widen JE, Cone-Wesson B, Sininger YS, Gorga MP, Folsom RC, et al. Identification of neonatal hearing impairment: characteristics of infants in the neonatal intensive care unit and well baby nursery. Ear Hear. 2000;21(5):373-82. https://doi.org/10.1097/00003446-200010000-00005
7. Lima GML, Marba STM, Santos MFC. Hearing screening in a neonatal intensive care unit. J Pediatr (Rio J). 2006;82(2):110-4. https://doi.org/10.1590/S0021-75572006000200006 https://doi.org/10.2223/JPED.1457
8. Pourarian S, Khademi B, Pishva N, Jamali A. Prevalence of hearing loss in newborns admitted to the neonatal intensive care unit. Iran J Otorhinolaryngol. 2012;24(68):129-34.
9. Meyer C, Witte J, Hildmann A, Hennecke KH, Schunck KU, Maul K, et al. Neonatal screening for hearing disorders in infants at risk: incidence, risk factors, and follow-up. Pediatrics. 1999;104(3):900-4. https://doi.org/10.1542/peds.104.4.900
10. Yoshikawa S, Ikeda K, Kudo T, Kobayashi T. The effects of hypoxia, premature birth, infection, ototoxic drugs, the circulatory system, and congenital disease on neonatal hearing loss. Auris Nasus Larynx. 2004;31(4):361-8. https://doi.org/10.1016/S0385-8146(04)00115-4
11. Fakhraee SH, Kazemian M, Hamidieh AA. Hearing assessment of high-risk neonates admitted to Mofid Hospital for Children during 2001-2002, using auditory brainstem response. Arch Iran Med. 2004;7(1):44-6.
12. Bilgen H, Akman I, Ozek E, Kulekci S, Ors R, Carman B, et al. Auditory brain stem response screening for hearing loss in high-risk neonates. Turk J Med Sci. 2000;30(3):479-82.
13. Mathur NN, Dhawan R. An alternative strategy for universal infant hearing screening in tertiary hospitals with high delivery rate, within a

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developing country, using transient evoked otoacoustic emissions and brainstem evoked response audiometry. J Laryngol Otol. 2007;121(7):639-43. https://doi.org/10.1017/S0022215106004403

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