PROFILE OF LISTENING NEEDS OF INDIVIDUALS

WITH HEARING LOSS

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A Masters Dissertation Submitted in Part Fulfilment of

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MANASAGANGOTHRI, MYSURU – 570 006

September 2021

CERTIFICATE

This is to certify that this dissertation entitled 'Profile of Listening Needs of Individuals with Hearing Loss' is a bonafide work in part fulfilment for the degree of Master of Science (Audiology) of the student with Registration No. 19AUD030. This has been carried out under the guidance of a faculty in this institute and has not been submitted earlier to any other University for the award of any Diploma or Degree.

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DECLARATION

This dissertation entitled 'Profile of Listening Needs of Individuals with Hearing Loss' is the result of my own study under the guidance of Dr. Manjula.P, Professor of Audiology, Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier to any other university for the award of any other Diploma or Degree.

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DEDICATED TO

MY FATHER,

MOTHER

AND BROTHER

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ABSTRACT

Aim: The study focuses on development of questionnaire to measure listening needs of individuals with hearing impairment in the Indian context. The questionnaire evaluates the hearing problems under five domains: detection, speech in quiet, speech in noise, noise tolerance and others (localization, music perception and telephone perception). It also evaluates the listeners' expectations from hearing aids.

Method: The questionnaire is framed under three sections-listening needs, order of significance/importance and expectations. The 22 items in the questionnaire were chosen based on literature survey, information from listeners with hearing impairment, knowledge and experience of audiologists. Listening needs and expectations data were obtained from 30 adults and 30 older adults with hearing impairment. The questionnaire was administered on 30 individuals, having hearing sensitivity within normal limits, for standardization and checking specificity and sensitivity.

Results: The results showed higher scores for adults and older adults with hearing impairment compared to those with normal hearing indicating the need for hearing aids among listeners with hearing impairment. The participants rated 'speech in noise' as the most significant domain of listening. The expectations results revealed most assistance from hearing aids is required for understanding speech in noisy situations.

Conclusions: The listening needs questionnaire is an important clinical tool to elicit patient's listening needs in order to know the need for a hearing aid. It is beneficial for custom pre-selection of hearing aids and fine tuning/ optimizing digital hearing aids. It is helpful in counselling about the extent of fulfilment from hearing aids and the possible hearing aid benefit based on the type and degree of their hearing loss.

Key Words: listening needs, expectations, hearing aid

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Chapter 1

INTRODUCTION

Hearing loss is a common sensory defect affecting more than 250 million people worldwide (Mathers et al., 2000). Hearing loss causes trouble understanding speech, communication difficulties, language development delays, social disengagement, economic and educational backwardness, and stigmatisation. In India, 63 million people (6.3 %) have substantial hearing loss (Garg et al., 2009). According to the 58th round of the National Sample Survey (NSS) on disability in Indian households, hearing impairment was the second most common cause of disability and the leading cause of sensory loss (Singh, 2015).

A persistent sensorineural hearing loss is linked to poor speech recognition, which is exacerbated in noisy environments. Further, communication breakdowns can have a number of negative repercussions, including an increase in the amount of depression symptoms, an increased risk of isolation, and a lower quality of life. Hearing aids are a typical option for overcoming the consequences of loss of audibility, especially for persons who have hearing deficits that are not medically/ surgically curable. Hearing aids improve ability to hear sounds by providing amplification/ gain to the incoming signals (Picou, 2020).

Hearing aid fitting/trial involves several areas of assessment such as case history, hearing assessment, listening / communication needs, and non-auditory needs (Valente et al., 2015). Clinically, case history and hearing evaluation are routinely followed for cases before performing a hearing aid trial. There are several questionnaires that evaluate the listening needs and there are a few questionnaires that evaluate the expectations from

a hearing aid. This aspect is important because if the expectations are too high compared to the realistic expectations, the person shall become a non-user of the hearing aid.

A variety of tools have been developed to assess the communication needs and to assist in evaluating expectations of the patient on hearing aid use. These questionnaires include a number of checklists such as the Client Oriented Scale of Improvement (COSI; Dillon et al., 1999), Hearing Handicap Inventory for the Elderly (HHIE; Ventry & Weinstein, 1982), Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox & Alexander, 1995), and Expected Consequences of Hearing Aid Ownership (ECHO; Bille & Parving, 2003). These assessment tools will assist in pre-selection of specific features in hearing aids for trial in terms of features such as noise reduction, directionality, frequency modulated (FM) systems or wireless microphone systems, telecoil, direct auditory input (DAI), feedback management, etc. Following the fitting, these same tools could be used to quantify the functional benefits that the patients get from hearing aid use.

In addition, information on lifestyle and listening needs when included in assessment would provide useful information in selecting the hearing aids (Valente, et al., 2006). This could form a basis for planning intervention. This is because audiometric data alone is not sufficient to determine or plan the intervention strategies. Further, hearing aid fitting using conventional prescriptive methods does not account for several subjective and technical considerations, which support consumer satisfaction (Picou, 2020). Thus, a checklist has to be developed to meet communication needs that are specific to patients, as in COSI, and to include the expectations in the same checklist would prove to be more useful clinically. This has to include providing realistic expectations and creating fitting goals that are specific to patients. This avoids use of a number of questionnaires/ checklists before and after hearing aid fitting.

In the Indian context, the listening situations and challenges are slightly different. Thus, the listening needs and expectations are also different that needs to be assessed before a hearing aid trial. There are a few checklists developed in India such as Hearing aid benefit questionnaire for adults (Kanwer & Devi, 2012) and Questionnaire for Evaluating Hearing Aid Benefit in Children (Nayana & Devi, 2011). These checklists also help in selection of hearing aid with appropriate features. There is a need to develop a checklist assessing the client's perception of his/her unaided performance in various listening situations in the Indian context. In addition, the expectations from a hearing aid in these situations could also be incorporated into the same questionnaire. There is relatively less information for the Indian context, in the literature, on the listening / communication needs and the non-auditory needs related to the pre-selection of hearing aids for trial. As this information forms a basis for planning / pre-selecting the hearing devices required for an individual, its importance cannot be underestimated. However, till date there is very little attempt aimed at systematic analyses of listening needs or rehabilitative needs of the hearing aid user to bridge the end user's expectations and satisfaction.

The specification of patient goals is continuing to be a challenge because of the new hearing aid features being introduced in these days. Patient expectations and demands increase because of the introduction of many hearing aid features such as noise reduction, automatic telecoil and adaptive directional microphones. Determination of patient-specific, comprehensive goals will assist the audiologist for selecting specific features according to the needs of the patient (Valente et al., 2006). This shall be facilitated with the use of a common checklist for listening needs and expectations. The same checklist shall be so designed so that it could be administered after fitting of the hearing aid to evaluate the outcome.

Need for the study

1. There are several questionnaires for the assessment of hearing needs (Hearing aids needs assessment - HANA, Profile of hearing aid performance - PHAP, Client oriented scale of improvement - COSI, Abbreviated profile of hearing aid benefit - APHAB etc.). These help to determine the listening needs according to situations, however these questionnaires that have been developed, existing in the literature cannot be directly used in the Indian context. There are differences in listening situations. Hence, there is a definite need to develop one such questionnaire to determine the listening needs which are relevant in the Indian scenario.
2. To choose a hearing aid with appropriate features for an adult with hearing loss, it is critical to first understand the limitations that the client faces in everyday life without a hearing aid, as well as the client's expectations. This forms a basis for selection of appropriate hearing aid and orient him/her so that they get maximal benefit. This emphasises the importance of creating a listening needs checklist that combines the restrictions of persons with hearing loss (as measured by traditional measures) with client-specific expectations in order to facilitate appropriate counselling and hearing aid selection in new users.
3. The existing questionnaires focus on aspects such as self-assessment, hearing aid benefit, outcome measure, psychological effects etc. But there is need of specific questionnaire assessing the requirements of the clients in everyday situations and hearing aid features.
4. With the advent of new technology, there is an increase in number of hearing aid features. Noise reduction strategies, feedback management, increased number of channels are some of the features that provide better listening and comfort for individuals with hearing impairment. The questionnaires that are developed in the past

have to be reviewed and questions shall be modified with reference to the Indian context, involving advanced features of recent technology. This will help in better fine tuning of hearing aids making it highly suitable for the client.

Objectives

- To develop a questionnaire for adults and older adults that will profile individual's listening needs along general audiological dimensions
- To create an inventory that incorporates the listener's limitations as well as their specific goals for rehabilitation.
- To evaluate the usefulness of questionnaire as a checklist for required hearing aid features.
- To discern the expectations from the hearing aids of individuals with hearing impairment.

Chapter 2

REVIEW OF LITERATURE

The audiological information is often used to clinically characterise a hearing impairment for fitting a hearing aid. However, information obtained just from an audiogram is insufficient for successful hearing aid selection. Factors such as an individual's listening needs, expectations are essential for selection of hearing aids. In the present study, a listening needs checklist will be developed. The literature relevant to this study is being given in the following sections.

Dreschler and Brons (2016) developed a profiling system to assess the rehabilitation needs of individuals with hearing impairment. . They combined the Amsterdam Inventory of Disability and Handicap (AIADH) and Client Oriented Scale of Improvement (COSI) to collectively design a tool which helps in specifying client needs in a systematic way. The aim of the study was to categorize the COSI targets under the six dimensions of AIADH. This way the 'performance' aspect of AIADH and 'preference of the client' aspect work well together to provide a basis for hearing aid prescription. The results showed high agreement and indicated that the dimensions can be used for categorization of COSI targets. It also offers a method to evaluate post-fitting results.

A certain number of listeners with hearing impairment participated in study of a detailed test battery developed to explore various audiological dimensions in a prior study. The current study was done to pilot test profile-based hearing aid settings to check if they have the ability to provide more targeted treatment with hearing aids. Methods of the study involved developing and testing four hearing aid settings on a sample of participants who were assessed in the preceding study. Multi-comparison preference evaluations were conducted in realistic sound circumstances as part of the evaluation.

Results revealed that listeners with varied auditory profiles had different preferences for the four settings examined. Further research into profile-based hearing aid fitting was supported by findings of this pilot study (Sanchez-Lopez et al., 2021).

According to Kochkin (2000), hearing aid dissatisfaction is a serious problem for rejection of hearing aids. Other reasons for this could be poor benefit, fit and comfort, price and expense, hearing aids being broken or ceased working, sound quality, background noise, some unidentified causes, negative side effects and volume control changes. It is essential to identify and eliminate the core causes of dissatisfaction if we are to reverse the unfavourable trends. The alternate way to eliminate this problem is to elicit the listening needs and expectations of the client prior to prescribing the hearing aids and counsel the client appropriately so as to prevent the non-use of hearing aids.

Table 1

List of details of questionnaires assessing hearing aid benefit, satisfaction and hearing disability or hearing handicap.

	Questionnaire	Authors	Year
Hearing Needs Assessment Profiles:			
HANA	Hearing Aid Needs Assessment	Schum	1999
COAT	Characteristics of Amplification Tool	Sandridge & Newman	2006
ECHO	Expected Consequences of Hearing Aid Ownership	Cox & Alexander	2000
SAC	Self-Assessment of Communication	Sahin et al.,	2012

Hearing Aid Benefit scales:

HAPI	Hearing Aid Performance Inventory	Walden et al.,	1984
PHAP	Profile of Hearing Aid Performance	Cox & Gilmore	1990
PHAB	Profile of Hearing Aid Benefit	Cox et al.,	1991
SHAPI	Shortened Hearing Aid Performance Inventory	Dillon	1994
APHAB	Abbreviated Profile of Hearing Aid Benefit	Cox & Alexander	1995
COSI	Client Oriented Scale of Improvement	Dillon et al.,	1997
PAL	Profile of aided loudness	Mueller and Palmer	1998
GHABP	Glasgow hearing aid benefit profile	Gatehouse	1999
IOI-HA	International Outcome Inventory-Hearing Aid	Cox et al.	2002

Satisfactory Profiles:

SADL	Satisfaction with Amplification in Daily Life	Cox & Alexander	1999

Hearing Handicap Profiles:

HHS	Hearing Handicap Scale	High et al.,	1964
HPI	Hearing Performance inventory	Giolas et al.,	1979
HHIE	Hearing Handicap inventory for the elderly	Ventry & Weinstein	1982
RHPI	Revised Hearing Performance	Lamb et al.,	1983

	Inventory		
M-A Scale	McCarthy-Alpiner Scale of Hearing Handicap	McCarthy-Alpiner	1983
CPHI	Communication Profile for the Hearing impaired	Demorest & Erdman	1987
HHIA	Hearing Handicap Inventory for Adults	Newman et al.,	1990
CSOA	Communication Scale for Older Adults	Kaplan et al.,	1997

Hearing aid Needs Assessment (HANA):

Schum (1999) developed Hearing aid needs assessment (HANA) inventory. In this, there are 11 questions taken from the Hearing Aid Performance Inventory (HAPI). The patient is asked to rate each of the 11 situations before the hearing aid fitting process for:

- How often he/she is in similar situations

- How much difficulty he/she currently experiences

- How much benefit he/she expects from new hearing aids.

A 3-point system was used to score all three sets of ratings, with “hardly ever” or “very little” (1) to “frequently” or “very much” (3)

For interpretation, the mean ratings for frequency of similar situations, severity of listening difficulty and expected hearing aid benefit for both previous and new hearing aid users were represented. The standard deviations were relatively large for all three sets of ratings, indicating significant variation from one subject to the other.

The advantages of this inventory are that the results of this inventory assists the audiologists to counsel patients seeking amplification. The questionnaire helps the patients to state the goals in realistic terms.

However, the number of questions included are inadequate to determine the listening needs of the patient. All the type of situations are not included in the questionnaire which would have provided extensive insight about expectations. For example, noise tolerance and localization abilities are not checked in this questionnaire.

Characteristics of Amplification Tool (COAT):

Sandridge and Newman (2006) developed a 9-item questionnaire that would help in hearing aid selection process. The questionnaire was designed for application in clinical practice. It consists of 9 questions which encapsulates client-specific difficult listening situations faced in everyday instances, priority of hearing, motivation to wear hearing aids, expectations from hearing aids, controls and features of hearing aids. It also elicits information about considerations, self-efficacy, cost and style of hearing aids.

The questionnaire is time-efficient, short in length, elicits information about style and technology required, simple and easy to administer. It is helpful in counselling for hearing aid selection. It does not effectively depict information about listening needs in various types of situations and listening domains.

Expected Consequences of Hearing Aid Ownership (ECHO):

Cox and Alexander (2000) developed Expected Consequences of Hearing Aid Ownership (ECHO) questionnaire to prevent setting unreasonable pre-fitting expectations which can deter the success of new hearing aid fittings. It consists of 15 questions which covers various topics such as psychological aspects, cosmetic appearance, hearing aids efficiency, cost and repair of hearing aids.

Four tests were done to define reasonable hearing aid expectations, evaluate expectations of new users, measure pre-fitting expectation dependability, and assess correlations between pre-fitting expectations and post-fitting satisfaction. It was discovered that novice hearing aid users had steady pre-fitting expectations about hearing aids, and that these expectations were unnecessarily high for the average person. Across subjects, there were a variety of different expectation patterns. Only one of the four subscales was predictive of the matching satisfaction data.

Self-Assessment of Communication (SAC):

Sahin et al., (2012) developed a tool to measure communication difficulty in various situations. The questionnaire consists of 11 items and the participant have to rate on a 5 point rating scale.

It deals with the situations encountered in daily life. It elicits information about listening difficulty, hearing aid use, psychological and social aspects. Twenty young adult subjects were tested (aged 22 to 43 years), 10 with normal hearing sensitivity and 10 with various degrees of long-standing, bilaterally symmetrical, sensorineural hearing loss.

The two reasons of the results that can have further research are the differences between groups may depend heavily on certain materials and test conditions used; if so, then other variations ought to be explored and the measures may be meaningful but only in characterizing individual performance.

Hearing Performance Inventory (HPI):

Giolas et al., (1979) developed Hearing Performance Inventory to assess the problems faced by hearing loss patients in everyday situations. It consists of 158 situations under several categories such as understanding speech, intensity, response to auditory failure, social, personal and occupational. A five-point rating scale 1 to 5, where 1 indicates 'least difficulty' and 5 indicates 'maximum difficulty'. Lamb et al., (1983) designed a revised shorter version of Hearing Performance Inventory.

It assesses the difficulty of hearing in several domains which helps in better understanding of the client's problems and providing proper rehabilitation. It proves to be a good assessment and planning tool. However, this is a lengthy questionnaire and time consuming to administer. The situations mentioned in the questionnaire are not often experienced by older population.

Profile of Hearing Aid Performance (PHAP):

Cox and Gilmore (1990) developed the PHAP. It is a self-administration inventory consisting of 66 items. This inventory measures aided performance in seven different dimensions. The seven domains include familiar talkers, aversiveness of sounds, ease of communication, reduced cues, distortion of sounds, reverberation and background noise. The goal of the PHAP is to measure the hearing aid benefit in all the seven dimensions.

All the 66 items included in the inventory help in descriptive assessment to measure hearing aid benefit. The questionnaire proved to have good internal consistency, reliability ranges from 0.70 to 0.91. Test-retest correlations range from 0.66 to 0.88.

Cox and Rivera (1992) showed that PHAB has a ceiling effect in three subscales, low internal consistency and low test-retest correlation.

PHAP and PHAB both have 66 items and are time consuming for clinical use.

Abbreviated Profile of Hearing aid Benefit (APHAB):

Cox and Alexander (1995) developed the APHAB. It consists of listening situations which are most encountered in everyday life. It is the shortened version of PHAB. It is rated on a 7-point Likert scale ranging from "Always" (99%) to "Never" (1%). It includes twenty-five items and consists of four subscales such as Ease of communication, reverberations, background noise and aversiveness of sounds.

The APHAB has proven to be a valid clinical instrument because of its high reliability and brevity. The graphical representation of APHAB provides a quick way for interpretation of responses and determine amplification needs.

The APHAB covers the disability domain but does not give enough attention towards psychological and emotional aspects of individuals with a hearing impairment. There is not enough research done to determine whether normative data is different for patients using high performance hearing aid.

Amsterdam Inventory for Auditory Disability and Handicap (AIADH):

Kramer et al. (1995) developed the AIADH questionnaire to assess hearing impairment in everyday situations. The AIADH questionnaire includes 30 questions related to everyday listening situations. The participant has to rate on a 4-point scale, measuring how often he/she is able to hear in a specific situation. These listening situations are commonly encountered and each item is accompanied by an image that visualizes the described hearing situation. It has six dimensions of outcome measures such as detection of sounds, speech in quiet, speech in noise, auditory localization, focus or discrimination, and noise tolerance.

This questionnaire has good reliability and validity. This hearing disability profile is useful in evaluating hearing aid benefit with respect to six aspects of auditory functioning. This questionnaire can be applied in the process of selecting the signal processing qualities of hearing aid specific to needs of the patient.

However, some of the situations present in the list may not be most relevant for a given patient.

Client Oriented Scale of Improvement (COSI):

Dillon et al. (1997) proposed the COSI for the evaluation of hearing aids, in which patients are supposed to mention five listening situations they would like to cope better. The order of significance for the five situations was asked to the patient to know the level of importance of each target. Each situation is sorted under one of the 16 categories of COSI and mentioned in the questionnaire. After a period of hearing-aid use, the patient rates to check whether the targets have been met.

This questionnaire helps the clinician to perform the usual assessment of identification of listening difficulties in a well-structured way. This questionnaire is quick in measuring hearing aid outcome and also helps to assess patient's rehabilitation needs.

The individualization property of the questionnaire complicates the comparison of needs or benefits across patients. This questionnaire uses two different type of ratings which can confuse the individuals with hearing impairment and can also affect the outcome of hearing aid.

Hearing Handicap Inventory for the Adults (HHIA):

Newman et al. (1990) developed a Hearing Handicap Inventory for the Adults. The purpose of the inventory is to identify the troubles caused by hearing impairment in everyday instances. The patient has to select an option among the three choices 'Yes', 'Sometimes' or 'No' for each question. It consists of 25 questions and handicap score is measured in percentage. It includes social and emotional concerns of individuals with hearing impairment. The questionnaire is administered both on hearing aid users and non-users. The hearing aid users are asked to answer the way they hear without the aid which might lead to confusions to the patient.

Hearing Handicap Inventory for the elderly (HHIE):

Ventry and Weinstein (1982) developed a Hearing Handicap Inventory for the Elderly. It consists of twenty-five questions which was sorted into emotional and social subscales. It assesses the impact of hearing impairment on social and emotional aspects in the elderly. It is rated based on a three-point system of "Yes", "Sometimes" and "Never". Scores range from 0 to 100, where higher the score, greater the perceived hearing handicap and vice versa.

The HHIE has proven to be useful to measure the hearing aid benefit. This has high reliability, high correlation and high internal consistency. This inventory is time efficient for clinical purpose.

Gatehouse (2001) reported less correlation between scores from the HHIE and speech identification scores, aided scores.

Chapter 3

METHOD

The objective of the study was to develop a questionnaire that will assess the listening needs and expectations of a prospective hearing aid user. For this the study was carried out in two phases - Phase I and Phase II. The Phase I involved development of the questionnaire. The Phase II involved validation of the questionnaire.

Phase I: **Development of the questionnaire-**

The questionnaire was developed in English language and questions were chosen based on the following:

1. Based on different listening situations in the Indian context under the six domains (Detection, Speech in Quiet, Speech in Noise, Noise Tolerance, Others) experienced by a person with hearing impairment.
2. Listening situations in different domains were framed based on
    a. Information from a few existing questionnaires [such as Glasgow hearing aid benefit profile (GHABP), Amsterdam Inventory for Auditory Disability and Handicap (AIADH), Client Oriented Scale of Improvement (COSI) and Profile of Hearing Aid Performance (PHAP)]
    b. Indian context - Based on the telephonic interview of 10 adults and 10 older adults with hearing impairment regarding the listening difficulties they faced in everyday situations.
    c. Five experienced audiologists who were working in clinical set-up who dealt with a variety of clients and conditions daily were also involved. They come across clients with their listening needs and various expectations from hearing aids. Hence inputs from them regarding various listening situations faced by clients were included while validating the listening needs inventory/ checklist.

A total of 40 questions on listening needs were finalised to form the checklist. The questions were categorised into five domains such as Detection/Recognition, Speech in Quiet, Speech in Noise, Noise Tolerance and Others. The questions were collected from above mentioned methods and sorted under the five domains (Detection, Speech in Quiet, Speech in Noise, Noise Tolerance, Others).

The questions were validated by different set of five experienced audiologists and their suggestions were adapted in the questionnaire. The questionnaire was administered on 30 individuals, having hearing sensitivity within normal limits, for standardization and checking specificity and sensitivity.

DOMAINS:

1. **Detection/ Recognition**: This domain consists of eight questions and assesses detection/ recognition of name call, certain household and environmental sounds e.g., Recognising birds singing/ chirping outside.

2. **Speech in Quiet:** This particular domain deals with the perception of speech in quiet situation. This helps to identify the frequency-specific needs of an individual e.g., Follow a conversation with family members at home.

3. **Speech in Noise:** This section focuses on the major difficulty faced by clients i.e., understanding of speech in noise. Some frequently encountered situations where conversations occur in the presence of background noise are specified e.g., Carry on a conversation with someone in a restaurant

4. **Noise Tolerance:** The noise tolerance domain includes checking if loud sounds are uncomfortable for clients and cause utter disturbance and irritability e.g., Tolerance of traffic noise, loud music etc.

5. **Others:** This section consists of six questions that checks upon three aspects, two questions from each domain of localization (e.g., Is it possible to figure out from which direction a car is approaching when you are outside?), music perception (e.g., Can you recognize melodies in music/song?) and telephone perception (e.g., perception of telephone conversation both in quiet and noise).

Phase II: Administration of the questionnaire-

The questionnaire that was developed was administered to individuals with hearing impairment who had no experience with listening through hearing aids. The participants were selected by inspecting the audiological database and case files. The listening needs questionnaire was administered telephonically.

Participants:

Participant Selection Criteria-

Inclusion Criteria:

1. 30 adults in the age range from 21 to 50 years and 30 older adults in the age range from 51 to 80 years.
2. Sensorineural and mixed hearing losses.
3. Unilateral and bilateral cases were considered.
4. In cases of symmetrical losses, the hearing loss in both sides was in the range of mild to severe degree.

5. In cases of asymmetrical losses, the hearing loss in the better ear was in the range of mild to severe degree.
6. All the participants in the study were non-users of hearing aids. They did not have any experience in the perception of sounds / speech through hearing aids.

Exclusion Criteria:

1. Individuals with conductive hearing losses.
2. Those with co-morbid conditions.
3. Individuals with neurological disorders such as auditory neuropathy spectrum disorder etc.
4. Individuals with history of psychological problems.

After selecting the participants who fulfilled the selection criteria, before administrating the questionnaire telephonically, their informed consent was taken by briefing them about the satisfied the inclusion criteria, the aim, objective and the need for the study were explained.

1. The questionnaire was administered on the selected participants by telephonic interview. The clients were asked about each situation and given enough time to understand each question.
2. The responses were recorded separately for each participant in google forms.
3. In case of difficulty to answer or listen to the questions over phone, the responses were obtained from caretakers/ significant others (such as spouse, children, friend) and recorded.
4. For each listening situation included in the questionnaire, the participants were asked to rate based on how much trouble they face in their everyday experience.

5. A 7-point rating scale was used with choices of '*Always*', '*Most of times', 'Frequently', 'Half the time', 'Occasionally', 'Rarely' and 'Never'*.
6. All the questions from five domains were asked to each participant and their listening needs specific to daily life instances were determined.
7. They also had to select any four domains out of the seven domains (Detection, Speech in Quiet, Speech in Noise, Noise Tolerance, Localization, Music Perception, and Telephone perception) in the order of significance for listening in everyday situations. They were supposed to rate in the order of importance in their everyday life. Ordering utilized numbers from 1 to 4 since they were required to order four among the seven domains. In the ordering, '**1'** indicated 'Not so important', '**2'** indicated 'Slightly important', '**3'** indicated 'Important', and '**4'** indicated 'Most important'. The elicitation of Order of Significance helps in pre-selection of models and features of hearing aids.
8. The "Others" domain was extended into three domains, Localization, Music Perception and Telephone perception for last part of the questionnaire i.e., Order of Significance and Expectations from Hearing Aids.
9. The questionnaire elicits expectations of listeners from hearing aids as to *"How well do they think Hearing Aids will improve their hearing in the given domain"*. The clients had to rate the four selected domains in the previous section on a 5-point rating scale with options of *'A little', 'Fairly', 'Sufficiently', 'Considerably' and 'Greatly'*. This information was included in the checklist as this will help in counselling the clients so that they will have realistic expectations from the hearing aids.

To check the test-retest reliability of listening needs, the data were collected again from 10 percent of the participants (three adults with HI and three older adults with HI), internal consistency was checked.

Response Analysis / Scoring:

The rating given by the participant was considered as the score for each question. The total score in each domain was the product of number of questions in that domain and the maximum rating/ score (i.e. 7). The obtained product was considered as the maximum score for each domain. For each participant, the total domain score was computed by adding all the ratings/ score in each domain. The overall score was calculated by adding the ratings / score in each domain as given by the participant. The scores were also converted to percentage.

As the objective of the study was to find out if there was a need for hearing aids, the scores of listening needs obtained by the group with normal hearing were compared with scores of adults with hearing impairment and older adults with hearing impairment. The data obtained after administration of listening needs questionnaire developed in Phase I was subjected to statistical analyses using SPSS version 21. Descriptive statistics was done followed by test of normality (Shapiro-Wilk test). Since scores under different domains did not follow normal distribution on Shapiro-Wilk test ($p<0.05$), non-parametric statistics was done.

Chapter 4

RESULTS AND DISCUSSION

The objective of the study was to develop a listening needs questionnaire that could be utilized for eliciting the difficulties in different listening domains, importance of different listening domains for an individual, as well as expectations from hearing aid in these important areas of difficulty. The obtained data were obtained from three groups – group with normal hearing (NH), group with adults having hearing impairment (A-HI) and group with older adults having hearing impairment (OA-HI). The data were statistically analysed using SPSS (version 21) software. The results are discussed under the following sections:

I. Comparison of listening needs scores among adult and older adult groups with hearing impairment with that of normal hearing.
II. Comparison of importance of listening needs between adult and older adult groups with hearing impairment.
III. Comparison of expectations from hearing aids in listening domains between adult and older adult groups with hearing impairment.
IV. To find out correlation between audiological data and listening needs data.

The ratings/ scores obtained on different domains of the listening needs questionnaire by groups with normal hearing (NH group), adults with hearing impairment (A-HI) and older adults with hearing impairment (OA-HI) were subjected to statistical analyses.

I. Comparison of listening needs scores among adult and older adult groups with hearing impairment with that of normal hearing.

The scores obtained from the descriptive analysis of the listening needs questionnaire data of the three groups, normal hearing, adults with hearing impairment and older adults with hearing impairment are depicted in Table 4.1. The percentage score is mentioned below each score within brackets.

Table 4.1

Mean, standard deviation, median, and interquartile range of scores (scores in %) in different listening domains across groups.

Listening Domains	*Groups*	*Mean (%)*	*Std. Deviation (%)*	*Median (%)*	*Interquartile Range (%)*
Detection (max. score = 42)	Normal Hearing	7.87 (18.73)	1.79 (4.27)	7.00 (16.67)	2.25 (5.36)
	Adult HI	20.77 (49.44)	13.50 (32.15)	17.00 (40.48)	26.25 (62.50)
	Older adult HI	19.13 (45.56)	11.37 (27.08)	14.50 (34.52)	21.50 (51.19)
Speech in Quiet (max. score = 49)	Normal hearing	10.80 (22.04)	2.96 (6.05)	10.50 (21.43)	5.00 (10.20)
	Adult HI	31.27 (63.81)	15.43 (31.50)	35.00 (71.43)	29.25 (59.69)

	Older adult HI	29.43 (60.07)	12.32 (25.15)	29.50 (60.20)	21.75 (44.39)
Speech in Noise (max. score = 35)	Normal hearing	8.27 (23.62)	2.39 (6.83)	8.00 (22.86)	3.25 (9.29)
	Adult HI	20.77 (59.33)	10.22 (29.19)	22.00 (62.86)	20.25 (57.86)
	Older adult HI	19.73 (56.38)	7.84 (22.41)	20.00 (57.14)	11.50 (32.86)
Noise Tolerance (max. score = 28)	Normal hearing	8.13 (29.05)	2.74 (9.78)	9.00 (32.14)	3.50 (12.50)
	Adult HI	6.17 (22.02)	5.31 (18.97)	4.00 (14.29)	0.00 (0.00)
	Older adult HI	6.63 (23.69)	5.36 (19.14)	4.00 (14.29)	1.00 (3.57)
Others (max. score = 42)	Normal hearing	10.17 (24.21)	3.27 (7.79)	11.00 (26.19)	5.25 (12.50)
	Adult HI	23.67 (56.35)	14.14 (33.66)	26.50 (63.09)	29.25 (69.64)
	Older adult HI	23.27 (55.39)	12.41 (29.55)	21.00 (50.00)	23.25 (55.36)
Total score	Normal	45.23	11.11	44.00	20.75

(max. score = 196)	hearing	(23.08)	(5.67)	(22.45)	(10.59)
	Adult HI	102.63 (52.36)	50.88 (25.96)	111.50 (56.89)	97.75 (49.87)
	Older adult HI	98.20 (50.10)	41.62 (21.23)	91.00 (46.43)	70.25 (35.84)

It is evident from the results in Table 4.1 that the scores of adults and older adults with HI, in different domains of listening need questionnaire, are higher compared to that in normal hearing group. Higher the scores imply more problem in hearing or more is the listening need for an individual. In order to see, if the scores were normally distributed, Shapiro-Wilk test was administered. The results from Shapiro-Wilk test indicated that the scores in majority of the domains did not follow normal distribution (p<0.05). Hence, non-parametric statistics was deployed.

In order to know if the scores on the listening needs questionnaire of the two groups with hearing impairment (i.e., A-HI; and OA-HI) statistically differed from that of the score obtained by the group with normal hearing (NH), Kruskal Wallis test was deployed. The results of the Kruskal Wallis Test are reported in Table 4.2. From Table 4.2, it can be inferred that there was significant difference (p<0.05) between the three groups in all the five main domains of the listening needs questionnaire.

Table 4.2

Comparison of scores on different domains of listening needs across groups, on Kruskal Wallis test.

Listening domains	*Test Statistic*	*p*
Detection	22.31	<0.05
Speech in Quiet	36.92	<0.05
Speech in Noise	34.14	<0.05
Noise Tolerance	16.88	<0.05
Others	18.76	<0.05

Table 4.3

Pairwise comparison of three groups on Mann-Whitney U test.

Listening Domain	*Groups comparison*	*U*	*|z|*	*p*	r_e
Detection	Normal hearing-Adult HI	-27.25	40.06	<0.05	00.52
	Normal hearing- Older adult with HI	-27.65	40.12	<0.05	00.53

Speech in quiet	Normal hearing-Adult with HI	-34.22	50.08	<0.05	00.66
	Normal hearing- Older adult with HI	-36.58	50.43	<0.05	00.70
Speech in Noise	Normal hearing-Adult with HI	-33.65	50.00	<0.05	00.65
	Normal hearing- Older adult with HI	-34.45	50.12	<0.05	00.66
Noise Tolerance	Normal hearing-Adult with HI	-2.33	00.39	>0.05	00.05
	Normal hearing- Older adult with HI	22.47	30.74	<0.05	00.48
Others	Normal hearing-Adult with HI	-23.85	30.54	<0.05	00.46
	Normal hearing- Older adult with HI	-26.45	30.93	<0.05	00.51

As indicated in Table 4.3, there was significant difference (p<0.05) between NH and A-HI, and, NH and OA-HI groups, in all the listening domains except for noise tolerance domain. In the noise tolerance domain, there was no significant difference found between normal hearing group and adults with HI group. All the remaining pairs of groups showed significant difference at the 0.05 level of significance. Apart from the significance, effect size (r_e) was also calculated using the formula $|z|/\sqrt{N}$ (Rosenthal, 1994). There was a large effect size ($r_e \geq 0.5$) noted for all the pairwise comparison in the domains of detection, speech in quiet and speech in noise indicating substantial difference in the listening needs.

Similarly, a large effect was noted for NH and OA- HI comparison in others domain thereby suggesting substantial difference in listening needs. Medium effect size ($r_e \geq 0.3$ and <0.5) was observed for NH and OA-HI comparison over listening needs in noise tolerance domain and NH and A-HI in others domain. Whereas NH and A-HI comparison over listening needs in noise tolerance domain had small effect size ($r_e \geq 0.1$ and <0.3) suggesting minimal difference (Cohen, 1988). Therefore, the difference between each group with hearing impairment and normal hearing group suggests that they require hearing aids for improving their listening in most of the domains and also to enhance their quality of life.

II. Comparison of significance of listening needs between adult and older adult groups with hearing impairment.

The order of significance or importance responses for only four domains out of seven domains, specified by the adults group and older adults group were subjected to frequency analysis and the results are depicted in Table 4.4 and Table 4.5 respectively. Only four domains were considered as there are only four program slots in majority of the digital hearing aids. That is a hearing aid can be programmed to help the individuals in four domains. The tables 4.4 and 4.5 show the domains in which the participants have the most listening need implying the need for amplification. Hence, the hearing aid chosen for them should have features that would improve listening ability in those domains.

As indicated by the Table 4.4, the adult group rated speech in noise as the most important domain and music perception as the least important domain. Further, the scores were converted to percentage for better comparison among domains and are depicted in the Figure 4.1. As depicted in Figure 4.1, speech in noise was the most important domain

since understanding of speech in background noise is a major problem faced by participants with hearing impairment. The audiologist can choose hearing aids with features of noise reduction, speech cue enhancement, directionality etc., to resolve these issues.

Table 4.4

No. of adults with HI (n=30) who rated different domains in the order of importance (4=most important, 1=least important).

Listening Domain	*Importance*			
	1	*2*	*3*	*4*
Detection	7	9	2	10
Speech in Quiet	5	6	16	1
Speech in Noise	-	3	9	17
Noise Tolerance	2	1	2	-
Others:				
- Localization	4	3	-	-
- Music Perception	-	2	-	-
- Telephone Perception	12	6	1	2

Figure 4.1

Graph depicting the importance of four listening domains as indicated by adults with HI group.

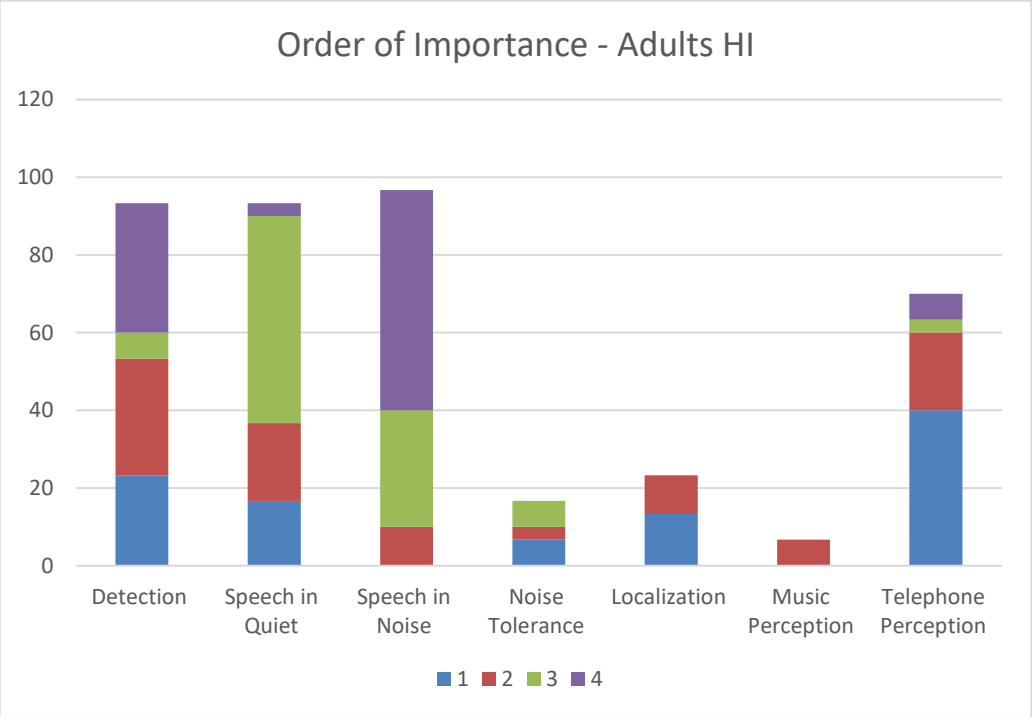


Table 4.5

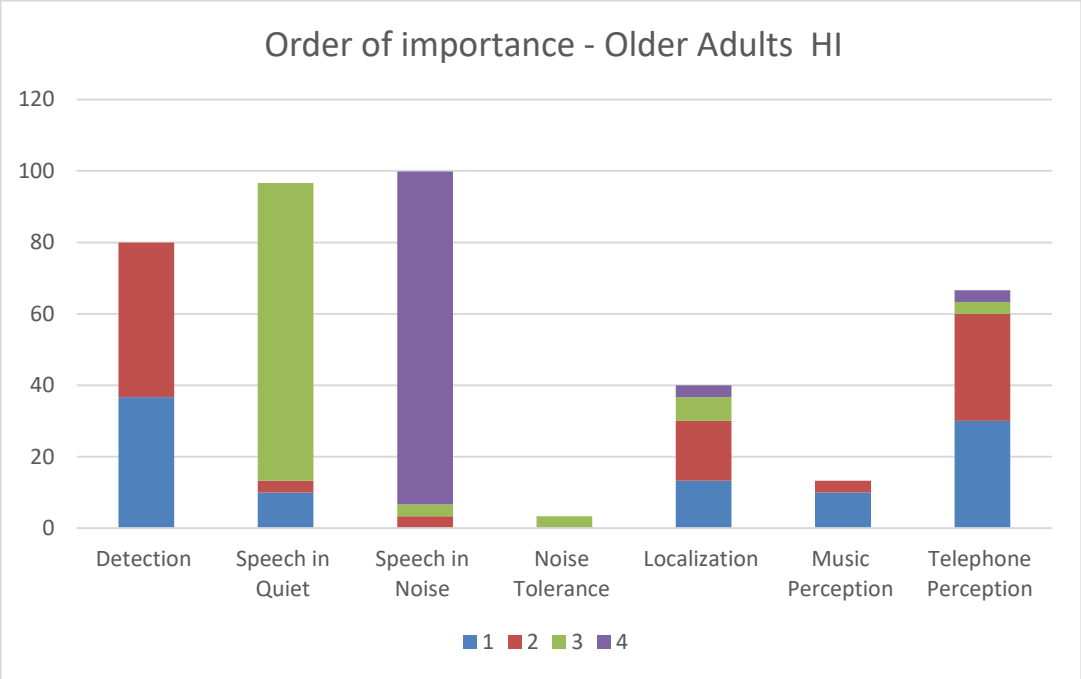
No. of older adults with HI (n=30) who rated different domains in the order of importance (4=most important, 1=least important).

Listening Domain	*Importance*			
	1	*2*	*3*	*4*
Detection	11	13	-	-
Speech in Quiet	3	1	25	-
Speech in Noise	-	1	1	28
Noise Tolerance	-	-	1	-
Others:				
-Localization	4	5	2	1
-Music Perception	3	1	-	-
-Telephone Perception	9	9	1	1

As indicated by Table 4.5, the older adults with HI rated speech in noise as the most important domain and music perception as the least important domain. The scores were converted to percentage for better comparison and are depicted in the Figure 4.2.

Figure 4.2

Graph depicting the importance of four listening domains as indicated by older adults with HI group.



The results of 'order of significance' section are corresponding to the results of Hearing aid needs assessment (HANA). According to the results of research using HANA scale, the listening difficulty was found to be highest in noisy situations. Similar results were found in our study, as 'speech in noise' was rated as the most important domain/ domain of most listening difficulty.

III. Comparison of expectations from hearing aids in listening domains between adult and older adult groups with hearing impairment.

The expectation responses for the four domains out of seven domains (seven, because in others domain, there were three sub domains), specified by the adults group and older adults with HI were subjected to frequency analysis and the results are depicted in Table 4.6 and Table 4.7 respectively. These tables show the expectations of the

participants in the four selected domains. This information assists the professional to compare patient's expectations to realistic expectations. Also, the patients can be counselled regarding the realistic expectations from hearing aids.

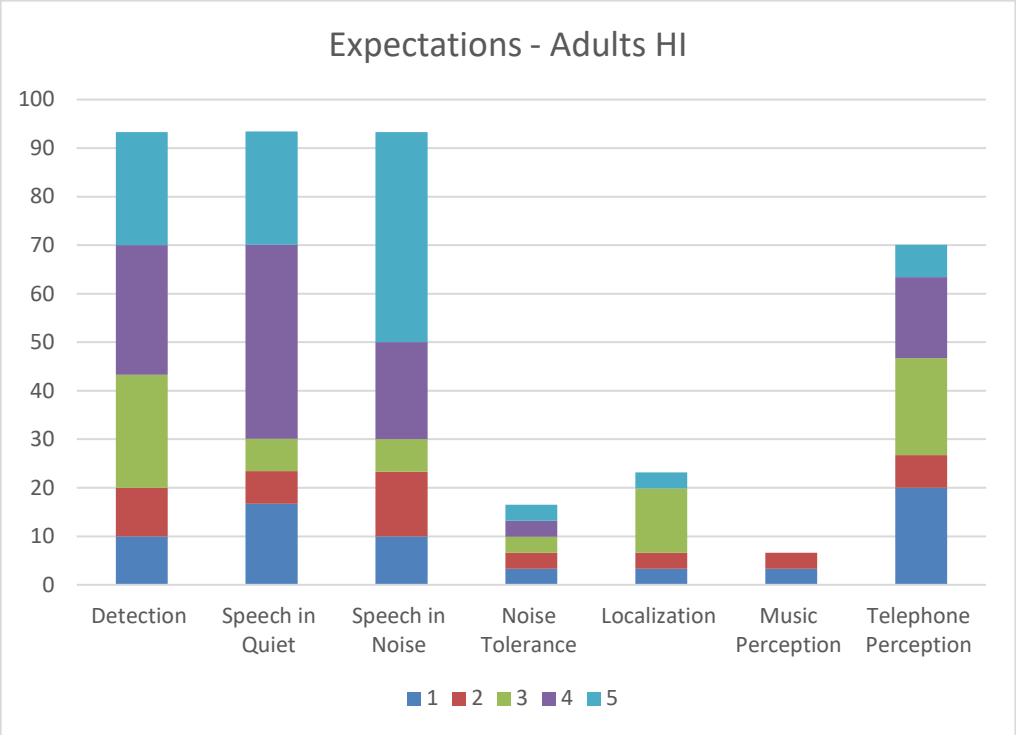
Table 4.6

No. of adults with HI (n=30) who rated the expectations for the four domains (5 = help greatly, 1 = help a little).

Listening Domain	*Expectations*				
	1	2	3	4	5
Detection	3	3	7	8	7
Speech in Quiet	5	2	2	12	7
Speech in Noise	3	4	2	6	13
Noise Tolerance	1	1	1	1	1
Others:					
-Localization	1	1	4	-	1
-Music Perception	1	1	-	-	-
-Telephone Perception	6	2	6	5	2

Figure 4.3

Graph depicting the expectations from hearing aid in four domains among adults with HI (5 = help greatly, 1 = help a little).



As depicted in the Figure 4.3, speech in noise and speech in quiet were the highest rated domains amongst all. Therefore, this indicates that listeners have high expectations from hearing aids for assistance in speech perception. These results help professionals monitor the expectations of patients and counsel about the amount of benefit that can be obtained through hearing aids.

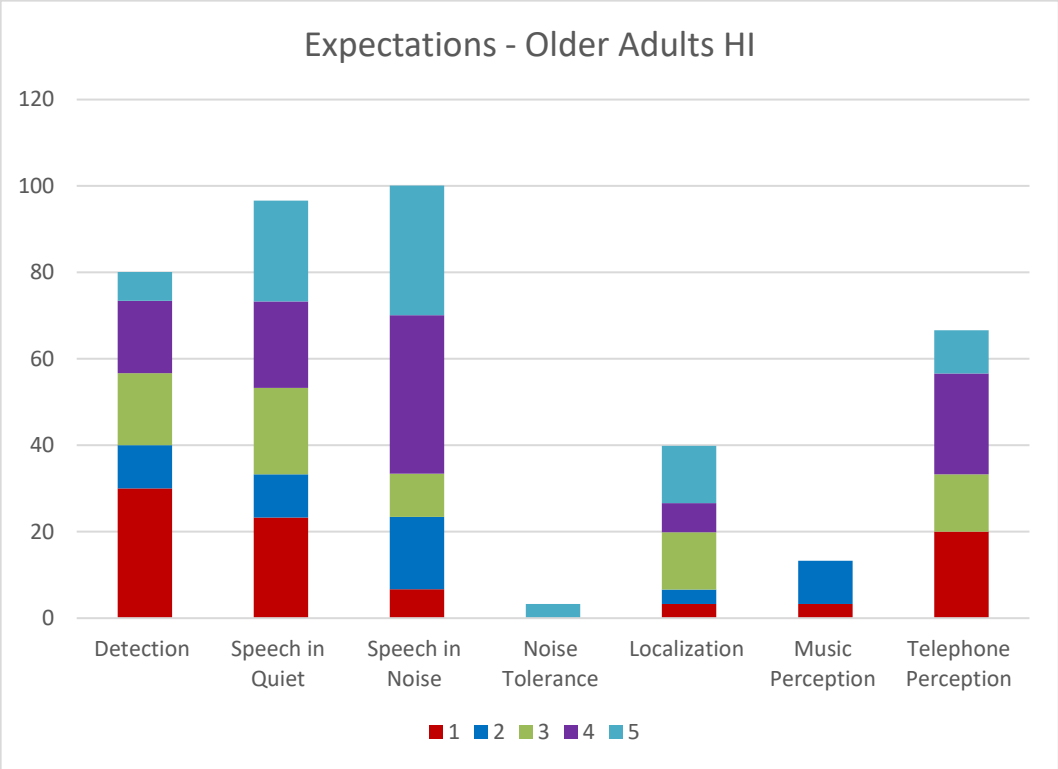
Table 4.7

No. of older adults with HI (n=30) who rated the expectations for the four domains (5 = help greatly, 1 = help a little).

Listening Domain	*Expectations*				
	1	2	3	4	5
Detection	9	3	5	5	2
Speech in Quiet	7	3	6	6	7
Speech in Noise	2	5	3	11	9
Noise Tolerance	-	-	-	-	1
Localization	1	1	4	2	4
Music Perception	1	3	-	-	-
Telephone Perception	6	-	4	7	3

Figure 4.4

Graph depicting the expectations from hearing aid in four domains among older adults with HI (5 = help greatly, 1 = help a little).



The Hearing aid needs assessment (HANA) scale investigates the expected and perceived benefit from hearing aids. The findings from administration of HANA indicated that the experienced hearing aid users had realistic understanding that hearing aids provide less benefit in more noisy situations. Although subjects without previous experience with hearing aids had the most difficulty in noisy situations, they expected that the benefit provided by amplification was not greater in noise than for quieter environments.

Since, results from our present study also revealed that ‘speech in noise’ domain has got highest expectations from participants, evidence from HANA scale research which states perceived benefit was not strongly correlated with needs or expectations,

can be used for counselling about the unrealistic expectations regarding speech understanding performance in noise.

IV. Correlation between audiological data and questionnaire data.

The results of this study would be reliable if the data obtained correlates well with the audiological data (pure-tone average, PTA). Hence, to assess the relationship between pure-tone average and the listening needs data, Spearman correlation test was applied to the data. The bivariate correlation Spearman's rho (ρ) was used to check for a significant correlation.

Table 4.8

Correlation coefficient (ρ) between pure-tone average and total scores on listening needs questionnaire in adults with HI (n=30).

Listening Domain	*PTA of Right/ Left ear*	*Spearman Correlation Coefficient*	*P*
Detection	Right	0.72	<0.05
	Left	0.68	<0.05
Speech in Quiet	Right	0.66	<0.05
	Left	0.59	<0.05
Speech in Noise	Right	0.69	<0.05
	Left	0.59	<0.05
Noise Tolerance	Right	-0.33	>0.05
	Left	-0.02	>0.05
Others	Right	0.68	<0.05

	Left	0.63	<0.05
Total score	Right	0.67	<0.05
	Left	0.61	<0.05

As can be observed in the Table 4.8, there was a significant positive moderate correlation between the listening domains (all domains except noise tolerance) and the PTA, in adults with HI group (p<0.05) for majority of the domains. The correlation between noise tolerance and the PTA for the right and left ear was negative i.e., as the PTA increased, the noise tolerance reduced. However, this correlation was not significant (p>0.05).

Table 4.9

Correlation coefficient (ρ) between pure-tone average and total scores on listening needs questionnaire in older adults with HI (n=30).

Listening Domain	*PTA*	ρ	*P*
Detection	Right	0.56	<0.05
	Left	0.59	<0.05
Speech in Quiet	Right	0.56	<0.05
	Left	0.59	<0.05
Speech in Noise	Right	0.55	<0.05
	Left	0.70	<0.05
Noise Tolerance	Right	-0.29	>0.05
	Left	-0.41	<0.05

Others	Right	0.51	<0.05
	Left	0.56	<0.05
Total	Right	0.50	<0.05
	Left	0.59	<0.05

As can be observed in the Table 4.9, there was a significant positive moderate correlation between the domains (all domains but noise tolerance) and PTA, in older adults with HI group (p<0.05) for majority of the domains. The correlation between noise tolerance and PTA was negative i.e., as the PTA increased, the noise tolerance reduced. However, this correlation was not significant (p>0.05). In order to know if the scores obtained on listening needs questionnaire was reliable or not, the ratings on listening needs questionnaire were collected once again on 10 percent of the participants (three adults with HI and three older adults with HI) and internal consistency test was deployed. The results indicated that Cronbach's alpha was between 0.70-0.95. The results showed acceptable to excellent test re-test reliability based on classification of internal consistency using Cronbach's alpha (Dunn et al., 2014).

The correlation between PTA and the listening needs across domains validates the usefulness of questionnaire in eliciting information from listeners with hearing impairment. In addition, it was found that the questionnaire had test- retest reliability. This reassures the accuracy of questions/ listening situations as well as reliability of the questionnaire. Thus, the listening needs questionnaire could reliably be utilized in the clinics to assess the hearing aid requirement.

Chapter 5

SUMMARY AND CONCLUSION

Several checklists and questionnaires are available to assess hearing aid benefit / outcome, satisfaction, and handicap assessment in individuals with hearing impairment. But they do not assess needs specific to client's listening situations and consider their expectations from hearing aids.

The purpose of the study was to develop a questionnaire in English to measure listening needs for adults and older adults with hearing impairment, especially in the Indian scenario. The listening situations included were relevant to everyday instances experienced by the clients. The study focused on measuring requirements of listeners with hearing impairment who were not using hearing aids.

A questionnaire was developed to assess hearing problems faced by listeners in five domains such as sound detection, speech in quiet, speech in noise, noise tolerance and others (localization, music perception and telephone listening). It also elicits the expectations of listeners from hearing aids. The 22 items in the questionnaire were chosen based on literature survey, information from listeners with hearing impairment, knowledge and experience of audiologists.

After framing the questionnaire, it was administered on adults and older adults with hearing impairment to measure and quantify their listening needs and expectations. The data collected were analysed using SPSS (version 21). The results of the study indicate that listening needs questionnaire is a valid and reliable tool to assess the listening needs in everyday situations.

The results of the study showed that the listening need scores for adults and older adults with hearing impairment in the five domains were higher than that of normal hearing group.

The order of significance rating/ scores implied that speech perception in noise was the most important listening domain in daily life situations whereas music perception was the least important listening domain. The findings on expectations suggested that the listeners expect hearing aids to resolve the issues related to 'speech in noise' domain. It is supported by the results from order of significance section as understanding speech in noise is rated as most important listening domain.

The results of the present study have the following clinical implications:

1. The listening needs questionnaire is a beneficial clinical tool to elicit patient's requirements and exploring client-specific hearing aid options. This helps in custom pre-selection of hearing aids.
2. Information obtained by means of questionnaire will be useful for fine tuning/ optimizing digital hearing aids according to patient's listening needs.
3. The hearing aid features such as noise reduction, directionality, number of channels etc., can be selected by obtaining information from administration of the questionnaire.
4. It can be utilized in selection of hearing aid features according to person's difficulty such as listening through telephone, listening to music etc.,
5. The last subscale can be helpful to counsel regarding the extent of fulfilment and realistic expectations and the possible hearing aid benefit according to the type and degree of their hearing loss.

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APPENDIX A

LISTENING NEEDS QUESTIONNAIRE

Name: Case number:

Age/gender: SRT (dB HL):

Diagnosis: R- SI Score (%):

L- Mobile no.:

Pure Tone Average: R- Date:

L-

INSTRUCTIONS: Please tick (✓) in the appropriate box after reading each question.

Rate the listening situations as much closest to your everyday experience,

in the given range from column **A** to **G**, where,

A-Always **E**-Occasionally

B-Most of times **F**-Rarely

C-Frequently **G**-Never

D-Half the time

In the '**H**' column, Rate any four domains in the **Order of Significance** for listening in daily situations. The rating scale is from 1 to 4 where,

1- Not so important

2- Slightly important

3- Important

4- Most important

Column '**I'** is to elicit your **Expectations from Hearing Aids**. Kindly fill your response based on "How well do you think Hearing Aids will improve your hearing in that domain?" for the four domains selected as significant in the 'H' column. Give your ratings in '**I**' column from 1 to 5 points where,

1- A little **4-** Considerably

2- Fairly **5-** Greatly

3- Sufficiently

Sl No.	Listening domains	A	B	C	D	E	F	G	H	I
I.	**DETECTION/RECOGNITION**									
1	Do you hear the following sounds from 10 feet distance? a. Mixer									
	b. Vehicle passing by									
	c. Cooker whistle									
2	Do you hear your name when called at moderate level from 10 feet distance?									
3	Can you differentiate the sound of a car and a bus?									
4	Can you distinguish between male and female voices?									
II.	**SPEECH IN QUIET**									
5	Can you understand a person talking at home without asking them to repeat?									
6	Can you carry on a conversation with someone in a quiet room? (Moderate speech from 3-5 feet) a. While looking at the speaker									

	b. While not looking at the speaker									
7	Can you understand the news on radio/TV from a distance of 10 feet?									
8	Can you follow conversation in groups, in a quiet environment?									
9	Can you understand a person talking from the next room?									
10	Can you understand a person talking at home, without asking them to speak louder?									
III.	**SPEECH IN NOISE**									
11	Can you understand a vendor in a crowded shop/ market from a distance of 3 feet?									
12	Can you follow a dialogue when watching a movie / a play in the theatre?									
13	Can you understand the news from radio/TV while family members are talking?									
14	Can you carry on a conversation with someone in a restaurant/ function?									
15	Can you carry on a one-on-one conversation in public transport (bus/train) at a distance of 3-5 feet?									
IV.	**NOISE TOLERANCE**									
16	Can you tolerate the following sounds? a. Mixer									
	b. Car/Bus horn									
	c. Drums									
	d. Loud Music									
V.	**OTHERS**									
17	Can you identify from what direction a car is approaching when you are outside?									

18	Can you identify the direction when somebody is calling your name at home?									
19	Can you recognize melodies in music/song?									
20	Can you recognize & distinguish different musical instruments?									
21	Can you carry on a mobile phone/telephone conversation in a quiet room?									
22	Can you understand a conversation while talking on mobile phone/telephone in a noisy room?									

*Others domain is extended to three domains for H & I column as Localization (questions 17 and 18), Music perception (19 and 20) and Telephone perception (21 and 22).