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# Hearing Impairment and its Associated Causes among Children below 5 year Age Group using Brainstem Evoked Response Audiometry

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## Article Info

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**Keywords:** Hearing Impairment, Brainstem, Audiometry, ototoxic drugs and speech & language development.

## Introduction

The ability to communicate is a crucial aspect of human life. Auditory acuity is very important for communication of any kind [1].

Two-thirds of people with hearing impairment worldwide live in developing countries. But the effects of the hearing loss are often overlooked and have not received proper attention, public-health funding and services that it deserves [2].

Reports from developing countries show the prevalence of hearing impairment among school children varying from 5.6% to 34%, least being in Kenya (5.6%) [3], and highest being in India (34%) [4].

Brainstem Auditory Evoked Responses (BAER) or Auditory Brainstem Response (ABR) is the most common application of auditory evoked responses to test both ear and brain. It is an objective hearing test based on the recording of electrical potentials at the brainstem, generated in response to an auditory stimulus [5].

Prevalence of hearing impairment & hearing sensitivity among children will help us to know the burden of disability among children of below 5 years of age group, hence early diagnosis & rehabilitative procedure can be started which will help in speech and language development.

## Material and Methods

The current study was a cross-sectional observation study. Children between zero to five years of age consulting or referred to ENT OPD, and Pediatric neurology OPD who fulfilled the inclusion criteria of study were included after taking informed consent.

Various studies showed the prevalence of hearing impairment in children as 60%. Hence a sample size of 96 was worked out. Thus, a total of 100 children were included in this study and 200 ears were evaluated.

## Selection Criteria

Children of under five years of age with delay or no speech and language development, inconsistent response to sound or inability to respond to sound and history suggestive of

high risk factors such as deafness in the family, consanguineous marriage in parents, difficult/obstructed labor, prematurity/low birth weight in infants, administration of ototoxic drugs likes amino glycosides either in mother during pregnancy or in the child, maternal infections like toxoplasmosis, rubella, cytomegalo virus, herpes were part of the study. In addition to this, children with ear malformations / infection and children brought with concern of parents about hearing sensitivity, learning disability noticed in school/ craniofacial malformations were also included in the study.

A pre-designed and pretested questionnaire was used to record the information. Examination of the participants included general physical examination and ENT examination. Examination of ear included pinna, preauricular area, post auricular area, external auditory canal; tympanic membrane and clinical testing of facial nerve function.

## BERA Test

All children underwent BERA test as per the standard protocol. From the BERA waves following were considered:

1. Threshold level
2. Latency of each wave
3. Interpeak latency

## Data Analysis

Data analysis was done by using rates, ratios and percentages by Descriptive Statistics.

## Results

Out of 100 cases neonates were 16 (16%), children of 1 month to less than one year were 27 (27%), one to three years were 38 (38%), 4 to 5 years were 19 (19%). The average age was 1.72 years. Males were predominant with 58% preponderance as opposed to females with 48% in this study.

11 of the total number of cases(11%) showed bilateral microtia out of which 9 cases (9%) showed stenosis of external auditory canal and tympanic membrane was not visualized due to stenosis in 4 cases (4%) of cases in right ear and 3 cases (3 %) in left ear. 2 of the cases showed right sided facial weakness. Tympanic membrane perforation was seen in 3 cases (3%) of right ear and 1 case (1%) of left ear.

## Hearing Sensitivity

**Normal Hearing Threshold (≤50-65 dB):** observed in 41 cases (41%) in right ear and 35 cases (35%) in left ear.

**Mild Degree Hearing Loss (65-80 dB):** observed in 03 cases (3%) in right ear and 01 case (1%) in left ear.

**Moderate Degree Hearing Loss (81-100 dB):** observed in 14 cases (14%) in right ear and 16 cases (16%) in left ear.

**Severe Degree Hearing Loss (101-120 Db):** observed in 12 cases (12%) in both the ears.

**Profound Degree Hearing Loss (>120Db) or Absent Waveforms:** observed in 30 cases (30%) in right and 36 cases (36%) of left ears.

**Normal Results:** Normal BERA findings were noted among 36 cases (36%) in the right ear and 30 (30%) in left ear.

**Abnormal Latency (AL):** Abnormal latency was found among 2 cases (2 %) in right ear and 4 cases (4%) in left ear.

**Abnormal Threshold (AT):** Abnormal threshold was noted among 20 cases (20%) in right ear and 11 cases (11%) in left ear.

**Both Abnormal Threshold & Latency (AT & AL):** were found in 18 cases (18%) of cases in right ear & 26 cases (26%) in left ear.

Cerebral palsy, mental retardation, ototoxic drugs, meningitis, prolonged labour, low birth weight, respiratory distress and maternal infections, all of them had hearing loss.

## Discussion

In our study the age group ranged from 0 to 5years. The average age was 1.72 years which was comparable with the study conducted by K. K. Desarda [6]. Male preponderance was comparable to studies done by Rout N et al, with male to female ratio of 1.19:1.00 [7]. The above studies aimed at assessing the hearing loss in 0 to 5 years of age which is the most vulnerable age for risk factors induced hearing loss, and also since speech development occurs in this age group.

In the present study, cases with inconsistent or no response to sound were seen in 69 (69%), delayed or no development of speech were in 53 (53%) and cases with ear malformations were 11 (11%).

## BERA Results

Normal threshold in our setup was taken as threshold values less than or equal to 50dB which elicit all the waveforms (Wave I to Wave V) and having proper morphology. Threshold values more than normalcy were taken as abnormal threshold for hearing, having some form of hearing impairment.

The mean absolute latencies of each wave were taken. The mean normal absolute latencies of Wave I is 1.75 msec, Wave II is 2.8 msec, Wave III is 3.9 msec, Wave IV is 5.1 msec, Wave V is 5.7 msec. The interpeak latency of waves I- III is 2.1 msec, I- V is 4.0 msec.

For practical convenience, wave I, Wave III, Wave V and inter peak latencies of waves I- III, I- V were taken which is more relevant than Wave II and Wave IV.

## Hearing Sensitivity of Children

**Normal Hearing Threshold (≤50-65 dB):** Observed in 41 cases (41%) in right ear and 35 (35%) cases (35%) in left ear. This was comparable with study by K.K. Desarda who reported 53 cases with normal hearing sensitivity in 150 children, this almost equates to 35.33% with normal hearing sensitivity [6].

**Mild Degree Hearing loss (65-80 dB):** Observed in 03 cases (3%) in right ear and 01 case (1%) in left ear. Sculerati N et al reported 23% of bilateral and 16% of unilateral cases with mild degree hearing loss [8]. K.K. Desarda reported 12 out of 150 cases with mild hearing [6].

**Moderate Degree Hearing Loss (81-100 dB):** Observed in 14 cases (14%) in right ear and 16 cases (16%) in left ear. Sculerati N, et al. Reported 30% in bilateral and 32% in unilateral cases [8]. K.K. Desarda reported 21 out of 150 cases with moderate degree hearing loss [7].

**Severe Degree Hearing Loss (101-120 Db):** Observed in 12 cases (12%) in both the ears. Sculerati N et al reported 20% in bilateral and 10% in unilateral cases [8]. K.K. Desarda reported 30 cases with severe hearing impairment in 150 children [7].

**Profound Degree Hearing Loss (>120Db) or absent waveforms:** Observed in 30 cases (30%) in right and 36 cases (36%) of left ears. Sculerati N reported 28% in bilateral cases and 42% in unilateral cases [8]. K.K. Desarda reported 34 cases with profound hearing loss in 150 children [7].

In normal hearing threshold group, 5 of 41 cases in right ear and 5 of 35 cases in left ear had abnormal latency periods of one or more waveforms and hence even threshold was normal they were considered to have hearing impairment. These children need strict follow-up and repeat tests for future monitoring of hearing level.

## Associated Factors in Hearing Loss

### Consanguinity

Seen in 36 cases out of which 26 (72.22%) were having hearing loss. This shows high degree of prevalence in those with a history of consanguinity among parents[9] and the need for genetic counseling.

Genetic disturbances caused due to consanguinity disturb the pathway of Planar Cell Polarity (PCP), which is involved in the formation of the polarized structure of the auditory sensory organ and regulates the embryonic development [9].

### Family History of Hearing Loss

Positive family history seen in 15 cases out of which 80% were having hearing loss. Saunders J. E. et al study in 96 cases showed family history of hearing loss in 33% [10]. Another study conducted by Cone BK, et al. In 6581 children reported 25% of cases positive family history [11]. Rout N et al reported 9.27% with positive family history of hearing loss in 1000 cases [7].

This directly reflects the inherent variations expected out of various epidemiological, geographical differences in various parts of the world and also highlights that in India a high corelation exists with the family history stressing the importance of early diagnosis by BERA and appropriate treatment.

### Hyperbilirubinemia

Noted in 12 cases out of which 50% were having hearing loss.

### Ear Malformation

Seen in 11 cases out of which 90.91% were having hearing loss. Two of the microtia cases showed right sided facial weakness but no other craniofacial malformations and systemic examination was normal. Hence these two cases were not attributed to any syndrome.

### Head Injury and Sepsis

Seen in 1% among each. The case which sustained head injury was of less severity and child did not have any hearing loss.

In this study cerebral palsy was seen in 5 cases, mental retardation in 4 cases, ototoxic drugs in 4 cases, meningitis in 3 cases, prolonged labor in 3 cases, low birth weight in 3 cases, respiratory distress in 3 cases, maternal infections in 2 cases, out of which all of them had hearing loss. This indicates the association with multiple varieties of etiologies and hence the need for universal screening.

## Conclusion

In our study the overall prevalence of hearing impairment in children below five years of age who presented with speech delay and were at high risk of hearing loss is 75%. This shows the high prevalence rate of hearing impairment. Hence as per the WHO, Primary Ear and Hearing Care (PEHC) have a major role to play. This program focuses on public health aspects of otology which includes promotive, preventive and therapeutic measures for ear care. WHO activities aim at encouraging and assisting countries to devise and implement National Programs for prevention of deafness and hearing impairment where none exists or to strengthen an existing program [12].

BERA being a sensitive and quite inexpensive appropriate and objective test, can be used for screening all the neonates at risk, those with positive family history of hearing loss, children with speech development abnormalities and other craniofacial malformation groups if universal screening for hearing is not feasible.

In our study majority of the cases were having moderate to severe and profound degree hearing loss. BERA helps in early diagnosis and hence prevents the vulnerable children from developing hearing impairment and its resultant complications. Early rehabilitation helps in acquiring cognitive skills and development of speech preventing the child from disability and helps in social and psychological wellbeing in the community.

The present study was carried out within the city limits but the prevalence of hearing impairment in rural areas also needs to be studied where the prevalence is expected to be more and the reach of advanced health care facilities is limited.

## Ethical Committee

Permission from the institutional ethical committee – obtained

## Conflict of Interest

Authors state no conflict of interest

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