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# FREQUENCY OF CONGENITAL HEARING LOSS IN NEONATES

*Original Research*

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## ABSTRACT

**Background:** Congenital hearing loss is one of the most common neonatal sensory deficits, affecting approximately 1–3 per 1,000 live births globally. Early identification during the neonatal period is crucial, as untreated hearing impairment can significantly delay speech, language, and cognitive development. Universal Newborn Hearing Screening (UNHS), supported by otoacoustic emissions (OAE) and auditory brainstem response (ABR), offers an effective strategy for timely detection and intervention in newborns at risk.

**Objective**: To determine the frequency of congenital hearing loss in neonates and assess the association of key demographic and clinical risk factors, including birth weight, gestational age, and family history of hearing impairment.

**Methods**: This cross-sectional study was conducted at CMH Kharian over a 12-month period from May 2023 to May 2024. A total of 200 neonates were consecutively enrolled. All participants underwent UNHS using OAE within the first 48 hours of life. Those who did not pass the initial screening underwent confirmatory ABR testing within one week. Hearing loss was categorized as mild (26–40 dB HL), moderate (41–70 dB HL), or severe to profound (>70 dB HL). Demographic data including birth weight, gestational age, gender, and family history were collected. Chi-square tests were used for statistical association with a significance level set at $p<0.05$.

**Results**: Out of 200 neonates, 15 (7.5%) were diagnosed with congenital hearing loss. Among these, 9 (60%) had mild, 4 (26.7%) moderate, and 2 (13.3%) severe to profound hearing loss. Hearing loss was observed in 8.3% of males and 6.5% of females ($p=0.44$). Low birth weight (<2.5 kg) was significantly associated with hearing loss (12% vs. 7.2%, $p=0.02$). Preterm neonates had a 10% prevalence, though not statistically significant ($p=0.08$). A family history of hearing loss was present in 20% of affected neonates ($p=0.04$).

**Conclusion**: The study identified a 7.5% frequency of congenital hearing loss in neonates, with low birth weight and positive family history emerging as significant risk factors. These findings support the continued implementation and strengthening of universal neonatal hearing screening programs for early detection and intervention.

**Keywords**: Auditory Brainstem Response, Congenital Hearing Loss, Family History, Low Birth Weight, Neonates, Otoacoustic Emissions, Universal Newborn Hearing Screening.

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## INTRODUCTION

Congenital hearing loss represents a major global health concern, particularly due to its profound implications on the development of speech, language, and cognitive abilities during the early stages of life. Affecting approximately 1 to 3 per 1,000 live births worldwide, it stands as one of the most common sensory impairments identified in newborns (1). During the critical period of brain development in infancy, auditory input plays a vital role in shaping linguistic and social competencies. Therefore, even a mild or unilateral hearing deficit, if left undetected, can disrupt a child's developmental trajectory and academic potential (2). The importance of early identification and timely intervention cannot be overstated, as these efforts are instrumental in minimizing the long-term consequences of hearing loss and facilitating better psychosocial and educational outcomes. The etiologies of congenital hearing loss are heterogeneous, encompassing a broad range of genetic, prenatal, perinatal, and environmental factors. Among these, genetic mutations—particularly those disrupting the structural or functional integrity of the cochlea—have been recognized as a predominant cause of sensorineural hearing loss in neonates (3,4). In addition, intrauterine infections such as cytomegalovirus and rubella, as well as complications like prematurity, low birth weight, and neonatal jaundice, have been associated with heightened risk for auditory impairment (5). Despite growing awareness and advancements in universal newborn hearing screening (UNHS) protocols across high-income countries, disparities remain, especially in low- and middle-income regions where healthcare infrastructure is often insufficient (6,7).

Delayed or missed diagnoses in these settings may be attributed to limited screening coverage, lack of trained personnel, and inadequate follow-up services (8). Current literature underscores the urgent need to strengthen early hearing detection and intervention systems globally, particularly in resource-constrained environments where the burden of undiagnosed congenital hearing loss continues to rise (9). While global efforts have led to notable progress in standardizing screening practices, significant gaps remain in understanding the regional frequency and context-specific risk factors associated with neonatal hearing loss. Addressing this knowledge gap is essential to informing public health strategies and tailoring screening programs to the unique needs of specific populations. In light of these considerations, the present study aims to determine the frequency of congenital hearing loss in neonates and to investigate the associated risk factors within a defined population (10).

## METHODS

This cross-sectional study was conducted at the Combined Military Hospital (CMH) Kharian over a period of one year, from May 2023 to May 2024, with the objective of determining the frequency of congenital hearing loss in neonates and identifying associated risk factors. The sample size was initially calculated as 20 using the WHO sample size calculator, based on a reported prevalence of congenital hearing loss of 1.3%, with a 95% confidence interval and a 5% margin of error (11). However, to enhance the generalizability and external validity of the findings, the sample size was pragmatically increased to 200 neonates. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of CMH Kharian and all parents or legal guardians provided written informed consent prior to enrollment of neonates into the study. Participants included all neonates born at CMH Kharian during the study period, irrespective of gestational age or birth weight. Neonates with postnatally acquired hearing loss due to infections, trauma, or other causes were excluded from the analysis to ensure the study focused solely on congenital cases. A consecutive sampling technique was employed to select the 200 neonates, thereby capturing a representative cross-section of the hospital's birth population.

Each enrolled neonate underwent a standardized Universal Newborn Hearing Screening (UNHS) protocol. This involved the administration of otoacoustic emissions (OAE) testing within the first 48 hours of life. For neonates who failed the initial OAE screening, a confirmatory auditory brainstem response (ABR) test was performed within the subsequent week to establish the diagnosis of hearing loss. A neonate was considered to have congenital hearing loss only if both OAE and ABR tests yielded abnormal results. Based on auditory thresholds, hearing impairment was further categorized into mild (26–40 dB HL), moderate (41–70 dB HL), and severe to profound (>70 dB HL) degrees (12,13). Demographic and clinical data were meticulously collected through hospital records and structured interviews with the mothers. Variables documented included gender, gestational age at birth, birth weight, maternal age, family history of hearing loss, and any relevant antenatal or perinatal complications. This comprehensive dataset allowed for a multifactorial analysis of potential risk factors. Statistical analysis was performed using SPSS software. Descriptive statistics, including

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means, standard deviations, frequencies, and percentages, were used to summarize the data. The primary outcome—the frequency of congenital hearing loss—was calculated based on the number of neonates diagnosed within the study cohort. Chi-square tests were conducted to assess associations between hearing loss and categorical variables such as gender, maternal age, and birth weight, with a p-value of <0.05 considered statistically significant.

## RESULTS

A total of 200 neonates were enrolled in the study, comprising 108 males (54%) and 92 females (46%). The mean birth weight was recorded at 3.2 kg, while the mean gestational age was 38.5 weeks. Among the total participants, 15 neonates (7.5%) were diagnosed with congenital hearing loss based on confirmatory otoacoustic emissions and auditory brainstem response testing. The severity distribution revealed that 9 neonates (60%) had mild hearing loss, 4 neonates (26.7%) had moderate hearing loss, and 2 neonates (13.3%) presented with severe to profound hearing loss. When stratified by gender, the frequency of hearing loss in male neonates was 8.3% (9 out of 108), whereas in females it was 6.5% (6 out of 92); however, this difference did not reach statistical significance ($p = 0.44$). Analysis based on birth weight indicated that neonates with low birth weight (< 2.5 kg) exhibited a higher prevalence of hearing loss at 12%, in contrast to 7.2% among those with normal birth weight, with this difference being statistically significant ($p = 0.02$). Similarly, preterm neonates (gestational age < 37 weeks) demonstrated a 10% frequency of hearing loss compared to 7% in term neonates; although this trend suggested increased risk, it was not statistically significant ($p = 0.08$). Regarding familial predisposition, 3 neonates (20%) among those diagnosed with congenital hearing loss had a positive family history of hearing impairment. A statistically significant association was noted between family history and congenital hearing loss ($p = 0.04$), underscoring the genetic contribution to neonatal auditory deficits.

**Table 1: Demographic Profile of Neonates**

| Variable | Value |
|---|---|
| Total Neonates | 200 |
| Male | 108 (54%) |
| Female | 92 (46%) |
| Mean Birth Weight (kg) | 3.2 |
| Mean Gestational Age (weeks) | 38.5 |

**Table 2: Severity Distribution of Hearing Loss**

| Severity | Number of Neonates | Percentage of Cases |
|---|---|---|
| Mild | 9 | 60% |
| Moderate | 4 | 26.7% |
| Severe to Profound | 2 | 13.3% |

**Table 3: Gender-wise Distribution of Hearing Loss**

| Gender | Total | Cases of Hearing Loss | Percentage | p-value |
|---|---|---|---|---|
| **Male** | 108 | 9 | 8.3% | 0.44 |
| **Female** | 92 | 6 | 6.5% | 0.44 |

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**Table 4: Risk Factor Association with Hearing Loss**

| Risk Factor | Frequency of Hearing Loss | p-value |
|---|---|---|
| Low Birth Weight (<2.5 kg) | 12% | 0.02 |
| Normal Birth Weight | 7.2% | 0.02 |
| Preterm (<37 weeks) | 10% | 0.08 |
| Term (≥37 weeks) | 7% | 0.08 |
| Family History Present | 20% | 0.04 |

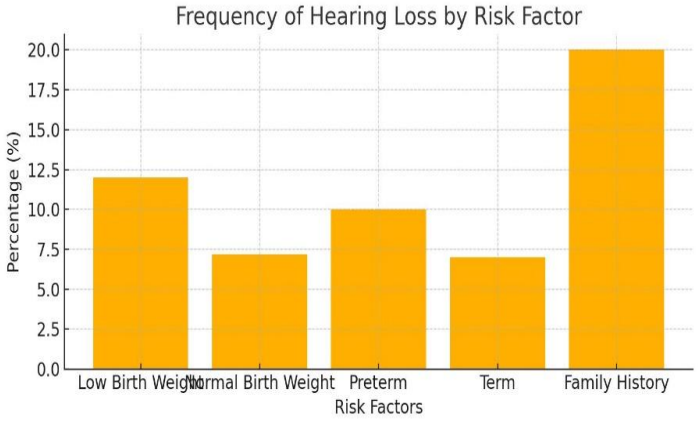


*Figure 1 Frequency of Hearing Loss by Risk Factor*

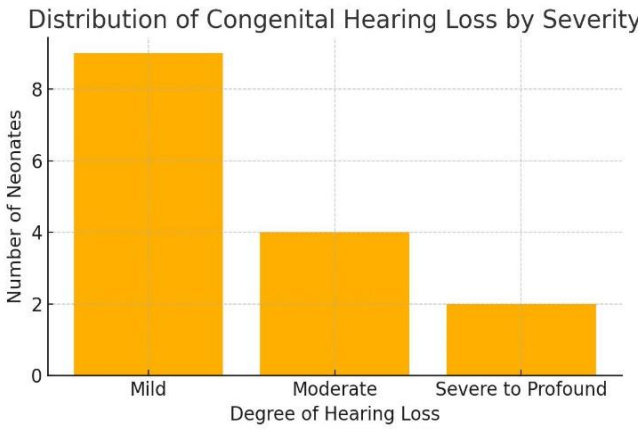


*Figure 2 Distribution of Congenital Hearing Loss by Severity*

## DISCUSSION

The findings of the present study revealed that congenital hearing loss affected 7.5% of neonates, with the majority exhibiting mild hearing impairment. This frequency is notably higher than global estimates, which place the prevalence between 1 to 3 per 1,000 live births (14). The elevated percentage observed may reflect differences in population characteristics, local environmental exposures, or the inclusion of high-risk neonates in the sample. Nonetheless, the results reaffirm the critical need for early screening, as undiagnosed hearing loss during the neonatal period can severely compromise the acquisition of speech, language, and cognitive skills during early childhood (15). Gender did not appear to be a significant factor in the distribution of hearing loss in this study, as the incidence was relatively similar between male and female neonates. This aligns with established evidence suggesting that congenital hearing loss is not strongly influenced by sex (16). In contrast, low birth weight was significantly associated with a higher frequency of hearing impairment, supporting prior studies that identify intrauterine growth restriction and associated complications as contributing factors to auditory dysfunction (17). Neonates weighing less than 2.5 kg demonstrated a 12% rate of hearing loss, suggesting a need for targeted auditory monitoring in this vulnerable subgroup during early neonatal care.

Preterm birth also demonstrated a trend toward increased hearing loss, although statistical significance was not achieved. The potential for auditory damage in preterm infants has been attributed to a combination of immature cochlear development, exposure to ototoxic medications, and prolonged stays in intensive care units (18). The lack of statistical significance in this finding may be attributed to a

limited number of preterm neonates within the study population (19). This limitation highlights the need for larger studies specifically powered to assess gestational age-related risk in greater depth. A significant association was found between congenital hearing loss and a positive family history of auditory impairment, reinforcing the well-documented role of genetic factors in congenital deafness (20). In this study, 20% of affected neonates had a familial predisposition, which corresponds with estimates reported in previous research across various populations (21). This underscores the importance of incorporating family history assessments as a routine part of neonatal risk evaluation during auditory screening. The screening protocol employed, which combined otoacoustic emissions (OAE) with follow-up auditory brainstem response (ABR) testing, proved effective in detecting congenital hearing impairment. This two-tiered approach is endorsed by the World Health Organization as a reliable strategy for early identification of neonatal hearing loss (21.22). The study's strength lies in its utilization of both objective tools within a universal newborn hearing screening framework, which minimized the likelihood of missed cases.

Despite these strengths, several limitations merit consideration. The study was conducted at a single center with a sample size of 200, which may limit the generalizability of the findings. Moreover, the exclusion of neonates with postnatal-acquired hearing loss may underestimate the broader burden of hearing impairment. The study did not evaluate several other known risk factors, such as maternal infections (e.g., rubella, CMV), NICU admission, consanguinity, APGAR scores, or exposure to ototoxic medications. The absence of these variables may have limited the scope of risk factor analysis and their potential confounding effects. Furthermore, the relatively small number of preterm or low birth weight infants may have impacted the statistical power for subgroup analyses. Future research should consider a multicenter design with larger and more diverse populations to validate these findings and better capture the epidemiology of congenital hearing loss. Inclusion of a broader range of risk variables, long-term developmental follow-up, and cost-effectiveness evaluations of screening programs would further enhance understanding and policy planning. In summary, this study contributes to the growing body of evidence supporting early identification of congenital hearing loss, especially among neonates with identifiable risk factors such as low birth weight and positive family history. Implementation of universal newborn hearing screening remains a vital public health measure to ensure timely diagnosis and intervention, thereby promoting better developmental outcomes in affected children.

## CONCLUSION

This study concludes that congenital hearing loss remains a significant concern among neonates, with strong associations observed with low birth weight, preterm birth, and a positive family history. The findings reinforce the critical need for universal newborn hearing screening programs as an essential component of early neonatal care. Early detection not only facilitates timely interventions but also supports better developmental, social, and educational outcomes for affected children. By identifying at-risk groups, the study contributes valuable insight toward refining screening protocols and guiding future healthcare strategies aimed at minimizing the long-term impact of undiagnosed hearing impairment.

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**Author Contributions**

| Author | Contribution |
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| Iqra Irfan* | Substantial Contribution to study design, analysis, acquisition of Data<br>Manuscript Writing<br>Has given Final Approval of the version to be published |
| Farooq Ikram | Substantial Contribution to study design, acquisition and interpretation of Data<br>Critical Review and Manuscript Writing<br>Has given Final Approval of the version to be published |
| Adeel Mehmood | Substantial Contribution to acquisition and interpretation of Data<br>Has given Final Approval of the version to be published |
| Basma Fatima | Contributed to Data Collection and Analysis<br>Has given Final Approval of the version to be published |
| Anum Pervaiz | Contributed to Data Collection and Analysis<br>Has given Final Approval of the version to be published |
| Tariq Nadeem | Substantial Contribution to study design and Data Analysis<br>Has given Final Approval of the version to be published |

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