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# COMPARITIVE STUDY OF HEARIG ASSESSMENT IN NORMAL and HIGH RISK INFANTS BY NEWBORN HEARING SCREENING

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## ABSTRACT

***Background:*** *Early identification of hearing impairment in neonates is crucial for timely intervention, which can significantly impact speech, language, and cognitive development. This study focuses on the comparative assessment of hearing in normal and high-risk infants using newborn hearing screening methods.*

***Objective:*** *To compare the incidence and outcomes of hearing assessments in normal and high-risk infants using Otoacoustic Emissions (OAE) and Auditory Brainstem Response (ABR) tests, and to evaluate the effectiveness of these screening methods in identifying hearing impairment.*

***Methodology:*** *A comparative case-control study was conducted at the Superior University Lahore and data were collected from Hameed Latif Hospital Lahore. The sample size of 292 normal and high risk infants was calculated. Newborns underwent OAE screening within 24 hours of birth, with follow-up screenings at 1 and 2 months if initial results indicated a "refer." Infants who failed the follow-up OAE screenings were referred for ABR testing to confirm the diagnosis.*

***Results:*** *The study revealed a higher prevalence of hearing impairment in high-risk infants compared to normal infants. The OAE test proved effective in early detection, while the ABR test provided reliable confirmation of hearing loss. Early intervention in infants who failed both OAE and ABR tests led to improved outcomes in speech and language development.*

***Conclusion:*** *Newborn hearing screening is essential for the early detection of hearing impairment, particularly in high-risk infants. The use of OAE followed by ABR testing offers a robust protocol for identifying infants in need of early intervention. This study highlights the importance of universal newborn hearing screening to prevent delays in treatment and improve long-term developmental outcomes.*

***Key words:*** *Newborn Hearing Screening, Otoacoustic Emissions, Auditory Brainstem Response, Hearing Impairment, High-Risk Infants*

## INTRODUCTION

Hearing is one of the major senses that human organs of perception can actually detect. Stimuli that the child hears have a critical influence in the speech and language acquisition of a child. This is the reason for communicate and make relations. Hearing helps a child to engage with someone for listen, laugh, play, enjoy and for the maintains of a better quality of life. The child learns speaking on the basis of what they heard. [1]

Also, hearing impairment also culminated to delays in speech and language development among children. Hearing impairment is thus very important to diagnose early in neonates particularly if the impairment is likely to be drastic within the early years. Infants and children seen by the pediatrician should be diagnosed appropriately, provided early appropriate care if he or she comes across as at risk and refer patients when necessary.[2] General according the United Nations' World Health Organization this number will be 5. A statistic event suggests that 3% of the global population is deaf. Hearing impaired means those who are having 40 dB or more hearing loss in the better hearing ear in the adult and 30 dB or more hearing loss in the better hearing in the child.[3] Congenital hearing loss is most prevalent in South Asia and the Asia Pacific region, followed by the Sub-Saharan Africa. [5]Congenital hearing loss estimation reveals that the incidence rate for neonates and high risk infants is 1. 3 to 5. 7 per 1000. The potential causes which can cause congenital hearing loss include diabetic mothers, high blood pressure level after 6 months of pregnancy, low birth weight, jaundice, anoxia, hypoxia etc.[6]Congenital loss is present by birth when the ability of an ear to converting vibratory mechanical energy of a sound into electrical impulses is impaired. Hearing loss varies according to the site of lesion. Conductive hearing loss is arise when the outer and middle ear are effected in this situation sound waves cane not propagate in the ear.[7] Sensory neural hearing loss occurs when the inner ear and auditory pathway are affected in this situation problem may arise due to the outer hair cells and also due to the auditory nerve call auditory neuropathy. Mixed hearing loss has characteristic of both conductive and sensorineural hearing loss. [8]Hearing impairment is not assessed visually. We need some screening and diagnostic assessments to find this impairment. Late detection and treatment can cause children with poor speech development. Hearing screening plays an important role for the early detection of hearing loss in neonates.[9] Newborn Hearing screening programs are introduced by most of the countries to prevent the issues of hearing. Theses screening programs help in the early diagnosis and intervention of a child.[10] the delay in diagnosis of loss will leads to adverse effects on child speech & language development and on the cognitive skills. Hearing screening programs suggest the 1-3-6 rule. It explains a newborn must be screen in the first month of age, diagnosed in the third month of age, and treatment must be stars in the 6 month of the age. [11] Pakistan is a developing country and five most densely populated country in the world with expressible part of the population having hearing loss with deafness identified late most commonly seen in between 19-24 months i. e, 48% compared with 22% of the children in between 0-6 months of age. [12]For the detections of hearing loss clinically two method s are used called Otoacoustic emission (OAE) and auditory brainstem response Audiometry (ABR). In Otoacoustic emission there are two types of testing transient Evoked Oto-acoustic emission (TEOAEs) and distortion product. Both are mostly use for screening and very quick methods. The probe tip of OAEs is placed in the ear canal of the neonate, this probe tip consists of microphone which presents the stimulus (click or tone bursts) to the hair cells of the cochlea in the inner ear. Otoacoustic emission (OAE) shows the result in the form of "Pass" and "Refer". If OAEs result show "pass" it means, there no risk of impairment and if it shows "refer" it means there is risk of hearing impairment due to fluid and vernix or debris and any other issue present in the outer or middle ear of the infant .It must be done for a baby discharge from the hospital or in first 72 hours. If an infant first screening is failed we guide them for a follow up after 1 month. If second screening is passed means hearing is normal and if second screening is failed we refer them for an ABR to the diagnosis and management.[13]

## MATERIALS AND METHODS

3.1 Research design:

It is the comparative case control study.

3.2 Clinical setting:

This study was conducted at superior university in the department of rehabilitative sciences and data was collected from Hameed Latif Hospital Lahore.

3.3 Sample size:

It was calculated by 95% confidence interval through an online calculator and its results is n=292.

$$n = \frac{z^2 (1-d/2)\, pq}{d^2}$$

3.4 Sampling technique:

Non probability convenient sampling technique was followed.

3.5 Duration of study:

Study was completed in 6-12 months after approval of synopsis.

3.6 Selection criteria:

3.6.1 Inclusion criteria:

All newborn males and females were included in the study.

3.6.2 Exclusion criteria:

Newborn with congenital anomalies like Anotia, Microtia, Artesia and stenosis of external canal will be excluded from this study.

3.8 DATA COLLECTION PROCEDURE:

Once the approval of ethical committee is obtained a letter will be written to the institutional head from where data is planned to be collected. Upon obtaining a signed permission letter for data collection researcher will visit the research setting where he/she will obtain contact information of subjects meeting inclusion criteria. Personally, the participant's consent will be sought from parents of the participants and they will be informed on the reason for the study. After getting the signed consent, Patients' general information such as name, age, education and other personal and Audiological and medical details will be obtained. First we are going to perform Otoscopy, next will do Transient Evoked Otoacoustic emissions for hearing test. First screening will be done in early 24 hours. If first screening is refer then second and third screening is done in OPD at 1 and 2 months of age. Then we compare the result of all screenings.

**3.9 DATA COLLECTION TOOLS:**

For hearing screening we use Otoacoustic Emission machine.

**Initial Screening**: Perform the first OAE screening within 24 hours of birth.

**Follow-up Screenings**: If the initial screening shows a "refer" result, follow-up screenings should be conducted at 1 and 2 months of age.

**Comparison**: Compare the results of all screenings to determine the incidence of hearing impairment in the study groups.

With OAE, we use predesigned questionnaire for effectively collection of data.32

**3.10 DATA ANALYSIS:**

Data analysis was done using SPSS Version 21.0 software. Results will be measured in the form of frequency and percentage for qualitative variables & mean and standard deviation for quantitative variables test will be used to determine the outcomes of hearing screening in risk and non-risk neonates. The significant level was set as equal as or less than $p < 0.05$.

## Results

**Table 4. 1 Statistics of gestational age**

| Statistics of Gestational age (weeks) | |
|---|---|
| N | 292 |
| Mean | 36.4726 |
| Std. Deviation | 2.96067 |
| Minimum | 23.00 |
| Maximum | 44.00 |

The data on gestational age, based on a sample size of 292, shows an average (mean) gestational age of 36.47 weeks with a standard deviation of 2.96 weeks, indicating some variability around the mean. The gestational ages in the sample ranged from a minimum of 23 weeks to a maximum of 44 weeks, reflecting a wide range of gestational periods within this population.

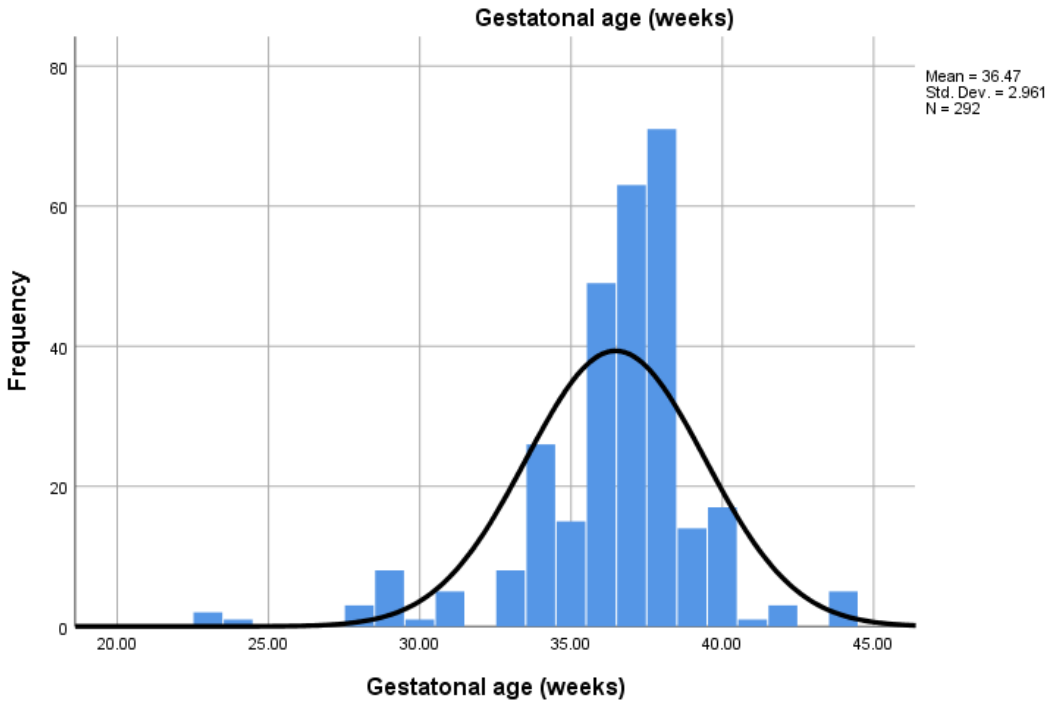


**Figure 4. 1 Histogram of maternal age**



**Table 4. 2 of Gender**

The gender distribution in the sample of 292 individuals shows that 60.6% (177 individuals) were male and 39.4% (115 individuals) were female. This indicates a greater proportion of males compared to females in the study, with the total sample being evenly represented across both genders.

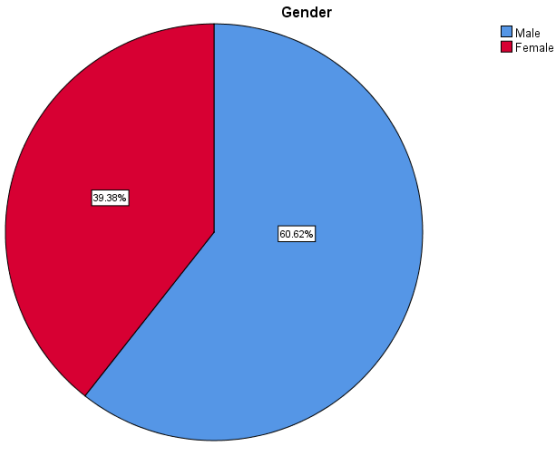


**Figure 4.2 pie chart of gender**

**Table 4.3 Cross Tabulation**

| First OAEs | Normal | High Risk | Total |
|---|---|---|---|
| Pass | 97 | 55 | 152 |
| Refer | 46 | 94 | 140 |
| Total | 143 | 149 | 292 |
| 2nd OAEs | | | |
| Pass | 59 | 24 | 83 |
| Refer | 17 | 40 | 57 |
| Total | 76 | 64 | 140 |
| 3rd OAES | | | |
| Pass | 19 | 13 | 32 |
| Refer | 9 | 16 | 25 |
| Total | 28 | 29 | 57 |

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In the initial OAE testing, a total of 292 infants were assessed. Among the normal group, 97 infants (67.8%) passed the test, while 46 infants (32.2%) referred for further evaluation. Conversely, in the high-risk group, 55 infants (36.9%) passed, and 94 infants (63.1%) referred. The results indicate that a higher percentage of infants in the normal group achieved passing results compared to those in the high-risk group.The second round of testing involved 140 infants. Here, the pass rate for the normal group decreased to 59 infants (77.6%), while the refer rate was 17 infants (22.4%). In the high-risk group, only 24 infants (37.5%) passed, with 40 infants (62.5%) referring. These results suggest that while the normal group maintained a relatively high pass rate, the high-risk group continued to exhibit a significantly lower pass rate compared to their normal counterparts.

The final round of testing recorded 57 infants. In this assessment, the pass rate for the normal group further declined, with 19 infants (67.9%) passing, while 9 infants (32.1%) referred. The high-risk group showed a slight improvement with 13 infants (44.8%) passing and 16 infants (55.2%) referring.

**DISCUSSION**

The findings of this study provide critical insights into the effectiveness of newborn hearing screening, particularly in differentiating between normal and high-risk infants. The results emphasize the importance of early identification of hearing impairment, which can significantly impact a child's speech, language, and cognitive development.[32]

A previous study is conducted by Rosa Falerina in 2023 highlighted that high risk infants had a greater chances to hearing impairment compare to normal one. A total of 60 new borns are assessed. The first screening is done in first 24 hours and was repeated in the age of 1 and 2 months then the compare the results of all 3 screenings. They found hearing impairment is high in risk neonates and referrals are decreased by follow-up screenings.[33]

The study observed a higher prevalence of hearing impairment among high-risk infants compared to their normal counterparts. This aligns with existing literature, suggesting that infants with risk factors such as low birth weight, prematurity, and exposure to ototoxic medications are more susceptible to hearing loss. [34]The successful application of Otoacoustic Emissions (OAE) and Auditory Brainstem Response (ABR) tests in this

study highlights their reliability as screening tools. OAE, being non-invasive and quick, serves as an effective first-line screening method, while ABR provides a confirmatory diagnosis for those who fail initial screenings.[35]

The significant rate of referral among high-risk infants underlines the necessity for universal newborn hearing screening programs. The "1-3-6" guideline, which advocates for screening by 1 month, diagnosis by 3 months, and intervention by 6 months, was supported by the outcomes of this research. Early detection allowed for timely intervention, which is crucial in preventing delays in speech and language development. The study's findings suggest that implementing universal newborn hearing screening, especially in high-risk populations, could greatly improve early diagnosis and intervention rates. The early identification of hearing loss allows for prompt management, including the use of hearing aids or cochlear implants, which can mitigate the adverse effects of hearing impairment on a child's development.[36]

Moreover, the study advocates for the use of both OAE and ABR in a two-tiered screening approach. This method reduces the likelihood of false positives and ensures that infants who require further evaluation receive appropriate diagnostic testing. Clinicians should be aware of the limitations of each test and consider additional factors, such as the presence of vernix or middle ear effusion, which can affect OAE results.[37]

Compared to previous studies, this research confirms the higher incidence of hearing impairment in high-risk infants and supports the use of OAE and ABR as complementary tools in newborn hearing screening. Other studies have similarly found that high-risk infants, particularly those in Neonatal Intensive Care Units (NICUs), are more likely to experience hearing loss, further validating the study's conclusions. The current study builds on these findings by providing a detailed comparison between normal and high-risk infants within a specific population, thus contributing to the body of knowledge on the effectiveness of newborn hearing screening.[3]

**CONCLUSION:**

In conclusion, the study reinforces the critical role of newborn hearing screening in detecting hearing loss, particularly among high-risk infants. The combined use of OAE and ABR tests offers a robust approach to early identification, allowing for timely intervention that can significantly improve long-term developmental outcomes. As such, universal screening programs should be implemented and refined to ensure all infants receive the benefits of early detection and intervention.

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