



Comparing outcomes of hearing testing between OAE and Audiometry in children with Autism spectrum disorder and Attention deficit hyperactive disorder.

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(Received: 02 September 2023

Revised: 14 October

Accepted: 07 November)

Keywords:

Hearing loss, Hearing screening, Autism

ABSTRACT:

BACKGROUND AND OBJECTIVES: Hearing function plays an important role in behavioral, intellectual academic, and social development in children. Early hearing screening is a must to reduce the impact of hearing loss among children. OAE is a common investigation done in high-risk neonates today to screen for early onset hearing loss. This study was undertaken to understand the role of OAE in the early childhood of children with Autistic Spectrum of disorders/ADHD/inattentiveness (where pure tone audiometry is still not reliable) in the identification of hearing disorders.

SUBJECTS AND METHODS: The study group comprised 35 children (2-6 years) diagnosed with Autistic Spectrum of disorders and Attention deficient hyperactive disorder came to the Department of ENT at a tertiary medical care centre (Sree Balaji Medical College) in January 2022 to June 2022. Conditioned play audiometry and transient evoked otoacoustic emission and distortion product otoacoustic emission testing were performed on all children.

RESULTS: From our study, with otoacoustic emission testing, 62.8% of the children received PASS and 22.88% of children received REFER. The children who co-operated during the conditioned play audiometry was 51.4% and for otoacoustic emission testing was 85.7% with a *p*-value of 0.00411 (<0.05) which is statistically significant. So, there is a significant difference in children who co-operated during conditioned play audiometry and otoacoustic emission.

CONCLUSION:

Proper screening of hearing loss plays an important role in early diagnosis and rehabilitation in children. Otoacoustic emission in children helps to provide data that can improve hearing screening outcomes. Otoacoustic emissions testing in children is more feasible and accessible in the community hearing screening in comparison to play audiometry and BERA.



INTRODUCTION

Hearing function plays an important role in the intellectual and social development in children, if disturbed it will affect the children's personal and social development causing impaired speech, language, cognitive and academic development. The estimated prevalence of childhood-onset deafness in India is 2%. Common causes of hearing loss in children are otitis media and congenital hearing loss. Hearing loss is also seen in children with mild to moderate mental retardation, autistic children, and children with global developmental delay. Hearing loss in children is progressively increasing, so early hearing screening is a must to reduce the number of hearing loss among children. Hearing screening programs are adapted across all paediatric populations to detect hearing loss in children and to tackle speech and language delay. Otoacoustic emissions have been an effective subjective screening method also among children in assessing the integrity of cochlear function.

Otoacoustic emissions are low-intensity sounds produced by the movement of outer hair cells of the normal functioning cochlea with the help of external stimuli.¹ OAEs are used commonly in the audiological assessment of the pediatric population to verify behavioral responses and obtain additional frequency information.² Otoacoustic emissions have many benefits: they are easy to obtain, non-invasive, and provide reliable information regarding cochlear status in a short time. They are an ideal tool that helps in the differential diagnosis between cochlear impairment disorders and neural dysfunction²

OAEs are a highly sensitive test for cochlear changes or minor middle ear dysfunction. At an early stage, OAEs are considered an effective method for detecting auditory variations, and also they can find changes before pure tone audiometry can³. They cannot take the place of tympanometry but can be a complementary screening procedure in children.

Autism spectrum disorder(ASD) is a behavioral disorder that is characterized by impaired social communication and repetitive behavioral actions. In autism spectrum disorder, some early signs include atypical auditory input response. But some studies show impaired hearing in autistic spectrum disorder along with common signs such as lack of emotion and voice recognition. Auditory processing deficits are one of the

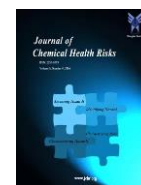
earliest signs of an autism spectrum disorder (ASD). Testing early auditory processing is difficult in very young, minimally verbal children, but the integrity of outer hair cell function can be evaluated reliably using otoacoustic emissions (OAEs). Attention deficit hyperactive disorder

MATERIALS AND METHODS:

The study group includes 35 children of age 2- 6 years who came to the Department of ENT at Sree Balaji Medical College and hospital, Chennai from January 2022- June 2022 after conducting various camps. These children presented with symptoms of difficulty in hearing from birth, inattentiveness, hyperactivity, and not responding to sounds. There were 21 children diagnosed with attention deficit hyperactive disorder and 14 children diagnosed with autism.

To be included in the screenings, each participant(child) had to be cooperative throughout testing. Informed written consent was obtained from the patient's parents before the study. A child was considered uncooperative if the child did not allow the examiner to complete the screening efficiently. Before Otoacoustic emission screening, routine otoscopy was performed. All children were screened individually, in a seated position, in the audiology room. First screening using conditioned play audiometry was conducted on all children.

An Audio- a SMART by Neurosoft analyzer machine is used to measure both transient evoked Otoacoustic emission and distortion product Otoacoustic emission. Otoacoustic emissions were tested on both the ears in all children with frequencies- for TEOAE- 1.5 Hz to 4 Hz and DPOAE- 1.7-4.2 Hz. A small probe is placed in the external auditory canal of the child and generates 'clicks. The test is in a short time frame of 1 and 5 minutes. Total time for testing, explanation of procedure with the parents, conducting the test, and recording may result in between 15- 20 minutes. A child received a pass if both ears passed the screening. The child was referred for further testing if one or both ears were referred from the screening. Parents were provided with a report of the screening results.



STATISTICAL ANALYSIS:

Data were analyzed using R software version 4.1.1. R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. All categorical data were presented using frequency and percentage and all continuous measurements were summarized using Mean SD after assessing the normality assumption using the chi-square test.

RESULTS:

Thirty-five children were included in the study. The age group criteria of ages 2-6 years were selected. Mean age 4.02 ± 0.21 with 1.248 SD (Table 1). According to our study, 63% of the children were male and 37% of the children were female. 51.4% of the children cooperated for conditioned play audiometry and 85.7% of the children co-operated for otoacoustic emission testing with a p -value of 0.00411 (<0.05) which is statistically significant. There is a significant difference in children who co-operated during conditioned play audiometry and otoacoustic emission (Table 3). With otoacoustic emission testing, 62.8% of the children received PASS and 22.86% of children received REFER (Table 4)

TABLE 1: Age Distribution

Age	Frequency (No of patients=35)	Percentage %	Mean	SD
2 years	04	11.4%	4.02±0.21	1.248
3 years	09	25.7%		
4 years	09	25.7%		
5 years	08	22.8%		
6 years	05	14.2%		

TABLE 2: Gender distribution

GENDER	NUMBER	PERCENTAGE
MALE	22	63%
FEMALE	13	37%

TABLE 3 Co-operated and Non-cooperated children in conditioned play audiometry and otoacoustic emission test

TABLE 4: PASS and REFER of otoacoustic acoustic emission

Hearing test	Cooperated	Non cooperated	P value	Chi stat value
Conditioned play audiometry	19 (51.4%)	16 (28.5%)	0.00411 Significant*	8.2313
Otoacoustic emission testing	30 (85.71%)	5 (14.28%)		
	Frequency n=30		Percentage	
PASS	22		62.86%	
REFER	8		22.86%	

DISCUSSION:

With the help of Otoacoustic emission, we can screen the child with hearing disabilities and also understand children who are at risk and not at risk. This study also helps us understand that children are more cooperative with Otoacoustic emission testing compared with that of

conditioned play audiometry, as it requires less time. From this study, 22.86% of the children have got REFER which means they have a hearing problem. These children are further evaluated for advanced audiological testing such as BERA.



A study by (Elizabeth cedars 2016) compares the outcomes of community-based low-income preschool hearing programs before and after implementation of OAE in a single visit. In this study, the overall pass rates increased from 92% to 95%. The identification of pathology in children with follow-up increased from 19% to over 50%. Further, disparities in pass rates of otoacoustic emission and ability to test seen in Year 1 were eliminated in Year 2.

Otoacoustic emission screening is a quick method for hearing screening among children who are at risk. So, the need for hearing screening in early childhood is important. They can be used to screen children with no access to normal medical care. Although conditioned play audiometry is a standard hearing screening in preschool children, otoacoustic emission yields objective data that can improve screening outcomes in preschool children and also in children who are diagnosed with autism and also attention deficit hyperactive disorder. Play audiometry and Transient evoked otoacoustic emission (TEOAE) measurements cannot yield quantitative results but can yield qualitative results for determining the presence of hearing impairment without sedative-induced sleeping at this critical age for children.

There are some studies on the assessment of hearing loss in Attention deficit hyperactivity disorder (ADHD) children. ADHD children show, as one of the main symptoms, an attentional impairment. Selective attention in the hearing process is the ability to understand speech in a noisy environment, which can be evaluated by several methods.⁷ One such method is with the use of transient evoked OAE with contralateral noise acoustic stimulation.⁷

A study by (Tammie SD 1994) found that the hearing threshold in children with ASD in the mid-range frequencies was significantly related to receptive and expressive language measures. The results suggest that TEOAEs may be a valuable part of the audiological test battery for children with autistic behavior⁹. So, audiological assessment abilities are important in the diagnosis and treatment of children with autism.

Otoacoustic emission testing is not a hearing test. It is a good indicator of hearing loss and it is an important test to check the cochlear function. Otoacoustic emission testing contributes to the differential diagnosis in audiology and also, and it can be used to assess the effects of the treatment and help in hearing aid selection and other surgical treatment options in children.

CONCLUSION:

This study shows that OAE screening, using a multi-step protocol, was found to be a feasible and accurate practice for identifying a wide range of hearing-health conditions warranting monitoring and treatment among children in early childhood care programs. Otoacoustic emission testing can be used in the community camp screening areas when compared to BERA and pure tone audiogram. We conclude that the test is reliable and highly sensitive and that it detects small conductive and sensory hearing losses in children with autism and attention deficit hyperactive disorder.

ACKNOWLEDGMENT: We would like to thank the audiologist at the Department of ENT, the Department of Pediatrics, Sree Balaji Medical college and hospital, Chennai for all their support during this project. We would like to thank the statistician for the data analysis presented in this study.

CONFLICT OF INTEREST: There is no conflict of interest in this study.

INFORMED CONSENT: Written informed consent was obtained from the participant's parents in the study

ETHICAL APPROVAL: All procedures performed in the study involving the human population were by the ethical standards of the institution.

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