

Original Research Article

Experience with newborn hearing screening in a tertiary hospital: a 6-month review from Kanyakumari

Jude Anselm Shyras D., Ganapathy S., Subramonia Biju C., Suneer R., Mathan Raj, Kiruthiga R., Anagha A.*

Department of Otorhinolaryngology-Head and Neck Surgery, Kanyakumari Government Medical College and Hospital, Asaripallam, Kanyakumari, Tamil Nadu, India

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*Correspondence:

Dr. Anagha A.,

E-mail: anaghaajayan1995@gmail.com

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ABSTRACT

Background: Early identification of congenital hearing loss is vital for optimal language, cognitive, and social development. Despite its significance, universal newborn hearing screening (UNHS) programs are not well-established in many regions of India. This study aimed to determine the prevalence of congenital hearing loss and assess the performance of otoacoustic emissions (OAE) and brainstem evoked response audiometry (BERA) in a tertiary care setting in Kanyakumari.

Methods: A retrospective review was performed on 830 newborns delivered at Kanyakumari Government Medical College Hospital from July to December 2022. All newborns underwent initial OAE screening within 24 to 72 hours of birth or prior to neonatal intensive care unit (NICU) discharge. Infants failing the second OAE screening were further evaluated with BERA. Relevant risk factors were documented, and families received counselling regarding follow-up.

Results: The incidence of congenital hearing loss was found to be 0.12%. Of the 93 infants who required repeat screening after failing the first OAE, 21 failed the second test, and one was confirmed to have hearing loss through BERA. The first OAE had a sensitivity of 100% and a specificity of 89%, while the second OAE maintained 100% sensitivity and 78% specificity. Family history of hearing impairment was a significant risk factor ($p < 0.001$).

Conclusions: This study highlights the practicality and efficacy of implementing UNHS in resource-constrained areas. OAE proves to be a reliable initial screening method, with BERA serving as a robust confirmatory tool. Improved awareness and access to healthcare can further enhance program success.

Keywords: Hearing screening, Congenital hearing loss, OAE, BERA, Newborn screening

INTRODUCTION

Congenital hearing loss is a significant health concern, with a global incidence ranging from 1 to 3 per 1000 live births.¹ Globally, neonatal hearing screening programs have been implemented to ensure early identification and intervention for hearing impairment.

The prevalence of congenital hearing loss varies widely across different regions and populations. Studies have reported an incidence of hearing loss ranging from 1 to 6

per 1000 live births in India.² A large review by Verma et al reported the incidence of neonatal hearing impairment to be 1.59 to 8.8 per 1000 births, with higher prevalence rates among at-risk neonates (7 to 49.18 per 1000).³ In a tertiary care centre in northern India, Upadhyay et al found an overall incidence of 7 per 1000 births, with significantly higher rates in high-risk neonates (41.38 per 1000) compared to low-risk neonates (2.9 per 1000).⁴ Similarly, Sharma et al reported an incidence of 2 per 1000 births in a rural-based tertiary care hospital in Gujarat, stated that 1.8% of high-risk neonates had confirmed hearing impairment. In a pilot study at a secondary care hospital

in North India, Rawat et al reported an incidence of 2.05% referral rate and an overall incidence of hearing impairment of 7 per 1000 neonates. The study highlighted the importance of using otoacoustic emissions (OAE) followed by brainstem evoked response audiometry (BERA) for accurate diagnosis and emphasized the need for effective follow-up to ensure timely interventions.⁵

Early diagnosis of hearing loss is essential to prevent delays in speech, language, and cognitive development, which can result in long-term social and financial burdens.⁶

Universal newborn hearing screening (NHS) has been shown to be an effective method for early diagnosis of hearing loss. In India, the National Programme for Prevention and Control of Deafness (NPPCD) has promoted NHS, but the coverage remains inconsistent across different regions.⁷ Studies have shown that early screening using OAE and BERA significantly improves the likelihood of detecting congenital hearing loss early.⁸

This study was done in a tertiary care hospital in Kanyakumari that serves a large population in southern Tamil Nadu. There is limited data on the Incidence of congenital hearing loss in this region, and this study aims to fill that gap by assessing the incidence of congenital hearing loss and identifying associated risk factors among newborns delivered at our hospital from July to December 2022. The findings from this study contributes database supporting the effectiveness of NHS programs in India and inform strategies for improving coverage and outcomes in rural and semi-urban populations.

METHODS

Study design

This is a retrospective, hospital record-based study conducted over a period of 6 months, from July 2022 to December 2022, at Kanyakumari Government Medical College Hospital (KGMCH), Kanyakumari, Tamil Nadu, India. The study includes all newborns delivered at KGMCH during the study period.

Study population

The study population comprises all newborns delivered at KGMCH between July 2022 and December 2022. Newborns excluded from the study were: newborns discharged and did not return for follow-up, and newborns who died during the study period.

Study tools

OAE machine was used for initial screening of all newborns for hearing loss.

BERA machine was used as a confirmatory test for newborns who failed the OAE screening.

Screening procedure

All newborns were screened for hearing loss using the OAE test between 24 to 72 hours after birth. For newborns admitted to the neonatal intensive care unit (NICU), screening was performed before discharge, once the newborn's condition stabilized.

Risk factors

Risk factors were assessed based on the guidelines provided by the universal newborn hearing screening (UNHS) program, which include both prenatal, perinatal, and postnatal risk factors. These risk factors encompass maternal health conditions, neonatal complications, and family history of hearing loss, as outlined in the recommended protocols for early hearing detection and intervention. Figure 2 shows the distribution of the risk factors in the study population.⁹

Counselling and follow-up

All mothers or caregivers were routinely counselled regarding the benefits of newborn hearing screening, the procedure, and the need for follow-up if the neonate failed the initial screening. Parents of babies who failed the OAE screening were asked to return for a repeat screening after 1 month. Babies who passed the second screening were excluded from the study. Babies who failed the second screening underwent the confirmatory BERA test. Figure 1 shows the screening protocol.

Confirmatory testing

For newborns who failed the second OAE test, a BERA test was conducted. The procedure was as follows.

Distortion product otoacoustic emission (DPOAE)

It was performed with frequency bands from 1000 to 6000 Hz, stimulus intensity of L1=65 dB SPL, L2=55 dB SPL, and a signal-to-noise ratio of at least 6 dB with a reproducibility score of at least 70%.

BERA

Both ears were subjected to unilateral click-evoked ABR using earphone inserts. Sedation is given if needed after getting paediatric consultation. A single-channel recording was made using standard electrode placement. Stimuli consisted of 1500 click stimuli with rarefaction polarity and a repetition rate of 11.1 clicks per second. The ABR waveforms were analyzed at a 15-20 ms time window. This methodology aligns with the approach detailed by Vignesh et al who reported similar findings in a cohort of 1405 neonates screened at a tertiary care center in Chennai and the American academy of Pediatrics guidelines.¹⁰⁻¹³

Based on BERA results, newborns with confirmed hearing loss were considered positive cases for congenital hearing

loss, that is the incidence in the study. Serological tests for known infective causes (TORCH) were done for these newborns after getting consent from the parents. Figure 1 shows the Newborn hearing screening protocol that was followed.

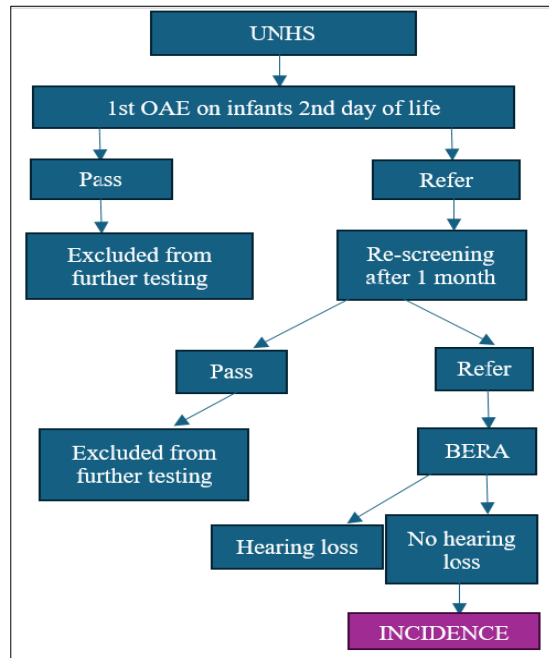


Figure 1: Newborn hearing screening protocol.

RESULTS

In this study, 0.12% of the 830 screened newborns were diagnosed with congenital hearing loss, confirmed by BERA.

Among the risk factors, family history of sensorineural hearing loss (SNHL) was significantly associated with congenital hearing loss (p value <0.001), highlighting its importance. Other factors such as sex, mode of delivery, birth weight, gestational maturity, antenatal history, and NICU admission were not significantly related to hearing loss (p values >0.05) (Figure 2).

In our study, 7% of newborns came from consanguineous marriages, but this was not linked to hearing loss ($p>0.05$). This low rate could be one reason for the reduced incidence of congenital hearing loss in our population.

Out of the 93 newborns who referred on the first OAE test, the second OAE showed refer in 21 newborns. Subsequent testing with BERA confirmed hearing loss in only one neonate (Figures 3 and 4).

The first OAE had a sensitivity of 100% and specificity of 89%, with an accuracy of 89%. The second OAE improved the positive predictive value to 4.76%, while maintaining 100% sensitivity and a specificity of 78%. This demonstrates the high accuracy of OAE as a screening tool for congenital hearing loss, with improved predictive value upon subsequent testing before referral for BERA. Table 1 shows the effectiveness of screening tools in identifying hearing loss among the newborns screened (Figure 5).

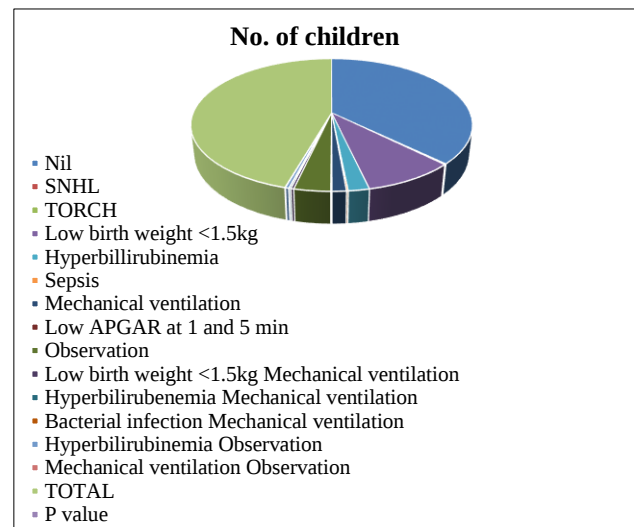


Figure 2: Risk factor distribution.

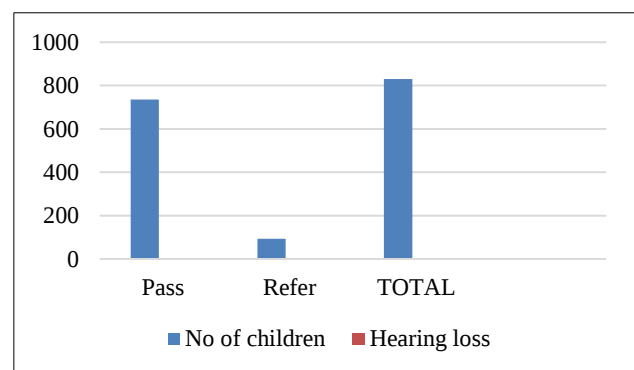


Figure 3: OAE 1 results.

Table 1: Comparison of OAE and BERA.

Test stage	Newborns screened	Referred	Confirmed hearing loss	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
OAE 1	830	93	-	100	89	1.06	100
OAE 2	93	21	-	100	78	4.76	100
BERA (confirmatory)	21	-	1	-	-	-	-

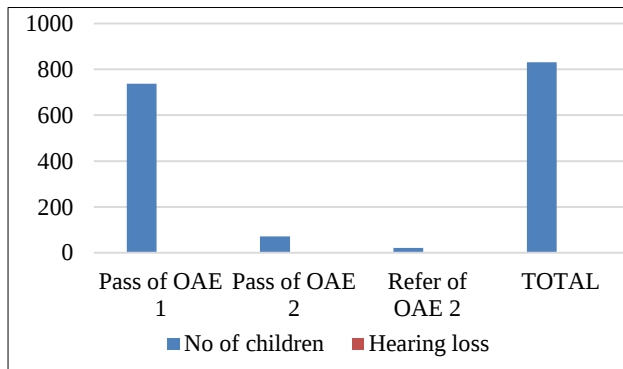


Figure 4: OAE 2 results.

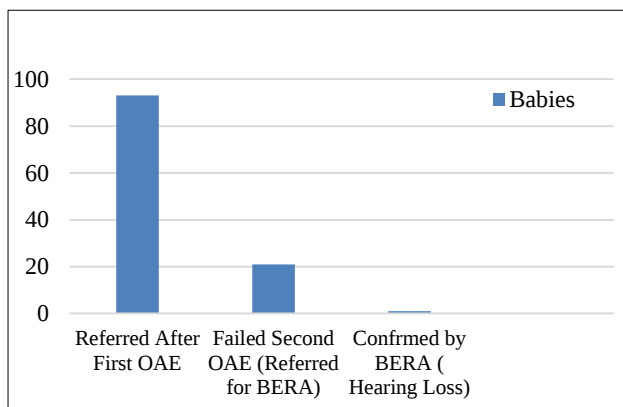


Figure 5: Referral and confirmation rates for congenital hearing loss.

DISCUSSION

Congenital hearing loss is a significant global health issue, affecting early childhood development, particularly in speech and language acquisition. Early identification through UNHS is crucial for timely intervention. In our study, the incidence of congenital hearing loss was found to be 0.12%, which is lower than the reported range in previous Indian studies, such as 0.7% by Upadhyay et al and 2 per 1000 (or 0.2%) by Sharma et al.

Several factors may contribute to this discrepancy. Firstly, regional healthcare variations play a crucial role in the observed differences. Kanyakumari being an urbanised district may have better access to healthcare resources and awareness of newborn screening. Kanyakumari district, in particular, has seen significant healthcare improvements in recent years. Factors such as increased awareness, enhanced antenatal care, and reduced maternal mortality rates could have contributed to the lower incidence of congenital hearing loss in this region. According to the National Family Health Survey (NFHS-5) for Tamil Nadu (2019-21), Kanyakumari has one of the highest rates of institutional deliveries (99.6%) and better maternal healthcare, which positively impacts neonatal health outcomes. Additionally, the district's high immunization rates and improved sanitation have contributed to overall better health indicators.^{14,15} However, the variability in

public awareness and education regarding the importance of early hearing screening could affect screening uptake and referral rates, potentially resulting in fewer cases being identified. Socioeconomic factors, urban versus rural settings, and specific demographic characteristics of newborns in Kanyakumari might differ from those in other studies, thereby impacting the prevalence of congenital hearing loss.

Consanguineous marriages are known to increase the risk of genetic conditions like hearing loss. The low rate of such marriages (7%) in our study could be one reason for the lower incidence of congenital hearing loss, as seen in other studies where higher consanguinity rates led to more hearing loss cases.

Role of OAE and BERA in screening

The role of OAE as a primary screening tool was reinforced in our study. The sensitivity of OAE (both initial and subsequent) was found to be 100%, making it an excellent screening method for early detection of hearing impairment. The positive predictive value (PPV) of the first OAE was low (1.06%), which significantly improved with the second OAE (4.76%). This highlights the necessity of a two-stage screening process, as recommended by international guidelines. A follow-up screening using BERA for confirmation showed that only one neonate, out of the 830 screened, had confirmed congenital hearing loss, demonstrating value of BERA as a definitive diagnostic tool.

Key risk factors

A significant correlation was found between family history of sensorineural hearing loss (SNHL) and congenital hearing loss in our study, with a p value of <0.001, affirming the genetic predisposition to hearing impairment. However, other potential risk factors like birth weight, sex, mode of delivery, and NICU admission did not show a statistically significant relationship with hearing loss. This aligns with the findings of Sharma et al, who reported similar non-significant results for most antenatal and perinatal risk factors.

Comparison with other studies

Our findings align with global data on the utility of OAE and BERA as effective tools for neonatal hearing screening. However, the incidence of hearing loss in our study (0.12%) is on the lower end compared to other Indian studies. Upadhyay et al reported an incidence of 0.7%, with a significantly higher incidence in at-risk neonates (41.38 per 1000 births). This could suggest that a longer study period and larger sample size might reveal a higher incidence rate in our setting. Moreover, unlike Sharma et al, where NICU admission was associated with a higher incidence of hearing loss, our study did not find such a correlation. Korver et al note that genetic factors and early intervention play a significant role in long-term

outcomes, which may explain differences in prevalence across regions. Furthermore, Davis et al emphasizes the importance of early screening in reducing the impact of permanent childhood hearing impairment, this may further validate our findings.¹⁷

Additionally, the smaller sample size of our study, that is 830 newborns, limited duration 6-month could contribute to the observed lower incidence. A larger cohort and extended study duration may yield different results, potentially uncovering higher rates of congenital hearing loss in our population.

Limitations

Limitation of our study is the relatively short time frame (6 months) and the limited sample size (830 newborns). A larger study population and longer follow-up might yield different results, especially regarding the incidence rate. Additionally, failure to follow-up in OAE testing and the unavailability of detailed genetic testing for all neonates could have impacted the results.

CONCLUSION

Our findings highlight a lower incidence of congenital hearing loss (0.12%) compared to previous studies, emphasizing the effectiveness of UNHS programs in identifying hearing impairments early. The necessity for ongoing UNHS initiatives and further research to better understand the epidemiology of congenital hearing loss in diverse regional contexts is evident. Adhering to UNHS guidelines fosters awareness, improves screening practices, and ultimately reduces the prevalence of undiagnosed hearing impairments in infants. Ongoing research and enhanced public health policies will play a critical role in addressing this significant public health issue.

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