TYMPANOMETRIC AND AUDITORY BRAINSTEM RESPONSE FINDINGS AMONG CHILDREN WITH DOWN SYNDROME

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ORIGINAL ARTICLE

ABSTRACT

Background: The Worldwide prevalence of Down syndrome children with hearing loss is 38–78% with conductive hearing loss accounting for the majority of cases and a documented 20%. Otitis media with effusion (OME) is common in 2-year-olds.**Objective:** To determine the tympanometric and auditory brainstem response findings among children with Down syndrome. **Methodology:** Cross sectional observational study was conducted to determine the tympanometric and auditory brainstem response findings among children with Down syndrome on a sample of 98 patients both Male and Female with Non-probability purposive sampling technique. The study was performed at the Children's Hospital and Institute of Child Health in Lahore. The duration of this study was 6 months, from January 2023 to June 2023. Children aged 1 to 6 years were included in this study. A self-structured questionnaire, tympanometry, and auditory brainstem response test were used to accumulate the data. The data was analysed using the SPSS version 24.0 software package. **Results:** Among the 98 DS patients, there were 52 (70.41%) male patients and 46 (29.59%) female patients. The majority of patients were in the age group 1-3 years, which is 61 (65.31%) in number. From the analysis of the tympanometry test, it was found that the majority of patients had type B tympanograms, which is 55 (56.1%), and type C tympanograms were also shown in 28 (28.6%) patients. Results of BAEP showed that most patients had moderate-degree hearing loss 70 (71.1%) and 15 (15.3%) had normal hearing. **Conclusion:** This study concluded that the majority of children had moderate degree conductive hearing loss rather than mild to severe degree mixed and sensorineural hearing loss.

INTRODUCTION

The most frequent chromosomal disorder associated with intellectual disability is Down syndrome, which manifests a number of distinctive clinical abnormalities. Around the world, 1 in in every 800 infants is born with it. Trisomy 21 can occur when there are 47 chromosomes present, either through nondisjunction.[1] Both invasive and non-invasive prenatal diagnostic methods are utilized to identify Down syndrome. The majority of a postnatal diagnosis, however, is based on the infant's clinical appearance within hours of birth, which is then confirmed by karyotyping or microarray.[2] Down syndrome is accompanied by short necks, projecting tongues, weak muscular tone, flattened faces, extreme obstructive snoring, obesity, seizures, gastrointestinal issues, heart anomalies, hearing loss, and ear infections, which are all characteristics of people with Down syndrome.[3] It is important to realize that people with DS develop differently, both in terms of cognitive development and possible physiological conditions like heart problems, hearing loss, and difficulties speaking and learning new languages. It has been

demonstrated that both children with Down syndrome and children who are typically developing are affected by minor hearing loss.[4] Children with DS typically have several anatomical features in their ears that may make them more susceptible to hearing impairment. A number of conditions, including cerumen impaction, which narrows ear canals, persistent middle ear effusion and otitis media, as well as tympanic membrane perforation, retraction pockets, cholesteatoma, and abnormalities of the mastoid,can result in conductive hearing loss. Up to 78% of people with Down syndrome experience hearing loss, with conductive hearing loss being the most common kind.[5] Every month, otoscopy and tympanometry tests were performed on children between the ages of two and six. It was discovered that 61% of the children had at least one middle ear effusion in the second year, up from 53% in the first. The prevalence of OME in the DS community ranges from up to 93% at age one to up to 68% at age five.[6] It is believed that the discrepancy in Eustachian tube length contributes to the high occurrence of OME by having a narrower and more cylindrical shape, which may indicate an unusual entry location.[7] Sensorineural hearing loss (SNHL) may be a challenge for kids with Down syndrome. It is unclear how often DS children experience it; estimates range from 4 to 55%. The loss of high-frequency hearing usually happens over time.[8] According to the American Speech and Hearing Association (ASHA), objective testing, such as the ABR, should be an essential component of the hearing loss diagnosis for kids who are having developmental issues. Immittance audiometry, otoacoustic emissions, a complete case history, behavioral observation, and functional hearing tests should all be performed or at least tried in order to supplement the ABR results. It has been demonstrated that the ABR can accurately determine hearing thresholds in the pediatric population.[9] ympanometry evaluates tympanic membrane movement as a sign of middle ear pathology and is a component of the audiologic test battery. Because Down's syndrome is associated with repeated cerumen impactions, delayed development, constriction of the ear canal, and uneven cooperation, accurate examination of the tympanic membrane may be difficult and less reliable. A referral to an otolaryngologist is made for medical assessment and management when tympanometry consistently reveals insufficient tympanic membrane mobility because this information raises the risk of reversible hearing impairments.[10] Therefore, it is essential to conduct studies on this population using unbiased tools like auditory evoked potentials. . One of the most effective tests for detecting hearing loss is the Brainstem Auditory Evoked Potential (BAEP), which identifies the electrophysiological threshold. Up till the brainstem, it evaluates the condition of the auditory pathway.[11] Very limited data is available regarding the focus on the tympanometric and auditory brainstem findings among children with Down syndrome at the international level, and no literature has been found nationally or in the local population.

MATERIALS AND METHODS

Study Design:

It was cross-sectional observational study.

Sampling Technique: Non-probability Purposive sampling technique.

Settings: Data was collected from Children Hospital and Institute of Child Health Lahore.

Duration of Study: The duration of this study was six months, from January 2023 to June 2023, after approval from the Research Ethical Committee.

Sample Size: On the basis of the prevalence of hearing loss in Down syndrome children , the sample size was calculated 98 through an online sample size calculator.

Data collection procedure

After getting written consent from their family members, the hearing of a child was assessed to check the severity of hearing loss.The ears were checked by tympanometry and assessed with BERA.A tympanometry procedure was performed to check the middle ear status of the child before starting the test procedure, the researcher guided the child or parents of the child on how toperform this procedure.For tympanometry, the child was sitting on the chair; guide the child or their parents; for BERA, sleep state is required.In BERA Soft electrodes (small sensor stickers) are placed near the ears and on the forehead. Clicking sounds and tones go through the earphones, and electrodes measure how the hearing nerves and brain respond to the sounds.

Data analysis

Data was analyzed through SPSS version 24.0 package. Data was analyzed through frequency and percentage.

Sample Selection Criteria:

Inclusion Criteria:

Males and females were included in this study. Children with 1 to 6 years age limit were included in this study. Children with Down syndrome were included in this study.

Exclusion Criteria:

Patients with co-morbidities that can result in hearing loss, cerebral palsy, ADHD, and other disabilities were excluded from this research. Cases of ototoxicity were excluded from this study. All congenital causes of hearing impairment and comorbidities like infections, such as rubella or herpes simplex virus, atresia, anotia, etc., were excluded from this research. Head trauma, autoimmune diseases, and heredity diseases were excluded from this research.

RESULTS:

According to Table 1, the majority of the 92 patients are in the age groups 1-3 years are 61(65.31%). There are 52 (70.1%) male patients and 46 (29.59%) female patients. There are 69 (70.410%) lower-class patients, 20 (20.41%) middle-class patients and 9 (9.18%) upper-class patients. According to the Table 2, the majority of children had type B tympanograms, 55 (56.1%) and 28 (28.65%) children had type C tympano-gramsand most of them had moderate degree hearing loss, which is 70 (71.4%) children had Normal hearing sensitivity were 15 (15.3%).

Table 1: Demographics characteristics of patients

Variables	Sub-Variables	Frequency Percentage (%)
Age (Year)	1-3	61 (65.31%)
	4-6	37 (34.69%)
Gender	Male	52 (70.41%)
	Female	46 (29.59%)
Socioeconomic Status	Lower class	69 (70.41%)
	Middle class	20 (20.41%)
	Upper class	9 (9.18%)

Table 2: Results of Tympanometry and Auditory Brainstem response:

Variables	Sub-Variables	Frequency Percentage (%)
Findings of Tympanometry	Type A(Normal)	11 (11.2%)
	Type As	3 (3.1%)
	Type Ad	1(1.0%)
	Type B	55(56.1%)
	Type C	28(28.6%)
Findings of BERA	Normal Hearing sensitivity	15 (15.3%)
	Mild degree	11 (11.2%)
	Moderate degree	70 (71.4%)
	Severe degree	2 (2.0%)

DISCUSSION

The purpose of this study was to investigate the tympanometric and auditory brainstem results in Down syndrome kids. A sample of 98 Down syndrome kids was gathered using a purposive sampling technique. Out of a total of 98 children, the demographic findings indicate that 61 (65.3%) of the children belonged to the age group (1-3) years, and 52 (70.41%) of the children were male, while 69 of the children had a lower socioeconomic status. Another investigation was made by Durante et al. This study looked into acoustic absorbance measurements in kids with Down syndrome. The age range of the 15 children in the study group ranged from 5 to 14, with an average age of 8.4 years. Eight boys and seven girls were present.[13] Rojnueangnit et al also conducted a study in which 50 Down syndrome kids were included. They had a mean age of 3.03 years, ranging in age from 2 months to 12 years, and were roughly equally split between boys and girls.[14] Another result of this research reveals that, of the 98 kids, the majority had type B tympanograms with a percentage of 55 (56.1%), and the minimum number of children had type Ad with 1 (1.0%). Type C (28.6%) and type A (11.2%) tympanograms were also seen in some children. An alternative study was conducted by A Abdullah et al. According to this study; there is strong evidence of a high prevalence of hearing loss in 66.4% of ears tested and 71.6% of individuals. 81% of the participants who experienced hearing loss had it on both sides. Conductive hearing loss was the most prevalent, and mild to moderate hearing loss is the most typical degree. 59% of patients exhibited tympanograms of type B, suggesting middle ear effusion. [15] An alternative study conducted by Pradilla et al. This study revealed that out of 40 DS children, 19 had a history of otitis media with effusion, and 17 of those had mild to moderate hearing loss that was primarily conductive. Four individuals experienced significant hearing loss, whereas 13 patients had moderate loss. Out of those for whom the kind of hearing loss could be identified, one person had sensorineural hearing loss, twelve had conductive hearing loss, and one had a mixed type. There was bilateral type A curves in 11 cases. Nine patients, six with AS curves, two with AD curves, and five with C curves, each had one ear with Type B curves. Four more curves were discovered to have negative pressure changes.[16] Study conducted by Carvalho et alin which tympanometry was used to evaluate the middle ear in three (42.8%) and four (57.1%) of the youngsters. Type A and Type B curves were discovered. According to the study of the auditory test, the majority of patients (42, 85%) had normal bilateral hearing and 57, 14%, had conductive hearing loss.[17] Mesolella et al conducted another study with the tympanometry results listed below: In group A, there were 33 normal tympanograms of types A, 4 type B, and 11 type C, while group B Contained 6 type B, 11 type C, and 30 normal tympanograms. OME, which is known to cause mild to moderate hearing loss in 60% of cases, is a common middle ear condition that affects DS children often.[18] The BERA results of this study showed that 15 (15.3%) of the children had normal hearing sensitivity and that the majority of the children, 70 (71.4%), had moderate-degree hearing loss. Only two children (2.0%) had severe-degree hearing loss. An alternative study was conducted by Lau et al in which these children (72.2%) with hearing loss and conductive deficiency underwent BAEP, and the majority have mild to severe hearing loss. Between mild and severe hearing loss affected (27.8%) children, eight (44.4%) of whom had bilateral hearing loss. 1 (7.7%) had severe symptoms, while 23.1% had moderate symptoms.[19] (Gregory et al aimed another study included a control sample in which auditory evoked potentials were accustomed to evaluate all of the kids and to look at the group differences in the central auditory pathway. The results of

children in the Down syndrome group showed longer wave latencies which may suggest that people with Down syndrome have difficulties with auditory recall and discrimination.[20]

CONCLUSION

This study concluded that the majority of children had moderate degree conductive hearing loss rather than mild to severe degree mixed and sensorineural hearing loss as per the auditory brainstem response test findings. As per the tympanometric findings majority of the patients had type B tympanograms.

RECOMMENDATIONS

As a result, it is preferable that the Parents should be aware of the newborn hearing screening because of the huge prevalence of hearing loss in Down syndrome children. At the time of birth, hearing screening should be done after 6 months, and regular follow-up should be conducted.

AUTHORS CONTRIBUTION

TT: Article write up, **DA:** Data collection, **SAB:** Data analysis, **MA:** Literature review and final write up, **FT:** Data collection

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