International Journal of Current Pharmaceutical Research

ISSN- 0975-7066 Vol 17, Issue 1, 2025

Original Article

ANALYZING RISK FACTORS AND OUTCOMES OF NEONATAL HEARING SCREENING

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Received: 23 Oct 2024, Revised and Accepted: 07 Dec 2024

ABSTRACT

Objective: Neonatal hearing loss can significantly impact a child's developmental trajectory. This study evaluates the risk factors associated with neonatal hearing impairment and analyzes the outcomes of a hearing screening program at a tertiary care center.

Methods: This prospective observational study involved 1175 neonates screened for hearing loss using Otoacoustic Emissions (OAE). Data were collected on high-risk factors such as consanguinity, family history of deafness, ototoxic drug exposure, and low birth weight, and their association with screening outcomes.

Results: The prevalence of high-risk factors included consanguinity (13.53%), family history of deafness (0.17%), ototoxic drug intake (0.26%), and low birth weight (19.91%). Of those initially referred for additional testing, 50% were lost to follow-up, and 50% confirmed for further diagnostic evaluation. Associations were noted between consanguinity and referral rates, as well as a strong correlation between family history and referrals.

Conclusion: The study highlights the effectiveness of initial neonatal hearing screenings but indicates the need for improved follow-up systems to ensure comprehensive care for all neonates at risk of hearing loss.

Keywords: Neonatal hearing screening, Risk factors, Early hearing detection and intervention, Consanguinity, Family history, Neonatal care

DOI: https://dx.doi.org/10.22159/ijcpr.2025v17i1.6007 Journal homepage: https://innovareacademics.in/journals/index.php/ijcpr

INTRODUCTION

Neonatal hearing screening is a critical first step in identifying infants who may have congenital hearing loss, a condition that, if undetected, can profoundly affect language development, cognitive skills, and social interactions. As such, understanding the risk factors associated with hearing impairment and analyzing the outcomes of neonatal hearing screening programs are essential to improve early detection and intervention strategies. This paper explores the multifaceted aspects of risk factors for hearing loss in neonates and evaluates the outcomes of hearing screening programs, aiming to enhance early diagnostic approaches and intervention outcomes [1-3].

Hearing loss in neonates can be influenced by a variety of risk factors including genetic predisposition, in-utero infections, birth complications, and exposure to ototoxic medications. The Joint Committee on Infant Hearing (JCIH) recommends that all newborns be screened for hearing loss by one month of age, ideally before hospital discharge, with those identified with hearing impairment receiving further diagnostic evaluation by three months and starting appropriate intervention by six months of age. Despite these recommendations, numerous challenges persist in the implementation of universal screening programs, ranging from logistical issues to disparities in access to healthcare services [4-6].

In recent years, there has been significant progress in the technology used for neonatal hearing screening, primarily involving Otoacoustic Emissions (OAE) and Automated Auditory Brainstem Response (AABR) tests. These advancements have improved the sensitivity and specificity of screenings. However, disparities in outcomes still exist, particularly in low-resource settings or among populations with limited access to healthcare. Moreover, even in settings with well-established programs, follow-up rates after a failed screening remain a significant concern, with many infants lost to follow-up, delaying critical interventions [7, 8].

The importance of detecting and managing neonatal hearing loss promptly cannot be overstated. Early identification allows for timely intervention, which is crucial for optimizing speech and language outcomes in children with hearing impairments. Research indicates that children who receive early intervention for hearing loss are more likely to achieve better language, social, and academic outcomes compared to those whose hearing loss is identified later [9].

Our study, aims to dissect the complex interplay of risk factors leading to neonatal hearing loss and scrutinize the effectiveness of current neonatal hearing screening protocols [10]. By analyzing data from a tertiary care center's screening program, this study will identify key factors that influence the success rates of early hearing detection and intervention (EHDI) programs and propose strategies to overcome barriers to effective screening and follow-up. In doing so, it will provide insights into optimizing screening protocols to ensure that all newborns receive the necessary screenings and follow-ups, ultimately paving the way for better developmental outcomes for those with hearing impairments.

MATERIALS AND METHODS

Study design

This study is a prospective observational study conducted to evaluate universal hearing screening in neonates.

Study area and period

The study was performed at SDM Medical College and Hospital, Sattur, Dharwad, from December 2019 to November 2020.

Study subjects

The subjects included neonates born at SDM Medical College and Hospital during the study period.

Sample size

A minimum of 1000 neonates were enrolled in the study.

Inclusion criteria

- Neonates delivered in SDM Hospital and subsequently shifted to the mother's side.

- Neonates whose parents provided written and informed consent.

Exclusion criteria

- Neonates requiring intensive care management.
- Neonates whose parents did not provide written and informed consent.

Methods of collection of data

Sample procedure

Data were collected using a pre-designed proforma after obtaining informed consent from the parents.

Study instrument

The primary instrument used was the Otoacoustic Emission (OAE) Machine from Otoread Company, equipped with the necessary hardware and software to generate test stimuli, measure OAEs, and display results. The instrument operates with 4 AA/UM-3/R6 alkaline batteries and features a liquid crystal display (LCD) and three light-emitting diodes for visual data presentation. The probe contains a microphone and two speaker tubes, using disposable eartips made of industrial elastomer, color-coded for size differentiation.

Mechanism of function

The OAE instrument generates test tones, directs them into the ear canal, and measures the level of the Distortion Product Otoacoustic Emission (DPOAE) tone generated by the cochlea. This process assesses the outer hair cell function across a frequency range of 2 to 6 kHz.

Procedure of the test

- **Pre-test counseling:** Parents are counseled about congenital hearing loss and the importance of early diagnosis and intervention.
- **ENT examination:** Prior to testing, a routine ENT examination is conducted. This includes inspection of the pre-aural, pinna, and post-aural regions, removal of any occluding wax or debris using a cotton-tipped swab, and otoscopic examination of the tympanic membrane using a Heine 3000 series otoscope.
- Testing procedure: The test is conducted in a quiet room. After a short observation period, the OAE test is performed. Neonates who pass the initial OAE test are labeled as normal hearers. Those who fail undergo a second OAE test the following day. Neonates who fail the second OAE test are then subjected to confirmatory Brainstem Evoked Response Audiometry (BERA) tests.

Ethical considerations

The study protocol was approved by the ethical committee of SDM Medical College and Hospital.

Statistical analysis

Data collected are input into Microsoft Excel and analyzed using SPSS software, employing descriptive statistics to interpret the findings.

RESULTS

The analysis of neonatal hearing screening at a tertiary care center revealed a variety of risk factors and their associations with hearing screening outcomes. The study's results are summarized in several tables that detail the presence of high-risk factors, the outcomes of referred cases, and the correlation between consanguinity, family history of hearing impairment, and screening results.

Table 1 presence of high-risk factors a total of 1175 neonates were evaluated for high-risk factors associated with hearing loss. Of these, consanguinity was present in 159 neonates (13.53%), indicating a higher risk of genetic conditions including hearing loss. Only 2 neonates (0.17%) had a family history of neonatal deafness, and 3 (0.26%) had been exposed to ototoxic drugs. Low birth weight, a significant risk factor for various neonatal complications including hearing loss, was noted in 234 neonates (19.91%).

Table 2 outcome referred cases in repeat screening (out of 2) of the neonates who were referred for repeat screening, half (50.00%) were lost to follow-up, underscoring the challenge of ensuring that families return for necessary diagnostic tests. The other referred neonate underwent Brainstem Evoked Response Audiometry (BERA), a definitive diagnostic procedure to confirm hearing loss.

Table 3 association between consanguinity and referred cases among the neonates with a consanguinity background, only 1 was referred (0.63%), while the vast majority, 158 (99.37%), were not referred after the initial screening. This contrasted with the neonates from non-consanguineous backgrounds, where none were referred, highlighting that while consanguinity increases the risk of hearing loss, the absolute number of referred cases remains low.

Table 4 association between family history and referred cases family history showed a significant correlation with hearing screening referrals. Out of the two neonates with a family history of deafness, one was referred (50.00%), whereas the referrals among neonates without such a history were negligible (0.00%). This indicates the strong predictive value of family history in identifying neonates at risk of hearing impairment.

The results suggest that certain genetic and prenatal risk factors are significantly associated with hearing screening referrals, although the overall referral rate is low. This underscores the importance of targeted screening and follow-up protocols, particularly for neonates identified with high-risk factors such as family history of deafness and consanguinity. The high rate of loss to follow-up remains a concern, highlighting the need for enhanced tracking and communication strategies to ensure that all at-risk neonates receive the follow-up care they require.

Table 1: Presence of high risk factors

Risk factors	Number	Percentage
Consanguinity	159	13.53%
Family history of neonatal deafness	2	0.17%
Ototoxic drug intake	3	0.26%
Low birth weight	234	19.91%

Table 2: Outcome referred cases in repeat screening (out of 2)

Referred cases	Number	Percentage
Loss of follow-up	1	50.00%
BERA	1	50.00%
Total	2	100.00%

Table 3: Association between consanguinity and referred cases

Consanguinity	Refer	%	Not refer	%	Total	%
Yes	1	0.63%	158	99.37%	159	13.53%
No	0	0.00%	1016	100%	1016	86.47%
Total	1	0.09%	1174	99.91%	1175	100.00%

Table 4: Association between family history and referred cases

Family history	Refer	%	Not refer	%	Total	%
Yes	1	50.00%	1	50.00%	2	0.17%
No	0	0.00%	1173	100.00%	1173	99.83%
Total	1	0.09%	1174	99.91%	1175	100.00%

DISCUSSION

This study underscores the critical nature of early identification of hearing loss in neonates and elucidates the complexity of managing risk factors associated with neonatal hearing impairment. The prevalence of consanguinity and low birth weight as significant risk factors is consistent with prior research, which suggests genetic and perinatal environmental influences significantly impact neonatal auditory health [11].

Notably, the low referral rates in initial screenings highlight the efficiency of the screening process but also raise concerns about potential under-identification of subtle cases. The significant loss to follow-up in referred cases further complicates this issue, underscoring a gap in the continuity of care that could delay crucial interventions for those with confirmed impairments. This finding points to the need for robust follow-up systems and community education to ensure that parents understand the importance of subsequent evaluations after a failed initial screen [12-14].

Furthermore, the distinct correlation between a family history of deafness and referral rates provides an essential insight into the targeted screening and counseling of at-risk families. It suggests that taking a detailed family history should be an integral part of neonatal hearing screenings to refine the risk assessment and follow-up protocols.

CONCLUSION

The findings from this study highlight the success of neonatal hearing screenings in identifying most at-risk neonates but also emphasize the critical need for improving follow-up mechanisms for those who fail initial tests. Enhancing parental education, streamlining communication processes, and integrating efficient tracking systems are imperative to reduce the rates of loss to follow-up. Ultimately, addressing these challenges will bolster the effectiveness of early hearing detection and intervention (EHDI) programs, thereby improving language, cognitive, and social outcomes for children with hearing impairments.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All authors have contributed equally

CONFLICT OF INTERESTS

Declared none

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