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FOCUS:

- Setting up public professional interface for wider spread of services to affected people.
- Industry-Institution partnership for contemporizing Audiology education.
- Referral Network of clinical establishments for optimal use of the Super Specialized raci1ity available in India.
- Promoting local Researchers and local Academicians.
- Events to promote the profession and showcase the best available practices.
- Bringing all the stakeholders together for making common cause of Clinical Development.

Editorial

Founder-Director, Institute of Health Sciences, Bhubaneswar

Audio Vestibular medicine has been breaking boundaries with the evolution of artificial intelligence, machine learning and virtual reality technologies for technology solutions. While cross disciplinary research is making inroads for blending of Audiological rehabilitation with pharmaceutical and neutraceuticals for more lasting solutions. Research, whether fundamental or applied should ultimately focus on solutions for existing problems and prevention of such disorders. The development of the ecosystem at the Autonomous Institute of Health Sciences for research, innovation and entrepreneurship will pave the way for lab to land translation. Development of products that can be patented, production and distribution of such products for growth of remedial intervention in the country and abroad is not a far cry. ISAM Journal - The Indian Journal of Audiology will evolve to be the suitable platform to showcase the progress of Audio Vestibular Sciences, Audio Vestibular medicine and Audio Vestibular.

Prof. Satya Mahapatra
Chief Editor

Dr. RAJENDRA KUMAR PORIKA
PhD ASLP, Fellowship in C.I., ASLP AYJNISHD (D) SRC, FOUNDER MEMBER & ADVISOR FOR TASLPA & UACA

Editor's Message

Om Jai Ganapathim

As an editor it's a great Honor & Opportunity to be a part of the International Symposium for Audiological Medicine (ISAM), Indian Journal of Audiology. The Journal is extensively disseminating knowledge to the budding ASLP professionals and research scholars. This journal is facilitating opportunity to stakeholder by sharing the latest information on Audiological research aspects happening in and around the Nation.

We are Privileged to receive good number of research articles from the Young Researchers. The Authors have submitted various research studies pertaining to current practice of Audiology and which are innovative in nature. This will encourage the research aspirants and also enrich them with good knowledge.

We appreciate your effort in making the clinical research studies and submission of your valuable compiled research articles to us. Form the editorial team we request all the readers and the authors to continue your encouragement to our team of ISAM Indian Journal of Audiology with your valuable support and motivation in terms of strengthen our Journal.

We Sincerely Thank you all Authors, Researchers and Stake holders. Happy Reading.

It's my gratitude to thank our Mentor & Chief Editor Professor Satya Mahapatra Sir for the leading from the front with the Dynamic Editorial team of experts, Dr. Subhasmita Sahoo.

Dr. Rajendra Kumar Porika
Editor

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AUDIOLOGICAL PROFILE OF INDIVIDUALS WITH ALLERGIC RHINITIS: A PRELIMINARY STUDY

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ABSTRACT

RATIONALE: Allergic rhinitis (AR) is an inflammatory disorder of the nasal mucosa induced by allergen exposure triggering IgE-mediated inflammation. The clinical symptoms of AR are nasal discharge, nasal inflammation, cold, nasal itching. Some of the researchers had found that there is a relation between hearing loss and allergic rhinitis.

OBJECTIVE: The present objective of the study is to assess and investigate the effects of allergic rhinitis on hearing between younger and elder age groups.

METHOD: Thirty individuals with AR were selected for the study that was further divided into younger (18-35 years) age group and elder (36-55 years) age group. Both the groups were subjected for audiological evaluations such as otoscopic examination, tuning fork tests, pure tone audiometry and tympanometry.

FINDINGS: Results revealed that lower frequencies were affected in younger age group where as high frequencies were effected in elder age group. Type B tympanogram and Mild CHL was prominent in both the groups. Abnormal OAE findings were also seen which shows improper functioning of outer hair cells.

CONCLUSION: It can be concluded from the study that allergic rhinitis patients had a higher prevalence of hearing loss in both younger and elder age groups.

Keywords: Allergic Rhinitis; PTA; OAE; tympanometry; weber; Rinne; hearing loss.

INTRODUCTION

Allergic rhinitis (AR) is an allergic inflammation of the nasal airways nasal mucosa, primarily mediated by immunoglobulinE. The clinical symptoms of allergic rhinitis are nasal obstruction, watery rhinorrhea, sneezing, and itching at the nose, palate, and nasopharyngeal region. Its diagnosis is based on physical examination history.[1] It begins to manifest itself typically after the 2nd year of life.

Age-related changes occur in every organ system, including the respiratory system. Specific to the nasal cavity, the physiological process of ageing results in neural, hormonal, mucosal, olfactory, and histologic alterations that cause morphological and functional changes in the ageing nose.[2] This makes the elderly population more vulnerable to symptoms such as rhinorrhea, nasal congestion, postnasal drip, dry nose, intranasal crusting, and decreased olfaction.

Patients with AR commonly experience ear symptoms, ear fullness, pressure, otalgia, popping or other sounds during swallowing and transient hearing loss can all be manifestations of Eustachian tube dysfunction. The major cause of hearing loss is also due to environmental air pollutants, which contain several compounds that may damage the nasal mucosa, thereby facilitating the access of inhaled allergens to cells of the immune system.[3] This damage may result in blockage of the Eustachian tube, which further affects the physiology of the middle ear. Thus the relationship between pollution and allergic rhinitis has received increasing attention over the past decade which results in hearing loss.

Since AR is a disease on the immunological base and it was demonstrated that it affected the middle ear during childhood, it affects the inner ear, which plays a role in humoral and cellular immunity.[4] Severe rhinitis associated with complications such as sinusitis or eustachian tube dysfunction can also cause conductive hearing loss. The presence of allergens and histamine inflammation affects the inner ear function, particularly on the outer hair cells, which sometimes leads to sensorineural hearing loss.[5] Hence, audiological examinations are important in determining the changes in the outer, middle and inner ear in those who complain from allergic rhinitis.

Karabulut et al. conducted a audiological evaluation on fifty-eight patients with positive skin prick test (Group 1) and 31 subjects with negative skin prick test (Group 2) and observed significant difference between the pure-tone threshold of group 1 and group 2 at 8000 Hz. Otoscopic examination, speech discrimination scores, tympanometry and acoustic reflexes were normal in both groups.[6] Whereas, Dwarakanath et al. conducted a audiological examinations on 15 individuals with allergic rhinitis and 15 individuals without any history of allergic rhinitis, found poorer pure-tone thresholds with reduced DP amplitude compared to normal with no middle ear or Eustachian tube dysfunction.[5]

AIM

The study aims to assess and investigate the effects of allergic rhinitis on hearing between younger and elder age groups.

OBJECTIVES

The primary objective of this research is to investigate how AR impacts hearing thresholds at various frequencies. This study aimed to examine how AR influenced the function of the outer hair cells in the middle ear. In addition, the audiological findings in younger and elder age groups of allergic rhinitis participants were administered.

METHODOLOGY

This study follows a diagnostic research design with a random sampling method was used to select the participants. The study was conducted in different ENT hospitals located in Hyderabad to investigate the effects of allergic rhinitis on hearing. A total of 30 Allergic Rhinitis patients ranging in age from 18 to 55 years old were considered for the research. Out of these 30 people, 16 subjects were then categorized into younger age group (18-35 years) and 14 were categorized into elder age group (36-55 years). The first group, which was comprised of 16 participants, was classified as group A, while the second group, which was comprised of 14 subjects, is classified as group B. The mean age of younger age group was 27.8 years whereas the mean age of elder age group was 45.8 years.

Permission was obtained to collect data from ENT hospitals in Hyderabad, such as Magnas ENT hospital, Maa ENT hospital, and KIMS hospital, as well as the Kondaveedu rehabilitation centre for speech and hearing clinic which was situated in Guntur. All the subjects who were selected for the study has undergone thorough ENT examinations in the ENT department and later audiological assessment of each subject was done in their respective speech and hearing unit. Individuals with a history of otologic factors, use of ototoxic agents, metabolic and systemic disease causing hearing loss, noise exposure, and history of neurological factors were not included for the study.

Procedure

All the subjects were subjected for detailed audiological evaluations such as Otoscopic Examination, Tuning fork Tests, tympanometry, Pure-tone audiometry, Oto Acoustic Emission. An Otoscope was used to examine the ears of thirty persons with allergic rhinitis. This was done largely to assess the anatomical characteristics of the outer and middle ear. An otoscopic examination can also be done to determine the state of the tympanic membrane. When there is a suspicion of hearing loss, tuning-fork tests should be performed. If only one fork is utilized, it should have a frequency of 500 cycles per second, since this is preferable to a lower frequency when there are many noise interferences. Rinne and Weber test was done to find poorer ear and also the type of hearing loss.

An Interacoustic AT235 impedance audiometer was used for tympanometry testing. The subjects were seated comfortably in a sound-treated room and were asked not to swallow during the testing period. A 226 Hz probe tone was used for Tympanometry, with pressure varied from +200 to −300 daPa and was classified according to modified Jerger's classification.

All the subjects were seated in a sound proof booth for obtaining air conduction and bone conduction thresholds using a calibrated MAICO MA-42 diagnostic audiometer. Air conduction thresholds were obtained across frequencies of 250,500, 1000, 2000, 4000, and 8000Hz. Bone conduction thresholds were obtained across frequencies of 250,500, 1000, 2000, 4000Hz. TDH39 headphones were used for AC testing and B-71 was used for BC testing. The degree of hearing loss was based on the WHO classification.

Natus instrument was used for OAE measurement and was carried out using systems developed by Intelligence Hearing System (Miami, Florida, USA). When measuring the Distortion product (DP) gram, the frequency separation of the primaries was f2/f1=1.22, with L1 and L2 set to 65 & 55 dB SPL, respectively. The Distortion Product Oto Acoustic Emission (DPOAE) were established across frequencies of 1000, 2000, 4000, and 8000Hz and considered to be present if the signal-noise ratio at every frequency was above 6 dB.

Statistical analysis

Descriptive statistical analysis were carried out for the data and summarized as Mean, ±SD (standard deviation) while discrete (categorical) in number and percentage. Pearson correlation analysis was used to assess association between the variables. A two-tailed (α=2) p-value less than 0.05 ($p<0.05$) was considered statistically significant. All analyses were performed using SPSS software (Windows version 17.0).

RESULTS

The aim of the present study is to check the results of audiological evaluations in both groups who were having allergic rhinitis. Audiological tests such as Otoscopic examination, tuning fork tests pure tone audiometry, tympanometry was done to evaluate the findings in subjects with allergic rhinitis. In this study, 53.3% patients were under younger age group (group A) with allergic rhinitis and rest 46.7% were under elder age group (group B) with allergic rhinitis. The most common complaints in both younger and elder age groups were cold, nasal allergy, nasal discharge and nasal block. The mean age of group A is 27.8 years whereas the mean age of group B is 45.6 years.

Otoscopic examination findings

Table 1 shows the Otoscopic examination findings in 30 individuals with AR. Perforated tympanic membrane was found in most of subjects in both the groups.

Tuning fork tests

The findings of rinne test are illustrated in the Table 1. Out of 32 ears in the younger age group, 22 ears were showing negative rinne indicative of conductive pathology whereas 10 ears were showing positive rinne. In elder age group (22 ears), 12 ears were showing negative rinne and 16 ears were showing positive rinne. Further, results of Weber test are illustrated in table 2.

Table 1 Frequency table for otoscopic examination and tuning fork test (Rinne) among group A and group B in both right and left ears

	Group A				Group B			
	Frequency		Percentage		Frequency		Percentage	
	Right	Left	Right	Left	Right	Left	Right	Left
Otoscopic Examination								
Normal TM	10	4	62.5	25	7	5	50.0	35.7
Retracted TM	-	-	-	-	1	2	7.1	14.3
Perforated TM	6	12	37.5	75	6	7	42.9	50
Tuning fork test (Rinne)								
Negative	9	13	56.3	81.3	6	6	42.9	42.9
Positive	7	3	43.8	18.8	8	8	57.1	57.1

Table 2 Frequency table of tuning fork test (weber) among group A and group B in both right and left ears

Tuning fork test (Weber)	Group A		Group B	
	Number	Percentage	Number	Percentage
Midline	5	31.3	4	28.6
Right	3	18.8	4	28.6
Left	8	50.0	6	48.9

Tympanometric findings

Tympanometry was done in 30 individuals with AR. Type B tympanogram was seen more prominent in both the age groups. In younger age group, type B tympanogram was seen more in right ear than left ear (Table 3).

Table 3 Frequency table for tympanometry findings in both groups

Types of tympanogram	Group A				Group B			
	Frequency		Percentage		Frequency		Percentage	
	Right	Left	Right	Left	Right	Left	Right	Left
A	6	3	37.5	18.8	6	5	42.9	35.7
As	-	1	-	6.3	1	1	7.1	7.1
B	9	12	56.3	75.0	7	6	50	42.9
C	1	-	6.3	-	-	1	-	7.1
Ad	-	-	-	-	-	1	-	7.1

PTA & OAE findings

Pure tone audiometry was done in 30 individuals to determine the type and degree of hearing loss in subjects who were having allergic rhinitis. The mean average in group A is 26.5 dBHL, 32.7 dBHL whereas in group B it is 26.6 dBHL, 27.3 dBHL. According to pure-tone average thresholds, left ear (32.7 dBHL) was more affected compared to right ear (26.5 dBHL) in a younger age group whereas there is no difference was seen in elder age group i.e., 26.6 dBHL, 27.3 dBHL respectively. Mild conductive hearing loss was more common in both groups (Table 4). Abnormal OAE was prominent in both the age that determines the improper functioning of outer hair cells (Table 5).

Table 4 Frequency table for type and degree of hearing loss among group A & B'

Type & Degree of hearing loss	Group A				Group B			
	Frequency		Percentage		Frequency		Percentage	
	Right	Left	Right	Left	Right	Left	Right	Left
Normal	5	2	31.3	12.5	4	3	28.6	21.4
Minimal	3	2	18.8	12.5	4	4	28.6	28.6
Mild CHL	5	7	31.3	43.8	4	5	28.6	35.7
Moderate CHL	2	3	12.5	18.8	1	1	7.1	7.1
Moderately severe MHL	1	2	6.3	12.5	1	1	7.1	7.1

Table 5 Frequency table for OAE findings in both groups

OAE	Group A		Group B	
	Frequency	Percentage	Frequency	Percentage
Bilateral Pass	5	31.3	6	42.9
Bilateral Refer	4	25.0	2	14.3
Right Refer, Left pass	3	18.8	3	21.4
Right Pass, Left Refer	4	25	3	21.4

On administering the Pearson's correlation, significant correlation results were obtained between otoscopic examination, tympanometry in both age groups as well as symptoms and audiological findings in both ears. In both age groups, there was a significant positive correlation between otoscopic examination and tympanometry($r=0.70$ and $p<0.05$), where as a significant negative correlation obtained between otoscopic examination and weber($r= -0.447$ and $p<0.013$), as well as pure tone audiometry and tympanometry($r= -0.52$ and $p<0.03$) in both ears. Similarly, there is significant a negative correlation of nasal block $r=-0.38$ and $p<0.034$) and otorrhea ($r=0.439$ and $p<0.015$) with OAE.

DISCUSSION

The present aim of the study is to assess audiological findings in individuals with allergic rhinitis. Tuning fork tests such as rinne & weber, pure tone audiometry, tympanometry tests were done in 30 individuals with allergic rhinitis which were further divided into younger and elder age groups. In the present study, almost 90% of the subjects were showing the symptoms of allergic rhinitis such as sneezing, nasal obstruction, nasal inflammation and nasal discharge which is in consensus with previous studies. [7,8]

Otoscopic examination findings revealed that more than half of the individuals selected in this study had abnormal tympanic membrane patterns. This is due to the fact that allergens play a definitive role in blockage of the Eustachian tube, leading to increased negative pressure in the middle ear and improper ventilation which in turn causes the retraction of the tympanic membrane. Hence it is concluded that abnormal structural appearances of the tympanic membrane were found in individuals with allergic rhinitis. Similar to this, a study conducted by Kumar et al., abnormal tympanic membrane findings such as retracted, congested, bulged and dull tympanic membrane were more common (21.15%) whereas, in perennial allergic rhinitis, abnormal tympanic membrane were observed in 44.32% cases.[9]

Tuning-fork tests should be a part of the examination of every subject with suspected hearing loss. The findings of Rinne and Weber test were shown in Table 1 & 2. In the present study it was found that most of the subject's weber test is lateralized to the poorer ear indicating bilateral asymmetrical conductive hearing loss. Similarly, a study conducted by Chan et al, (1967) revealed that the weber is lateralized to the poorer ear in AR patients. Likewise, Rinne test was administered in 30 subjects with AR and found that left ear was mostly affected in younger age group than in elder age group of allergic rhinitis.[10]

In the present study, abnormal tympanograms (type B/C) was found in most of subjects indicating that these patients had middle ear dysfunction (Table 3). This is due to mediators of inflammation, stimulating factors generated by mucosal mast cells and other inflammatory and epithelial cells in the nose and nasopharynx cause allergies and otitis media with effusion. The Eustachian tube is blocked by these mediators in a variety of ways. Nasal inflammation is caused by both viral upper respiratory infections and nasal allergy reactions, which leads to Eustachian tube dysfunction and reduced ventilation. The tympanic membrane retracts, resulting in conductive hearing loss. Similarly, in a research of 346 patients conducted by Ogawa, it was determined that allergic rhinitis patient has a significant prevalence of middle ear dysfunction.[11]

Pure tone audiometric results reveals that there is a reduced hearing in both the groups , low and mid frequencies are affected in group A whereas in group B high frequencies are affected (Table 6), left ear (32.7 dBHL) was more affected compared to right ear (26.5 dBHL) in younger age group (Table 5) where as there is no difference was seen in elder age group i.e., 26.6 dBHL, 27.3 dBHL respectively and also found that mild conductive hearing loss was more common in both the groups (Table 4).

The Oto-acoustic emission test results reveal that, OAE's were absent largely in subjects with allergic rhinitis (Table 5). Also, elder group subjects had more number of subjects with absent OAE's when compared to younger group. Reduced outer hair cell function can be related to allergen-induced alterations in outer hair cell activity. When an allergen triggers the inner ear's endolymphatic sac (ES) which may process antigens and develop its own local antibody response. The inflammatory mediators and toxic chemicals produced may interfere with hair cell activity, affecting hearing. Hence, from the results of the study, it was concluded that allergens have a negative impact on the outer hair cell activity.

Karl Pearson coefficient test was administered to describe the correlation between the variables. It shows a significant positive correlation between otoscopic examination and tympanometry(r=0.70

and p<0.05), indicates that if there was any change in the results of otoscopic examination which in turn effects the results of tympanometry in both the age groups whereas a significant negative correlation obtained between pure tone audiometry and tympanometry(r= -0.52 and p<0.03) in both ears, indicates during the initial stages of AR there is no decline in hearing thresholds even though tympanometric findings seems to be abnormal.

Similarly, nasal block (r=-0.38 and p0.034) and otorrhea (r=0.439 and p0.015) had a negative connection with OAE ,indicates if there is any ear discharge or nasal block, that might effects audiological findings of OAE. Nasal block, nasal discharge, otorrhea, tinnitus were most common symptoms observed in patients with AR

From the present study, it is concluded that allergic rhinitis shows a major impact on hearing in both younger and elder age groups. In addition to this, pure tone thresholds were poorer at low and high frequencies compared to mid frequencies. Lower frequencies were highly affected in younger age group whereas high frequencies were affected in high age group. Abnormal OAE findings were also seen which shows improper functioning of outer hair cells. Type B and type C tympanograms were seen prominently which indicates the presence of middle ear pathology. Thus the study concludes that the involvement of outer, middle and inner ear pathologies were seen in patients with allergic rhinitis. Therefore, this study can be used in clinical practice to know the impact of hearing in patients with allergic rhinitis and also helps to find out the comparison of audiological findings in younger and elder age groups.

Further research is needed to establish a cause and effective relationship in the fields AR and hearing. Detailed research should also be done for better understanding of diagnostic modalities and treatment protocols in patients with AR. Additional studies in this area are required with a larger sample population to assess the benefits of hearing evaluation in allergic rhinitis patients for early detection of hearing loss.

Limitations of the study, same study can be duplicated on higher number of AR patients. Also, imaging techniques and audiological tests results can be correlated by comparing the amount of conductive hearing loss and audiological findings.

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DEVELOPMENT AND TRANS ADAPTION OF MULTIPLE ACTIVITY SCALE FOR HYPERACUSIS (MASH) INTO TELUGU LANGUAGE.

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INTRODUCTION:

Hyperacusis is a hearing disorder, characterized with an unusual tolerance to ordinary environmental sounds. It is a type of reduced tolerance for sound. People with hyperacusis often find ordinary noises too loud and loud noises uncomfortable or painful. The most common cause of hyperacusis is damage to the inner ear from ageing or exposure to loud noise. It's is often associated with tinnitus (buzzing, ringing or whistling noises in the ears) and distortion of sounds. It can influence emotional well-being, hearing, sleep, and concentration, cause anxiety and interfere with speech perception in noise. It is estimated that about half of patients with hyperacusis also have a psychiatric or anxiety disorder. Most hyperacusis patients have hearing within normal limits (Johnson, 1999). It is subjective phenomenon, which is not easily defined or quantified by objective measurements. Adults are more likely to develop hyperacusis since aging is associated with this condition. Many people experience sensitivity to sound, but true hyperacusis is rare, affecting approximately 1 in 50,000 individuals, but is increasing in occurrence due to loud noise exposure. There are two types of hyperacusis: cochlear and vestibular. Cochlear, the most common form causes pain in the ear, frustration, and a general feeling of intolerance to everyday sounds. Vestibular hyperacusis, on the other hand, causes feelings of nausea, dizziness, and imbalance when particular sounds are present. Both types of hyperacusis can cause anxiety, stress, depression, social isolation, and phonophobia (fear of normal sounds). Categories of Hyperacusis are Loudness, Annoyance, Pain and Fear. Hyperacusis symptoms are like ordinary sounds seeming too loud, your own voice sounding too loud, discomfort in your ears, headaches, difficulty concentrating pain when hearing sudden noises, a popping sensation in the ear when hearing loud noises, anxiety, poor sleep, fatigue and Fear of social situations.

Tinnitus is when you experience ringing or other noises in one or both of your ears. The noise you hear when you have tinnitus isn't caused by an external sound, and other people usually can't hear it. Tinnitus is a common problem. Tinnitus is usually caused by an underlying condition, such as age-related hearing loss, an ear injury or a problem with the circulatory system. For many people, tinnitus improves with treatment of the underlying cause or with other treatments that reduce or mask the noise, making tinnitus less noticeable. It affects about 15% to 20% of people, and is especially common in older adults. Causes of tinnitus include Hearing loss., Ear infection or ear canal blockage, Head or neck injuries, Medications, Other causes of tinnitus

There are two kinds of assessments for an individual with hyperacusis. In Objective assessment the Case History Audiological Evaluation, Otological and audiological assessment may assist in accurate differential diagnosis of hyperacusis. Loudness Discomfort Level (LDL)/Uncomfortable Loudness Level (ULL), A loudness discomfort level (LDL) may be achieved using a variety of acoustic stimuli.

An abnormal LDL result will demonstrate a reduced sound tolerance range when compared to LDL results of individuals without hyperacusis. It may be beneficial to take this measurement several times because an individual's hyperacusis may fluctuate. In Subjective patient questionnaires may be used in the identification, assessment, and management of hyperacusis. Different questionnaires will address different measures (e.g., disability, functional impact, psychological factors, quality of life). These include the following tools: Such as German Questionnaire on Hypersensitivity to Sound (GUF; Blasing, Goebel, Flotzinger, Berthold, & Kroner-Herwig, 2010), Modified Khalfa Hyperacusis Questionnaire (Khalfa et al., 2002), Multiple Activity Scale for Hyperacusis (MASH) (Rene´ dauman & Fre´ de´ ric Bouscau- faure,2003).

For the evaluation of psychological problems in patients who present with hyperacusis the following questionnaires are recommended, Generalized Anxiety Disorder 7 item scale (GAD-7), Short Health Anxiety Inventory (SHAI), Mini-Social Phobia Inventory (Mini-SPIN), Obsessive-Compulsive Inventory-Revised (OCI-R), Penn State Worry Questionnaire-Abbreviated (PSWQ-A), Patient Health Questionnaire (PHQ-9)

NEED OF THE STUDY:

India being a multilingual country with a multicultural background and being a developing country, the population who can read and understand English is less. Most of the population of India still depends on the regional language for communication purposes. In such circumstance administering the English version Scale, become difficult and sometimes impossible for assessment. As this Scale quantified the alterations of the daily life of an individual due to hyperacusis and due to the non-capability of multilingual Speech & Hearing professionals to translate accurately the English version of MASH in to the regional languages and to avoid communication interruptions. Hence this study focused on developing MASH in Telugu language and to standardize the same.

Aim of the Study:

The present study aimed to development and trans adaption of Multiple Activity Scale for Hyperacusis (MASH) into Telugu language and assessing its reliability by administrating it on the population with the complaint of tinnitus.

OBJECTIVE OF THE STUDY:

Development and Tran's adaptation of Multiple Activity Scale for Hyperacusis (MASH) into Telugu language.

To check the reliability of the Multiple Activity Scale for Hyperacusis (MASH) into Telugu language by administrating it on 50 people suffering from tinnitus.

HYPOTHESIS:

The reliability of the Multiple Activity Scale for Hyperacusis (MASH) into Telugu language will be high.

METHOD:

The present study aimed at the adaptation of Multiple Activity Scale for Hyperacusis (MASH) in Telugu language and to assess this Scale in individuals with Tinnitus. A total number of Fifty (50) Telugu speaking individuals within the age range of 20 to 65 years of both genders (male and female) with the complaint of tinnitus.

Study included individuals with or without hearing loss. Individuals should be proficient in the Telugu language. Individuals with a complaint of tinnitus for at least 6months. Individuals who can read and write.

Study excluded individuals with neurological, psychological and behavioral issues. Participants below 20 years and above 65 years. Participants with severe limitations of understanding and expressing to respond to the scale and those who did not agree to participate. Participants with a different native language other than Telugu.

Procedure:

Preparation of Multiple Activity Scale for Hyperacusis (MASH) into Telugu language.The study was carried out in two phases:

I. Preparation of Test material

II. Forward Translation: The English version of Multiple Activity Scale for Hyperacusis (MASH) will be translated to Telugu language by the individuals who have experience of 3-5 yrs in teaching Telugu language.

Backward Translation: Translated Telugu version will be back translated to English by English tutors having minimum experience of 3-5 yrs in teaching to check translational reliability.

Professional validation: Three experienced Speech-language Pathologists and Audiologists reviewed the translated Scale. Modifications and changes were made in the Scale depending on the feedback and opinions received from these expert Speech-language pathologists and Audiologists. While preparing test material adaption in the original English Scale were made due to cultural and ethnic diversity. Material adapted was belonging to Telugu speaking population. The overall domains in Scale remained the same. The final version of the Scale was sent to the linguist for approval. After approval from the linguist, the final questionnaire was sent to Audiologists and Speech-language pathologists to check for validity.

Description of Scale: The scale was devised with three goals in mind: (i) to take account of the diverse situations wherein an individual may experience noise discomfort, whatever his/her age, occupation and social status; (ii) to separate noise aggressiveness from noise-induced deterioration of speech understanding, the latter having a different clinical significance to that of hyperacusis; and (iii) to quantify the severity of hyperacusis from the perspective of longitudinal studies on this condition.

In addition to evaluating the MASH in a large group of patients, the purposes of this prospective study were: (i) to determine the prevalence of hyperacusis in a population of patients seeking treatment, or at least counseling, for tinnitus; (ii) to elucidate the relationship between tinnitus and hyperacusis; and (iii) to investigate the effect of time on hyperacusis.

Second phase: Administered of Multiple Activity Scale for Hyperacusis (MASH).

The participants were selected based on the inclusion and exclusion criteria. The Scale was administered on the individuals who participated in the study. Before administration, it was informed that it is a self-rated scale they must rate the questions given in the scale. Also, it was told that their data would be kept confidential, and the participation for this study would be voluntary. Written consent was taken from everyone before administration.

Scoring:

For each individual activity in the MASH, the patient was asked to provide a score from 0 to 10. If the subject did not attend concerts, because of a dislike of or lack of interest in live music, his/her reaction to loud music was taken into consideration. When the scores for cinema and TV differed, the highest was selected. When the patient felt unable to indicate a score for a given item, the item was deleted, even though the activity may have been relevant to him/her. The most frequently mentioned "other" noises (open-set) were small motorcycles and emergency vehicle sirens. The mean MASH score was calculated by dividing the total score by the number of relevant activities, which varied from 7 to 15, but generally ranged between 10 and 12. The Scale can be completed within 10 minutes and requires no special training. For the Multiple Activity Scale for Hyperacusis (MASH),the subjects has to choose zero(0) to ten(10) rating i.e. zero(0) no hyperacusis; mild hyperacusis <3; moderate hyperacusis (3.1-5.0); substantial hyperacusis (5.1- 7.0); and severe hyperacusis (>7.1) which is most suitable to them for each question. When subjects hesitated between two adjacent scores, the average value was taken (e.g. 6.5 when the subject indicated "6 or 7").

Statistical Analysis:

The obtained data was statically analyzed using SPSS software (version 21.0).

To check the reliability of the Scale, Cronbach's alpha coefficient was used.

RESULTS & DISCUSSION:

The final scale Multiple Activity Scale for Hyperacusis (MASH) was administered on 50 participants in the age range of 20 -65 years. The obtained data was further used for the statistical analysis to check the reliability of the test by using SPSS software.

Trans adaptation of Multiple Activity Scale for Hyperacusis into Telugu language (MASH-T). The final trans adapted test material enclosed in appendix 1.

The reliability of the Multiple Activity Scale for Hyperacusis in Telugu (MASH-T).

Item statistics of the response score in MASH-T

The mean and SD of the responses given by 50 participants has been calculated for every question of MASH-T and the data was tabulated in table1. higher means were observed for the items A2, A3, A14 and A15, this indicates most of the participants were responded well for these items and similarly, items A7 and A8 scored '0' by all the participants which indicates normal.

Table 1 Shows mean and SD of the responses for all the items in MASH-T

Activities	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	TOTAL
N	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Mean	1.26	3.04	3.32	1.84	2.72	.92	.00	.00	.74	1.14	.16	1.12	.72	3.38	3.18	25.50
SD	1.96	3.37	4.03	2.26	3.20	1.38	.00	.00	2.46	2.11	.65	2.08	2.51	4.03	3.81	14.57

Reliability of MASH-T

Cronbach's alpha was obtained was .957, which lies between 0.90 to 1.0, this indicates excellent reliability and the scale excellent reliability and can be used with hyperacusis and tinnitus individuals. Data was given in the table 2.

Table 2 Shows Cronbach's alpha test result for MASH

Cronbach’s Alpha	Cronbach’s Alpha Based on standardized items	N of items
.957	.968	13

6Inter item correlation indicates that the items which falls between 0.90-1.0 are excellent correlation, 0.70-0.90 are high positive, 0.50 to 0.70 moderate positive correlation and 0.30 to 0.50 low positive correlation, bold items in the table 3 are referred to be as low moderate positive correlation when compared to other items. **Table 3**

Shows inter item correlation of all the items

	A1	A2	A3	A4	A5	A6	A9	A10	A11	A12	A13	A14	A15
A1	1.000	.763	.796	.734	.760	.728	**.524**	.628	**.477**	**.559**	**.506**	.761	.807
A2		1.000	.985	.942	.876	.883	**.523**	.756	**.468**	.755	**.493**	.975	.967
A3			1.000	.955	.906	.864	**.478**	.691	**.415**	.688	**.459**	.987	.961
A4				1.000	.898	.825	**.428**	.601	**.351**	**.588**	**.408**	.955	.935
A5					1.000	.654	**.216**	**.508**	**.179**	**.519**	**.193**	.911	.895
A6						1.000	.820	.819	.741	.732	.791	.854	.865
A9							1.000	.828	.943	.641	.979	**.462**	**.526**
A10								1.000	.813	.873	.808	.683	.736
A11									1.000	**.587**	.926	**.412**	**.449**
A12										1.000	**.590**	.651	.738
A13											1.000	**.455**	**.509**
A14												1.000	.968
A15													1.000

Item total correlation reveals that the items A1, A4, A5, A10 and A12 falls under high positive correlation, A2, A3, A6, A14 and A15 falls under very positive correlation and finally the items A9, A11 and A13 falls under Moderate positive correlation. Cronbach's alpha increases if the items were deleted, but due the requirement of the activity in test tool the activities were remained same. Items A7 and A8 are not calculated as all participants scored 0. The whole data was given in the table 4.

Table 4: Shows item total correlation of all the items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
A1	22.28	798.287	.803	.954
A2	20.50	688.949	.963	.948
A3	20.22	676.053	.948	.950
A4	21.70	772.908	.901	.952
A5	20.82	741.987	.798	.953
A6	22.62	815.710	.934	.955
A9	22.80	797.878	**.628**	.957
A10	22.40	789.633	.817	.954
A11	23.38	867.914	**.602**	.961
A12	22.42	797.596	.759	.955
A13	22.82	799.253	**.603**	.958
A14	20.16	677.974	.938	.950
A15	20.36	685.092	.960	.949

SUMMARY & CONCLUSION:

The final scale Multiple Activity Scale for Hyperacusis (MASH) was administered on 50 participants in the age range of 20 -65 years. The obtained data was further used for the statistical analysis to check the reliability of the test by using SPSS software.

The MASH-T scale was successfully developed by using translation procedures and was administered on 50 participants. In this present study, the Multiple Activity Scale for Hyperacusis in Telugu (MASH-T) scale which is a scale to rule out how hyperacusis is affecting an individual's quality of life. The reliability of the scale was measured which indicates α= 0.957 which indicates excellent correlation and can be used effectively with the individuals having hyperacusis and tinnitus. Inter item correlation indicates that the items which falls between 0.90 -1.0 are excellent correlation, 0.70-0.90 are high positive, 0.50 to 0.70 moderate positive correlation and 0.30 to 0.50 low positive correlation, few items are referred to be as low moderate positive correlation when compared to other items, this indicates that most of the participants were scored less based on the activities. Item total correlation reveals that the items A1, A4, A5, A10 and A12 falls under high positive correlation, A2, A3, A6, A14 and A15 falls under very positive correlation and finally the items A9, A11 and A13 falls under Moderate positive correlation. Cronbach's alpha increases if the items were deleted, but due the requirement of the activities in test tool the activities were remained same. Items A7 and A8 are not calculated as all participants scored 0. Intra class correlation of all the items showed .957 which states very high positive correlation and whereas p value is 0.000 ($p<0.001$) indicates high significant difference.

To conclude the current study, the reliability of the scale (MASH-T) was measured which indicates $\alpha = 0.957$ which indicates excellent correlation and can be used effectively with the individuals having hyperacusis and tinnitus. The limitations of the study include No. of participants were less, No gender specifications, No type classification, Restricted to one language, Clinical Implications, Can be used with hyperacusis and tinnitus population, Can be used compare pre and post management results, The results can be used as reference data, It gives better understanding of the problem. Future directions include that it Can be extended to large population, Can check gender variations, Can check and compare various types of hyperacusis and tinnitus, Can be extended to other languages.

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AUDITORY PERCEPTION IN A CASE WITH COCHLEAR IMPLANT ELECTRODE TRANSLOCATION

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ABSTRACT

A paediatric cochlear implant recipient reported to our institute with poor auditory perception. Post audiological and radiological evaluation it was noticed that there was suboptimal electrode placement. The child's auditory perception was improvised to the best possible level by modifying the speech processor map within the limit of existing condition.

Keywords: Cochlear Implant, Electrode translocation

INTRODUCTION

Hearing loss is the most common sensory processing disorder with more than 5% of the world's population [1]. Rehabilitation options for hearing loss are limited to use of hearing aids and cochlear implant; where hearing aids have limited functional benefits over cochlear implant. Surgery for cochlear implant has been proven to be a safe and successful procedure but still carries some risks and complications [2]. Electrode translocation is one of many complications related to the implantation [3]. Displacement of electrode from scala tympani to scala vestibuli could result in loss of pre-operative residual hearing and will negatively affect the benefits of cochlear implant [4].

Main objectives of our case report were to find out the reasons for poor auditory perception over use of cochlear implant through audiological and radiological findings and thus suggesting the best solutions in order to maximize the performance in context of scalar translocation.

Case Report

A female child aged 4.2 years was referred to our institute with primary complaint of poor speech discrimination through cochlear implant. She was diagnosed as delayed speech and language development secondary to bilateral profound hearing loss at the age of 12 months. She started using high power digital hearing aid bilaterally along with speech and language therapy thereafter. Since performance over hearing aid was unacceptable, at the age of 2.5 years, subject was operated with cochlear implant in the right ear (CI24RE- straight with s 'CP802' processor by Cochlear Ltd.) under the scheme of 'Assistance to disabled persons for purchase/fitting of aids/appliances' (ADIP) elsewhere. Post switch-on, subject was using bimodal fitting with power Siemens BTE hearing aid in the left ear.

At the time of assessment her experience with implant was 1.5 yrs. An array of audiological tests was administered to the child to find out the reasons behind subject's poor auditory perception. Tests including Conditioned Play Audiometry, Impedance audiometry, Aided Audiogram, Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS), Neural Response Telemetry (NRT), and detailed Mapping Review were administered. Radiological evaluation including X-Ray and computed tomography of temporal bone were carried out to find out the positioning of electrode array of cochlear implant. Based upon the radiological and audiological evaluation, appropriate changes were considered in the MAPs of child's speech processor until we got the best possible responses from the subject. We recorded aided audiogram under four situations:

A1- Cochlear implant in right ear before any changes made to speech processor.

A2- Cochlear implant in right ear after changes made to speech processor.

A3- Only hearing aid in left ear.

A4- Bimodal fitting with changes made to speech processor.

Initially we conducted Play Audiometry to the subject without any amplification devices; thereby results were 'Bilateral Profound Hearing Loss'. (Table 1). Ling sound test [5] was also conducted under different conditions. Only sound /a/ was detected by the subject when administered in A1condition, in A2 all ling sounds were detected except /s/ & /ʃ/. Finally, in A4 i.e. cochlear implant in right ear with changes made to speech processor and hearing aid in left ear, all of the ling sounds were detected by the subject. Immittance evaluation suggested bilateral 'A' type of tympanogram suggestive of no middle ear pathology with absent ipsilateral and contralateral acoustic reflexes. Aided responses under different scenarios have been mentioned in the Table 1. Aided audiograms were below the speech spectrum for all the conditions (A1, A2, and A3) except A4. IT-MAIS score was 13 and 28 out of 40 under the condition A1 and A4 respectively.

Table 1. Close field unaided and aided responses over different conditions All values in dBHL

	Frequency	250 Hz	500 Hz	1K Hz	2K Hz	4K Hz
Unaided	Right Ear	100	NR	NR	NR	NR
	Left Ear	75	80	90	105	110
Aided	A1	60	55	60	65	65
	A2	30	35	30	35	30
	A3	45	40	40	50	65
	A4	30	30	30	35	30

Impedance of all electrodes in all the stimulation modes was within normal range. NRT could not be found out across all electrodes. C level could not be established within the compliance limit of electrodes. Initially, we increased the pulse width value to 37 from default setting of 25 with rate of 900 PPS but the response was not acceptable then the pulse width was increased to 50 with same rate and C-based MAP was provided to the subject. No intolerance problem and auditory fatigue was reported by the subject or parents. Radiological evaluation suggested that electrode array of the implant is within the cochlea but has been translocated from scala tympani to scala vestibuli as shown in Image 1.

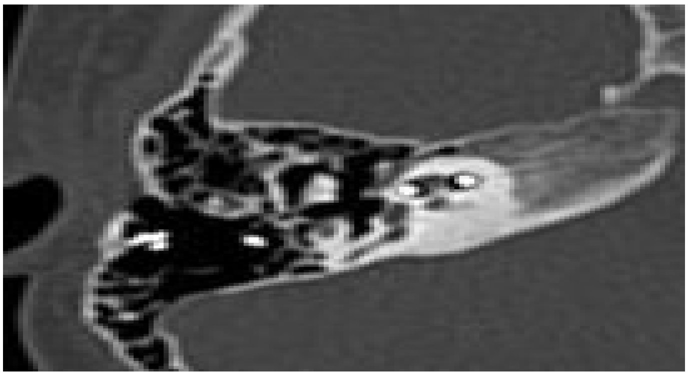

Image 1. Translocated electrode within the cochlea

DISCUSSION

Although cochlear implant has been a proven rehabilitation option for person with hearing loss but due to its surgical involvements more or less it carries some risks and complications. Scalar translocation is one of the rare complications associated with the surgical procedures but has been reported in many individual cases. Identification of scalar translocation is a perplexing work for audiologists, radiological evaluation is still considered as a gold standard for identification of the positioning of the electrode inside the cochlea [6].In our case report we observed that scalar translocation negatively affects the auditory development thereby, auditory perception was very poor even with the cochlear implant. The solutions for the scalar translocation are also limited. MAPs were modified in such a way to get the desirable result from the subject as this was the non-invasive best possible method. Currently, child's aided responses are under the speech spectrum and post intensive training she has gross discrimination of the sounds.

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HEARING LOSS AND CORTICAL ATROPHY: A CASE STUDY

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INTRODUCTION

Dementia and hearing loss are both highly prevalent neurologic conditions in older adults, each having considerable impact on quality of life [1, 2]. A growing body of literature suggests that these two conditions are interrelated and that hearing loss may be a risk factor for the development of dementia in older adults and vice versa [3,4]. Cerebral atrophy results from the loss of neurons and their connections with the brain. Brain atrophy is one of the links between cognitive decline, Mild Cognitive Impairment (MCI), Alzheimer's disease (AD) and hearing loss; in fact, all conditions cause atrophy of the brain. As dementia progresses, an increasing number of neural connections die off. Brain atrophy may potentially damage hearing capacity through the impairment of primary and secondary auditory centres which are located in the temporal lobe. Hearing loss is thought of as a normal part of getting older: as we get older, we start to hear things a little less distinctly. Loss of memory is also usually thought to be a normal part of aging because dementia and Alzheimer's are far more widespread in the senior citizen population than the general population. While there is no proven evidence or definitive evidence that hearing loss results in cognitive decline and mental health issues, there is definitely some connection and several clues that experts are looking into. Typically, age-related hearing loss (ARHL) is characterized by elevated pure-tone audiometric thresholds for high-frequency sounds [5]. ARHL is multifactorial, with increased audiometric thresholds at high frequency often resulting from damage to cochlear outer hair cells or the stria-vascularis in the auditory periphery [6,7]. ARHL or presbycusis is characterized by bilateral progressive hearing loss and impaired speech understanding, especially in noisy environments [8]. [3] Have shown that individuals with mild to moderate presbycusis have worse results in executive function and psychomotor processing, while other studies have shown that hearing loss is significantly related to global cognitive decline, which can lead to social isolation and depression [9, 10, 11]. Furthermore, a recent prospective cohort has reported that presbycusis subjects with audiometric hearing thresholds worse than 40 dB are more likely to develop dementia [12]. The pathological correlate of presbycusis can display different features, including cochlear hair cell loss, stria vascularis atrophy, and auditory-nerve neuron loss [8]. Several human studies have found brain structural changes in patients with hearing loss, including gray matter volume reduction in the right temporal lobe [13, 14].

The underlying causal mechanisms leading to the connection between these two conditions are not well understood, though several possible mechanisms have been suggested. Generally, it can be understood in one of the two possible ways, in which on the one hand hearing loss involves structural and functional changes to the brain, and on the other cognitive decline correlated with age facilitates the onset of hearing deficiency and demands a loss of perception and verbal comprehension [15]

ARHL can be modified by appropriate rehabilitation when identified at earlier stages of cognitive decline. This is in turn would benefit individual with cognitive decline or dementia from further worsening of the problem and associated behavioural symptoms. Through this case report, the occurrence of ARHL with a mild dementia is been highlighted. Documenting such cases would be helpful in creating the importance of rehabilitation of elderly population with a cognitive decline or dementia.

CASE REPORT

A 60-year-old male individual was brought to the clinic with a complaint of reduced hearing sensitivity in both the ears since 3 to 4 years. Other otological symptoms such as blocked ear sensation, tinnitus and vertigo were also not reported. No family history of hearing loss reported. The earlier evaluations included Audiological and Radiological (CT) tests which were carried out 4 years before. The findings were as follows:

Previous Audiological findings:

1) Pure tone audiometry: Bilateral mild sensori neural hearing loss
2) Immitance Audiometry & reflexometry: Bilateral 'A' type tympanogram with ipsilateral and contralateral reflexes present at 500Hz and 1000Hz.
3) Oto acoustic emissions: Bilateral DPOAE's absent suggestive of outer hair cell dysfunction.

Radiological findings: NCCT Head

Findings:

- Both cerebral hemispheres show normal attenuation.
- Bilateral basal ganglia appear normal.
- The supra sellar cisterns and subarachnoid spaces appear normal.
- The third and lateral ventricles appear normal.
- The interhemispheric fissure is in midline.
- No extra-axial collection is seen.
- The basal cisterns appear normal.
- Both cerebellar hemispheres show normal attenuation.
- The brainstem shows no abnormality.
- The fourth ventricle appears normal.
- Bony calvarium is normal.

Impression: No significant abnormality detected in brain parenchyma.

METHOD

The ethical approval was obtained from the Institutional ethical committee before the conductivity of the study similarly an informed consent was signed from the participant explaining all the procedures concerned during this study**.** A detailed case history was obtained followed by which Otoscopic evaluation to visualize the external auditory canal and tympanic membrane status. All the audiological evaluations were carried out in a sound treated room. Tympanogram and Acoustic reflex thresholds were assessed using GSI Tympstar instrument. Tympanogram was measured using a 226 Hz probe tone, with sweep pressure starts point at -200 dapa to end point of +400 dapa. Ipsilateral and Contralateral acoustic reflex were obtained using Pure tone activator stimuli 500 Hz, 1 kHz, 2 kHz and 4 kHz at 90dBHL, 100dBHL and 110dBHL. The patient was instructed to sit quiet and not to move during the procedure. Distortion product Oto acoustic emissions (DPOAEs) were recorded using IHS Jr instrument to check to outer hair cell (OHC) function. Tone pair was sequential, with an F2/F1 ratio of 1.2. Intensity of the tone pairs was 65- and 55-dB SPL for L1 and L2, respectively. Two separate runs per ear were collected for determining repeatability. Validity and reliability of normal outer hair cell function was determined by analysing each distortion product frequency separately. Passing criteria for DPOAE was 6dB SNR.

Cognitive function was assessed by two tests which were Mini mental state examination (MMSE) [16] and Clinical Dementia Rating Scale (CDR) [17]. MMSE assesses global cognitive function including orientation, registration, attention, calculation, visual-spatial, recall and language. It scores from 0 to 30, lower scores implying worse cognitive function. The CDR is a structured, clinician-rated interview that collects information on cognitive capacity from both the informant and patient for the evaluation of staging severity of dementia. Six domains are assessed and then synthesized to assign a Global CDR score. The domains are memory, orientation, judgment and problem solving, community affairs, home and hobbies, and personal care. The scoring ranges from 0 to 3, high score indicating severe dementia. The test was administered by a research assistant who is an experienced speech language pathologist.

RESULTS

Otoscopic examination: Otoscopic examination was performed for evaluating the status of the external ear canal and tympanic membrane. No significant abnormality was observed.

Pure tone Audiometry: Pure tone audiometry revealed bilateral mild to moderate sensorineural hearing loss (Figure.1).

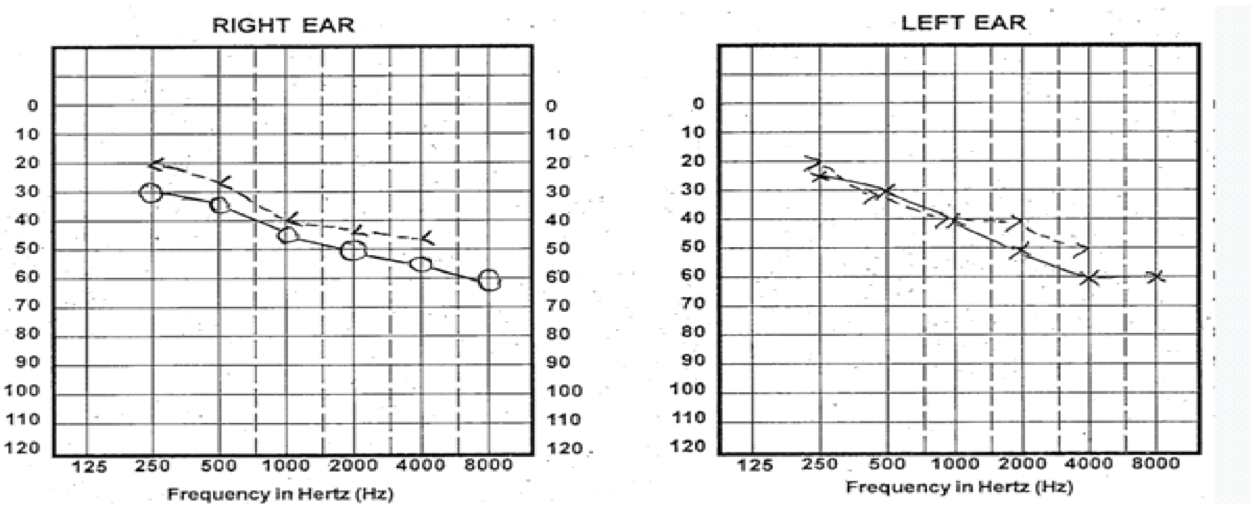

Figure1. Pure tone Audiometry findings

Tympanometry and reflexometry: Tympanometry and reflexometry results revealed bilateral 'A' type tympanometry with absent ipsilateral and contralateral reflexes respectively suggestive of no middle ear pathology (As shown in figure 2).

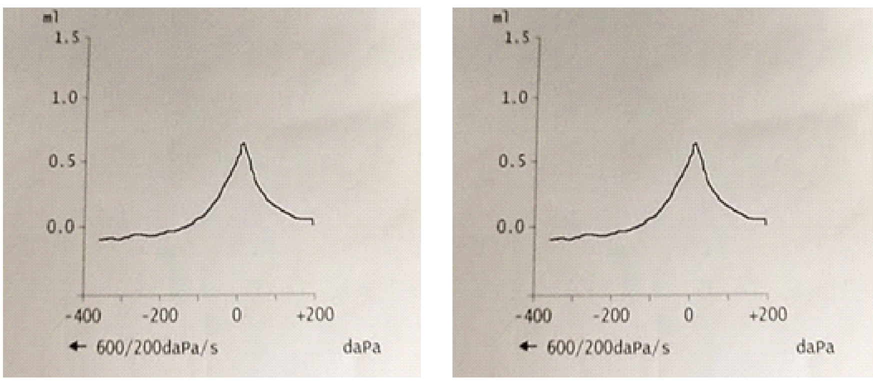

Figure 2. tympanometry findings (Left and right ear respectively)

Oto acoustic emission: DPOAE evaluation showed bilateral absent DPOAE suggestive of outer hair cell dysfunction (figure 3).This finding is in well corelation with other audiological test results indicating bilateral sensorineural hearing loss.

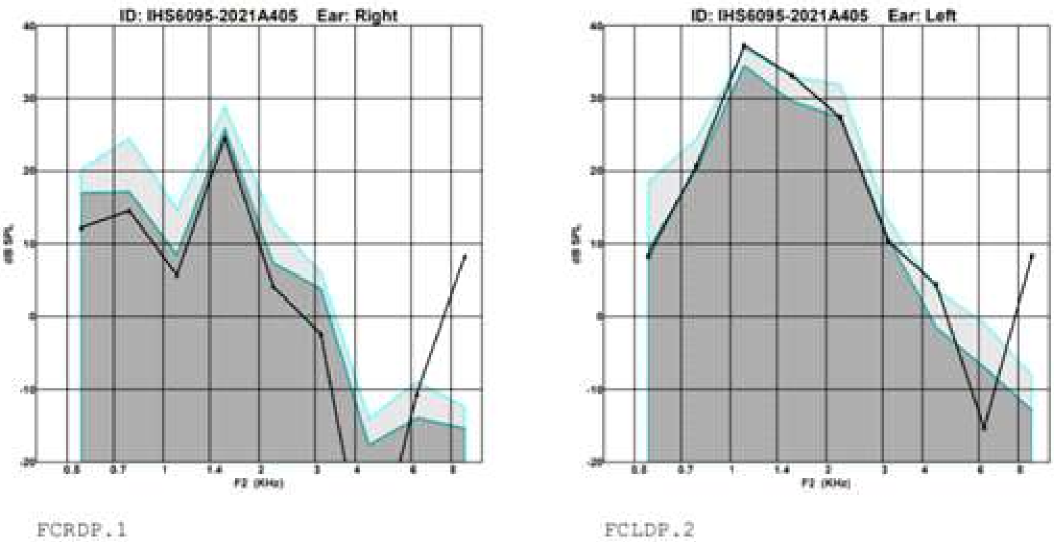

Figure 3. DPOAE findings of right and left ear respectively

Radiological findings: CT Head (Plain)

Findings:

- Posterior fossa structures normal
- Periventricular and deep white matter confluent hypo densities are noted in bilateral fronto parietal regions suggestive of ischemic changes
- Rest of cerebral parenchyma shows normal attenuation
- Lateral ventricles are dilated
- Third ventricles are prominent
- Cortical sulci and fissures appear enlarged
- Bilateral sylvian fissures appear enlarged
- No mass effect / midline shift evident

Impression: Cortical Atrophy with White Matter Ischemic Changes as Detailed

Cognitive function test result:

Two tests were administered to evaluate cognitive function (MMSE & CDR scale). MMSE score was 20 which are indicative of mild cognitive impairment. CDR score was 1, suggestive of mild dementia.

There are possible explanations of above findings. Sensory measures are generally good predictors of higher levels of cognitive functioning, especially in older age, although cross sectional studies have shown that hearing loss is a better predictor than visual acuity of age-related decline in more complex intellectual abilities [12, 18]. The above result shows a relationship between general cortical atrophy and poorer hearing in the high-frequency range. Similar findings were reported in a population based sample of 70 year old women with general cortical atrophy and reduced hearing in high frequencies [19]. In this case reflexes and DPOAE were absent which is in well correlation with previous studies which has reported absence of reflexes and decline in DPOAE provide a diagnostic marker for aging-related changes in the cochlea [20].

DISCUSSION

Many studies have found an association between untreated hearing loss, Alzheimer's disease and other types of dementia. Meaning, people with hearing loss are more likely to develop cognitive problems than people who do not have hearing loss. This is an area of intense research with many unanswered questions. According to several major studies, older adults with hearing loss especially men are more likely to develop Alzheimer's disease and dementia, compared to those with normal hearing. Men with hearing loss were 69% more likely to develop dementia than those with no hearing impairment. Most recently, a study published in July 2021 found that people who struggle to hear speech in noise were more likely to develop dementia than those with normal hearing, as measured over an 11-year period [21]. The prevalence of dementia has increased, with rapid increases in the population. Dementia is associated with a higher risk of mortality, higher health care costs, and disability. Current treatment strategies only ameliorate symptoms and do not change the disease course. Identification of patients at risk of dementia is critical for preventing an impending dementia epidemic. Hearing loss (HL) has recently been recognized as a risk factor for dementia. The risk of HL increases with age and is associated with lower scores on tests of memory and a higher risk of incident all-cause dementia [3, 9]. Evidence suggests that even mild levels of HL increase the long-term risks of cognitive decline and dementia. [12, 22, 23, 24]. Hearing loss in older adults may play a role in social isolation, depression, disability, lower quality of life, and risk dementia [25]; however, HL is a possible biomarker of and modifiable risk factor for cognitive decline, cognitive impairment, and dementia [26]. In a recent study of population-based sample an association between general brain atrophy and hearing loss was documented. Moreover, when hearing loss and cognitive difficulties are co morbid, not only the communicational difficulties will increase other factors like stress, isolation would also be present which can affect their quality of life. This in turn can lead to a burden for their care givers.

This study also has some limitations. First, the analysis was based on a single case rather than from a large sample size which prevented further analyses on the influence of patient characteristics on the outcome. In addition, the association between hearing loss and dementia can vary according to the severity of hearing loss, age, gender as well as any other internal or external factors which could be only determined based on a study on large heterogeneous population.

CONCLUSION

The patient presented in this case study had gone through multiple tests including Behavioural, Physiological, Radiological and Cognitive evaluation. All the findings conceal that hearing loss can be a factor that may lead to cortical atrophy which can in turn lead to other problems like cognitive decline and dementia. Results of our study highlight the importance of audiological evaluation in elderly individuals with cognitive impairment. If appropriate audiological intervention is provided cognitive deterioration can be delayed and other associated behavioural symptoms like agitation, isolation and depression.

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ROLE OF SUBJECTIVE HEARING EVALUATION IN DECIDING COCHLEAR IMPLANT CANDIDACY AMONG A RARE CASE WITH AUDITORY NERVE DEFICIENCY: CASE REPORT

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INTRODUCTION

Optimal hearing is an important aspect in the life of young children for the development of language along with reading, writing and other communication behaviors. Children with hearing loss goes through the different negative and unwanted consequences of hearing loss. Most of these young children suffers from hearing loss due to either subnormal development of cochlea or damage to the parts of cochlea during pregnancy. Cochlear implant is an ideal solution for these young children having severe to profound sensorineural hearing loss. Being an invasive surgical procedure, a person must meet basic minimal requirements before cochlear implantation. Neural survival is a crucial part in determining suitable candidate of cochlear implant. Radiological evaluation has been a gold standard in identification of complication to auditory nerve, but still there are chances that clinical imaging procedure might miss these complications. Imaging techniques sometimes cannot delineate the accurate status of auditory nerve. Therefore, subjective evaluation should be considered as an important measure in identification of a candidate suitable for cochlear implant.

Need of the study

The inner ear malformations in association with auditory nerve dysplasia have been reported in 10-22% of severe to profound hearing loss. In such cases where auditory nerve is either not visible or deficient to any degree, cochlear implantation has always been a contraindication. In order to understand the functional aspect of auditory nerve it is important to explore results of subjective hearing evaluation with and without hearing aid(s) to decide candidacy of cochlear implant versus auditory brainstem implant.

AIM

To identify the role of subjective audiological evaluation in deciding the candidacy for cochlear implant in a case with auditory nerve complication.

OBJECTIVES

- To co-relate radiological imaging techniques with subjective hearing evaluation result.
- To find out the outcome of cochlear implant in subject with cochlear nerve aplasia or hypoplasia.

CASE REPORT

A case aged 5yrs/male with a complaint of inability to hear and communicate verbally reported to speech and hearing department, SAIMS, Indore for the pre-evaluation of cochlear implant candidacy. The case was assessed for the suitability of cochlear implant under RBSK scheme- a government-initiated scheme. Audiological evaluation including detailed case history followed by immittance audiometry, pure tone audiometry, oto-acoustic emission, auditory brainstem response and aided audiogram were assessed in order to find out the eligibility of the child for cochlear implant under the government scheme.

Audiological, Psychological, Speech and Language Evaluation tests and ENT examination confirmed that the child met the criteria for cochlear implantation.

Computed tomographic scanning and magnetic resonance imaging (1.5 tesla) of temporal bone of both ears was done to evaluate the internal structure of middle ear, mastoid, cochlea and auditory nerves. Imaging study revealed deficient apical turn of cochlea with normal basal turn on either side suggesting cochlear malformation associated with stunted/hypoplastic lateral, superior, posterior semicircular canal and absent of cochlear nerve (Fig: 1.1).

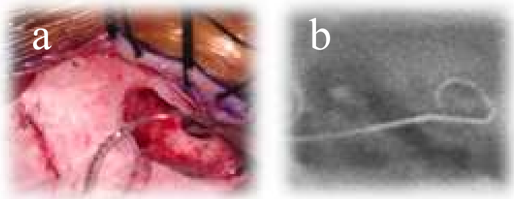

Fig 1. 1: a) Cochlear Implant electrode insertion through PT technique, b) Post opt X -Ray of temporal bone: Cochlear Implant array in situ.

Bilateral cochlear nerve aplasia (absence of auditory nerve) is contraindicative of cochlear implants (CI) as CI bypasses the function of ear till cochlea only. Auditory nerves caries the electrical impulses generated by cochlear implant form cochlea to auditory cortex. In such cases only viable treatment option left is the auditory brainstem implant (ABI) which bypasses the auditory system till auditory nerve. However, ABI is recommended only when no or limited benefit is received from CI and/or hearing aid in person with hearing impairment.

Imaging techniques sometimes cannot delineate the accurate status of auditory nerve. Hence, confirmation of functional status of cochlear nerve needs to be confirmed by using subjective hearing tests or in cases where subjective responses are not reliable or absent, electrical auditory brainstem (EABR) response techniques must be used. Conditioned play audiometry repeated thereafter to re-evaluate the auditory responses from 250Hz to 8KHz through air conduction and bone conduction mode. Audiogram showed consistent behavioural responses at low and mid frequency at higher intensities (Fig 1.2). Aided play audiometric results also showed benefit from the hearing aid. These responses were recorded in audio and video format for evidence-based practice. These consistent auditory responses are suggestive of presence of auditory nerve thus allowing auditory stimulus to reach the auditory cortex.

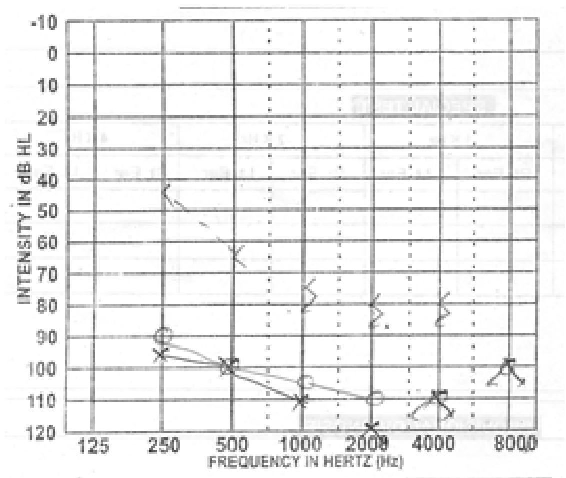

Figure 1.2 showing audiogram of conditioned play audiometry

Based on the findings, surgeon operated right ear with cochlear implant. Intra-operative impedance and neural response telemetry (NRT) was carried out to assess device functioning and neural responsiveness of the auditory nerve. Neural responses were present for all electrodes from 1 (base) to 22 (apex) which strongly suggests that all electrodes are within cochlea and current generated by active electrodes of cochlear implant are received by the auditory nerve (fig 2a &2b). This finding correlates with the results of subjective hearing evaluation and confirms the presence of the auditory nerve.

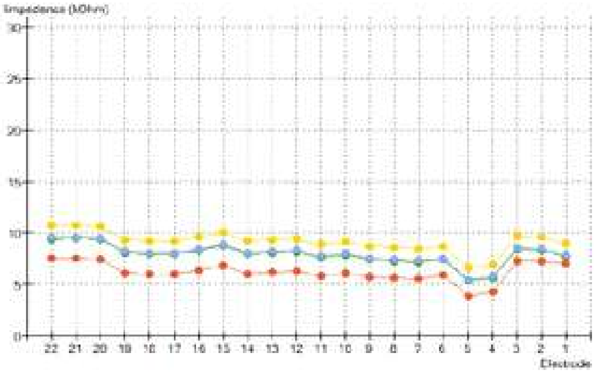

Figure 2a: showing normal post-op impedance

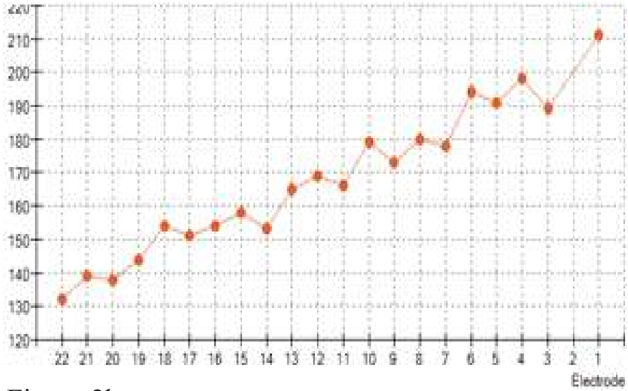

Figure 2b: Post opt Neural Response Telemetry Report.

X- ray in stenver's view was recorded and it showed that all the electrodes are inserted into the cochlea. This finding correlates with the results of subjective hearing evaluation and confirms the presence of the auditory nerve. Post operative initial activation of the device also revealed the presence of robust neural responses and after 3 months of device activation, subject was able to detect all the ling sounds along with the environmental sounds.

CONCLUSION

Imaging techniques are gold standard for detection of any structural abnormalities present in cochlea but many researchers in past have found that radiological techniques in temporal bone study have failed in many instances to give accurate picture of cochlear vestibular anatomy. Researchers have also found significant audiological benefits post cochlear impalnt in subjects with cochlear nerve aplasia or hypoplasia. Thus, to sum up, in such cases subjective audiological evaluation plays a major role in combination of radiological findings to select appropriate implantable hearing prosthesis and achieve optimal hearing outcomes.

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SCREENING AUDITORY PROCESSING DIFFICULTIES IN CHILDREN WITH AUTISM SPECTRUM DISORDERS USING CHILDREN'S AUDITORY PERFORMANCE SCALE.

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INTRODUCTION

Autism Spectrum Disorder (ASD), is a heterogeneous group of idiopathic neurodevelopmental disorders with a strong genetic basis. According to Brittany Allen (2009), Autism is a developmental disability that appears in the first 3 years of life and affects brain development in areas of social interaction and communication skills (both verbal and nonverbal). The exact cause of ASD is currently unknown. It is a complex condition and may occur as a result of genetic predisposition, environmental, or unknown factors.

Many causes of autistic features were proposed including seizures, hyperoxia, and early developmental insults in utero. (Schain & Yanet, 1960; Rutter & Lockyer, 1967; Walker 1977). Most researchers agreed that they were searching for multiple and interacting causal factors for the disorder (Rutter, 1968), consistent with current biopsychosocial theories for the majority of mental disorders.

Auditory processing disorder (APD), rarely known as auditory disability with normal hearing (ADN), central auditory processing disorder (CAPD) is a neurodevelopmental disorder affecting the way the brain processes auditory information. Individuals with APD usually have normal structures and functions of the outer, middle, and inner ear (peripheral hearing) but they cannot process the information they hear in the same way as others do, which leads to difficulties in recognizing and interpreting sounds, especially the sounds composing speech. It is thought that these difficulties arise from dysfunction in the central nervous system. It is highly prevalent in individuals with other neurodevelopmental disorders, such as Attention Deficit Hyperactivity Disorder, Autism Spectrum Disorders, Dyslexia, and Sensory Processing Disorder. The actual prevalence is currently unknown, it has been estimated to be 2–7% in children in US and UK populations (CDC, 2011). Approximately 5% of school-age children have some type of auditory processing disorder (APD) and according to the National Institutes of Health, in children with learning difficulties the prevalence of auditory processing disorder has been found to be 43%.

The Abnormalities in auditory processing are one of the most commonly reported sensory processing impairments in children across the autism spectrum (Kellerman, & Gorman, 2005; Samson et al., 2006; Del Rincon, 2008). Children with Autism Spectrum Disorder (ASD) consistently exhibit atypical responses to auditory stimuli. Individuals with autism spectrum disorder frequently struggle with spoken language comprehension. This could be attributed to the higher-order global impairment of autism, yet these people frequently exhibit specific auditory problems. Although a diagnosis of Auditory Processing Disorder is not always accurate, some individuals do have auditory processing abnormalities and can benefit from APD management. Auditory Processing Center specializes in functional APD assessments for people on the autism spectrum in order to evaluate the sort of auditory processing problems the child is having and to help discover successful therapy.

NEED FOR THE STUDY:

Considering the fact that children with autism have abnormal auditory, visual, and somatosensory functions. Additionally, studies show that cortical and subcortical structures connected to the areas of the brain responsible for language and hearing function are impaired. Though the majority of autistic children exhibit normal structural and functional development of the peripheral auditory system, it is important to assess the central auditory system and its function. Furthermore, autistic children can be both hypo and hypersensitive to noise. Identification of auditory processing disorders in autistic children is crucial. For early detection and early intervention using auditory training programs, it is crucial to identify children who are at risk of auditory processing disorders. Numerous electrophysiological studies have shown that autistic children have impaired auditory information processing. However, there are few studies that use behavioral observation to find ASD children who are CAPD-at-risk. The Children's Auditory Performance Scale (CHAPS) is recommended as a screening tool for identifying children who are at risk for CAPD, and parents or teachers can use it with ease. Hence, this scale is chosen and administered to children with autism to identify children who are at risk.

METHODS:

AIM OF THE STUDY: The aim of the study is to assess auditory processing difficulties in different listening conditions in children with autism spectrum disorders (ASD) using the Children's Auditory Performance Scale (C.H.A.P.S).

OBJECTIVES OF THE STUDY:

To identify the ASD children who are at risk for Central auditory processing disorder.

To compare the C.H.A.P score of the ASD group vs Typically developing group.

To identify which listening condition is more affected in the ASD group.

Study design and sampling: Quasi-experimental design and purposive Random sampling is used.

PARTICIPANTS:

A total number of 86 participants of age range from 7-15 years including both males and females (mean age of 9.85) were included in the study, which was divided into two groups:

EXPERIMENTAL GROUP: 56 children with severe to high-functioning (Mild) autism spectrum disorder (mean age of 9.70) Age range and Gender: 7-15 years of age, 47 male and 9 females.

CONTROL GROUP: 30 typically developing children (mean age of 10.13) Age range and Gender: 7-15 years of age, 22 males and 8 females.

Inclusion criteria: Subjects to be considered were both sexes who had been diagnosed with autism spectrum disorder based on the diagnostic criteria for ASD as mentioned in The American Psychiatric Association's Diagnostic and Statistical Manual, Fifth edition (DSM-5).

Second, subjects between the age of 7-15 years were included in the study.

Child should be diagnosed with ASD below 5 years of age.

Children with Autism spectrum disorder with no other medical history were included.

Child should be taking any therapy (Occupational therapy, Behavioural therapy, Speech therapy) for at least 1 year.

Exclusion criteria: Child's age range below 7 years and above 15 years or diagnosed after 5 years were excluded and children diagnosed with hearing loss were not taken in the study. Children with other comorbid factors like Epilepsy etc., were excluded.

Tool of the study: The Children's Auditory Performance Scale (C.H.A.P.S) is a 36-item questionnaire developed by Walter. Smoski, Ph.D., Michael A. Brunt, Ph.D., Curtis Tannahill, Ph.D. in 1992 & 1998 for assessing child's listening behavior against his/her peer group in 6 different listening conditions. C.H.A.P.S was designed for teachers and parents to complete for children aged 7 years and above. It is listed in American Speech- language-Hearing Association (ASHA, 2005) and the American Academy of Audiology (AAA, 2010) and suggested as a screening tool for assessing children who are at risk of central auditory processing disorder. C.H.A.P Scale uses 7-point Likert scale to rate child's listening skills in 6 different listening conditions. The following are the listening conditions:

Noise condition (7-item)

Quite condition (7-item)

Ideal condition (3-item)

Multiple Input condition (3-item)

Auditory Memory Sequencing condition (8-item)

Auditory Attention Span condition (8-item)

PROCEDURE:

56 children in the age range 7-15 years, who are diagnosed with ASD by professional Speech Language Pathology using Childhood Autism Rating Scale (CARS). Based on CARS scoring participants were divided into mild, moderate, and severe autistic categories. 30 typically developing school-going children in the age range of 7-15 years were included in the study who has no complaint of any auditory or language deficits.

The C.H.A.P.S. was given to the child's parent to rate the child's auditory skills in different conditions. Data for both groups were mostly collected in an interview fashion where the clinician asked questions to the participant and marked the same response on a printed questionnaire sheet as reported. Some participant's parents in the control group assessed and rated the scale by themselves and few responses were collected online by sending the google forms.

Scoring: There are 36 questions in total across 6 listening conditions, with options ranging from

+1 (less difficulty) to -5 (cannot function in the situation). All the scores are added for each listening condition. To obtain the average condition score in each listening condition, each condition score is divided by the number of items in that condition. For example, if the condition score in NOISE is “-14”, the average score is calculated as - 14/7 i.e., “-2”. If the Average condition score is less than -1, considered as PASS. If the average score is above -1, considered at risk for CAPD. Total C.H.A.P score can range from +36 to -180, and the more negative the score the greater difficulty that is noted. In total C.H.A.P Score, the PASS RANGE is +36 to -11 and the AT-RISK FOR CAPD RANGE is -12 to -180.

STATISTICAL ANALYSIS: The results of the current study were tabulated based on group-wise and analyzed using the latest version of the Statistical package for the social sciences (SPSS V29.0). The mean, and standard deviation, were administered on the data as per the objectives. A one-way ANOVA is used to test significant differences among the Experimental group. An Independent sample T-test is used for comparison between the 2 groups. Pearson Correlation and 2-tailed test used for testing statistical significance.

RESULTS:

The ASD group consists of 56 participants, out of which 47 children are males (84%) and 9 females (16%). The control group has 30 participants, which include 22 males (73%) and 8 females (27%). Different age groups between 7-15 years were included in this study out of which a maximum of 20.93% were of 7 years and minimum 5.81% of 14-15 years old children. Mean age of ASD group and control group was 10.13 years & 9.70 years respectively and their standard deviation was 2.55 & 2.50 respectively.

Mean and Standard deviation was used for the data analysis. The Sum of all 6 domains represents the total CHAPS score. The minimum and maximum total CHAP score is +36 to -180 respectively. A score between +36 to -11 indicates PASS range and scores between -12 to -180 indicate AT-RISK range. The mean total score is -94.29 in the ASD group & -4.37 in control group.

In ASD group, mean total CHAP score for mild, moderate and severe autism is -74.80, - 93.94, -132.23 respectively.

Average of total CHAP score represents the total average score. Maximum & minimum total average score in CHAP scale is 1.0 & -5.0 respectively. The score between +1 to - 1 represents pass range and the score between -1.1 to -5 indicate children are at risk of auditory processing difficulties. The mean of total average score is -2.36 in ASD group & -0.103 in control group. All participants in the control group have mean total average scores that are less than -1, indicating that they are not at risk of APD, whereas all participants in the ASD group have mean total average scores that are greater than - 1.1, indicating that they are at risk of APD.

In ASD group, mean of total average score for mild, moderate and severe autism is - 2.15, -2.5, -3.6 respectively.

Among the ASD group, mild category showed less negative score comparted to moderate and severe category but all the three at risk of APD.

Individual domain mean scores of all 6 listening conditions were calculated in mild, moderate and severe ASD group. When compared to the other 6 conditions, ASD children who were listening in an ideal situation with no distractions showed less difficulty, but still at risk for APD with total mean score -1.63. Parents reported poor performance in auditory memory sequencing and listening in noisy environments with more negative total mean score -3.13 & -3.05 respectively. Auditory attention span, multiple inputs and listening in quite are also similarly affected in all the 3 ASD group with total mean score -2.36, -2.27 & -2.33 respectively (Table 1).

Table 1 Individual Domain average mean scores and standard deviation for mild, moderate and severe categories of the ASD group

		N	Mean	Std. Deviation
Noise Average Score	Mild	25	-2.50	.771
	Moderate	18	-3.04	.507
	Severe	13	-4.12	.672
	Total	56	-3.05	.919
Quiet Average Score	Mild	25	-1.684	.5684
	Moderate	18	-2.406	.5418
	Severe	13	-3.500	.7303
	Total	56	-2.338	.9290
Ideal Average Score	Mild	25	-1.144	.4341
	Moderate	18	-1.606	.3903
	Severe	13	-2.623	.7949
	Total	56	-1.636	.7796
Multiple Inputs Average Score	Mild	25	-1.72	.589
	Moderate	18	-2.34	.648
	Severe	13	-3.25	.798

	Total	56	-2.27	.887
Auditory memory Sequencing Average Score	Mild	25	-2.612	.9675
	Moderate	18	-3.200	.5980
	Severe	13	-4.062	.6145
	Total	56	-3.138	.9644
Auditory Attention Span Average Score	Mild	25	-1.820	.9323
	Moderate	18	-2.300	.3742
	Severe	13	-3.492	.8703
	Total	56	-2.363	1.0122

On administering the Pearson's correlation results obtained from the correlation across domain average scores and total average scores for the autistic group indicates that there is a significant and positive correlation (r= 0.7 to 0.9, $p < 0.001$), the ASD group shows a strong positive correlation.

The performance patterns in individual domains within the groups and between groups show significance differences as tested by one-way analysis of variance (ANOVA) where $p < 0.001$.

Table 2. Testing the significance of difference in domain average scores across mild, moderate, and severe cases in the ASD group using one-way ANOVA

		F	Sig.
Noise Average Score	Between Groups	24.713	.000
	Within Groups		
	Total		
Quiet Average Score	Between Groups	39.215	.000
	Within Groups		
	Total		
Ideal Average Score	Between Groups	33.786	.000
	Within Groups		
	Total		
Multiple Inputs Average Score	Between Groups	23.136	.000
	Within Groups		
	Total		
Auditory memory Sequencing Average Score	Between Groups	14.480	.000
	Within Groups		
	Total		

Auditory Attention Span Average Score	Between Groups	19.691	.000
	Within Groups		
	Total		
TOTAL AVG SCORE (CHAPS score/36)	Between Groups	27.329	.000
	Within Groups		
	Total		

To determine whether there is a statistically significant difference between the total average score and total CHAP score of the control group and ASD group independent sample T-test was administered. T-test results reveal that *p* values ($p < 0.001$) are statistically significant in both groups (Table 3).

Table 3 Independent Sample t-test comparing total average scores and total CHAPS scores of Control and ASD groups

	Group	N	Mean	Std. Deviation	t	Sig.(2-tailed)
TOTAL AVG SCORE (CHAPS score/36)	Control group	30	-.107	.2067	16.30	0.00
	ASD Group	56	-2.645	.8369	21.50	0.00
TOTAL CHAPSSCORE	Control group	30	-4.37	7.093	15.81	0.00
	ASD Group	56	-94.29	30.617	20.95	0.00

The results reveal that there is a positive correlation between domain average score and total average score of ASD group. There is a statistically significant difference in domain average scores between the mild, moderate, and severe ASD groups, as well as a statistically significant difference in total average score and total CHAP score between the control and ASD groups.

DISCUSSION

The present study aimed to screen the auditory processing difficulties in children with autism spectrum disorder and compare with of typically developing children of age 7-15 years using CHAPS. The results of this study revealed that the mean total CHAPS score in the ASD and control groups is -94.29 and -4.37 respectively, indicating that all of the children in the ASD group are at risk of having auditory processing difficulties, while the children in the control group are in the pass range. Similar outcomes were attained in the study conducted by Kelsey E. Egelhoff (2011) found that there are difficulties in auditory processing abilities in ASD when compared to that of typically developing children by using Auditory Behaviour Questionnaire.

Individuals with autism spectrum disorder frequently struggle to understand speech, especially in poor acoustic environments and exhibit noise intolerance or sound sensitivity. Moore and his colleagues

(2014) studied speech in noise perception in high functioning autistic children and concluded that they have poor auditory information processing in presence of noise compared to typically developing group. In the present study the mean average score in noise domain is poorer (-3.05) when compared to other domain average scores, indicates ASD group have more difficulty in processing auditory information in presence of noise.

The mean scores of the auditory memory (-3.13), auditory attention (- 2.36), listening in noise (-3.05) were poorer than other domains, similar results were obtained in the study conducted by David Downs et al., (2005) using the Children's Auditory Performance Scale, where most parents rated their child as having more difficulty than peers in auditory memory, auditory attention, listening in noise, and listening while doing another task.

In mild, moderate & severe ASD groups highly affected domain is Auditory memory sequencing, and listening in noisy environment and less affected domain is listening in ideal condition.

There are many neurophysiological studies that have found evidence of impaired auditory information processing at the brainstem and cortical levels in autistic children.

In the recent study conducted by Maryam et al., (2019) on high functioning autism children using speech ABR, they found all the latencies of waveforms predominantly V-A wave are significantly longer than control group.

The authors concluded that children with ASD have deficits in the temporal encoding of speech at the brainstem level as a result of abnormal auditory information processing.

The results of the study revealed that there are auditory processing difficulties in ASD group when compared to control group and there is positive correlation between individual domains score & total average score as well as there is a significant difference between ASD and control group in mean of total CHAP score and total average score. Hence CHAPS can be used to screen auditory processing difficulties in autism spectrum disorder.

CLINICAL IMPLICATIONS:

1. The current study contributes to the prediction of auditory processing difficulties in autism spectrum children which are more important for understanding language development.

2. This scale can be used in assessment protocol of ASD in screening auditory processing difficulties.

LIMITATIONS OF THE STUDY:

Classification of ASD such as Autistic, Asperger's, PDD-NOS, is not considered in the study. Equal number of males and females and equal number of mild, moderate and severe ASD group were not included. Comparison between males and females are not included. Age of diagnosis and Duration of therapy was not included.

FUTURE IMPLICATIONS:

Study can be extended with large number of populations in different ASD sub groups to identify which classification of ASD is more affected. CHAPS can be used as a screening tool and can tell whether the child is at risk of having APD, but it does not help in identifying which aspects of processing like localization, auditory discrimination, auditory pattern recognition and temporal aspects of audition is affected. Further researches in evaluation of auditory processing in children with ASD should include diagnostics tests such as dichotic listening, SPIN, temporal processing tests. Additionally, future researches can study the effect of auditory integration training in management of auditory processing difficulties in ASD children.

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