Exploring the real world hearing aid usage and outcome: Current Indian Scenario. (ARF Project No. 55)

Introduction

Communication is a very important feature of humans and most communications are achieved through hearing. Therefore, a deprivation or impairment in hearing will have a huge impact on the life of an individual. It also results in psychological and social consequences. The most common among the types of hearing impairment in adults is sensorineural hearing loss (SNHL) and it is an irreversible condition. Providing suitable hearing aids is one of the common mode of management for those who are diagnosed with permanent hearing impairment (Gatehouse, 2002).

With the advancement in technology, the extent of satisfaction with the use of hearing aid has improved. Nevertheless, there are persons who are not satisfied with their hearing aids and there are many factors that can influence this. Studies are being carried out to recognize the probable factors that lead to better outcomes. If the hearing loss is left untreated/unmanaged, then it can result in withdrawal from social activities or interaction and this in turn will affect the quality of life of an individual. Therefore, it is necessary to give proper rehabilitation services to those with hearing impairment in the early stages itself.

Unfortunately, not all the individuals fitted with hearing aids use them consistently. Kochkin (2000) has conducted many studies to recognize the reasons associated with the non-use of hearing aid in United States. He listed 32 reasons and discussed top ten reasons. They include cost, limited benefit, noise, don't need help, hearing aid do not work, comfort & fit, negative side effects, quality of sound, adjustments of volume control, and no specific reason.

Gianopoulos, Stephens, and Davis (2002) studied 116 adults fitted with hearing aids. On follow-up, they found that 66 of them were not using hearing aids. Similarly, in another study by Lupsakko, Kautiainen, and Sulkava (2005), 24 out of 100 were non-users of hearing aids. Bertoli, Staehelin, Zemp, Schindler, Bodmer, and Probst (2009) conducted a study on 8,707 individuals with hearing loss and found that 1,086 of them occasionally or never used the hearing aids. Hartley, Rochtchina, Newall, Golding, and Mitchell (2010) on a follow-up session revealed that 78 out of 322 people were non-users of hearing aid.

Researchers have tried to explore reasons for rejection of hearing aids. The reasons have been identified, including hearing aid cost, maintenance of the hearing device, fit, comfort, attitude, factors related to the device, issues related to - feedback, psycho-social or

situational, attitudes of professionals, ear problems, and appearance (McCormack & Fortnum, 2013). Many studies have been attempted to bring improvisation in those areas. Despite those attempts, prevalence of hearing aid use is still low and the non-use of hearing aids among elderly is still a crucial issue that needs to be addressed.

Assessment of outcome is an integral component of hearing rehabilitation. The importance of outcome measurement is multifold (Abrams, 2000). The outcome measurement allows audiologists to (1) establish and follow 'best practices', (2) market the practice using evidence, (3) validate clinical decisions taken, (4) demonstrate treatment success to patients/their family members, (5) demonstrate service effectiveness to accrediting agencies, and (6) provide documentation to external agencies like insurers. In the field of hearing rehabilitation using hearing aids, the outcomes can be measured in many ways including use of clinic/ lab based tests (such as speech perception tests) or methods that use standardized self-report questionnaires or personal interviews or focus group discussions.

A large number of individuals who could have actually reaped benefit from hearing aid, refuse to procure and use the hearing aids (Popelka et al., 1998; Smeeth et al., 2002; Smits, Kramer, & Houtgast, 2006). Further, not all adults who are issued hearing aids use them optimally or they do not use it at all, nor do they wear them regularly, nor are they satisfied with it. Surveys carried out in Australia, Denmark, Finland, the United Kingdom, and the United States have revealed that 1% to 40% of hearing aids dispensed are never or are rarely used (Dillon, Birtles, & Lovegrove, 1999; Hickson & Worrall, 2003; Lupsakko, Kautiainen, & Sulkava, 2005).

It is generally assumed that the sequence of events in the life of individuals with hearing impairment while obtaining help has an impact on an individual to procure a hearing aid, use it, to get satisfaction from it. Guidance that a person gets varies such as support from hearing professionals or internet sources or from others who have been using hearing aids. It is also reported that people may quit the rehabilitation process (Schumacher & Carruth, 1997; Gianopoulos & Stephens, 2005), and there is limited information on where could the potential user be and the reasons for it. These are some of the reasons for both subjective and objective approaches for assessing the hearing aid outcome in terms of benefit and satisfaction.

Subjective Outcome Measures of Hearing aid outcome: There are several self-assessment inventories/ questionnaires/ checklists available to quantify the subjective perception of hearing aid users regarding the hearing aid outcome. There are many questionnaires which assess the perception of the communication partners/ significant others.

Questionnaires such as Self Assessment of Communication (SAC) and the Communication Scale for Older Adults (CSOA; Schow & Nerbonne, 1982) assess the hearing aid handicap. There are many more questionnaires (Table 1.1) which assesses benefit and/or satisfaction from hearing aids. These self assessment tools give a subjective impression regarding the communication difficulties and the ensuing consequences faced by persons with hearing loss and their communication partners.

For validation process, there are specific questionnaires which assess the outcome from the hearing aid. These hearing aid outcome questionnaires are intended to find out the treatment efficacy. Some common measures for assessing the hearing aid outcome include the Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox & Alexander, 1995), the Client Oriented Scale of Improvement (COSI; Dillon, James, & Ginis, 1997), the Glasgow Hearing Aid Benefit Profile (GHABP; Gatehouse, 1994), and the Hearing Aid Performance Inventory (HAPI; Walden, Demorest, & Hepler, 1984). Even though these tools vary with their content and formatting, most of them assess the listening capabilities of individuals with and/or without hearing aids.

Saunders and Abrams (2005) have rightly pointed out that the usage of several outcome measures is not practical in clinical settings, with respect to time and cost. They have further stated that there are several outcome measures are available and that these are either performance-based measures or self-report based measures for rating the activity limitation or auditory disability, with and without hearing aids. These are disease-specific measures for outcome, there are other measures including generic health status instruments. The generic measures provide comparison of treatment effects and costs across different disciplines. The commonly used generic tools such as Sickness Impact Profile (Gilson et al., 1975) and Medical Outcomes Survey Short Form - 36 (Ware & Sherbourne, 1992) lack sensitivity to the effects of hearing aid.

Outcome Measures of hearing aid outcome: Measurement of speech perception through speech recognition material is the traditional way of finding out the hearing aid benefit. There are speech material available in different languages. Some languages lack appropriate standardized speech material. This in turn makes these tests insensitive to determine the actual capabilities of hearing aid users with their hearing aids. Many of these studies are actually conducted in laboratory or clinical settings and generalizations of these findings in day-to-day life makes it more unrealistic (Cox, Gilmore, & Alexander, 1991).

There are several speech perception tests e.g., Connected Speech Test (CST; Cox, Alexander, & Gilmore, 1987), Lexical Neighborhoods Test (LNT; Kirk, Pisoni, & Osberger, 1995), Quick Speech in Noise Test (Quick SIN; Killion, Niquette, Gudmundsen, Revit, & Banerjee, 2004), Words in Noise (WIN; Wilson, 2003) that have been developed in order to provide a more accurate reflection of understanding speech by a listener. Most of these speech material were developed using specific guidelines and also include the psychometric function. All of these could be used to document validity and reliability in order to provide reflection of understanding speech by the hearing aid user.

The subjective outcomes have become the "gold standard" for comparing the hearing aid benefits. The results of Mendel (2007) better define the relationship between the scores obtained on some objective sentence tests and subjective responses on the Hearing Aid Performance Inventory (HAPI). An objective measurement of subjective impressions is important for knowing the efficacy of the treatment outcomes from hearing aids. That is, the objective evidence that a speech recognition test material is a sensitive measure of speech perception should support the use of such test material in the hearing aid evaluation process. Such findings can have strong clinical impact and face validity, and may provide more standardization to the hearing aid evaluation across clinics.

Mendel (2007) suggests that collecting objective outcome data from the R-SPIN, HINT threshold in quiet, QuickSIN, and SNR Loss, along with subjective outcome data from the HAPI, can help to quantify, benefit of hearing aids - that of improved performance of speech perception. It is difficult to verify the improvement if not documented subjectively and objectively in hearing aid evaluation. These define the relationship between objective and subjective outcome measures in an attempt to better portray the hearing aid benefit.

1.1 Questionnaires to assess hearing aid outcome:

Several self report measures have been framed to measure the outcome from hearing aid in multiple domains such as satisfaction, benefit, participation restriction, and activity limitations. Table 1.1 provides a list of self assessment questionnaires to assess the benefit, satisfaction, hearing handicap, and hearing disability in different domains.

Table 1.1: List of self assessment questionnaires to assess the benefit, satisfaction, and hearing handicap in different domains, in adults.

Table 1.1: Details of questionnaires assessing hearing aid benefit		
Benefit scales	*Authors (year)*	*Details*
Hearing Aid Performance Inventory (HAPI)	Walden, Demorest, and Hepler (1984).	64-item inventory. This assesses hearing aid benefit in four listening situations, i.e., speech in quiet, speech in noise, speech with reduced information in the signal, and non-live speech or non-speech; across a wide range of ages. Uses 5-point rating. The questionnaire has high internal reliability. Schum (1992) developed a shortened version of the HAPI, i.e., SHAPI with 38 items.
Profile of Hearing Aid Performance (PHAP)	Cox and Gilmore (1990)	66-items, self-administered inventory. It evaluates and quantifies performance with hearing aids in everyday life using profiles. The profiles assess experience with amplification in terms of speech communication in different types of listening situations.
Profile of Hearing Aid Benefit (PHAB)	Cox, Gilmore, and Alexander (1991)	66 items, self-assessment tool to find out hearing aid benefit. All questions are prefixed by 'with my hearing aid' and 'without my hearing aid'.
Shortened Hearing Aid Performance Inventory (SHAPI)	Schum (1992)	Performance in noise, listening with lesser cues (eg. no visual cues) and a subscale consisting of listening in quiet, listening from close, and hearing non-speech sounds. SHAPI was derived from the HAPI in three stages. First, nine items that were clearly inapplicable to many elderly people were deleted. Second, published data were used to delete a further 15 items on the grounds of low item-total correlation, low inter-subject standard deviation, and low factor loadings. Third, 18 of the remaining 40 items were

		modified.
Abbreviated Profile of Hearing Aid Benefit (APHAB)	Cox and Alexander (1995)	Shortened version of the PHAB. Is a 66-item self-assessment, disability-based inventory. The purpose is to record the outcome of a hearing aid, to compare several fittings, or to evaluate the same fitting over time.
Client Oriented Scale of Improvement (COSI)	Dillon, James, and Ginis (1997)	A tool which has diagnostic utility, good test-retest reliability, and is suitable for routine clinical use. It uses interview technique. The client lists up to five listening situations where he has problem in hearing where he/she requires improvement. With rehabilitation, COSI quantifies reduction in disability and the ability to communicate in the specific situations listed.
Profile of Aided Loudness (PAL)	Mueller and Palmer (1998)	This is used to determine if loudness restoration has been accomplished through amplification. It includes 12 listening situations where hearing aid users have to rate their listening situations based on - loudness rating from 0 to 7 - satisfaction rating from 5 to 1.
Glasgow Hearing Aid Benefit Profile (GHABP)	Gatehouse (1994)	To assess issues related to disability and hearing aid benefit. It is designed to assess 6 dimensions, the efficacy and the effectiveness of rehabilitation / intervention on reducing disability and handicap for individuals with hearing loss. This in turn demonstrates the value of hearing aids and related services.
International Outcome Inventory for Hearing Aids (IOI-HA)	Cox, Stephens, and Kramer (2000)	To assess the outcome in 7 domains. It has 7 domains having rating from 1 to 5; where 1 is for lower outcome and 5 is for best outcome.

Table 1.2: Details of questionnaires assessing hearing aid satisfaction

Satisfaction scales	*Author (Year)*	*Details*
Hearing Aid User's Questionnaire (HAUQ)	Forster and Tomlin (1988)	To assess the outcome based on satisfaction, usage, and benefit of government funded hearing aids. It includes 11 questions regarding hearing aid usage and benefit, usage, problem, and satisfaction.
Satisfaction with Amplification in Daily Life (SADL)	Cox and Alexander (1999)	Is a self-report inventory to quantify satisfaction with hearing aids. This questionnaire was developed as an outcome of a series of interviews with hearing aid users. It included 15 questions regarding the satisfaction of hearing aid and 15 items about the expectations of hearing aids.

Table 1.3: Details of questionnaires assessing hearing disability or hearing handicap

Hearing handicap profile	*Authors (Year)*	*Details*
Hearing Handicap Scale High (HHS)	High, Fairbanks, and Glorig (1964)	Is used to assess hearing handicap and its relationship to hearing impairment. It consists of 45 items concerned with various aspects of auditory function such as problems in speech perception, telephone usage, localization, communication experiences, vocational difficulties, emotional reactions to hearing loss.
Hearing Performance Inventory (HPI)	Giolas, Owens, Lamb, and Schubert (1979)	Is to assess hearing problem experienced in everyday listening. It consists of six sections: (1) Understanding speech, (2) Intensity, (3) Response to auditory failure, (4) Social, (5) Personal, and (6) Occupational. This uses a self-report format for responses and includes sentences describing a number of listening situations like one to one conversation; group conversation and social gathering etc.

Hearing Handicap Inventory for the Elderly (HHIE)	Ventry and Weinstein (1982)	Is a self-assessment tool for elderly, to assess the impact of hearing loss on the emotional and social adjustment. The inventory consists of two subscales: a 13-item subscale to explore the emotional consequences of hearing loss; and a 12-item subscale to explore both social and situational effects.
Hearing Handicap Inventory for the Elderly-Screening (HHIE-S)	Ventry and Weinstein (1983)	To detect the degree of hearing problems in the emotional and social adjustment of elderly individuals. From HHIE, only 10 items were selected to explore social and situational effects.
Revised Hearing Performance Inventory (R-HPI)	Lamb, Owens, and Schubert (1983)	Revised version of HPI, maintains the strength of the previous form while reducing the time required for its administration. The R-HPI contains 90 items from 256 questions of HPI. This revised version is a comprehensive tool to assess hearing handicap.
Mc Carthy-Alpiner Scale of Hearing Handicap (M-A SCALE)	Mc Carthy-Alpiner (1983)	Is a self-assessment tool to assess hearing handicap and can also be used in family counselling. It measures the psychological, social, and vocational impact of hearing loss as reported by individuals with hearing loss.
Hearing Handicap Inventory for the Elderly-spouse (HHIE-SP)	Newman and Weinstein (1986)	To investigate the spouse's perceptions of the handicap experienced by partners having hearing impairment. It is a modification of hearing handicap inventory for elderly. It includes 13 items targeting emotion and 12 for social subscale.
Communication Profile For the Hearing Impaired (CPRI)	Demorest and Erdman (1987)	This provides a systematic and comprehensive assessment of communication problems. For adults, a 145-item self-assessment inventory, with four areas: communication performance, communication environment, communication

		strategies, and personal adjustment.
Hearing Handicap Inventory for Adults (HHIA)	Newmao, Winstein, Jacobson, and Hug (1990)	A modification of HHIE that could be used with young adults with hearing loss. It is a self-assessment scale with 25 items using two subscales i.e., emotional and situational. This questionnaire 1) helps to validate a person's hearing problem that is not evident by conventional audiometric testing, (2) facilitate decisions regarding need for hearing aids, (3) assists in the counselling, (4) serves as a guide for client centered rehabilitation program, and (5) serves as a criterion measure in record the impact of rehabilitation, including hearing aid
Communication Scale for Older Adults (CSOA)	Kaplan, Bailly, Brandt, Busacco, and Pray (1997)	To provide detailed information regarding the effect of auditory rehabilitation on daily life. It has a 41-item Communication Strategies scale and a 31-item Communication Attitudes scale; to evaluate the communication strategies and attitudes of an individual client Changes in the use of communication strategies and attitudes of clients, 3 months and 9 months after completion of aural rehabilitation program can be assessed.

1.2 Hearing Aid Usage:

Arlinger and Billermark (1999) compared one month and one year follow-up in 29 hearing aid users (mean age was 65 years). They used the abbreviated profile of hearing aid benefit (APHAB) (Cox & Alexander, 1995), Gothenburg profile (Ringdahl, Eriksson-Mangold, & Andersson, 1998), and sound quality judgment (Ringdahl et al., 1998) to find out the benefit and outcome from hearing aids. They found that as the participants shifted to digital hearing aid from analogue hearing aid, there was an improvement in outcome and hearing aid usage, from 6 hours of use per day to 11 hours of use per day.

Baumfield and Dillon (2001) examined certain factors that might influence the usage of hearing aid, satisfaction and perceived benefit in 29 elderly individuals having mild-to-moderate hearing loss, fitted with both an ITE and a BTE hearing aid having similar electroacoustic characteristics. After wearing the devices for a six-week period each, the participants were informed to choose the preferred hearing aid. The amount of hearing aid usage was not specified but it was inferred that the usage was related with accuracy of fitting, hearing aid management, and comfort.

Cox and Alexander (2002) administered the International Outcome Inventory for Hearing Aids (IOI-HA) questionnaire (Cox et al., 2000) by mailing it to 260 adult hearing aid users, out of which 172 patients replied. The results of the study showed the participants used the hearing aid for 4.1 hours on an average and showed a significant improvement in satisfaction, and quality of life.

Cox, Alexander, and Beyer (2003) established norms for International Outcome Inventory for Hearing Aids (IOI-HA) questionnaire (Cox et al., 2000) by administering this questionnaire on 154 participants from 80 clinics including different genders and hearing loss. The results showed that the hearing aid usage ranged from 1 to 4 hours per day in those with mild to moderate; and from 4 to 8 hours per day in those with moderate to severe degree of hearing loss. The norms also showed the corresponding satisfaction and quality of life in that range.

Bertoli et al. (2009) investigated the impact of the Swiss hearing aid dispensing system, and determined the factors leading to successful hearing aid usage. They distributed Swiss version of IOI-HA through postal means to 8707 adult hearing aid owners. Among them, 62% of the participants replied. They found that 85% used their device(s) regularly, 12% only occasionally, and 3% never used their hearing aids. They even concluded that participants who used their hearing aid regularly have higher rate of satisfaction and benefit. Whereas, participants who were not regular users, faced difficulties in managing the aid and were not satisfied.

Brännström and Wennerström (2010) investigated the clinical application of Swedish translation of IOI-HA in 224, i.e., 107 females and 117 males (age range from 27 to 94 years; mean age 66.1 years). They were new hearing aid users. The data on hearing aid usage were collected after six months. The findings included the average number of hours of hearing aid use was 3.9 hours/day. They found significant effect ($p<0.05$) of hearing aid use on the audiometric findings, benefit, quality of life, and satisfaction.

Chang, Tseng, Chao, Hsu, and Liu (2008b) evaluated speech performance differences and subjective outcomes among two groups of digital hearing aid users; first group with participants in the age from 65 to 80 years (n=32) and second group with participants >80 years of age (n=27). The outcomes between the two group users were compared using speech recognition threshold (SRT), Most Comfortable loudness Level (MCL), COSI, and HHIE screening protocol to identify elderly individuals with problem in hearing, and a custom questionnaire. They found more than 8 hours/day of hearing aid usage among 37.5% of 65 to 80 years of participants and 33.3% of more than 80 years of participants. They found that age by itself was not a limiting factor for elderly users of hearing aids to benefit from digital hearing aids. The number of hours of hearing aid use was a contributing factor for subjective benefit and satisfaction.

Collins, Souza, O'Neill, and Yueh (2007) studied by reviewing the medical records of naïve users of hearing aids to know if group visits worsen the hearing aid outcomes. This was carried out at the Department of Veterans Affairs Puget Sound Health Care System from September 2004 to March 2005. The outcome questionnaires such as HHIE (Ventry & Weinstein, 1982), SADL scale (Cox & Alexander, 1999), and a custom questionnaire were administered to compare between those seen for individual and group fitting and/or visits for follow-up of 90 days. The results revealed that individuals who were fitted and followed up in a group reported to more hearing aid usage (12.4 hours/day) compared to individually fitted group (10.2 hours/day). It was further noted that those who received fitting and follow-up in a group reported similar hearing handicap and better hearing-related function, satisfaction, and adherence than those who received individual visits.

Cook and Hawkins (2007) administered the IOI-HA questionnaire (Cox et al., 2000) through mail on 262 patients to describe the usefulness in terms of outcome for a hearing aid program. The patients were issued new hearing aids and rehabilitative services at Mayo Clinic for one year. The results showed that 79% of the participants used their hearing aid at least for 4 hours/ day and they found high level of satisfaction and an improved quality of life.

Desjardins and Doherty (2009) investigated the ability of hearing aid use in experienced hearing aid users by administering SADL, APHAB questionnaire, practical hearing aid handling skill test (Desjardins & Doherty, 2009), and a custom questionnaire. The result showed >12 hours of hearing aid usage per day by 38% of participants, 2 to 5 hours per day by 18% of participants, and <2 hours by 6% of participants. They concluded that more

experienced hearing aid users were able to manipulate and use their hearing aid more efficiently.

Dillon et al. (1999) administered the APHAB questionnaire (Cox & Rivera, 1992), COSI (Dillon et al., 1997), and Hearing Aid User's Questionnaire (Forster & Tomlin, 1988) on 4421 participants randomly chosen from 46 different hearing aid centres. The data were collected from 200 clinicians. The results of follow-up after 4 to 8 weeks and 3 months showed hearing aid use of >8 hours per day in 34%, 4 to 8 hours per day in 27%, 1 to 4 hours per day in 28%, <1 hours per day in 1%, <1 hour per week in 1%, and never in 1% of the hearing aid users. The results showed a relationship of hearing aid use with comfort, presence of feedback, quality of user's own voice (r=0.42), benefit (r=0.43), and satisfaction (r=0.48).

Gaffney (2008) investigated 40 participants i.e., 39 male and 1 female; aged 49 to 86 years (mean age being 70 years). Half of them were naive hearing aid users and the other half had experience using hearing aids. The objective was to find out the duration of hearing aid usage as reported by the users and compare this with the hearing aid data logged results. The objectively recorded hearing aid use in quiet and noise environment via data logging was also compared with self assessment outcome measure (IOI-HA). They compared the reported hearing aid use with all objective information of use in different listening situations and found an overestimation by 1.4 hours. They concluded that more hearing aid use led to a better outcome in older adults. Each of the two groups showed strong correlations between the reported and data logging hourly use. The new users had an $r = 0$ 0.621, $p<0.01$; while the experienced users had an $r = 0.774$, $p<0.01$. In quiet, the reported and estimated use of hearing aid was found to be 55.17% and 66.15% respectively. In noise, the reported and estimated hearing aid use was found to be 34.32% and 28.30% respectively. The total score of IOI-HA significantly correlated with the group reported use of hours i.e., longer use of hearing aid correlated with success.

Gianopoulos, Stephens, and Davis (2002) examined 105 males (in the age range from 8 o 16 years) long-term use of hearing aids following a postal hearing screening using social hearing handicap index (Rosen, 1979), hearing measurement scale (Noble & Atherley, 1970), and through an interview. The study revealed that 43% of them used regularly and 57% never used their hearing aids. This was strongly associated with the outcome, management, and size of the hearing aid.

In this evidence-based era, there is an increased emphasis on measurement, demonstration, and documentation of the outcome success following any treatment

procedures. In the evidence-based practice of hearing health care sector, there is a need for the audiologist to demonstrate real world usage and outcome from hearing aids. There are multiple ways for measuring hearing aid usage and outcome.

Conventionally, the duration of hearing aid usage was measured only on the basis of self-report by patients (or their communication partners) themselves. However, now technological advancement has lead to development of features like data logging in hearing aids which help to measure hearing aid usage objectively. To evaluate the hearing aid outcome, an audiologist can adopt either objective lab based procedures for gathering data or information, such as speech perception tests or subjective methods such as patient interview, focus group discussions comprising of hearing aid users / significant others, or self-reports.

1.3 Data logging:

It has become increasingly important to assess the benefit from hearing aids in adults. The basis for the data from questionnaires includes retrospective recall of events and experiences. This can be inaccurate often. Questionnaires also do not reveal the daily variation that typically occurs in specific situations and experiences. The data logging feature in a hearing aid makes it is easier to measure the hearing aid usage.

The data logging feature in the current digital hearing aids is emerging as one of the objective and valid tools for measuring hearing aid usage. With data logging feature, information on average time of hearing aid usage, duration of individual program use, volume control changes can be tracked and displayed during the follow-up appointment. This feature in hearing aids allows for more focused communication between the hearing instrument wearer and the dispensing professionals. This information basically helps us to analyze the patient preferences in daily life and provide appropriate fine-tuning corrections and suggestions. Thus, Fabry (2005) considers data logging as a means for communicating between the hearing aid user and the audiologist.

Naive hearing aid users usually over estimate the number of hours of hearing aid use every day, by at least 2 to 4 hours (Gaffney, 2008). Further, usage of hearing aids for a longer periods of time each day report higher satisfaction with their hearing aid experience (Gaffney, 2008; Humes, 1999). In fact, Fabry et al. (2005) revealed that hearing aids returned for credit were used at least 5.8 hours per day less than the overall average. Relying on self-report assessment is insufficient for reliable information. Troubleshooting hearing

aids has become more complex and comprehensive with the ability to track hearing aid use by the patient electronically.

Interview:

According to Harrell and Bradley (2009), interview is used as one of the data gathering methods. Interviews can be unstructured, semi-structured and structured depending on the amount of control exercised. In unstructured interviews, there is a minimum control over the way the respondent answers but there is a clear plan. In semi-structured interviewing, the researcher uses a guide, with questions and topics to be covered. There is some choice about the order in which questions are asked. The questions are used and probes may be provided to ensure that the correct material is gathered. This kind of interview collects detailed information using conversation style. This kind of interview is often used when one wants to cover a topic deeply and to thoroughly understand the answers. In structured interviews, the questions are fixed and they are asked in a specific order. The respondents will be asked identical questions and in the same order.

Focus group discussion:

Powell and Single (1996) defined a focus group as a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research. According to Gibbs (1997), the main purpose of focus group studies is to know about the beliefs, experiences, attitudes, feelings, and reactions of the participants. This is the method to obtain in depth information compared to using other approaches. In comparison with personal interviews, which are to obtain individual attitudes, beliefs and feelings, in a group setting, focus groups extract a multiple views and emotional inputs too.

The focus groups have been successful with adults having hearing loss. For example, in a study of attitudes toward hearing impairment in the workplace, (Hétu Getty, & Waridel, 1994) and in a study of consequences of hearing impairment on work life (Tye-Murray, Spry, & Mauze, 2009) focus group discussions were utilized. Stika (1997) conducted focus groups study with adults having hearing problem (n=107) and family members (n=37) to compare and contrast the impact of hearing impairment on social interactions. Focus groups have also been conducted for knowing the attitudes in relation to cochlear implantation of audiologists (Fitzpatrick, McCrae, & Schramm, 2006; Fitzpatrick et al., 2009), and regarding barriers to

work by people with hearing impairment by adults with hearing impairment (Laroche, Garcia, & Barette, 2000). Laroche et al. (2000) conducted separate focus groups for adults with hearing impairment and audiologists. The study investigated the perspective of both clients and audiologists on the hearing aid usage.

Across the globe, researchers have tried to assess hearing aid outcome. Apart from hearing aid usage, a few of the commonly targeted outcome areas include satisfaction, benefit, improvement in quality of life, and reduction in participation restriction. Traditionally, the most practical and preferred method for assessing outcome is use of self-report questionnaires. However, acknowledging the advantages of focus group discussions (FGD) and personal face-to-face interview, recently the researchers have started using these methods as a valid and appropriate tool to comprehensively understand real world hearing aid outcome.

Of late, researchers in the field of Audiology have started using FGDs. In 2013, Laplante-Lévesque et al. conducted an FGD on 17 participants in 4 different sessions on 'Optimal hearing aid use' having audiologists and experienced adult hearing aid users as participants. Galvez et al. (2012) organized FGD on the topic 'ecological momentary assessment of hearing difficulties' encountered by hearing aid users. Dawes, Maslin, and Munro (2014) conducted FGD on three groups of hearing aid users, each comprising of five to six individuals, in order to understand on concept of 'Getting used to hearing aids' or acclimatization. In 2016, Archana, Krishna, Rajashekhar, and Bhargavi used FGD on 30 audiologists and 10 hearing aid users, to know more about whether adult auditory training should be a part of aural rehabilitation. Again in 2013, Kelly et al. have used FGD to find answer for the question 'What elderly people require to successfully adjust to life with a hearing aid?' which highlights the lack of pre- and post- information and post-fitting support. The older adults concerned about their limitation in making informed choices between services by private and National Health Service (NHS) and highlighted the distress caused by the waiting list and uncertainty with NHS. It was concluded that information and psychosocial aspects of care are the keys to enable older adults to adjust and optimize hearing aid benefit. Further, group rehabilitation approaches may be an acceptable alternative for some older adults. All these studies have demonstrated successful application of FGD in gaining thorough insight into the focused areas of interest.

Aim and Objectives:

The aim of the study was to uncover the current scenario of real world hearing aid usage and outcome. The specific objectives were 1) to acquire better insights into the aspects related to ‘real world’ hearing aid usage by developing questionnaires for Hearing Aid Usage and Real world Experience with Hearing Aid; 2) to measure and compare data-logged (objective) and reported (subjective) hearing aid usage measures; 3) to measure the relationship between the usage measures with reported outcome assessed using IOI-HA questionnaire. These objectives were framed in order to acquire better insights into the aspects related to ‘real world’ hearing aid usage and outcome issues from hearing aid users and their communication partners, through focus group discussions and semi-structured interviews.

Methods

To acquire better insights into the aspects of real world hearing aid usage and outcome, the study was conducted in two stages. The Stage I involved development and validation of two questionnaires, one to know the usage of hearing aid i.e., Questionnaire on hearing aid usage (Q-HAU) and the other to assess the real world experiences with hearing aid i.e., Real world experiences with Hearing Aid (REHA). Stage II involved two parts, Part A and Part B, involving the actual data collection. Part A of Stage II involved collecting information on hearing aid usage through objective measure, i.e., information from data logging; and subjective measure, i.e., using Q-HAU and IOI-HA. Part B of Stage II involved conducting Focus Group Discussion (FGD) and semi-structured interviews using REHA. The Table 2.1 depicts the different stages involved in the study.

Table 2.1: Different stages involved in the study.

Stage I	**Stage II**	
Development of two questionnaires	***Hearing aid use and outcome***	
	Part A	***Part B***
1. Questionnaire on hearing aid usage (Q-HAU) 2. Real world experiences with Hearing Aid (REHA)	1. Data logging 2. Administration of a. Q-HAU b. IOI-HA	1. FGD 2. Semi-structured interview

2.1. Participants:

The Stage I of the study involved 20 digital BTE hearing aid users (with at least one year experience in hearing aid use), 10 communication partners (with at least six months experience in interaction with the hearing aid user), and 5 audiologists (with a minimum of 5 years of clinical experience in the area).

Further, Part A of Stage II involved 24 hearing aid users with at least three months of hearing aid experience. The participants using hearing aid/s from one of the four pre-determined brands (i.e., Microtech/Beltone/Danavox/Oticon) of digital BTE hearing aids were included in the study. Irrespective of the income slab, the participants used the hearing aids that was self-funded. For Part B of Stage II, a total of 69 participants, i.e., 41 digital BTE

hearing aid users (7 participants each in 3 FGD; 20 for semi-structured interview) with 3 months to one year of experience in hearing aid use; and 28 communication partners (6 partners in each of 3 FGDs; 10 for semi-structured interview) with at least 3 months of experience in interaction with the hearing aid user were considered.

The participants were native speakers of Kannada language and with the ability to read and write in Kannada. Kannada is a south Indian language spoken in the state of Karnataka in India, having its origin from the Dravidian Language. The hearing aid users were in the age range from 18 to 65 years (mean age of 48.07 ± 12.69 years), and had post-lingually acquired hearing loss. The participants were categorized into young adults (18 to 50 years of age) and older adults (50 to 65 years of age). There were 28 male and 24 female participants, with an educational background of at least 6th grade. Hearing loss of the participants varied from moderate to profound degree with mixed and sensorineural types. There were equal numbers of participants from rural and urban backgrounds. The demographic data of participants is given in Table 2.2.

Table 2.2: Demographic data of participants.

S. No.	*Age (in yrs.)*	*Gender*	*Education*	*Socioeco-nomic status**	*Resi-dent*	*Duration of hearing loss (in years)*	*Degree of hearing loss in test ear*	*Type of hearing loss in test ear*	*Speech identification score (SIS) (max.SIS =25)*
1.	62	Male	12th Std.	Slab 3	Urban	6	Moderate	Mixed	22
2.	50	Male	10th Std.	Slab 1	Rural	8	Moderate	Sensorineural	19
3.	65	Male	Graduate	Slab 2	Rural	6.5	Moderate	Mixed	20
4.	60	Male	Graduate	Slab 3	Urban	4	Moderately severe	Sensorineural	15
5.	61	Male	12th Std.	Slab 3	Urban	7	Moderate	Sensorineural	18
6.	23	Male	Graduate	Slab 2	Rural	7	Moderate	Sensorineural	17
7.	40	Male	Graduate	Slab 2	Urban	4	Severe to profound	Mixed	15
8.	62	Male	10th Std.	Slab 1	Urban	4	Severe to profound	Mixed	17
9.	63	Male	10th Std.	Slab 1	Urban	5	Moderate	Sensorineural	20
10.	40	Male	Graduate	Slab 2	Rural	6	Moderate	Sensorineural	19

11.	53	Male	12th Std.	Slab 2	Rural	5	Moderate	Sensorineural	20
12.	62	Male	Graduate	Slab 3	Urban	1	Moderately severe	Sensorineural	20
13.	63	Female	10th Std.	Slab 1	Urban	3	Moderate	Sensorineural	19
14.	49	Female	10th Std.	Slab 1	Urban	1	Severe to profound	Mixed	12
15.	54	Female	Graduate	Slab 2	Rural	3	Severe to profound	Sensorineural	9
16.	54	Female	12th Std.	Slab 2	Urban	4	Moderate	Mixed	21
17.	61	Female	Graduate	Slab 2	Rural	6	Moderately severe	Sensorineural	19
18.	46	Female	12th Std.	Slab 2	Urban	5.5	Moderate	Sensorineural	20
19.	57	Female	<10th Std.	Slab 1	Rural	3	Moderately severe	Sensorineural	18
20.	54	Female	Graduate	Slab 2	Urban	0.5	Moderately severe	Mixed	18
21.	45	Female	Graduate	Slab 1	Rural	2	Moderate	Sensorineural	16
22.	55	Female	Graduate	Slab 3	Urban	1	Moderate	Sensorineural	18
23.	41	Female	12th Std.	Slab 2	Urban	3	Moderately severe	Mixed	17
24.	25	Male	10th Std.	Slab 2	Rural	2	Moderate	Sensorineural	20
25.	31	Female	10th Std.	Slab 2	Rural	2	Moderate	Sensorineural	19
26.	33	Male	10th Std.	Slab 2	Rural	1.5	Moderately severe	Sensorineural	13
27.	32	Male	12th Std.	Slab 2	Rural	1.6	Moderately severe	Sensorineural hearing loss	15
28.	34	Male	12th Std.	Slab 1	Urban	2	Moderately severe	Sensorineural	14
29.	46	Male	Graduate	Slab 1	Rural	3	Severe to profound	Mixed	13
30.	57	Male	Graduate	Slab 1	Urban	2	Moderate	Sensorineural	21
31.	46	Female	12th Std.	Slab 3	Rural	2	Severe to profound	Mixed	14
32.	41	Female	10th Std.	Slab 3	Rural	3	Severe to profound	Sensorineural	16
33.	62	Male	10th Std.	Slab 2	Rural	3	Moderately severe	Sensorineural	12
34.	62	Male	10th Std.	Slab 1	Urban	4	Moderately severe	Sensorineural	15
35.	21	Female	12th Std.	Slab 2	Urban	3	Moderate	Sensorineural	20

36.	54	Female	12th Std.	Slab 3	Urban	0.5	Severe to profound	Mixed	14
37.	42	Female	12th Std.	Slab 1	Rural	0.5	Severe to profound	Mixed	16
38.	52	Male	10th Std.	Slab 1	Urban	0.5	Moderately severe	Sensorineural	17
39.	54	Male	Graduate	Slab 2	Urban	1	Moderate	Sensorineural	21
40.	64	Male	Graduate	Slab 2	Rural	1	Moderately severe	Sensorineural	16
41.	31	Male	12th Std.	Slab 2	Rural	2	Severe to profound	Mixed	15
42.	33	Female	Graduate	Slab 1	Urban	0.9	Severe to profound	Mixed	17
43.	41	Male	12th Std.	Slab 1	Urban	0.8	Moderately severe	Sensorineural	14
44.	45	Male	12th Std.	Slab 1	Rural	0.7	Moderately severe	Mixed	17
45.	43	Male	12th Std.	Slab 1	Rural	3.00	Moderately severe	Sensorineural	17
46.	18	Male	12th Std.	Slab 1	Rural	3	Severe to profound	Mixed	15
47.	36	Female	<10std	Slab 1	Urban	2	Severe to profound	Sensorineural	13
48.	45	Female	10th Std.	Slab 3	Urban	4	Severe to profound	Mixed	16
49.	65	Female	<10std	Slab 3	Rural	2	Moderately severe	Sensorineural	14
50.	49	Female	10th Std.	Slab 1	Rural	1	Moderately severe	Mixed	15
51.	57	Female	10th Std.	Slab 2	Rural	1	Moderate	Sensorineural	19
52.	61	Female	Graduate	Slab 2	Urban	3	Moderate	Sensorineural	20

Note: *:Slab 1: <Rs.10,000/- per month; Slab 2: Rs.10,000/- to Rs. 20,000/- per month; Slab 3: >Rs.20,000/- per month

2.2. Material:

In total, three questionnaires were used in the study. The first of those was the existing Kannada version of International Outcome Inventory for Hearing Aids of the IOI-HA English version (Cox & Alexander, 2002) and IOI-HA Kannada version (Thammaiah, Manchaiah, Easwar, & Krishna, 2016) to assess the hearing aid outcome. Second, a questionnaire to assess hearing aid usage, i.e., Hearing Aid Usage Questionnaire (Q-HAU) that was developed as part of this study. Finally, another questionnaire that also developed as part of this study, i.e., Real World Experiences with Hearing Aid (REHA) questionnaire to conduct Focus Group Discussions (FGDs) and semi-structured interview for assessing hearing aid usage and

outcome. These two questionnaires were developed in English language and the Kannada translated version of Q-HAU and REHA were used for data collection.

2.3. Procedure:

A qualitative research design was used to explore the usage and outcome of hearing aids. The study was conducted in two stages. Stage I involved development and validation of two questionnaires, the hearing aid usage questionnaire (Q-HAU) in Kannada and the questionnaire to assess the real world experiences with hearing aid (REHA) in Kannada. Stage II involved Part A and B designed for data collection. Part A involved collecting information on hearing aid usage through an objective measure, i.e., information from data logging of hearing aid; and through two subjective measures, i.e., using Q-HAU and IOI-HA (Kannada version). Part B involved conducting Focus Group Discussion (FGD) and semi-structured interview using REHA.

2.3.1 Stage I: Development, translation, and validation of the questionnaires:

This stage involved development of questionnaire on hearing aid usage (Q-HAU) and real world experiences with hearing aid (REHA) questionnaire. Both the questionnaires were developed using the well accepted guidelines given by Diem (2002). This included guidelines for developing questionnaire based on purpose, targeted population, measuring variables, data collection method, and measurement scale.

2.3.1.1 Development of Hearing Aid Usage Questionnaire: With the purpose of finding out hearing aid usage in different listening conditions, data logging features in different hearing aids of different companies were reviewed and given in Table 2.2. The term ‘data logging’ is the feature in the hearing aid that monitors the duration of use of the hearing aid, or different listening environments that the user encounters in daily life. The extent of information in data logging varies considerably across hearing aid manufacturers, as well as within different products from the same manufacturer. With the purpose of finding out the hearing aid usage in different listening conditions among the participants, the data logging feature of different hearing aids of different companies / brands were reviewed and the features of data logging are summarized in Table 2.3. When the hearing aid is connected to the programming software, some hearing aids display the total or average number of hours of hearing aid use; whereas others track the programs or memories that are used or even the characteristics of the listening environment itself - such as quiet, noise, and speech in noise. After determining the recordable features from data logging, different questionnaires available in the literature were explored – either specifically developed to find out hearing aid

usage, or developed as a part of a general hearing aid questionnaire that measures the outcome. Only those questions which can be verified objectively through data logging were included in the development of the new questionnaire.

Table 2.3. Information under data logging feature of hearing aids from different companies.

Data Logging Feature	*Hearing aid make*						
	Beltone	*Danavox*	*Hansaton*	*Interton*	*Microtech*	*Oticon*	*Phonak*
Average use per day	✓	✓	✓	✓	✓	✓	✓
Different programs – hours of use	✓	✓	✓	✓	✓	✓	-
Volume per program	✓	✓	✓	✓	✓	✓	-
Volume per environment	-	✓	-	-	-	-	-
Volume change	✓	✓	✓	✓	✓	-	-
Total usage time	✓	✓	✓	✓	-	✓	✓
Date since last programming	✓	✓	✓	✓	✓	✓	✓
Directionality	-	-	-	-	✓	✓	-
Average battery life	-	-	-	-	✓	-	-

This questionnaire was developed, then reviewed and validated by an expert audiologist having more than 25 years of experience to see validity of questionnaire with reference to data logging information of different models of hearing aids which were pre-defined based on the amount of information those models were providing. A questionnaire comprising of 11 questions was framed and was given for validation to six audiologists to rate them on their appropriateness based on a four-point rating scale i.e., 100 % appropriate,

75% appropriate, 50% appropriate, and 25% appropriate. Those questions, which had appropriateness rating of ≥75% were included in the final version of the questionnaire. Based on this criterion, eight questions were finalized containing fixed types of responses, either in the form of 'yes' / 'no' type or multiple choice type.

2.3.1.2 Development of Real world Experiences with Hearing Aid (REHA) questionnaire: Two versions of REHA questionnaire have been developed, one targeting hearing aid users and the other targeting communication partners. The reason for framing two versions of the questionnaire was that the perception of the hearing aid user and that of the communication partner might differ. For example, the user may say that the hearing aid was not at all useful whereas the partner might feel that the hearing aid helped in certain situations. The perception of benefit also depends on the expectations from the hearing aid. Each version of the questionnaire had 10 open-ended questions, involving information on hearing aid usage (such as acclimatization, handling, maintenance cost, repair etc.) and outcome (such as satisfaction, quality of life, benefit etc.). For developing this questionnaire, information was collected from the existing questionnaires and audiologists working in area of hearing aid research and clinical set up. For the purpose, a set of 30 questions was prepared. After reviewing of these questions by an expert audiologist, the number of questions was reduced by deleting 15 questions, which had repeated / overlapping information and the rest of the 15 questions were given to five audiologists for validation and categorization in different categories i.e., acclimatization, handling, maintenance cost, repair satisfaction, quality of life, and benefit. After validation from the audiologists, the questionnaire was finalized to have 10 questions with two questions each targeting benefit, satisfaction and quality of life; and one question each for acclimatization, handling, maintenance cost, and repair.

2.3.1.3 Translation of Q-HAU and REHA questionnaires: Both the questionnaires were translated following the guidelines by American Academy of Orthopaedic Surgeons (AAOS) (Beaton, Bombardier, Guillemin, & Ferraz, 2000). The guidelines involved five stages. They are i) forward translation, ii) synthesizing common translation, iii) backward translation, iv) expert committee review, and v) pre-final testing.

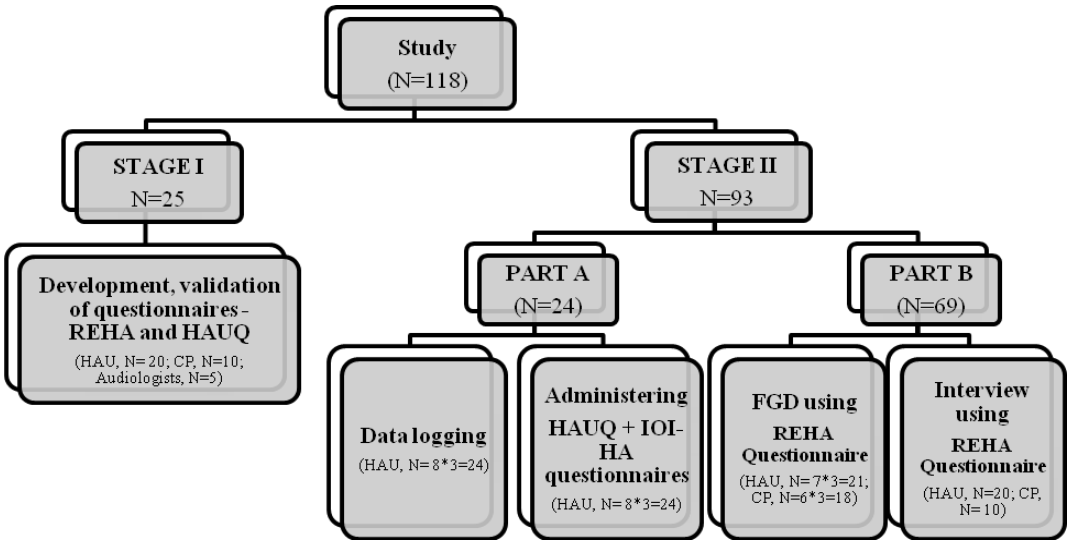
Independent translations of the Q-HAU and REHA questionnaires were done by two Kannada-English bilingual adult translators whose first language was Kannada. Both of the translators were experienced audiologists with a minimum of five years of research experience. An expert audiologist with experience of more than 25 years in the field of

Audiology compared both the translations and obtained a common synthetized translation based on linguistic style and preference for words, easier, clearer, unambiguous, and more colloquial of the two versions. This version of the questionnaire was given for a backward translation to a Kannada-English bilingual linguist, who was also a qualified audiologist, for detecting inaccuracies (if any) in the synthetized forward translation. To identify such inaccuracies, an expert was involved after reviewing the forward and backward translations. A pre-final testing was involved in validation. The questionnaire was administered on five hearing aid users in order to fine tune the questions for easy comprehension.

2.3.1.4 Validation of Q-HAU and REHA: Before presenting the final version of the questionnaire (which was already validated by six audiologists for Q-HAU and five audiologists for REHA based on their appropriateness and context), 20 hearing aid users, 10 communication partners, and 5 audiologists were involved as participants to find out their opinion about the questionnaire. For this, the participants were requested to rate the questions in 'yes' or 'no' about its simplicity, clarity, relevancy, and comfort. The opinion responses were analyzed to check for correctness and necessary changes were incorporated to prepare the final version of the questionnaire. The Q-HAU (English and Kannada versions) is given in Appendix A and the REHA (English and Kannada versions) is given in Appendix B.

2.3.2 Stage II: Data collection on hearing aid use and outcome:

This stage involved two parts. Part A involved collecting information on hearing aid usage and outcome through objective (data logging) and subjective techniques (Q-HAU and IOI-HA questionnaire). Part B will involve conducting Focus Group Discussions (FGDs) and semi-structured interviews using REHA questionnaire. Figure 2.1 provides a block diagram of the stages involved in the study.



Note: Q-HAU – Questionnaire on Hearing Aid Usage; REHA - Real World Experiences with Hearing Aid; HAU - Hearing aid users; CP - Communication Partners; IOI-HA - International Outcome Inventory for Hearing Aids; N=n= Number of participants.

Figure 2.1: Summary of stages in the present study.

2.3.2.1 Part A: Acquiring information on hearing aid usage through subjective and objective measures: After the purchase of the prescribed hearing aid, during the first follow-up visit of the hearing aid user, with a minimum gap of 5 to 6 weeks from their hearing aid fitting, information from the data logging feature of the BTE hearing aid was collected from the hearing aid users. In order to evaluate the reliability of hearing aid usage information collected, the communication partners were asked to describe the number of hours of hearing aid usage. In addition, during the follow-up session, the hearing aid users were instructed to

read fill in/answer the Q-HAU and IOI-HA questionnaires. Reliability of responses were verified on 10 of these hearing aid users, after a gap of three months.

2.3.2.2 Part B: Obtaining information on real world hearing aid usage and outcome: Three focus group discussions (FGD) were organized for hearing aid users and three more FGDs were organized separately for their communication partners. In this study, seven hearing aid users and six communication partners were included for each of the three respective FGDs (Simon, 1999; Krueger, 2002). The REHA questionnaire, with 10 open-ended questions, was used during the discussion. The FGDs were conducted in separate rooms for the users of hearing aids and their communication partners. Each session lasted for 90 minutes. One of the researchers with an experience of more than 25 years in the field of Audiology served as the moderator. Two qualified professionals were included, one served as an observer and the other as a note taker. Written informed consent was taken from all the participants. They were informed about the presence of an observer and note taker. They were also informed about the audio recording of the focus group discussion.

The moderator introduced the questions one after the other and facilitated / probed in order to generate maximum number of possible responses, experiences, and opinions of the participants. The entire discussion was audio recorded. The note taker also noted down any other information on related topic such as non-verbal expressions.

Further, on another group of 32 participants (22 digital BTE hearing aid users and 10 communication partners), 12 males and 10 females, having a minimum of three months experience of hearing aid usage were included in a face-to-face semi-structured interview (SSI). The hearing aid users and communication partners were seated in a quiet room for two different sessions during their follow-up visit. They were told about the purpose of the study and were made to sign a consent form regarding the participation and audio recording of the sessions. The participants were asked eight questions included in REHA and further questions were asked to probe for information based on their answer. At the end of each SSI, information on hearing aid usage and outcome were collected from the hearing aid users and their communication partners. In addition, information regarding quality of life, satisfaction, maintenance cost, and benefit were also collected during the semi-structured interviews.

Statistical Analyses:

The information with regard to the hearing aid usage of the hearing aid users were tabulated and entered in the statistical software, SPSS (version 21) .The tabulated data were subjected to descriptive statistical analysis. The values were represented in bar diagrams. After this, the data were subjected to reliability tests, Cronbach's alpha value were obtained for the different parameters. To check for the agreement between the parameters pertaining to the subjective and objective responses the Kappa coefficient values were employed.

The data were further subjected to a series of non-parametric tests. Chi square was done to find the association between parameters. Kruskal Wallis test and Mann Whitney U test were performed to find the level of significant difference between the different groups/ parameters. The results obtained using the various statistical tests are discussed in the next section.

1. Detailed analysis of results indicating contributions made towards enhancing the status of knowledge in the subject:

Results

The aim of the study was to find out hearing aid usage and outcome in the real world. The study was divided into two phases. The first phase included development and validation of two questionnaires. The second phase was sub-divided in two stages. Two questionnaires i.e., questionnaire on hearing aid usage (Q-HAU) and international outcome inventory for hearing aid (IOI-HA) were administered in the second stage. In this stage, report on the hearing aid usage was noted down objectively through data logging feature in the hearing aids. Stage two also included administration of the questionnaire on real world experience with hearing aids (REHA) through focus group discussions and semi-structured interview. The results of the study will be discussed under following headings.

3.1. Hearing aid usage in real world.

3.2. Comparison of data on hearing aid usage obtained through different modalities, i.e., hearing aid users' report, communication partners' report, and data logging report.

3.3. Factors that affect hearing aid usage.

3.4. Comparison of hearing aid usage with hearing aid outcome.

3.1 Hearing aid usage in real world:

The Q-HAU questionnaire included eight questions in order to collect information on hearing aid usage in different listening environments. The information collected on the eight questions of the Q-HAU from 52 participants has been given under eight sub headings:

3.1.1. Number of hours of hearing aid usage

3.1.2. Duration of hearing aid usage in a fairly quiet environment

3.1.3. Duration of hearing aid usage in noisy environment

3.1.4. Manipulation of the volume control (enabled during the first follow-up visit) in the hearing aid

3.1.5. Monaural vs. binaural hearing aid usage

3.1.6. Aware of automatic changes in hearing aid settings/programs based on listening environment

3.1.7. Aware that the use of hearing aid can be monitored

3.1.8. Time / situation in which the hearing aid is switched-off.

3.1.1. Number of hours of hearing aid usage

Information on the average number of hours of hearing aid (HA) usage per day, both on working days and holidays, was tabulated (Figure 3.1, Table 3.1). The responses of the participants showed that there was no difference in the number of hours of hearing aid usage on a working day and a holiday. As mentioned earlier, the participants were categorized into young adults (≥18 to <50 years of age) and older adults (≥50 to <65 years of age). The average number of hours of hearing aid usage per day was grouped under four categories, for these two groups of participants. They were <1 hour per day, 1 to 4 hours per day, and 4 to 8 hours per day, and > 8 hours per day. It was found that five young adults (9.61%) used their hearing aids for 4 to 8 hours, whereas nine older adults (17.30%) used their hearing aid for 4 to 8 hours. In both the groups of participants, equal number (i.e., 19 participants, 36.53%) used their hearing aid for more than eight hours in a day. It was also found that 21 male (40.38%) and 17 female (32.69%) participants used their hearing aids for more than 8 hours per day. Whereas, equal number of participants in both male and female groups, i.e., 7 (13.46%) used their hearing aid for 4 to 8 hours per day.

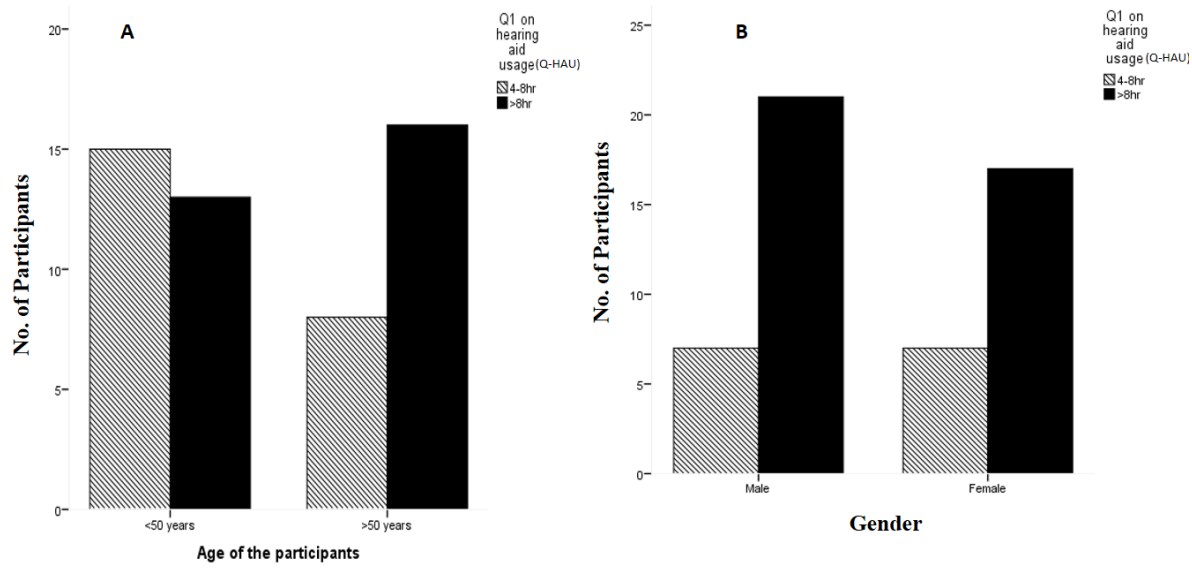


Figure3.1: Number of participants using their hearing aids for 4-8 hours and >8 hours per day; A: Young adults and older adults. B: Male and female participants.

To check the reliability of information collected, ten participants were interviewed again after three months. The Cronbach's alpha was used to check the internal consistency of these ten participants. The Cronbach's alpha was 0.571.

Table 3.1: Duration of hearing aid usage by the participants.

Duration of HA use	*No. of participants (n=52)*			
	Young adults	*Older adults*	*Male*	*Female*
< 1 hour/day	-	-	-	-
1-4 hours/day	-	-	-	-
4 - 8 hours/day	5	19	7	7
> 8 hours/day	9	19	21	17

3.1.2. Duration of hearing aid usage in a fairly quiet environment

Information on the average number of hours of hearing aid usage per day in a fairly quiet environment is depicted in Figure 3.2.and Table 3.2. It can be noted that 9 young adults (17.30%) and 15 older adults (28.84%) used their hearing aid for 4 to 8 hours and more than 8 hours per day respectively. Whereas, 14 participants (26.92%) in each of the age groups used their hearing aid for 4 to 8 hours and more than 8 hours per day. Across the genders, it was found that 15 male (28.84%) and 8 female (15.38%) participants used their hearing aid for 4 to 8 hours; whereas 13 male (25%) and 16 female (30.76%) participants used their hearing aids for more than 8 hours.

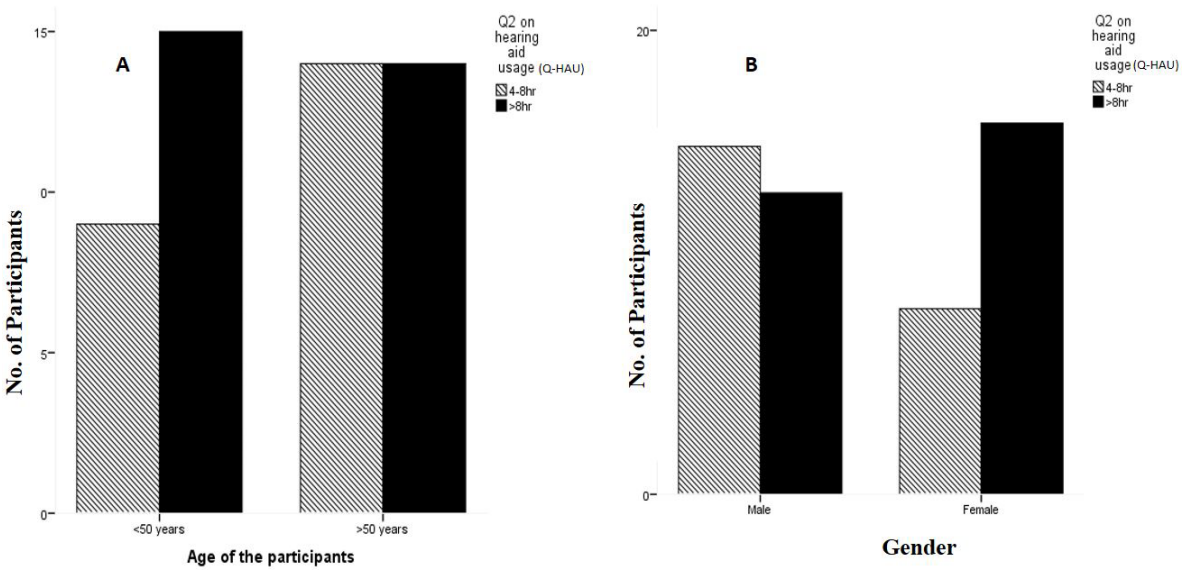


Figure 3.2: *Number of participants using their hearing aids for 4-8 hours and >8 hours per day in quiet situation; A: Young adults and older adults. B: Male and female participants.*

Table 3.2: Duration of hearing aid usage by the participants in quiet environment.

Duration of HA use in quiet	***No. of participants***			
	Young adults	***Older adults***	***Male***	***Female***
< 1 hour/day	-	-	-	-
1-4 hours/day	-	-	-	-
4 - 8 hours/day	9	15	15	13
> 8 hours/day	14	14	8	16

To check the reliability of the data, 10 participants were administered the question 2 after a gap of three months. The Cronbach's alpha was calculated for this question. The Cronbach's alpha (0.89) revealed a good reliability for this question.

3.1.3. Duration of hearing aid usage in noisy environment

Information on the average number of hours of usage of hearing aid per day in noisy environment is provided in Figure 3.3 and Table 3.3. It was noted that 5 (9.61%), 12 (23.07%), and 7 (13.46%) young adults used their hearing aid in noisy environment for 1 to 4 hours, 4 to 8 hours, and >8 hours per day respectively. Whereas 6 (11.53%), 16 (30.76%), and 6 (11.53%) older adults used their hearing aid in noisy environment for 1 to 4 hours, 4 to 8 hours, and >8 hours per day respectively. Across the gender, it was found that 2 (3.84%), 16 (30.76%), and 10 (19.23%) male participants used their hearing aid for 1 to 4 hours, 4 to 8 hours, and >8 hours per day respectively. Whereas, 8 (17.30%), 12 (23.07%), and 3 (5.76%) female participants used their hearing aid for 1 to 4 hours, 4 to 8 hours, and >8 hours per day respectively.

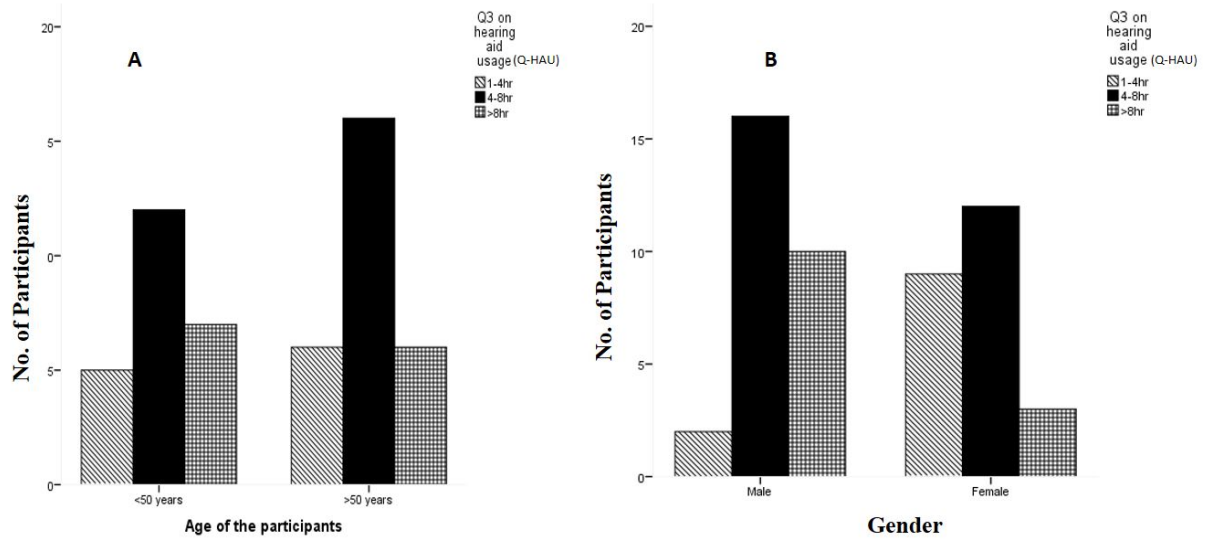


Figure 3.3: *Number of participants using their hearing aids for1 to 4 hours, 4 to 8 hours, and >8 hours per day in noisy situation. A: Young adults and older adults. B:Male and female participants.*

Table 3.3: Duration of hearing aid usage by the participants in quiet environment.

Duration of HA use in noise	No. of participants			
	Young adults	Older adults	Male	Female
< 1 hour/day	-	-	-	-
1-4 hours/day	5	6	2	9
4 - 8 hours/day	12	16	16	12
> 8 hours/day	7	6	10	3

To check the reliability of the data, 10 participants were administered the question again after three months. The Cronbach's alpha was calculated for Question 3. The Cronbach's alpha (0.94) revealed excellent reliability for this question.

3.1.4. Manipulation of the volume control in the hearing aid

There were three parts of Question 4. The first subset had open-ended questions that were targeted towards situations in which participants tend to change the volume setting of their hearing aid. It was found that in eight of the participants (15.38%), the volume control

was disabled and the rest of them manipulated the volume control and many of them listed out more than one situation in which they manipulated the volume setting. The details were categorized as shown in Table 3.4.

Table 3.4: Situations in which the participants manipulated the volume control (VC) of their hearing aids.

S.No.	*Situations*	*No. of participants*	*Tend to increase VC*	*Tend to decrease VC*
1.	General conversation	7	7	0
2.	General conversation in the presence of noise	11	10	1
3.	Group conversation with multi talker	12	12	0
4.	Group conversation with multi talker, in the presence of noise	17	9	8
5.	Television	21	21	0
6.	Telephone	8	8	0
7.	Traffic	5	0	5
8.	Low Battery	2	2	0

To check reliability on 10 participants, Cronbach's alpha was calculated for Question 4. The Cronbach's alpha (0.90) revealed a good reliability for this question.

3.1.5. Monaural vs. binaural hearing aid usage.

Information on the binaural or monaural usage of the hearing aids by the participants was tapped and given in Figure 3.4 and Table 3.5. Of the total 52 participants, 31 purchased binaural hearing aids whereas 21 purchased monaural hearing aids. Among those who purchased binaural hearing aids, 13 (25%) young adults used binaurally, and 11 (21.15%) young adults used their hearing aid only in one ear. Whereas, 14 (26.92%) older participants used the binaural hearing aids and another 14 (26.92%) older adults used monaural hearing aids. Across the genders, 15 (28.84%) males used binaural and 13 (25%) males used monaural hearing aids. Whereas, 12 (23.07%) females used binaural hearing aids and 12 females (23.07) used monaural hearing aids.

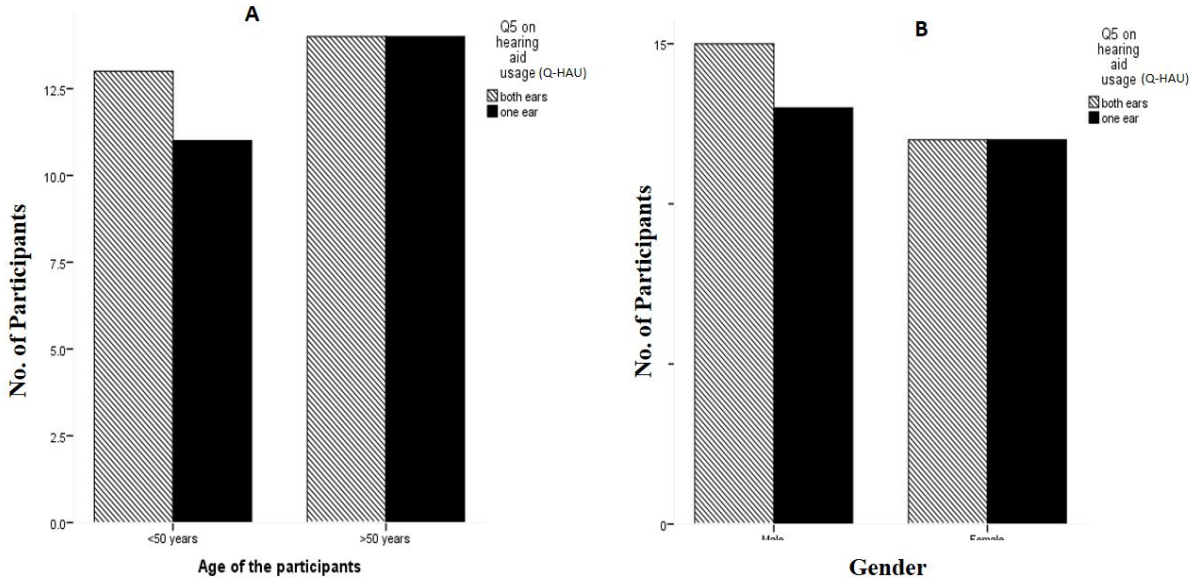


Figure 3.4: *Number of participants who used binaural vs. monaural hearing aids, A: Young adults and older adults. B: Male and female participants.*

Table 3.5: Number of participants who used binaural vs. monaural hearing aids, A: Young adults and older adults. B: Male and female participants.

Mode of HA use	***No. of participants***			
	Young adults	***Older adults***	***Male***	***Female***
Binaural	13	14	15	12
Monaural	11	14	13	12

To check the reliability of response to this question in the questionnaire, 10 participants were administered the questionnaire after three months. The Cronbach's alpha (1.00) revealed excellent reliability for this question.

3.1.6. Aware of automatic changes in hearing aid settings/programs based on listening environment

Information on knowledge of the participants regarding automatic changes made by the hearing aid in terms of programs / settings is depicted Figure 3.5 and Table 3.6. In the study, 8 (15.38%) young adults reported changing the hearing aid program setting. Whereas, 7 (13.46%) young adults reported that they never changed the program. Nine (17.30%) of the young adults reported that they were not aware that they could change the program. Whereas, among the older adults, 5 (9.61%) participants reported that sometimes they feel in

change of hearing aid settings automatically and 8 (15.38%) reported that, they never experienced any changes like that. Whereas, 15 (28.84%) participants were not aware about any automatic changes. To check reliability, the Cronbach's alpha was calculated for Question 6. The Cronbach's alpha (0.84) revealed good reliability for this question.

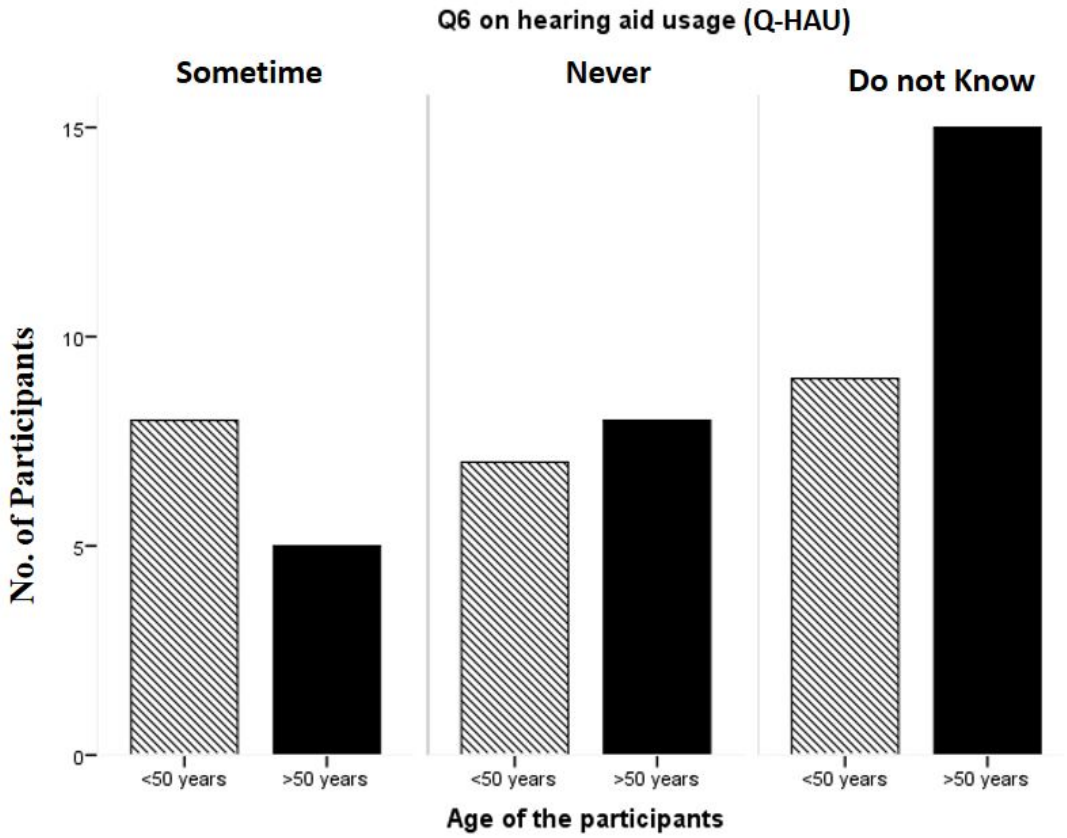


Figure 3.5: *Number of participants reporting perception of automatic change in hearing aid settings*.

Table 3.6: Number of participants reporting perception of automatic change in hearing aid settings.

	No. of participants			
HA use	***Young adults***	***Older adults***	***Male***	***Female***
Sometimes	8	5	8	5
Never	7	8	7	8
Do not know	9	15	13	11

3.1.7. Aware of monitoring the hearing aid usage

Information was collected on the knowledge of the participants regarding the fact that the audiologist can monitor the duration of hearing aid usage by connecting the hearing aid to the computer with the software. Out of the 52 participants, none of the participants were aware that an audiologist can monitor their hearing aid usage through objective means, i.e., their hearing aid had 'data logging' feature. To check the reliability, the Cronbach's alpha was calculated for Question 7. The Cronbach's alpha (-1.02) revealed poor reliability for this question. This may not be appropriate to evaluate, as the participant were told about the 'data logging' feature during the first interview. Due to this fact they would have the knowledge when the same question was asked after three months.

3.1.8. Time / situation in which the hearing aid is switched-off.

It was found that there were participants who were not using their hearing aid. So, information regarding the situations in which the participants had to switch off or remove their hearing aids was tabulated (Table 3.7). It was reported that six participants, including three males and three females, switched off their hearing aids. The details regarding the number of participants who switched off their hearing aid and reason behind that are shown in Table 3.7. To check reliability, the Cronbach's alpha was calculated for Question 8. The Cronbach's alpha (0.86) revealed good reliability for this question.

Table: 3.7 Situations in which the participants who switched off / did not use their hearing aids.

S.No.	***Situations***	***No. of Participants (n=52)***	***Reason for switching off / not using the hearing aid***
1.	Traffic noise	2	Too loud
2.	Family function	5	To hide their disability
3.	Ear discharge	1	As suggested by the audiologist
4.	At home	3	Can manage without hearing aid
5.	Working place	1	Too noisy / to hide disability

3.2. Comparison of data on hearing aid usage obtained through three modalities:

The facts on usage of hearing aids are being reported for three modalities. In addition, this information will be compared across different modalities. i.e.,

3.2.1. Hearing aid usage based on data logging, report by hearing aid users and report by communication partners

3.2.2. Comparison of hearing aid usage obtained from three modalities.

3.2.1. Hearing aid usage based on data logging, report by hearing aid users, and report by communication partners.

Information on the duration of hearing aid usage obtained through data logging, as reported by hearing aid users, and their communication partners is provided in Tables 3.8, 3.9, and 3.10.

Table 3.8: Number of hours of hearing aid usage as obtained through data logging.

	No. of hours/day of HA usage revealed through data logging		
	1-4 hours	*4-8 hours*	*> 8 hours*
No. of participants (n=52)	10	20	22

Table 3.9: Number of hours of hearing aid usage as reported by its users.

	No. of hours/day of HA usage as reported by its users		
	1-4 hours	*4-8 hours*	*> 8 hours*
No. of participants (n=52)	0	14	38

Table 3.10: Number of hours of hearing aid usage as reported by the communication partners.

	No. of hours/day of HA usage as reported by the communication partner		
	1-4 hours	*4-8 hours*	*> 8 hours*
No. of participants (n=52)	12	28	12

3.2.2. Comparison of hearing aid usage obtained from three modalities.

It was noted that the information on duration of hearing aid use obtained through data logging, hearing aid users and their communication partners varied. The duration obtained by different modalities was compared under the following headings:

3.2.2.1 Comparison of duration of hearing aid usage obtained through data logging and hearing aid users

3.2.2.2 Comparison of duration of hearing aid usage obtained through data logging and communication partners

3.2.2.3 Comparison of duration of hearing aid usage as reported by hearing aid users and their communication partners

3.2.2.1 Comparison of duration of hearing aid usage obtained through data logging and hearing aid users.

On comparison of the information obtained through hearing aid users and data logging (Table 3.11), it was noted that none of the hearing aid users reported that the duration of hearing aid use was less than four hours per day. Further, among the 14 users who reported 4 to 8 hours of hearing aid usage, the data logging information revealed eight, six, and none of them used their hearing aids for 1-4 hours, 4-8 hours ,and >8 hours per day respectively. In addition, among the 38 users who reported >8 hours of hearing aid usage, the data logging information revealed that two, fourteen, and twenty-two of them used their hearing aids for 1-4 hours, 4-8 hours, and >8 hours per day respectively. Thus, it can be inferred that some of the hearing aid users (except for 28 of them, i.e., 6+22) over estimated the duration of hearing aid usage. It is interesting to note that none of the users under estimated the duration of hearing aid usage.

Table 3.11 Comparison of number of hours of hearing aid usage reported by the hearing aid users and that obtained through data logging

No. of hours/per day of HA usage as reported by users	***No. of hours of HA usage obtained through data logging***			***Total No. of participants***
	1-4 hours	*4-8 hours*	*> 8 hours*	
1-4 hours	0	0	0	0
4-8 hours	8	6	0	14
> 8 hours	2	14	22	38

From a different view point, 14 of the 52 participants reported 4 to 8 hours of hearing aid use per day. The data logging of the hearing aid revealed that only 6 out of 14 used it for that duration and the rest of the participants (i.e., 8) used it only for 1 to 4 hours. Similarly, 38 participants reported more than 8 hours of hearing aid use. However, the data logging showed that only 22 participants out of 22 used their hearing aids for that duration. Of these 38, two participants used it for 1 to 4 hours, and the rest (i.e., 14) used it for 4 to 8 hours only. Thus, 24 (46%) (i.e., 8+2+14) participants out of 52 overestimated the overall duration of hearing aid usage.

To find out the agreement between information on duration of hearing aid usage as reported by the users and that obtained through data logging, Kappa test was administered. The Kappa coefficient was 0.214 and it was statistically significant ($p = 0.02$). This implies that there was poor but significant agreement between the duration of hearing aid usage as reported by the users and that obtained through data logging.

3.2.2.2 Comparison of duration of hearing aid usage obtained through data logging and communication partners

Out of 52 communication partners (Table 3.12), the data logging revealed that 10 users used their hearing aid for 1-4 hours per day. The information obtained from communication partners also revealed that 10 users used their hearing aid for 1-4 hours per day. Likewise, the information obtained through data logging and communication partners was matching for 19 users. However, one of the communication partners overestimated the duration of hearing aid use, when actually the data logging revealed 4-8 hours of use per day. In this instance, the hearing aid user was employed and the communication partner had assumed that the user used the hearing aid at work also. Further, the data logging report showed that 22 participants used their hearing aid for more than 8 hours, the communication partners reported that only 11 used their hearing aid for that duration, while the 9 of the 22 reported 4 to 8 hours of usage; and 2 of the 22 reported 1 to 4 hours of hearing aid usage.

Table 3.12 Comparison of number of hours of HA usage as reported by communication partners and through data logging

No. of hours/per day of HA usage as revealed by data logging	***No. of hours/per day of HA usage as reported by communication partners***			***Total no. of participants***
	1-4 hours	*4-8 hours*	*>8 hours*	
1-4 hours	10	0	0	10
4-8 hours	0	19	1	20
>8 hours	2	9	11	22

To find out the association between hearing aid usage reported by communication partners and that obtained through data logging, the Kappa test was administered. The Kappa coefficient was 0.64 and it was statistically significant (p = 0.00). This implies that there was substantial agreement that was significant, between the duration of hearing aid usage as reported by the communication partners and that obtained through data logging.

3.2.2.3 Comparison of duration of hearing aid usage as reported by hearing aid users and their communication partners.

Out of 52 communication partners (Table 3.13), none reported that the hearing aid users used the device for 1-4 hours per day. Out of 52 participants, 14 hearing aid users reported that the duration of hearing aid usage is 4 to 8 hours per day. On the other hand, the communication partners reported that only 5 used it for 4 to 8 hours, 8 used it for 1 to 4 hours, and 1 used it for more than 8 hours. Similarly, 38 hearing aid users reported of more than 8 hours per day of hearing aid use. However, the communication partners reported that only 11 users used their hearing aids for more than 8 hours. It was reported by the communication partners that 4 participants used it for 1 to 4 hours and the rest (i.e., 23) used it for 4 to 8 hours only. From this it can be noted that, 35 communication partners under estimated the duration of hearing aid usage and one communication partner overestimated the duration of hearing aid use.

Table 3.13. Comparison of number of hours of HA usage as reported by HA users and their communication partners

No. of hours/day of HA usage as reported by hearing aid users	*No. of hours/day of HA usage as reported by communication partners*			*Total No. of participants*
	1-4 hours	*4-8 hours*	*> 8 hours*	
1-4 hours	0	0	0	0
4-8 hours	8	5	1	14
> 8 hours	4	23	11	38

To find out the association between the duration of hearing aid usage as reported by hearing aid users and communication partners, Kappa test was administered. The Kappa coefficient (0.48) did not reveal a significant agreement (p = 0.90). This implies that there was no agreement between the reports on duration of hearing aid usage as reported by hearing aid users and their communication partners.

3.3 Factors affecting hearing aid usage:

Chi-square test was performed to know if there was any association between usage of hearing aid and other demographic and audiological factors. The demographic factors included in the study were age, gender, education, socioeconomic status, and location of residence. The audiological factors considered were degree of hearing loss, type of hearing loss, speech identification score, and duration of hearing loss. It was found that there was no association between hearing aid usage and age [X^2 (2, n = 52) = 1.68, p =0.431], gender [X^2 (2, n = 52) = 1.026, p =0.59], education [X^2 (6, n = 52) = 2.173, p =2.17], socioeconomic status [X^2 (4, n = 52) = 0.93, p =0.91], and location of residence (i.e., rural or urban) [X^2 (2, n = 52) = 0.38, p =0.83]. Further, there was no association between hearing aid usage and degree of hearing loss [X^2 (4, n = 52) = 4.48, p =0.34], type of hearing loss [X^2 (2, n = 52) = 0.66, p =0.71], speech identification score [X^2 (22, n = 52) = 17.67, p =0.72], and duration of hearing loss [X^2 (30, n = 52) = 29.95, p =0.46].

3.4. Comparison of hearing aid usage with hearing aid outcome:

The actual hearing aid use found through data logging was compared with score obtained on international outcome inventory for hearing aids (IOI-HA) as follows:

3.4.1. Hearing aid usage and Question 1 of IOI -HA (Duration of HA usage)

3.4.2. Hearing aid usage and Question 2 of IOI-HA (Benefit)

3.4.3. Hearing aid usage and Question 3 of IOI-HA (Residual activity limitation)

3.4.4. Hearing aid usage and Question 4 of IOI-HA (Satisfaction)

3.4.5. Hearing aid usage and Question 5 of IOI-HA (Residual participation restriction)

3.4.6. Hearing aid usage and Question 6 of IOI-HA (impact on others)

3.4.7. Hearing aid usage and Question 7 of IOI-HA (Quality of life).

The detailed definition of the terms used to describe the outcomes in different domains of IOI-HA as provided by Cox (2003) was used.

3.4.1. Hearing aid usage and Question 1 of IOI-HA (Duration of HA usage)**:** Response to this question was similar to the response of the question number 1 of Q-HAU. This has already been discussed earlier under section 3.1.1.

3.4.2. Hearing aid usage and Question 2 of IOI-HA (Benefit)**:** The median (quartile deviation) values of answer for Question 2 of IOI-HA targeting benefit (maximum possible score being 4) with hearing aid of the participants in those with low- (1-4 hours), mid- (4-8 hours) and high- (>8 hours) hearing aid usage were 3 (0), 4 (0.5), and 4 (0) respectively. From this, it can be noted that as the duration of hearing aid usage increased, the benefit from the hearing aid also increased. To know if the difference in outcome was significantly different between the three groups, Kruskal Wallis test was performed. This showed a significant difference (χ^2 = 8.64; p=0.01) in the outcome between the low-, mid-, and high-hearing aid users. Pair-wise comparison using Mann Whitney-U test revealed a significant difference between low- and mid- usage groups (Z= 2.29, U=54, p=0.02); and low- and high-usage groups (Z= 2.70, U=48, p = 0.00) only. There was no significant difference (Z=1.14, U=179, p=0.25) between mid- and high- hearing aid usage groups.

3.4.3. Hearing aid usage and Question 3 of IOI-HA (Residual activity limitation)**:** The median (quartile deviation) values of Question 3 of IOI-HA targeting residual activity limitation (maximum possible score being 4) with hearing aid of the participants in those with low- (1-4 hours), mid- (4-8 hours), and high- (>8 hours) hearing aid usage were 3 (0.5), 3 (0.75) and 3 (0.5) respectively. From this, it can be noted that with the increased duration of hearing aid usage, the difficulties which they were facing were reduced significantly. To know if the difference in outcome was significantly different between the three groups, Kruskal Wallis test was performed. This showed a significant difference (χ^2=8.73; p=0.01) between the outcome among the low-, mid-, and high- hearing aid users. Pair-wise comparison using Mann Whitney-U test revealed a significant difference between low- and high- usage groups (Z= 2.74, U=46.50, p = 0.00) only. There was no significant difference between low- and mid- usage groups (Z=1.81, U=62.00, p=0.07); and between mid- and high- hearing aid usage groups (Z = 1.61, U=161, p=0.10).

3.4.4. Hearing aid usage and Question 4 of IOI-HA (Satisfaction)**:** The median (quartile deviation) values of Question 4 of IOI-HA targeting satisfaction (maximum possible

score being 4) with hearing aid of the participants in those with low- (1-4 hours), mid- (4-8 hours), and high- (>8 hours) hearing aid usage were 3 (0.25), 2 (0.5), and 3 (1.12) respectively. From this, it can be noted that as the duration of hearing aid usage increased, the satisfaction from the hearing aid also increased. To know if the difference in outcome was significantly different between the three groups, Kruskal Wallis test was performed. This showed a significant difference (χ^2 = 13.39; p=0.00) between the outcome among the low-, mid-, and high- hearing aid users. Further, pair-wise comparison using Mann Whitney-U test revealed a significant difference between low- and high- usage groups (Z= 3.89, Z=21.00, p = 0.00) only. There was significant difference between low- and mid- usage groups (Z=2.20, U=53.50, p<0.05); and between mid- and high- hearing aid usage groups (Z= 1.38, U=168.5, p<0.05).

3.4.5. Hearing aid usage and Question 5 of IOI-HA (Residual participation restriction)**:** The median (quartile deviation) values of Question 5 of IOI-HA targeting residual participation restriction (maximum possible score being 4) with hearing aid of the participants in those with low- (1-4 hours), mid- (4-8 hours), and high- (>8 hours) hearing aid usage were 2 (0.96), 1 (0.13) and 2 (0.16) respectively. From this, it can be noted that as the duration of hearing aid usage increased the participation restriction reduced. To know if the difference in outcome was significantly different between the three groups, Kruskal Wallis test was performed. This showed that there was significant difference (χ^2 = 3.11; p<0.01) between the outcome among the low-, mid- and high- hearing aid users.

3.4.6. Hearing aid usage and Question 6 of IOI-HA (impact on others)**:** The median (quartile deviation) values of Question 6 of IOI-HA targeting impact on others (maximum possible score being 4) with hearing aid of the participants in those with low- (1-4 hours), mid- (4-8 hours), and high- (>8 hours) hearing aid usage were 3 (07.5), 3 (1.25) and 4 (1.5) respectively. From this, it can be noted that as the duration of hearing aid usage increased, the users were less bothered by the hearing difficulties. To know if the difference in outcome was significantly different between the three groups, Kruskal Wallis test was performed. This showed a significant difference (χ^2 = 9.80; p=0.00) between the outcome among the low-, mid-, and high- hearing aid users. Pair-wise comparison using Mann Whitney-U test revealed that there was no significant difference between low- and mid- usage groups (Z= 1.71, U=75.00, p=0.24). There was a significant difference between mid- and high- hearing aid (Z=2.50, U=126.00, p=0.01), and low- and high- usage groups (Z= 2.61, U=50, p = 0.00).

3.4.7. Hearing aid usage and Question 7 of IOI-HA (Quality of life)**:** The median (quartile deviation) values of Question 7 of IOI-HA targeting quality of life (maximum possible score being 4) with hearing aid of the participants in those with low- (1-4 hours), mid- (4-8 hours), and high- (>8 hours) hearing aid usage were 2 (0), 2 (0.5) and 2 (0) respectively. From this, it can be noted that as the duration of hearing aid usage increased, the quality of life also improved, as they started enjoying their life in a much better way, compared to before starting to use hearing aids. To know if the difference in outcome was significantly different between the three groups, Kruskal Wallis test was performed. This showed a significant difference (χ^2 = 11.25; p=0.01) between the outcome among the low-, mid-, and high- hearing aid users. Pair-wise comparison using Mann Whitney-U test revealed a significant difference between low- and mid- usage groups (Z= 3.10, U=35.50, p=0.02); and low- and high- usage groups (Z= 2.68, U=51.0, p = 0.00) only. There was no significant difference between mid- and high- hearing aid usage groups (Z= 0.80, U=194.00, p=0.25).

Table 3.14 provides a summary of the results of comparison between the hearing aid usage and the hearing aid outcome. Table 3.15 is a summary of results of comparison of low-, mid-, and high- hearing aid usage groups and different parameters of hearing aid outcome. Tables 3.14 and 3.15 reveal that most of the hearing aid users do not use their hearing aid optimally as it was found that many participants used their hearing aid for less than 8 hours a day. Another interesting fact noted was that the hearing aid users tend to overestimate and the communication partners tend to under estimate the duration of hearing aid usage. Thus, there is always a need for objective verification measures i.e., data logging to cross-verify the subjective information used in current study.

Table 3.14. Summary of comparison of hearing aid usage with different parameters of hearing aid outcome.

IOI-HA	*Category of hearing aid usage*	*Median*	*Quartile Deviation*
Q2 **(**Benefit)	1- 4 hours	3	0
	4-8 hours	4	0.5
	> 8 hours	4	0
Q3 (Residual activity limitation)	1- 4 hours	3	0.5
	4-8 hours	3	0.75
	> 8 hours	3	0.5
Q4 (Satisfaction)	1- 4 hours	3	0.25
	4-8 hours	2	0.5

	> 8 hours	3	1.12
Q5 (Residual participation restriction)	1- 4 hours	2	0.5
	4-8 hours	1	0.37
	> 8 hours	2	0.5
Q6 (Impact on others)	1- 4 hours	3	0.75
	4-8 hours	3	1.25
	> 8 hours	4	1.5
Q7 (Quality of life)	1- 4 hours	2	0
	4-8 hours	2	0
	> 8 hours	2	0
Overall Score	1- 4 hours	23.5	3.12
	4-8 hours	26	2
	> 8 hours	27	3

Table 3.15 Summary of the results of comparison of low-, mid-, and high- hearing aid usage groups and different parameters of outcome.

Question of IOI-HA	***Groups***	***Kruskal Wallis p-value***	***Mann Whitney-U test p value***
Q2 **(**Benefit)	1-4 hours vs.4-8hours	0.01**	0.02*
	4-8 hours vs.>8 hours		0.25
	1- 4 hours vs.>8 hours		0.00**
Q3 (Residual activity limitation)	1-4 hours vs.4-8hours	0.01**	0.07*
	4-8 hours vs.> 8hours		0.107
	1-4 hours vs.> 8hours		0.00**
Q4 (Satisfaction)	1-4 hours vs.4-8hours	0.00**	0.02*
	4-8 hours vs.> 8hours		0.167
	1-4 hours vs.> 8hours		0.00*
Q5 (Residual participation restriction)	1-4 hours vs.4-8hours	0.211	0.96
	4-8 hours vs.> 8hours		0.134
	1-4 hours vs.> 8hours		0.163
Q6 (Impact on others)	1-4 hours vs.4-8hours	0.00**	0.242
	4-8 hours vs.> 8hours		0.01**
	1-4 hours vs.> 8hours		0.00**
Q7	1-4 hours vs.4-8hours	0.00**	0.002*

(Quality of life)	4-8 hours vs.> 8hours		0.421
	1-4 hours vs.> 8hours		0.00**
Overall Score	1-4 hours vs.4-8hours	0.00**	0.00**
	4-8 hours vs.> 8hours		0.05
	1-4 hours vs.> 8hours		0.00**

Note: *=significant at 0.05, ** =significant at 0.01.

The pattern of hearing aid usage across the hearing aid users was not found to be affected by any of audiological or non-audiological factors. The hearing aid users were divided into low-, mid- and high- hearing aid usage groups. The positive outcome and the duration of hearing aid usage seemed to be related.

Semi-structured interview and focused group discussion

Another objective of the study was to find out the real world hearing aid usage and outcome. In order to study this, in Part B of the Stage II, information was collected through two modalities, viz., and face-to-face semi-structured interview (SSI) and focused group discussion (FGD) from hearing aid users and their communication partners. The REHA questionnaire, having ten open-ended questions, was used to find out specific answers and further questions were probed to find out more details regarding the experience about their hearing aid.

The data involved information collected through semi-structured interview from 22 hearing aid users and 13 communication partners using the questionnaire Real world Experience with Hearing Aid (REHA). There were ten questions in this questionnaire. Information collected on each of these ten questions was compiled and is provided in the following sections.

1. **Expectations from hearing aid and fulfillment of the expectations, and factors that influenced the purchase of hearing aid,**

Information on expectations from hearing aid and the factors that influenced the purchase of hearing aid was sought in a question having three parts, i.e., “When you purchased this hearing aid, what actually were you looking for? Who and what influenced you to purchase this particular type of hearing aid? Did this hearing aid fulfill your expectations?” It was found that there were multiple expectations from the participants. The details expectations from hearing aid are provided in Table 3.16 A.

Table 3.16. A. Expectations from hearing aids

Expectations from hearing aids							
S.No.	***Expectations***	***Hearing aid users***			***Communication partners***		
		No. of participants (n= 22)	*Did the hearing aid fulfill the expectations*		*No. of participants (n=13)*	*Did the hearing aid fulfill the expectations?*	
			Yes	*No*		*Yes*	*No*
Semi-structured interview							
1.	Shall provide good understanding of speech in quiet conditions	19	14	5	9	7	2
2.	Shall provide good understanding of speech in noisy conditions	11	9	2	5	4	1
3.	Shall provide good sound quality	21	18	3	11	10	1
4.	Shall not be visible	12	5	7	4	1	3
5.	Economically affordable	16	15	1	8	6	2
6.	Shall provide good wearing comfort	12	11	1	4	3	1
7.	Shall improve quality of life	3	2	1	1	1	0
8.	Shall help in hearing from distance	15	12	3	7	5	2
9.	Shall require less no. of repetitions	11	9	2	8	7	0
10	Shall be able to reduce volume of entertainment appliances (eg. TV)	14	9	5	9	7	2
11	Shall help to understand speech better on telephone.	16	10	6	7	4	3

Table 3.16 A. Expectations from hearing aids (contd..)

Focus Group Discussion

S.No.	*Expectations*	*Hearing aid users*			*Communication partners*		
		No. of participants (n= 21)	*Did the hearing aid fulfill the expectations*		*No. of participants (n=18)*	*Did the hearing aid fulfill the expectations?*	
			Yes	*No*		*Yes*	*No*
1.	Shall provide good understanding of speech in quiet conditions	12	9	3	7	5	2
2.	Shall provide good understanding of speech in noisy conditions	8	6	2	5	4	1
3.	Shall provide good sound quality	15	10	5	7	5	2
4.	Shall not be visible	8	6	2	4	2	2
5.	Economically affordable	14	12	2	8	6	2
6.	Shall provide good wearing comfort	10	9	1	4	3	1
7.	Shall help in hearing from distance	5	2	3	3	1	2
8.	Shall be able to reduce volume of entertainment appliances (eg. TV)	9	6	3	8	6	2
9.	Shall help to understand speech better on telephone.	14	10	4	6	3	3

It was found that the major concern for hearing aid users regarding their hearing aids were good sound quality, understanding speech in quiet, understanding speech on telephone, and cost. The communication partners were also concerned about good understanding of speech, and good sound quality. In addition to these, the communication partners were concerned about the demand for repetition, speaking loudly, increased volume of entertainment appliances viz. television, and better communication on phone. Further, it was found that 76% of the overall expectations of the hearing aid users and 75.34 % of the overall expectations of their communication partners were fulfilled.

1B. Factors influencing hearing aid purchase

Second part of the first question sought information about the factors that influenced purchase of hearing aids. This information is provided in the Table 3.16 B. In the present study, all the participants had purchased the hearing aids, i.e., self-funded. Most of the hearing aid users bought their hearing aid on recommendation by an Audiologist, who prescribed the hearing aid after a hearing aid trial. The second major concern was found to be the cost of the hearing aid, 17 (77.2%) out of 22 participants choose that type and model of hearing aid according to the affordability. Interestingly, it was found that only a few participants were concerned about the features such as size and style over the money.

Table 3.16 B. Factors influencing hearing aid purchase

Factors influencing hearing aid purchase		
Semi-structured interview		
Factors	*Hearing aid users (n=22)*	*Communication partners (n=13)*
Audiologist's recommendation	16	7
Size / style of hearing aid	5	4
Cost of hearing aid	17	10
Hearing aid features	4	2
Funded/self funded	8	2
ENT doctor's recommendation	7	4
Factors	*Hearing aid users (n=22)*	*Communication partners (n=13)*
Audiologist's recommendation	14	8
Size / style of hearing aid	3	2
Cost of hearing aid	13	9
Hearing aid features	4	2
Funded/self funded	3	1
ENT doctor's recommendation	6	4

2. Situations in which hearing problem was faced and the extent to which the hearing aid helped in those situations

Information on the situations in which problem in hearing was faced and the extent of help provided by the hearing aid was sought in question no. 3, i.e., "In what situations do you face difficulty with your hearing? (eg. conversation, telephone, music, TV, social meets, market). Did your hearing aid help you to overcome that?" Responses to this question were varied. Hence, the results were divided into sub-categories i.e., awareness of sounds, speech understanding in easy situations, speech understanding in difficult situations, and others.

2A. Awareness of sounds: Table 3.17A shows the problems experienced in awareness of sound without the hearing aid.

Table 3.17A. Awareness of sound

Awareness of sounds						
	Hearing aid users (n=22)			*Communication partners (n=13)*		
Problem in hearing	*No. of participants*	*Did your hearing aid help you to overcome that?*		*No. of participants*	*Did the hearing aid help him/her to overcome that?*	
		Yes	*No*		*Yes*	*No*
Semi-structured interview						
Warning/alerting sounds (too loud /inaudible)	5	4	1	1	1	0
Indoor sounds (shutting of doors/ pressure cooker whistle, telephone ring, door bell)	4	4	0	1	1	0
Focus Group Discussion						
	Hearing aid users (n=22)			*Communication partners (n=13)*		
Problem in hearing	*No. of participants*	*Did your hearing aid help you to overcome that?*		*No. of participants*	*Did the hearing aid help him/her to overcome that?*	
		Yes	*No*		*Yes*	*No*
Warning/alerting sounds (too loud /inaudible)	2	1	1	1	1	0
Indoor sounds (shutting of doors/ pressure cooker whistle, telephone ring, door bell)	3	3	0	1	1	0

It can be noted from Table 3.17A that the hearing aid users reported that without the hearing aid, the warning/alerting sounds viz. vehicle horn to be too loud or inaudible; and that the indoor sounds were inaudible. All of them reported to have benefitted from the hearing aid except one client who reported that the warning sound was too loud. Among communication partners, one reported of problem in hearing warning and indoor sounds; and this was solved with hearing aid use.

Tables 3.17B and 3.17C depict the problems faced by hearing aid users in understanding speech in easy- and difficult- to hear environments. This shows that 20 participants reported that they have problem in listening to soft sounds, followed by problem in group conversation, and in noisy environment. It was found that 67.67% reported that their hearing aid fulfilled their expectations. It was found that 45 % participants wanted some more help to listen to soft sounds. The communication partners reported problem in listening to soft sounds, group conversation, and speech in noise as the main problems with hearing loss. However, except in group conversation, at least 50% of participants reported that their hearing aid was helping them in those particular situations.

Table 3.17B. Speech understanding in easy to hear situations

Speech understanding in easy to hear situations						
Problem in listening	*Hearing aid users (n=22)*			*Communication partners (n=13)*		
	No. of participants	*Did your hearing aid help you to overcome the problem in hearing?*		*No. of participants*	*Did the hearing aid help him/her to overcome the problem in hearing?*	
		Yes	*No*		*Yes*	*No*
1. General conversation	16	13	3	4	3	1
2. Missing out word in a phrase	15	11	3	6	4	2
3. Difficulties in understanding without speech reading	12	9	3	6	3	3
4. Soft speech	20	11	9	8	4	4
5. Television	9	6	3	3	3	0

Table 3.17C. Speech understanding in difficult to hear situations

Speech understanding in difficult to hear situations						
Problem in listening	*Hearing aid users (n=22)*			*Communication partners (n=13)*		
	No. of participants	*Did your hearing aid help you to overcome the problem in hearing?*		*No. of participants*	*Did the hearing aid help him/her to overcome the problem in hearing?*	
		Yes	*No*		*Yes*	*No*
6. General conversation	16	13	3	4	3	1
7. Missing out word in a phrase	15	11	3	6	4	2
8. Difficulties in understanding without speech reading	12	9	3	6	3	3
9. Soft speech	20	11	9	8	4	4
10. Television	9	6	3	3	3	0

Focused Group Discussion

Problem in listening	*Hearing aid users (n=22)*			*Communication partners (n=13)*		
	No. of participants	*Did your hearing aid help you to overcome that?*		*No. of participants*	*Did the hearing aid help him/her to overcome that?*	
		Yes	No		Yes	No
1. Group conversation	13	10	3	6	3	3
2. Speech in noise	12	8	4	6	3	3
3. Soft sound	16	10	6	7	4	3
4. Speech through telephone	10	6	4	4	2	2

Difficulties to understand speech was the most frequently encountered complaint mentioned by hearing aid users. In addition, it was found that ten participants were still not satisfied with hearing aid in any particular situation. It was also reported that the hearing aid users tend to keep the volume of television very high without their hearing aid. It was found

that six participants were satisfied with the performance of their hearing aid. Further, it was found that most of the communication partners were satisfied with the performance provided by the hearing aid.

There were other difficulties which were mentioned by the participants that include problem in tolerating sounds like car horn, loud music etc. The other common difficulties were localization of the sound source, understanding stranger's speech, discrimination of male and female voices, and listening to music. Table 13.17D shows the number of participants who are reaping benefit with their hearing aid in these particular situations. Whereas communication partners reported directional difficulties as a major complaint and most of them reported that the hearing aid is helping the hearing aid users in that particular situation.

Table 3.17D. Other problems in hearing.

Other problems in hearing.						
Semi-structured interview						
	Hearing aid users (n=22)			*Communication partners (n=13)*		
Problem in hearing	*No. of participants*	*Did your hearing aid help you to overcome that?*		*No. of participants*	*Did your hearing aid help you to overcome that?*	
		Yes	*No*		*Yes*	*No*
1. Directional difficulties	3	3	1	5	4	1
2. Understanding stranger's voice	2	2	0	0	0	0
3. Male/Female voice discrimination	1	1	0	0	0	0
4. Music	1	0	1	0	0	0
5. Some sounds - too loud	5	3	2	2	2	0
Focused Group Discussion						
	Hearing aid users (n=22)			*Communication partners (n=13)*		
Problem in hearing	*No. of participants*	*Did your hearing aid help you to overcome that?*		*No. of participants*	*Did your hearing aid help you to overcome that?*	
		Yes	*No*		*Yes*	*No*
6. Directional difficulties	3	2	1	2	2	0
7. Some sounds - too loud	4	2	2	2	2	0

3. Situations in which the hearing aid is worn/not worn maximally

Information on when and where the hearing aid is used/not maximally used was collected and compiled (Table 3.18). Table 3.18 shows that the hearing aid users used their hearing aid mostly at home and at the working place. A large number of participants were found to be using their hearing aids during travelling and whole the day (i.e., waking hours). Whereas, 11 participants were found to be not using their hearing aids at family functions - either to hide their problem, feel ashamed, and disturbance in hearing aid output due to high noise levels. The responses of communication partners were in good agreement with that of hearing aid users on this aspect.

Table 3.18: Situations in which hearing aid is worn/not worn

Situations in which hearing aid is worn/not worn					
Semi-structured interview					
Situations	*Hearing aid users (n=22)*		*Communication partners (n=13)*		*Reasons for not using the hearing aid*
	Used their hearing aid maximally	*Do not use their hearing aid*	*Used the hearing aid maximally*	*Do not use the hearing aid*	
At home	15	6	6	4	- Can manage without the hearing aid - Avoid to wear - Most of the time, resting at home - Developed compensatory mechanisms
At office/work place	9	4	8	2	- Guilt, feel ashamed - Afraid of getting removed from the jobs - Too much disturbance
In friends/family function	5	11	2	9	- Guilt, feel ashamed - Too much disturbance

While travelling	13	5	1	3	- Fear of losing the hearing aid - Sudden increase in loudness due to vehicle sound - Feel ashamed
Environment as a barrier (agricul-tural fields, noisy environment, factory)	-	5	-	2	- Fear of getting wet/dirty - Too noisy environment
Most of the time in a day (except while sleeping, bathing and/or hearing aid sent for repair)	14	-	4	-	
College (class room) by student/teacher	6	1	2	0	- Shy to use it in front of other students
Conductive ear pathology	0	1	0	0	- Creates blocking sensation
Focused Group Discussion					
Situations	*Hearing aid users (n=22)*		*Communication partners (n=13)*		*Reasons for not using hearing aid*
	Used their hearing aid maximally	*Do not use their hearing aid*	*Used the hearing aid maximally*	*Do not use the hearing aid*	
At home	4	6	4	4	- Can manage without hearing aid - Avoid to wear - Most of the time resting at home - Developed compensatory mechanisms (i.e., visual cues).

At office/work place	6	4	6	2	- Guilt, feel ashamed - Afraid of getting removed from the jobs - Too much disturbance
In friends/family function	4	8	2	7	- Guilt, feel ashamed - Too much disturbance
While travelling	3	5	1	2	- Fear of losing - Sudden increase in loudness due to vehicle sound - Feel ashamed
Environment as a barrier (agricultural fields, noisy environment, factory)	-	3	-	4	- Fear of getting wet/dirty - Too noisy environment
Most of the time in a day (except while sleeping, bathing and/or hearing aid sent for repair)	10	-	3	-	-
College (class room) by student/teacher	5	1	2	0	- Shy to use it in front of other students
Conductive ear pathology	0	1	0	0	- Creates blocking sensation

4. Knowledge about use of hearing aid

Through question no. 4 i.e., “Do you think that you have limited knowledge about the manipulation of hearing aid; hence, you are not using the hearing aids? Please specify the areas in which you require information / help” information was collected Table 3.19. The information collected from communication partners was not included for compilation as they did not seem to know specific information on care and manipulation of hearing aids.

Table 3.19. Knowledge on the use of hearing aid

Knowledge on the use of hearing aid			
Semi-structured interview			
Particulars on use of hearing aid	*Yes*	*No*	*Areas in which the hearing aid users required information / help*
Limited knowledge about the manipulation	6	16	- Cleaning ear mould or dome of hearing aid - Changing wax guard - Manipulation of programs - Changing volume, especially in cases when program switch and volume control are common.
Does limited knowledge prevent you from using your hearing aid?	5	17	
Focus Group Discussion			
Limited knowledge about the manipulation	4	2	
Does limited knowledge prevent you from using your hearing aid?	2	3	

In response to this question, most of the hearing aid users stated that they have been counselled properly and thus there was nothing like 'limited knowledge' that was preventing them from using their hearing aids. Six participants (out of 22) reported that they had problem in hearing aid manipulation and out of them only five participants reported that it prevents them to use their hearing aid effectively. The reasons are listed in Table 3.19 and most commonly, blockage of ear mould frequently and wax guards issue were found to be the main reasons that prevented them from using their hearing aid.

5. Acclimatizaton to hearing aid use

Information on the duration it took to get used to hearing aid was obtained through question no. 5, i.e., **"**How many hours per day do you use your hearing aid currently? How many days did it take to use your hearing aid for that duration?" It was reported that the hearing aid users used their hearing aid from 4 to 11 (Mean=7.22, SD=1.68) hours per day. For the information on acclimatization, the users reported that they were instructed to use their hearing aid for that much time from very first day. But it took 3 to 5 months for them to

use hearing aids for this much duration (i.e., 4 to 11 hours). The communication partners reported that the hearing aid users used their hearing aid from 3 to 9 hours per day (Mean = 6.50, SD= 1.56). The acclimatization period as reported by the communication partners was from 0 to 12 months (Mean = 3.45, SD= 2.78).

6. Maintenance cost of the hearing aid

In order to seek knowledge on whether the cost incurred in maintaining the hearing aid, in terms of spares and repair, prevented them from using the hearing aid, in question no. 6, i.e., "Does the cost incurred for repair/servicing and repair facility of the hearing aid prevent you from using it regularly? Please specify" was used. Most of the participants reported that they did not give their hearing aid for any major repair, which prevented them from using their hearing aid. Three participants reported that they procured a new hearing aid due to frequent problem related to the hearing aid. These were those participants who got a new replacement of hearing aid within the two years of warranty period, as their hearing aids had gone for repair frequently.

On an average, they had given their hearing aid for repair that took 7 to 10 days in every 6 months. It was reported that there was a lag of 15 to 20 days in the process to buy a new hearing aid. The rest of the participants reported that they had issues with the herring aid once or twice, which was resolved by the institute / centre from where they procured the hearing aid, in a day or two. The responses given by the communication partners agreed well with that of hearing aid users.

7. Reaction in situations where the hearing aid fails to help them

In order to seek information on the reaction in situations where the hearing aid failed to help, the question 7 i.e., "Do you think that the hearing aid helps you to understand the speech of the people with whom you speak frequently? How do you feel if your hearing aid does not help you in those situations?" was utilized. Except for one user, all the other hearing aid users indicated that the hearing aid was helping them. Most of the hearing aid users reported that the hearing aid is helping them to understand speech of people whom they speak to frequently. Most of them reported that when their hearing aid does not help them, they feel sad, frustrated, and depressed. Two of the participants reported that at times they just remove the hearing aid. Such situations occurred for speech in noise, group situations, and family functions.

8. Effect of hearing aid on self confidence

The answer to question no. 8, i.e., “Does the use of hearing aid increase your self-confidence?” elicited information on the effect of hearing aid on self confidence. All the participants reported an increase in self-confidence after using it. All the communication partners also reported the same.

9. Cost-benefit effect

The answer to question no. 9, i.e., “Do you think your hearing aid is worth the trouble/cost? Do you feel the cost involved in maintenance of the hearing aid is more and that you are not using your hearing aid because of this?” revealed information on whether the money spent on hearing aid was worthwhile. The responses during semi structured interview to this question are depicted in Table 3.20. This shows that 17 (out of 22) hearing aid users were satisfied with the outcome of the hearing aid when compared with the hearing aid costs. Further, 21 users did not report that the cost of maintenance was more. None of the users or the communication partners reported that the cost of maintenance prevented the hearing aid use. Whereas, during focus group discussion, 16 hearing aid users (out of 21) reported that hearing aid users were satisfied with the outcome of the hearing aid when compared with the hearing aid costs. Further, none of the hearing aid users reported that the cost of maintenance was more. None of the users or the communication partners reported that the cost of maintenance prevented the hearing aid use.

Table 3.20. Cost and usage of hearing aid

Cost and usage of hearing aid						
Participants	***Worth the trouble or cost***		***Cost of the maintenance of hearing aid is more***		***Not using the hearing aid because of this***	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*
Semi-structured interview						
Hearing aid users (n=22)	17	5	1	21	0	22
Communication partners (n=13)	10	3	1	12	0	13
FGD						
Hearing aid users (n=21)	16	5	0	21	0	21
Communication partners (n=18)	17	1	0	18	0	18

10. Desired features in a new hearing aid

The question no. 10, i.e., “In case you want to go in for a new hearing aid, what features in a hearing aid are you looking for?” provided information on desired features in a hearing aid. The responses to this question are depicted in Table 3.21.

Table 3.21. Desirable features in a new hearing aid

Desirable features in a new hearing aid		
Semi-structured interview		
Features	*Hearing aid users* (n=22)	*Communication partners* (n=13)
Better speech understanding in quiet	15	9
Better speech understanding in noisy condition	6	3
Better speech understanding in group conversation	9	6
Small size	10	2
Mobile connectivity	3	0
Water proof	2	0
Chargeable batteries	1	0
More gain / Louder	13	8
Satisfied with current hearing aid feature	7	4
Focus Group Discussion		
Features	*Hearing aid users* (n=21)	*Communication partners* (n=18)
Better speech understanding	12	9
Speech in noisy condition	5	2
Better speech understanding in group conversation	4	3
Small size	1	0
Mobile connectivity	2	0
Water proof	1	0
Chargeable batteries	0	0
More gain / Louder	12	8
Satisfied with current hearing aid feature	8	4

Table 3.21 shows that 15 hearing aid users wanted better speech understanding as the main feature, followed by 13 users desiring louder and clearer output. Smaller size of the hearing aid was desired by 10 users, and 9 users wanted their hearing aids to give better speech understanding in group conversation.

Information on number of hours of hearing aid use and outcome from hearing aid was collected using objective and subjective means of eliciting the information. From these, direction as to which aspect our approach should focus on the hearing aid user in order for him/her to be satisfied can be reached.

Discussion

The questionnaire on hearing aid usage (Q-HAU) has been derived as a means to measure hearing aid usage. In the routine context, this questionnaire can be used to infer about hearing aid benefit and satisfaction. It can be useful during counselling, re-programming/ optimization, follow-up visit, and also to find out situations which can influence the hearing aid usage. Previous research has identified the importance of hearing aid use associated with dimensions such as hearing aid usage, satisfaction when assessing the effectiveness and cost effectiveness of interventions, hearing aid benefit, and residual disability (Gaffney, 2008). This tool aims to resolve the need to access multi-dimensional information associated with hearing aid usage to improve the satisfaction of the client.

The hearing aid user and/or their significant others can be utilized to estimate average daily hearing aid usage. In the current study, it has been found that a large number of the users do not use their hearing aids for optimal duration, i.e., 8 to 10 hours per day. The first few questions of the Q-HAU were directed to find out the average duration of hearing aid usage. Interestingly, it was found that none of the participants reported that they use their hearing aid for less than four hours. The duration of hearing aid usage is related to the hearing aid outcome.

There are many reports in literature which report about the use of hearing aid directly by a custom made questionnaire (Gaffney, 2008), standard questionnaires (Cox et al., 2000) or by objective means (Martin, Champlin, & Chambers, 1998;Wilson, 2004; Mendel, 2007). In these studies, the participants were asked to report on the average duration of hearing aid use, usually expressed in number of hours per day. There are reports in literature regarding the ways to find out the hearing aid usage. They include hearing aid usage diaries, which compute the average self-reported hearing aid use over a time period (Humes, 1999; Mäki-Torkko, Sorri, & Laukli, 2001). Often, the hearing aid usage is estimated with a single item on a questionnaire (Vestergaard Knudsen, Öberg, Nielsen, Naylor, & Kramer, 2010). There are many questionnaires that intend to collect information on this aspect, e.g., the first item of the International Outcome Inventory-Hearing Aids (Cox et al., 2000). The IOI-HA tries to seek information on the reported number of hours of hearing aid usage by its users. This information can be helpful to find out the outcome of the hearing aids (Gaffney, 2008). Cox et al. (2000) reported that hearing aid outcome is proportional to the duration of hearing aid usage. In some other questionnaires the hearing aid use is quantified for several listening situations, e.g., the Glasgow Hearing Aid Benefit Profile (Gatehouse, 1999) seeks information

on hearing aid usage for eight different listening situations, each having five response options, i.e., never/not at all, about 1/4 of the time, about 1/2 of the time, about 3/4 of the time, and all the time. The different listening situations included in the questionnaire are quiet, noise, group, and television where the hearing aid users use their hearing aid.

It has been found that the duration of hearing aid usage comes down in older population due to reduction in dexterity to manipulate hearing aid or applying alternative coping mechanisms e.g., turning the volume up on the television, moving closer to television, lesser benefit, high expectations (Bertoli et al., 2009; Gussekloo et al., 2003). In the current study, it was found that a majority of older adults (>50 years of age) did not change the volume control setting or did so very rarely in different listening environments.

Relying on the reports by hearing aid users regarding duration of hearing aid usage can mislead the audiologist regarding outcome of the hearing aid. It also has been found that those participants who do not have knowledge about their hearing aid usage being monitored of hearing aid by the audiologist overestimated the duration of hearing aid usage (Gaffney, 2008; Humes, Halling, & Coughlin, 1996;Taubman, Palmer, Durrant, & Pratt, 1999). Whereas, the users reported the duration of hearing aid usage that was found to be consistent with objective measure, when they were made aware of the fact that the duration of hearing aid usage could be monitored through data logging feature of the hearing aid (Taubman et al., 1999).

Information on automatic change of program settings, directionality, and gain of the hearing aid was sought through the questionnaire. Thirteen participants out of 52 reported change in hearing aid program settings in terms of the clarity of the sound. However, it was found that only 2 out of 13 participants had the facility of automatic change of program in their hearing aids. This implies that according to different listening environments, the listening needs and expectations of the user changed. For example, in a quiet situation, the user required higher volume. The user misinterprets this as change executed by the hearing aid setting. For example, in a crowdy situation they feel that the sound from the hearing aid decreased. But actually it is the environmental sound which might be masking the incoming sound. In addition, data logging tool in hearing aids help audiologist to find out the listening environment in which the participant spends their time maximally. The gain settings and the programs can be optimized accordingly.

Comparison of hearing aid usage through different means i.e., subjective report (by hearing aid users and by communication partners) and objective report (data logging).

In literature it has been found that most of the hearing aid users try to overestimate (Gaffney, 2008; Humes, Halling, & Coughlin1996) or under estimate (Walker et al., 2013) the duration of hearing aid usage. In the current study too, where an attempt was made to cross validate the hearing aid usage report by hearing aid users by both subjective (communication partners) and objective (data logging) measures, a similar observation was made. It is recommended to use both objective and subjective means for cross validation of hearing aid use, as a lot of variation in hearing aid usage across time has been reported, in both younger and older adults (Brooks, 1996; Mäki-Torkko et al., 2001). The results from the current study showed that none of the participants who used their hearing aid for 1 to 4 hours/day reported that they used it for <4 hours/day. It was also found that 53.84 % hearing aid users over estimated their hearing aid usage which is consistent with the previous reports where participants overestimated the duration of their hearing aid usage (Gaffney, 2008; Humes, Halling, & Coughlin 1996; Mäki-Torkko et al., 2001; Taubman et al., 1999)

Factors affecting hearing aid usage

One of the objectives of the present study was to find out the real world usage of the hearing aids. The previous section of the discussion showed that the hearing aid users are either not using their hearing aid optimally or they try to overestimate the duration of hearing aid usage. The following section of the discussion reflects the way in which factors related to hearing aid usage can affect the hearing aid outcome. It is necessary to find out the reasons for not using their hearing aid efficiently or optimally. Hence, this study intended to find out the association between hearing aid usage with different factors like age, gender, education, socioeconomic status, residence location, type of hearing loss, degree of hearing loss, speech identification score, and duration of hearing loss. From the present study, it has been found that there is no association between hearing aid usage and factors mentioned. The subsequent sections provide the details regarding this.

Age:

In the current study, no difference was noted in terms of hearing aid usage in young and older adults. Previous studies have also reported similar findings. Knudsen et al. (2010) reviewed 39 studies in which most of the investigators tried to find out the effect of age on

hearing aid usage, satisfaction, and hearing aid uptake. It was found that there was no effect of age on hearing aid usage. Likewise, Hickson, Hamilton, and Orange (1986) have reported no significant relationship between hearing aid use and age. This was supported by a range of studies (Bentler, Niebuhr, Getta, & Anderson, 1993; Norman, George, & McCarthy, 1994; Brooks & Hallam, 1998; Henrichsen, Noring, Christensen, Pedersen, & Parving, 1988; Hickson, Timm, Worrall, & Bishop, 1999; Chang, Tseng, Chao, Hsu, & Liu, 2008). However, a study by Mulrow, Tuley, and Aguilar (1992) revealed greater benefit from hearing aid in younger adults, which in turn made them to use their hearing aid more often.

Gender:

In the current study, it was found that there is no association between hearing aid usage and gender. Several studies have also examined the influence or tried to find out the association between hearing aid usage and gender. Most of them failed to find an association (Hickson et al., 1986; Gatehouse, 1994; Norman et al., 1994; Brooks & Hallam, 1998; Hickson et al., 1999; Lupsakko et al., 2005).

Education:

In the current study, it was found that there is no association between hearing aid use and education background. In the current study none of the participants were illiterate due to inclusion criteria of the study. Garstecki and Erler (1998) stated that educational status reflects the perception of the impact of progression of hearing loss with advancing age and the need to consider amplification. The understanding about his/her hearing problem also helps hearing aid users not to have high expectations from their hearing aid. This in turn leads to acceptance of hearing aid, uptake, and use of their hearing aid. However, in their study too, they did not find any relationship between hearing aid use and the education.

Socioeconomic status:

In the current study, it was found that there was no association between hearing aid usage and socioeconomic status. Garstecki and Erler (1998) found that those who have higher income can have more access to medical and audiological care that eases the finance burden. This leads to more acceptance and use of the hearing aid. But, Kochkin (1996) did a survey and found that there was no difference in hearing aid use between people from different socioeconomic backgrounds. The present study supports Kochkin’s findings.

Degree of hearing loss and type of hearing loss:

It has been found in this study that there was no association of degree and type of hearing loss with hearing aid use. Previous studies also support this finding. Brooks and Hallam (1998), and Jerram and Purdy (2001) did not find any relation between hearing aid usage and hearing sensitivity. These results were also supported by Hickson et al. (1986) and Hickson et al. (1999) who did not find any association of degree and type of hearing loss with duration of hearing aid use. On the other hand, Berger et al. (1982) reported that those with greater degree of hearing loss used the hearing aids for more duration per day than the subjects with lesser degree of hearing loss.

Speech identification scores:

In the present study, it was found that there is no effect of speech identification scores on hearing aid usage. Berger et al. (1982) reported results of a survey on hearing aid use involving 244 respondents. Five different usage categories (1-2 hours, 3-4 hours, 5-6 hours, 7-8 hours and 8+ hours) were reported in relation to categories of gender, age, pure-tone average, and speech discrimination scores. Hearing aid usage was not different based upon speech identification scores in quiet. In another study involving 257 respondents, Berger and Hagberg (1982) found no correlation between duration of hearing aid use and the factors such as age, pure-tone average or speech discrimination ability in quiet. Ovegard and Ramstrom (1992) carried out follow-up interview sessions to obtain information regarding naive hearing aid users, approximately one year after their fittings. These researchers also did not report of any relationship between speech recognition and hearing aid usage.

Hearing aid usage versus outcome

From the current study, it has been noted that the hearing aid outcome is associated with hearing aid usage. Among seven parameters, all the users showed a significant improvement in their hearing aid outcome in association with increase in hearing aid usage, except residual participation restriction. Previous reports also support these findings (Bertoli et al., 2009). Bertoli et al. conducted a survey to collect information on hearing aid usage and satisfaction in Swiss population. They found that 84.6% of the population used their hearing aid regularly, 12.3% occasionally, and 3.1% never used it. The usage was associated with policies to provide hearing aid (self-funded, partially self-funded or fully funded schemes), type of fitting (binaural/monaural), type of hearing aids (digital/analogue), age, audiometric data, experience with hearing aid. They concluded that regular hearing aid use led to greater satisfaction among the participants.

Brannstrom and Wennerstrom (2010) investigated the clinical application of Swedish translation of IOI-HA. The mean hours of hearing aid usage was 3.9 hours per day (SD being 1.1 hours/day, and range being 1to 4 hours/day). They found that the hearing aid use was associated with audiometric data, benefit, quality of life, and satisfaction ($p<0.05$). Dillon et al. (1999), during establishing normative data for the COSI and HAU questionnaires, found that 34% of the population used their hearing aid for more than 8 hours/day, 27% used for 4 to 8 hours/day, 28% used for 1 to 4 hours/day, 7% used for less than 1 hour/day, 2% used for less than 1 hour/ week; and 1% never used their hearing aids at all. In their study, usage was found to be associated with comfort, presence of feedback, quality of the user's own voice ($r=0.42$), benefit ($r=0.43$), and satisfaction ($r=0.48$).

Keidser et al. (2008) in the effort to investigate the long-term benefit of digital hearing aid, found a daily usage of between 1 to 4 and >8 hours by most of the participants. It was also found that the hearing aid usage was associated with satisfaction. Meister et al. (2005) investigated the factors underlying successful hearing aid fittings/outcomes. They reported that an average score of about 8 on a 11-point scale (never-to-always) on hearing aid usage. The usage was found to be associated with hearing aid performance, acceptance of hearing loss, attitude towards rehabilitation, expectations, benefit, handicap, and satisfaction ($p<0.05$). Olusanya (2004) evaluated self-reported outcomes among hearing aid users using IOI-HA. It was found that 51%, 21%, 16% and 7% used their hearing aid for >8 hours/day, 4 to 8 hours/day, 1 to 4 hours/day, and <1 hour per week respectively; whereas, 5% of the participants never used their hearing aid. The usage of hearing aid was associated with the impact of hearing loss on daily activities, benefit, and quality of life.

Purdy and Jerram (2001) evaluated a shortened version of the Profile of Hearing Aid Performance (PHAP) and (APHAB) and found hearing aid use of 10.9 hours/day. In the same study, it was reported that the usage was associated with degree of hearing loss ($p=0.001$), satisfaction ($p=0.001$) and hearing aid performance ($p<0.006$). Uriarte et al. (2005) investigated hearing aid satisfaction using SADL and Client Satisfaction Survey (CSS) adapted from the Hearing Aid Users Questionnaire (HAUQ) outcome measures. The report of in the ear hearing aid showed that 30% of the participants used their hearing aid for >8 hours/ day, 26% used for 5 to 8 hours/ day, 35% used for 1 to 4 hours/ day, 5% used for <1 hour/ day, 2% used for <1 hours/ week, and 3% never used their hearing aid. It was found that the usage was associated with satisfaction ($p<0.001$). Walden and Walden (2004) investigated the relationship between various demographic data, audiometric measures, and hearing aid outcome using IOI-HA. The average hearing aid use was found to be 8.6 hours/day (SD being

4.2). Further, the usage was associated with degree of hearing loss ($p<0.01$), benefit ($p<0.01$), and satisfaction ($p<0.01$).

Yet another objective of present study was to find the real world usage and outcome of the hearing aid. For that, a series of interviews were carried out on 22 hearing aid users and 13 communication partners using a questionnaire with 10 questions developed as a part of this study. This was titled Real world Experience with Hearing Aid (REHA). The questionnaire taps different areas to find out the outcome from the hearing aid like acclimatization, handling, maintenance cost, repair, satisfaction, quality of life and benefit. From the results, it can be seen that the participants have given multiple responses in each categories. From the responses of one of questions of REHA, it was evident that most of the participants wanted their hearing aid to provide a good sound quality and help them to understand speech in different listening environments. Barcham and Stephens (1980) tried to find out the hearing aid related issues through open-ended questions and hearing aid related issues in the hearing aid users. They also found general conversation, group conversation, radio/TV, speech in noise, and telephone communication as maximally difficult situations faced by individuals with hearing impairment. It was evident that individuals with hearing impairment were mostly influenced by the recommendations made by the audiologist and cost of hearing aid for purchasing/uptake of their hearing aids. All the users, except one, had hearing aid that was tested and prescribed by the audiologist at All India Institute of Speech & Hearing, Mysore.

It was found that a large number of users were satisfied with the prescribed hearing aid. If we look into the responses for a question in REHA, 15 hearing aid users wanted better speech understanding as the main feature followed by 13 users desiring louder and clearer output. Ten users wanted the hearing aid to be smaller and 9 wanted their hearing aids to give better speech understanding in group conversation. A systematic pre-fitting policy, which gives more focus on the listening needs of the individual, pre-counselling on realistic expectations, and features of the hearing aid, before giving a hearing aid trial helps the individuals with hearing impairment to choose and accept a better hearing aid for a successful outcome. During programming, it is important to seek the information on listening needs and program for different programs (P1, P2…) to enable automatic program change. Further, during follow-up visits, specific questionnaires could be utilized and optimizing or fine tuning the hearing aid settings needs to be practiced. If this is protocol is strictly followed, the problem experienced with hearing aid for audibility of soft sounds or warning/alerting sounds would minimize.

While analyzing the results of the previous studies, Barcham and Stephens (1980) have also divided the hearing related issues with their hearing aids giving different weightage to it. In addition, it was found that most of the issues with their hearing aids were related to understanding speech in group and in noisy conditions, understanding soft sounds, and directional hearing. They have been described these as major issues with weightage of 2.9 (Barcham & Stephens, 1980) suing a custom derives computation.

The response to a question in REHA shows that the hearing aid users used their hearing aid mostly at home and at their working place. A large number of participants were using their hearing aid during travelling and participants were not using their hearing aid at family functions either due to shyness/guilt or due to high disturbance. The responses of communication partners were well in agreement with that of hearing aid users. Previously, many researchers have cited embarrassment, too much disturbance, job related issues, and unnatural increase in loudness as the reasons of not using the hearing aids (Barcham & Stephens, 1980; Tomita, Mann, & Welch, 2001). In response to a question in REHA, six hearing aid users responded that they have problem in manipulation of hearing aids and major issues were in cleaning the ear mould or changing the wax guard (for receiver in the canal hearing aid), manipulation of programs or volume - especially when both the functions have a common switch. It was also found that the hearing aid users used their hearing aid from 4 to 11 (Mean=7.22, SD=1.68) hours per day. During counselling, stressing on the procedure to be used for cleaning the ear mould and changing the wax guard (in RIC hearing aids) is thus important.

For the response on acclimatization, some users reported that they started using their hearing aids for current number of hours of use from the very first day after purchase and commonly it was reported to be 3 to 5 months (Mean = 3.6, SD= 3.03). Previous studies to find out hearing aid use by Brännström and Wennerström (2010) found a hearing aid usage of 1 to 4 hours (Mean = 3.7 hours). Whereas, Collins et al. (2007) found it to be 10.2 hours per day. Santos, Petry, and Costa (2010) found that the hearing aid users get usually acclimatized to their hearing aid within 1 to 3 months. During counselling, information on how to slowly get used to the increased durations of hearing aid used needs to be emphasized.

The maintenance cost and repair cost can play a role in preventing hearing aid users to use their hearing aid, especially in older adults who have poor motor skills. It is very difficult for them to adjust without their hearing aid (Sorri, Luotonen, & Laitakari, 1984). Individuals having more problem in managing and manipulating the hearing aids were not much satisfied,

perceived less benefit, and reported lesser use of their hearing aids when compared with individuals who had less problem in manipulating their hearing aids (Humes, Ahlstrom, Bratt, & Peek, 2009).

In the current study, most of the participants reported that their hearing aid has not undergone any repair. Only a few participants had to procure a new hearing aid because of the recurrent problems with their hearing aids. Most of the hearing aid users reported that the hearing aid is helping them to understand speech of people whom they speak to frequently. Most of them reported that when their hearing aid does not help them, they feel sad, frustrated, and depressed. As a result of which a person with hearing impairment tries to avoid social activities, spend less time with family and significant others, have personal and social problems, and feel isolated (Stephens, 1977). All the participants included in the study reported that their self-confidence had increased after hearing aid fitting.

The present study showed that 77.27% of hearing aid users were satisfied with the outcome of the hearing aid when compared with the hearing aid costs. Further, 95.4% users did not report that the cost of maintenance was high. This shows that even though the amount to maintain the hearing aid is high, the benefit they are getting from it is much more than the cost for the maintenance. When it was asked from hearing aid users about the desirable features from a new hearing aid (in case they had to buy one more), they desired for better speech understanding in quiet, speech understanding in noisy condition, better speech understanding in group conversation, small size, mobile connectivity, water proof, chargeable batteries, and more gain / louder. It was found that so many of these features were included in the expectations towards their current hearing aid but may be shortage of money to buy a hearing aid with more advanced features would have prevented them from buying hearing aids with such features.

14. Conclusions summarizing the achievements and indications of scope for future work

Summary and Conclusions

The primary clinical management of individuals with permanent hearing loss is fitting hearing aids. Unfortunately, not all the individuals fitted with hearing aids use them optimally. Despite several attempts to improve hearing aid usage, the usage is still low and the non-use of hearing aids among elderly is still a crucial issue. The outcome measurement allows audiologists to establish and follow 'best practices'; market the practice using evidence; validate the clinical decisions taken; demonstrate treatment success to patients/their family members; demonstrate service effectiveness to accrediting agencies; and provide documentation to external agencies like funding resources/insurers. In the field of hearing rehabilitation using hearing aids, outcomes can be measured in multiple ways including use of clinic/lab based tests e.g. speech perception tests, or methods such as use of standardized self-report questionnaires or personal interviews or focus group discussions.

The aim of the present study was to find out real world hearing aid usage and outcome. The study included development of the two questionnaires i.e., questionnaire for hearing aid usage (Q-HAU) and questionnaire on real world experience with hearing aid (REHA). Further objective was to administer these two in addition with international outcome inventory of hearing aid (IOI-HA) on hearing aid users and their communication partners. In addition, in order to cross verify the report by the users on hearing aid usage and other information, other measures such as data logging and the report by communication partners were utilized.

The Q-HAU and IOI-HA were administered on hearing aid users. The Q-HAU was administered on hearing aid users and their communication partners. Information on duration of hearing aid usage from users, communication partners and data logging was collected. Whereas, REHA was administered on both hearing aid users and communication partners, in two modalities, i.e., face-to-face semi-structured interview (SSI) and focused group discussion (FGD).

The analysis of the results paved way for many interesting findings. Many hearing aid users were found to be not using their hearing aid optimally and they overestimated the duration of their hearing aid usage. The communication partners tended to give more reliable information on hearing aid usage, when compared to users themselves and this information was closer to that provided by data logging.

Some questions targeted the usage of hearing aids in different listening situations, e.g., hearing aid usage in quiet and in noisy situations. The questions also sought information on the situations where hearing aid users do not use their hearing aid. These can directly give information to an audiologist regarding the needs of the hearing aid users in terms of hearing aid fitting, programming, and counselling.

Due to low benefit, high expectations, reduction in dexterity to manipulate hearing aid or gaining of alternative mechanisms to cope (e.g., turning up the volume of the television), it has been noted that hearing aid usage comes down in older adults. In the current study, it was found that a large population of older adults (>50 years) did not change volume control or it was found to be done rarely.

The overall outcome can give an idea to audiologists regarding the situations in which the hearing aid users required help and if there are some physical barriers (such as dexterity & poor vision), especially in older adults. It was also noted that the hearing aid users were unaware that an audiologist could monitor their hearing aid usage through data logging. If participants are counselled regarding this aspect, they might give correct answer to the question on duration of hearing aid usage per day. Some hearing aid users reported that there is an automatic change in settings of the hearing aid. Actually, it was found from data logging that there was no instance like that. On the other hand, it can be implied that the hearing aid users had different listening needs and thus used different hearing aid settings in different listening environments as was warranted.

When the hearing aid usage was compared with the hearing aid outcome, it was found to be directly proportional to the usage under all the parameters of IOI-HA, except disability. For example, if a hearing aid user used his/her hearing aid for eight hours per day, there was a significant increase in the hearing aid outcome. After eight hours of hearing aid use, hearing aid outcome improved, but not much.

The results of REHA in both settings show more than 50 different responses towards 10 open ended questions. The hearing aid users gave multiple and overlapping responses towards the different questions like the expectations from the hearing aid. Most of the hearing aid users wanted their hearing aid to give more clear sound quality, better speech understanding in both quiet and noisy environment, economically affordable, and smaller in size. It was found that 76% of the expectations of the users were full filled.

The hearing aid purchased was mainly influenced by the cost of the hearing aid and the recommendation made by an audiologist. This implies better pre-fitting policies, which give more focus on the listening need of the individual, realistic expectations, and features of the hearing aid, before giving a hearing aid trial. This can help individuals with hearing impairment to choose a better hearing aid that is cost effective and beneficial.

The hearing problem reported by hearing aid users were mainly while listening to soft sounds, comprehension in noisy environment and in group situations, directional hearing, and awareness of alarming/alerting sounds. Most of the hearing aid users were satisfied with their hearing aid, except that their hearing aid was not effective for audibility of soft sounds, hearing in noisy environment, hearing in group situation, and telephone. It was also found that hearing aid user used the hearing aid mostly at home and at their working place. This highlights the importance of probing the listening needs and programming the hearing aid accordingly. A large number of users were found to be using their hearing aid during travelling also. The users were found to be not using their hearing aid at family functions either due to shyness or due to high disturbance due to the noisy environment.

The responses of communication partners were well in agreement with hearing aid users. A small number of hearing aid users responded that they have problem in manipulation of hearing aids and major issues were in cleaning the ear mould or changing the wax guard (in case of RIC hearing aid), manipulation of programs or volume, especially when both the functions are done by a common switch. These findings emphasize strengthening of the counselling at the time of hearing aid issue and also follow up to monitor and improve the hearing aid usage. The users had good dexterity and appropriate hearing aid handling skills when checked informally. All the participants included in the study reported that their self-confidence had increased after they started using the hearing aid. They also reported that they were very satisfied to talk to their friends, family members, and close ones.

In the current study, most of the participants reported that their hearing aids had not undergone any repair. Only a few participants had to procure a new hearing aid because of the recurrent problems with their hearing aid. In such cases, the repair time and follow up did not stop them using their hearing aids. Even though most of the hearing aid users were satisfied with their hearing aid, they expressed that they desired better speech understanding, smaller size, and louder sound. Thus, Q-HAU and REHA are powerful tools to collect information on real world hearing aid usage and outcome. Strengthening the counselling at

the time of hearing aid issue and follow up of the hearing aid users to motivate them to use the hearing aid might pay.

In future, studying different target groups and people with different listening needs would throw more light on the usage and outcome in different groups of individuals. This is warranted since the listening needs of different target groups are different. Younger age group may need the hearing aid more for their communication needs and hence might use it for longer durations.

Appendix A

Questionnaire on Hearing Aid Usage (Q-HAU) (in English)

Questionnaire on hearing aid usage		
Particulars	***Subjective report***	***Data logging information***
1.How many hours in a day do you wear your hearing aid/s? Working day: a. less than 1 hour b.1 to 4 hours c.4 to 8 hours d. more than 8 hours Holidays: a. less than 1 hour b.1 to 4 hours c.4 to 8 hours d. more than 8 hours		
2.What percentage of time do you think you were wearing hearing aid/s in a fairly quiet environment? a. less than 1 hour b.1 to 4 hours c.4 to 8 hours d. more than 8 hours		
3.What percentage of time do you think you were wearing them in a noisy environment? a. less than 1 hour b.1 to 4 hours c.4 to 8 hours d. more than 8 hours Did you change program switch to P2 in these situations? Yes/No		
4. Do you change volume control of your hearing aid? 1. Name those situations. 2. in those situation how many times do you change the volume Sometimes always never don't know 3. In different situation do you decrease or increase the volume ? Describe		
5.If you have two hearing aids, are you wearing a. Both of them all the time, b. Monaurally all the time c. others		
6.The hearing aid settings / programs change based on your listening environment. Can you make out that the hearing aid has changed its settings and do you feel that it switches appropriately? Sometimes always never don't know		
7.Are you aware that your hearing aid usage can be monitored? Yes/No		
8.Do you face any particular time / situation in which you need to switch off the hearing aid, except while sleeping and bathing? Yes/No, If yes, please specify		

Questionnaire on Hearing Aid Usage (Q-HAU) (in Kannada)

<table>
<tr><td></td><td>Questionnaire on hearing aid usage
ಶ್ರವಣ ಯಂತ್ರದ ಬಳಕೆ - ಪ್ರಶ್ನಾವಳಿ</td><td></td><td></td></tr>
<tr><td>S.No.</td><td>Particulars</td><td>Subjective report</td><td>Data logging information</td></tr>
<tr><td>1.</td><td>ಒಂದು ದಿನದಲ್ಲಿ ಸುಮಾರು ಎಷ್ಟು ಗಂಟೆಗಳ ಕಾಲ ನೀವು ಶ್ರವಣಯಂತ್ರವನ್ನು ಉಪಯೋಗಿಸುತ್ತೀರಾ ?
<table>
<tr><td colspan="3">a. ಕೆಲಸದ ದಿನ</td><td></td></tr>
<tr><td>1 ಗಂಟೆಗಿಂತ ಕಡಿಮೆ</td><td>1 ರಿಂದ 4 ಗಂಟೆಗಳು</td><td>4 ರಿಂದ 8 ಗಂಟೆಗಳು</td><td>8 ಗಂಟೆಗಳಿಗಿಂತ ಅಧಿಕ</td></tr>
<tr><td colspan="3">b. ರಜೆ/ರಜದ ದಿನ</td><td></td></tr>
<tr><td>1 ಗಂಟೆಗಿಂತ ಕಡಿಮೆ</td><td>1 ರಿಂದ 4 ಗಂಟೆಗಳು</td><td>4 ರಿಂದ 8 ಗಂಟೆಗಳು</td><td>8 ಗಂಟೆಗಳಿಗಿಂತ ಅಧಿಕ</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>2.</td><td>ನಿಶ್ಯಬ್ಧ ವಾತಾವರಣದಲ್ಲಿ ಸುಮಾರು ಎಷ್ಟು ಸಮಯ ನೀವು ಶ್ರವಣಯಂತ್ರವನ್ನು ಧರಿಸುತ್ತೀರಾ?
a. 1 ಗಂಟೆಗಿಂತ ಕಡಿಮೆ b. 1 ರಿಂದ 4 ಗಂಟೆಗಳು c. 4 ರಿಂದ 8 ಗಂಟೆಗಳು d. 8 ಗಂಟೆಗಳಿಗಿಂತ ಅಧಿಕ</td><td></td><td></td></tr>
<tr><td>3.</td><td>ಗದ್ದಲದ ವಾತಾವರಣದಲ್ಲಿ ಸುಮಾರು ಎಷ್ಟು ಸಮಯ ನೀವು ಶ್ರವಣಯಂತ್ರವನ್ನು ಧರಿಸುತ್ತೀರಾ?
a. 1 ಗಂಟೆಗಿಂತ ಕಡಿಮೆ b. 1 ರಿಂದ 4 ಗಂಟೆಗಳು c. 4 ರಿಂದ 8 ಗಂಟೆಗಳು d. 8 ಗಂಟೆಗಳಿಗಿಂತ ಅಧಿಕ
ಆಗ ಶ್ರವಣಯಂತ್ರದ ಪ್ರೋಗ್ರಾಮ್ ಅನ್ನು ಬದಲಾಯಿಸುವಿರಾ? ಹೌದು/ ಇಲ್ಲ</td><td></td><td></td></tr>
<tr><td>4.</td><td>ಶ್ರವಣಯಂತ್ರದ "ಶಬ್ದದ" ಮಟ್ಟವನ್ನು (volume) ನೀವು ಬದಲಿಸುವಿರಾ ?
1) ಆ ವಾತಾವರಣಗಳನ್ನು ಹೆಸರಿಸಿ.
2) ಆ ವಾತಾವರಣಗಳಲ್ಲಿ ಎಷ್ಟು ಬಾರಿ ಶಬ್ದದ ಮಟ್ಟವನ್ನು ಬದಲಾಯಿಸುತ್ತೀರಾ?
a. ಕೆಲವೊಮ್ಮೆ b. ಯಾವಾಗಲು c. ಬದಲಾಯಿಸುವುದಿಲ್ಲ d. ಗೊತ್ತಿಲ್ಲ
3) ವಿವಿಧ ವಾತಾವರಣಗಳಲ್ಲಿ ನೀವು "ಶಬ್ದದ" ಮಟ್ಟವನ್ನು, ಹೆಚ್ಚು ಮಾಡುವಿರಾ ಅಥವಾ ಕಡಿಮೆ ಮಾಡುವಿರಾ ? ವಿವರಿಸಿ</td><td></td><td></td></tr>
<tr><td>5.</td><td>ನಿಮ್ಮಲ್ಲಿ ಎರಡು ಶ್ರವಣಯಂತ್ರಗಳು ಇದಲ್ಲಿ ನೀವು
a. ಎರಡನ್ನೂ ಯಾವಾಗಲೂ ಬಳಸುತ್ತೀರಾ?
b. ಯಾವಾಗಲೂ ಒಂದು ಶ್ರವಣಯಂತ್ರವನ್ನು ಮಾತ್ರ ಬಳಸುತ್ತೀರಾ?
c. ಇತರ (ಹೆಸರಿಸಿ)</td><td></td><td></td></tr>
<tr><td>6.</td><td>ನೀವಿರುವ ವಾತಾವರಣಕ್ಕೆ ಅನುಗುಣವಾಗಿ ಶ್ರವಣಯಂತ್ರದ ಪ್ರೋಗ್ರಾಮ್ ಗಳು ಬದಲಾಗುತ್ತವೆ. ಈ ಬದಲಾವಣೆಗಳು ಸ್ವಯಂಚಾಲಿತವಾಗಿ ಆಗುತ್ತದೆ, ಹಾಗು ಕೇಳುವ ಸಂದರ್ಭಕ್ಕೆ ಸೂಕ್ತವಾಗಿ ಆಗುತ್ತದೆ ಎಂದು ನಿಮಗೆ ಅನಿಸುತ್ತದೆಯೇ?
a. ಕೆಲವೊಮ್ಮೆ b. ಯಾವಾಗಲು c. ಯಾವ ಸಂದರ್ಭದಲ್ಲೂ ಇಲ್ಲ d. ಗೊತ್ತಿಲ್ಲ</td><td></td><td></td></tr>
<tr><td>7.</td><td>'ಶ್ರವಣಯಂತ್ರವನ್ನು ನೀವು ಎಷ್ಟು ಗಂಟೆಗಳ ಕಾಲ ಉಪಯೋಗಿಸುತ್ತೀರಾ' ಎಂದು ಶ್ರವಣತಜ್ಞರು ಪರಿಶೀಲಿಸಬಹುದು. ಇದರ ಬಗ್ಗೆ ನಿಮಗೆ ಅರಿವಿದೆಯೆ? ಹೌದು/ ಇಲ್ಲ</td><td></td><td></td></tr>
<tr><td>8.</td><td>ದಿನದ ಕೆಲ ಸಮಯಗಳಲ್ಲಿ (ಉದಾ: ಸ್ನಾನ ಮಾಡುವಾಗ, ನಿದ್ದೆ ಮಾಡುವಾಗ) ನೀವು ನಿಮ್ಮ ಶ್ರವಣಯಂತ್ರವನ್ನು ಆಫ್/ off ಮಾಡುತ್ತೀರಾ? ಹೌದು/ ಇಲ್ಲ, 'ಹೌದು' ಆಗಿದ್ದಲ್ಲಿ ವಿವರಿಸಿ</td><td></td><td></td></tr>
</table>

Appendix B

Questionnaire on Real-world hearing aid use – For hearing aid users (in English)

S.No.	Real-world hearing aid use – For hearing aid users	
1.	When you purchased this hearing aid, what actually were you looking for? Who and what influenced you to purchase a particular type of hearing aid? Did this hearing aid fulfil your expectations?	S
2.	In what situations do you face difficulty with your hearing? (Conversation, telephone, music, TV, social meets, market). Did your hearing aid help you to overcome that?	B
3.	When and where do you use and do not use your hearing aid maximally?	B
4.	Do you think that you have limited knowledge about the manipulation of hearing aid; hence, you are not using the hearing aids. Please specify the areas in which you require information / help.	M
5.	How many hours you use your hearing aid currently? How many days it took to use your hearing aid for that duration?	A
6.	Does the cost incurred for repair/servicing and repair facility of the hearing aid preventing you from using it regularly? Please specify.	CR
7.	Do you think that the hearing aid helps you to understand the people you speak with most frequently? How do you feel if your hearing aid does not help you in those situations?	QoL
8.	Does the use of hearing aid increase your self-confidence?	QoL
9.	Do you think your hearing aid is worth the trouble/cost? Do you feel cost of the maintenance of hearing aid is more and you are not using your hearing aid because of this?	MC
10.	In case you want to go in for a new hearing aid, what features in a hearing aid are you looking for?	S

Note. S: Satisfaction, B: Benefit, C&R: care and Repair, Acc: Acclimatisation, MC: Maintenance Cost, Qol: Quality of Life, M: Manipulation

Questionnaire on Real-world hearing aid use – For communication partners (in English)

S.No.	Real-world hearing aid use – For communication partners	
1.	What actually he/she was looking for while buying this hearing aid, Who and what influenced him/her to purchase this type of hearing aid. Do you feel the hearing aid fulfilled his/her expectation?	S
2.	Do you feel it was hard to communicate with him/her in particular situations (Conversation, telephone, music, TV, social meets, market)? After he/she started to use the hearing aid, has he/she overcome the problems in these situations?	B
3.	When and where does he/she use and do not use the hearing aid maximally?	B
4.	Does he/she effectively use and manipulate the hearing aid? If not, specify how we can help to solve these issues.	M
5.	How many hours per day does he/she use the hearing aid currently? How many days did he/she took to use the hearing aid for that duration?	A
6.	Does the cost incurred for repair/servicing and repair facility of the hearing aid preventing him/her from using it regularly? Please specify.	CR
7.	Is he/she able to understand the conversation with you and the people he/she speaks with most frequently? Do you feel hearing aid is not helping in those situations? Specify.	QoL
8.	Is he/she more confident after using hearing aid?	QoL
9.	Do you think your hearing aid is worth the trouble/cost? Do you feel cost of maintenance of hearing aid is more and hence he/she is not using the hearing aids?	MC
10.	In case he/she wants to go in for a new hearing aid, what features do you think a hearing aid should have to improve his/her listening ability?	S

Note. S: Satisfaction, B: Benefit, C&R: care and Repair, Acc: Acclimatisation, MC: Maintenance Cost, Qol: Quality of Life, M: Manipulation

Questionnaire on Real-world hearing aid use – For hearing aid users (in Kannada)

	ನೈಜ ಪ್ರಪಂಚದಲ್ಲಿ ಶ್ರವಣ ಯಂತ್ರದ ಬಳಕೆ **- ಶ್ರವಣ ಯಂತ್ರ ಬಳಕೆದಾರರಿಗಾಗಿ**
S.No.	***Particulars***
1.	ನೀವು ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಖರೀದಿಸಿದಾಗ, ನಿಮ್ಮ ಅಪೇಕ್ಷೆಗಳು ಏನಿತ್ತು? ಯಾವುದರ/ ಯಾರ ಪ್ರಭಾವದಿಂದ ಶ್ರವಣಯಂತ್ರವನ್ನು ಖರೀದಿಸಲು ನಿರ್ಧರಿಸಿದಿರಿ? ನಿಮ್ಮ ನಿರೀಕ್ಷೆಯನ್ನು ಈ ಶ್ರವಣ ಯಂತ್ರವು ಪೂರೈಸಿತೇ ?
2.	ಯಾವ್ಯಾವ ಸಂದರ್ಭಗಳಲ್ಲಿ ನಿಮಗೆ ಕೇಳಿಸಿಕೊಳ್ಳಲು ಕಷ್ಟವಾಗುವುದು? (ಸಂಭಾಷಿಸುವಾಗ, ದೂರವಾಣಿಯಲ್ಲಿ ಮಾತನಾಡುವಾಗ, ಸಂಗೀತ ಕೇಳುವಾಗ, ಟಿ.ವಿ ನೋಡುವಾಗ, ಸಾಮಾಜಿಕ ಭೇಟಿ ಮಾಡಿದಾಗ, ಮಾರುಕಟ್ಟೆಯಲ್ಲಿ). ಆ ಸಂಧರ್ಭಗಳಲ್ಲಿ ಶ್ರವಣಯಂತ್ರದಿಂದ ಉಪಯೋಗವಾಯಿತೇ?
3.	ಯಾವ್ಯಾವ ಸಂದರ್ಭಗಳಲ್ಲಿ ಮತ್ತು ಎಲ್ಲೆಲ್ಲಿ ನೀವು ಶ್ರವಣಯಂತ್ರವನ್ನು ಅತಿ ಹೆಚ್ಚು ಬಳಸುತ್ತೀರಾ /ಬಳಸುವುದಿಲ್ಲ?
4.	ಶ್ರವಣಯಂತ್ರದ ಬಳಕೆಯ ಬಗ್ಗೆ ಕಡಿಮೆ ಮಾಹಿತಿ ಇರುವುದರಿಂದ , ಅದನ್ನು ಕಡಿಮೆ ಉಪಯೋಗಿಸುತ್ತಿದೀರ ಎಂದು ಅನಿಸುತ್ತದೆಯೇ? ದಯವಿಟ್ಟು ಯಾವ ವಿಷಯಗಳಲ್ಲಿ ಹೆಚ್ಚು ಮಾಹಿತಿ ಬೇಕೆನಿಸುತ್ತದೆ ಎಂದು ವಿವರಿಸಿ.
5.	ಪ್ರಸ್ತುತ ಸುಮಾರು ಎಷ್ಟು ಗಂಟೆಗಳ ಕಾಲ ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಉಪಯೋಗಿಸುತ್ತಿರುವಿರಿ? ಇಷ್ಟು ಗಂಟೆಗಳ ಕಾಲ ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಬಳಸಲು ನಿಮಗೆ ಎಷ್ಟು ದಿನಗಳು ಬೇಕಾಯಿತು?
6.	ಶ್ರವಣಯಂತ್ರದ ದುರಸ್ತಿ / ರಿಪೇರಿ ವೆಚ್ಚ ದುಬಾರಿ ಎಂದು ಅದನ್ನು ಉಪಯೋಗಿಸುತ್ತಿಲ್ಲವೆ? ದಯವಿಟ್ಟು ಕಾರಣಗಳನ್ನು ವಿವರಿಸಿ. ಶ್ರವಣ ಯಂತ್ರದ ನಿರ್ವಹಣೆಯ ವೆಚ್ಚವು ಹೆಚ್ಚು ಎಂದು ಶ್ರವಣ ಯಂತ್ರವನ್ನು ನೀವು ಉಪಯೋಗಿಸುತ್ತಿಲ್ಲವೇ ?
7.	ನೀವು ಇತರರೊಡನೆ ಮಾತನಾಡುವಾಗ ಶ್ರವಣ ಯಂತ್ರವು ನಿಮಗೆ ಸಹಾಯ ಮಾಡುತ್ತದೆ ಎಂದು ಅನಿಸುತ್ತದೆಯೇ? ಆ ಸನ್ನಿವೇಶಗಳಲ್ಲಿ ಶ್ರವಣಯಂತ್ರದಿಂದ ಉಪಯೋಗವಾಗದಿದ್ದರೆ ನಿಮಗೆ ಹೇಗೆ ಅನಿಸುತ್ತದೆ?
8.	ಶ್ರವಣ ಯಂತ್ರದ ಬಳಕೆಯಿಂದ ನಿಮ್ಮ ಆತ್ಮವಿಶ್ವಾಸ ಹೆಚ್ಚಾಗಿದೆಯೇ ?
9.	ನಿಮಗೆ ಶ್ರವಣಯಂತ್ರದಿಂದ ಆಗಿರುವ ಲಾಭವು/ ಸಹಾಯವು, ಅದಕ್ಕೆ ತಗಲಿದ ವೆಚ್ಚ/ ಖರ್ಚಿಗಿಂತ ಮಿಗಿಲಾದುದು ಎಂದು ಅನಿಸುತ್ತದೆಯೆ?
10.	ಒಂದು ವೇಳೆ ನೀವು ಹೊಸ ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಖರೀದಿಸಬೇಕಾದರೆ, ನೀವು ಶ್ರವಣಯಂತ್ರದಲ್ಲಿ ಯಾವ ವಿಶೇಷಣ/ಸೌಲಭ್ಯ ಗಳನ್ನು ಅಪೇಕ್ಷಿಸುತ್ತೀರಾ ?

Questionnaire on Real-world hearing aid use – For communication partners (in Kannada)

	ನೈಜ ಪ್ರಪಂಚದಲ್ಲಿ ಶ್ರವಣ ಯಂತ್ರದ ಬಳಕೆ - ಸಂವಹನ ಪಾಲುದಾರರಿಗಾಗಿ
S.No.	***Particulars***
1.	ಅವರು ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಖರೀದಿಸಿದಾಗ, ಅವರ ಅಪೇಕ್ಷೆಗಳು ಏನಿತ್ತು? ಯಾವುದರ/ ಯಾರ ಪ್ರಭಾವದಿಂದ ಅವರು ಶ್ರವಣಯಂತ್ರವನ್ನು ಖರೀದಿಸಲು ನಿರ್ಧರಿಸಿದರು? ಅವರ ನಿರೀಕ್ಷೆಗಳನ್ನು ಈ ಶ್ರವಣ ಯಂತ್ರವು ಪೂರೈಸಿತೇ?
2.	ಯಾವ್ಯಾವ ಸಂದರ್ಭಗಳಲ್ಲಿ ಅವರಿಗೆ ಕೇಳಿಸಿಕೊಳ್ಳಲು ಕಷ್ಟವಾಗುವುದು? (ಸಂಭಾಷಿಸುವಾಗ, ದೂರವಾಣಿಯಲ್ಲಿ ಮಾತನಾಡುವಾಗ, ಸಂಗೀತ ಕೇಳುವಾಗ, ಟಿ.ವಿ ನೋಡುವಾಗ, ಸಾಮಾಜಿಕ ಸಂಧರ್ಭಗಳಲ್ಲಿ, ಮಾರುಕಟ್ಟೆಯಲ್ಲಿ) . ಶ್ರವಣ ಯಂತ್ರವು ಆ ಸನ್ನಿವೇಶಗಳಲ್ಲಿ ಅವರಿಗೆ ಸಹಾಯ ಮಾಡಿತೇ?
3.	ಯಾವ್ಯಾವ ಸಂದರ್ಭಗಳಲ್ಲಿ ಮತ್ತು ಎಲ್ಲೆಲ್ಲಿ ಅವರು ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಅತಿ ಹೆಚ್ಚು ಬಳಸುತ್ತಾರೆ/ಬಳಸುವುದಿಲ್ಲ?
4.	ಶ್ರವಣ ಯಂತ್ರ ಬಳಕೆಯ ಬಗ್ಗೆ ಅವರಿಗೆ ಕಡಿಮೆ ತಿಳುವಳಿಕೆ ಇದೆ ಎಂದು ನಿಮಗೆ ಅನಿಸುತ್ತದಯೆ? ಅದರಿಂದಾಗಿ ಅವರು ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಕಡಿಮೆ ಬಳಸುತ್ತಿದ್ದಾರಾ? ಯಾವ ವಿಷಯದ ಬಗ್ಗೆ ಹೆಚ್ಚು ಮಾಹಿತಿ ಬೇಕೆನಿಸುತ್ತದೆ ಎಂದು ವಿವರಿಸಿ.
5.	ಪ್ರಸ್ತುತ ಅವರು ಸುಮಾರು ಎಷ್ಟು ಗಂಟೆಗಳ ಕಾಲ ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಉಪಯೋಗಿಸುತ್ತಿದ್ದಾರೆ? ಇಷ್ಟು ಗಂಟೆಗಳ ಕಾಲ ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಬಳಸಲು ಅವರಿಗೆ ಎಷ್ಟು ದಿನಗಳು ಬೇಕಾಯಿತು?
6.	ಅವರು ಶ್ರವಣ ಯಂತ್ರದ ದುರಸ್ತಿ / ರಿಪೇರಿ ವೆಚ್ಚವನ್ನು ದುಬಾರಿ ಎಂದು ಭಾವಿಸಿ, ಅದನ್ನು ಬಳಸುವುದಿಲ್ಲವೇ? ದಯವಿಟ್ಟು ಕಾರಣಗಳನ್ನು ವಿವರಿಸಿ. ಶ್ರವಣ ಯಂತ್ರದ ನಿರ್ವಹಣೆಯ ವೆಚ್ಚವು ಹೆಚ್ಚು ಎಂದು ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಅವರು ಉಪಯೋಗಿಸುತ್ತಿಲ್ಲವೇ ?
7.	ಅವರು ಇತರರೊಡನೆ ಮಾತನಾಡುವಾಗ ಶ್ರವಣ ಯಂತ್ರವು ಅವರಿಗೆ ಸಹಾಯ ಮಾಡುತ್ತದೆ ಎಂದು ನಿಮಗೆ ಅನಿಸುತ್ತದೆಯೇ ? ಅಂತಹ ಸನ್ನಿವೇಶಗಳಲ್ಲಿ ಶ್ರವಣ ಯಂತ್ರದಿಂದ ಉಪಯೋಗವಾಗದಿದ್ದರೆ ಅವರಿಗೆ ಹೇಗೆ ಅನಿಸುತ್ತದೆ?
8.	ಶ್ರವಣ ಯಂತ್ರದ ಬಳಕೆಯಿಂದ ಅವರ ಆತ್ಮವಿಶ್ವಾಸ ಹೆಚ್ಚಾಗಿದೆಯೇ ?
9.	ಅವರಿಗೆ ಶ್ರವಣಯಂತ್ರದಿಂದ ಆಗಿರುವ ಲಾಭವು/ ಸಹಾಯವು ಅದಕ್ಕೆ ತಗಲಿದ ವೆಚ್ಚ/ ಖರ್ಚಿಗಿಂತ ಮಿಗಿಲಾದುದು ಎಂದು ನಿಮಗೆ ಅನಿಸುತ್ತದೆಯೆ?
10.	ಒಂದು ವೇಳೆ ಅವರು ಹೊಸ ಶ್ರವಣ ಯಂತ್ರವನ್ನು ಖರೀದಿಸಬೇಕಾದರೆ , ಅವರು ಶ್ರವಣಯಂತ್ರದಲ್ಲಿ ಯಾವ ವಿಶೇಷಣ/ಸೌಲಭ್ಯ ಗಳನ್ನು ಅಪೇಕ್ಷಿಸುತ್ತಾರೆ ?

Abstract of the project for inclusion in the annual report /Website (300 words)

Not all who are provided hearing aids use them optimally or are satisfied with them. The purpose of the study was to acquire better insights into the 'real world' hearing aid usage and outcome of hearing aid users and communication partners, through focus group discussions (FGD) and semi-structured interviews (SSI) through the use of questionnaires.

Objectives:

- To develop measures for hearing aid usage and outcome
- To measure and compare data-logged (objective) and self-reported (subjective) hearing aid usage.
- To measure the relationship between the usage measure with reported outcome.

Design:

This exploratory study involved development of two questionnaires in Stage I, i.e., Questionnaire on Hearing Aid Usage (Q-HAU) and Real world Experiences with Hearing Aid (REHA). Stage II involved two parts. Part A of Stage II involved collecting information on hearing aid usage through objective measure, i.e., information from data logging; and subjective measure, i.e., using Q-HAU and International outcome inventory – hearing aid (IOI-HA). Part B of Stage II involved conducting FGD (n=21 hearing aid users & 18 communication partners) and SSI (n=22 hearing aid users & 10 communication partners), using REHA.

Results:

Descriptive and inferential statistics were deployed. Communication partners gave a more realistic number of hours of hearing aid usage that closely matched with that from data logging. Most of the hearing aid users were satisfied with their hearing aids, except that their hearing aid was not effective for audibility of soft sounds, noisy environment, group situation, and telephone. Some hearing aid users expressed that they have problem in manipulation of hearing aids. Major issues were in cleaning the ear mould or changing the wax guard (in case of RIC hearing aid), and manipulation of programs or volume, especially when both the functions are done by a common switch.

Conclusions:

The two questionnaires developed for hearing aid usage and outcome can be used to measure the outcome from hearing aids. The usage could be enhanced by strengthening the counselling and follow-up.

References

Archana, G., Krishna, Y., Rajashekhar, B., & Bhargavi, P. G. (2016). Adult auditory training is it part of aural rehabilitation? Focused group discussion. *Indian Journal of Otology, 22*(1), 24-27.

Arlinger, S., & Billermark, E. (1999). One year follow-up of users of a digital hearing aid. *British Journal of Audiology, 33*(4), 223-232.

Barcham, L. J., & Stephens, S. (1980). The use of an open-ended problems questionnaire in auditory rehabilitation. *British Journal of Audiology, 14*(2), 49-54.

Baumfield, A., & Dillon, H. (2001). Factors affecting the use and perceived benefit of ITE and BTE hearing aids. *British Journal of Audiology, 35*(4), 247-258.

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine, 25*(24), 3186-3191.

Bentler, R. A., Niebuhr, D. P., Getta, J. P., & Anderson, C. V. (1993). Longitudinal study of hearing aid effectiveness. II: Subjective measures. *Journal of Speech, Language, and Hearing Research, 36*(4), 820-831.

Berger, K. W., & Hagberg, E. N. (1982). *Hearing aid users attitudes and hearing aid usage.* Monographs of contemporary Audiology, 3(4).

Berger, K. W., Hagberg, E. N., Varavvas, D. M., & Vottero, D. M. (1982). Comparison of hearing threshold level and most comfortable loudness level in hearing aid prescription. *Ear and Hearing, 3*(1), 30-33.

Bertoli, S., Staehelin, K., Zemp, E., Schindler, C., Bodmer, D., & Probst, R. (2009). Survey on hearing aid use and satisfaction in Switzerland and their determinants. *International Journal of Audiology, 48*(4), 183-195.

Brännström, K. J., & Wennerström, I. (2010). Hearing aid fitting outcome: clinical application and psychometric properties of a Swedish translation of the international outcome inventory for hearing aids (IOI-HA). *Journal of the American Academy of Audiology, 21*(8), 512-521.

Brooks, D., & Hallam, R. (1998). Attitude to Hearing Diffculty and Hearing Aids and the Outcome of Audiological Rehabilitation. *British Journal of Audiology, 32*(4), 217-226.

Brooks, D. N. (1996). The time course of adaptation to hearing aid use. *British Journal of Audiology, 30*(1), 55-62.

Chang, W.-H., Tseng, H.-C., Chao, T.-K., Hsu, C.-J., & Liu, T.-C. (2008a). Measurement of hearing aid outcome in the elderly: Comparison between young and old elderly. *Otolaryngology—Head and Neck Surgery, 138*(6), 730-734.

Chang, W.-H., Tseng, H.-C., Chao, T.-K., Hsu, C.-J., & Liu, T.-C. (2008b). Measurement of hearing aid outcome in the elderly: Comparison between young and old elderly. *Otolaryngology--Head and Neck Surgery, 138*(6), 730-734.

Collins, M. P., Souza, P. E., O'Neill, S., & Yueh, B. (2007). Effectiveness of group versus individual hearing aid visits. *Journal of rehabilitation research and development, 44*(5), 739.

Cook, J. A., & Hawkins, D. B. (2007). Outcome measurement for patients receiving hearing aid services. *The Laryngoscope, 117*(4), 610-613.

Cox, R. M., Alexander, G. C., & Gilmore, C. (1987). Development of the connected speech test (CST). *Ear and Hearing, 8*(5), 119S-126S.

Cox, R. M., & Gilmore, C. (1990). Development of the profile of hearing aid performance (PHAP). *Journal of Speech, Language, and Hearing Research, 33*(2), 343-357.

Cox, R. M., Gilmore, C., & Alexander, G. C. (1991). Comparison of two questionnaires for patient-assessed hearing aid benefit. *Journal of the American Academy of Audiology, 2*(3), 134-145.

Cox, R. M., & Alexander, G. C. (1995). The abbreviated profile of hearing aid benefit. *Ear and Hearing, 16*(2), 176-186.

Cox, R. M., & Alexander, G. C. (1999). Measuring satisfaction with amplification in daily life: The SADL scale. *Ear and Hearing, 20*(4), 306.

Cox, R., Hyde, M., Gatehouse, S., Noble, W., Dillon, H., Bentler, R., ... & Kramer, S. (2000). Optimal outcome measures, research priorities, and international cooperation. *Ear and Hearing, 21*(4 Suppl), 106S-115S.

Cox, R. M., & Alexander, G. C. (2002). The International Outcome Inventory for Hearing Aids (IOI-HA): psychometric properties of the English version: El Inventario International de Resultados para Auxiliares Auditivos (IOI-HA): propiedades psicometricas de la version en ingles. *International Journal of Audiology, 41*(1), 30-35.

Cox, R. M., Alexander, G. C., & Beyer, C. M. (2003). Norms for the international outcome inventory for hearing aids. *Journal of the American Academy of Audiology, 14*(8), 403-413.

Cox, R. M., Hyde, M., Gatehouse, S., Noble, W., Dillon, H., Bentler, R., . . . Wilkerson, D. (2000). Optimal outcome measures, research priorities, and international cooperation. *Ear and Hearing, 21*(4), 106S-115S.

Cox, R. M., & Rivera, I. (1992). Predictability and reliability of hearing aid benefit measured using the PHAB. *J American Academy Audiology, 3*(4), 242-254.

Dawes, P., Maslin, M., & Munro, K. J. (2014). 'Getting used to'hearing aids from the perspective of adult hearing-aid users. *International Journal of Audiology*, *53*(12), 861-870.

Dawes, P.D., Maslin, M.R.D., Munro, K. (2014). 'Getting used to' hearing aids from the perspective of adult hearing-aid users. *International Journal of Audiology*, 53(12), 861-870.

Demorest, M. E., & Erdman, S. A. (1987). Development of the communication profile for the hearing impaired. *Journal of Speech and Hearing Disorders*, *52*(2), 129-143.

Desjasrdins, J., & Doherty, K. (2009). Do experienced hearing aid users know to use their hearing aids correctty. *American Journal of Audiology*, *18*(1), 69-76.

Diem, K. G. (2002). A step-by-step guide to developing effective questionnaires and survey procedures for program evaluation and research. *Rutgers Cooperative Research & Extension, NJAES, Rutgers, The State University of New Jersey*.

Dillon, H., Birtles, G., & Lovegrove, R. (1999). Measuring the Outcomes of a National Rehabilitation Program: Normative Data for the Client Oriented Scale. *Journal of the American Academy of Audiology, 10*(2), 67-79.

Dillon, H., James, A., & Ginis, J. (1997). Client Oriented Scale of Improvement (COSI) and its relationship to several other measures of benefit and satisfaction provided by hearing aids. *Journal of American Academy of Audiology, 8*, 27-43.

High, W. S., Fairbanks, G., & Glorig, A. (1964). Scale for self-assessment of hearing handicap. *Journal of Speech and Hearing Disorders*, *29*(3), 215-230.

Fabry, D. A., & Tchorz, J. (2005). DataLogging: A clinical tool for meeting individual patient needs. *Hearing Review*, *12*(1), 26-29.

Fitzpatrick, E., McCrae, R., & Schramm, D. (2006). A retrospective study of cochlear implant outcomes in children with residual hearing. *BMC Ear, Nose and Throat Disorders*, Open Access, *6*(1), 7.

Fitzpatrick, E., Olds, J., Durieux-Smith, A., McCrae, R., Schramm, D., & Gaboury, I. (2009). Pediatric cochlear implantation: How much hearing is too much?. *International Journal of Audiology, 48*(2), 91-97.

Forster, S., & Tomlin, A. (1988). *Hearing aid usage in Queensland.* Paper presented at the Audiological Society of Australia Conference.

Gaffney, P. (2008). Reported hearing aid use versus datalogging in a VA population. *Hearing Review, 15*(6), 42.

Galvez, G., Turbin, M. B., Thielman, E. J., Istvan, J. A., Andrews, J. A., & Henry, J. A. (2012). Feasibility of ecological momentary assessment of hearing difficulties encountered by hearing aid users. *Ear and Hearing, 33*(4), 497-507.

Garstecki, D. C., & Erler, S. F. (1998). Hearing loss, control, and demographic factors influencing hearing aid use among older adults. *Journal of Speech, Language, and Hearing Research, 41*(3), 527-537.

Gatehouse, S. (1994). Components and determinants of hearing aid benefit. *Ear and Hearing, 15*(1), 30-49.

Gatehouse, S. (1999). Glasgow hearing aid benefit profile: derivation and validation of. *Journal of American Academy of Audiology, 10*(80), 103.

Gatehouse, S. (2002). Electronic aids to hearing. *British medical bulletin, 63*(1), 147-156.

Gianopoulos, I., & Stephens, D. (2005). General considerations about screening and their relevance to adult hearing screening. *Audiological Medicine, 3*(3), 165-174.

Gianopoulos, I., Stephens, D., & Davis, A. (2002). Follow up of people fitted with hearing aids after adult hearing screening: the need for support after fitting. *BMJ, 325*(7362), 471.

Gibbs, A. (1997). Focus groups. *Social research update, 19*(8), 1-8.

Gilson, B.S., Gilson, J.S., Bergner, M., Bobbit, R.A., Kressel, S., Pollard, W.E., Vesselago, M. (1975). The sickness impact profile. Development of an outcome measure of health care. *American Journal of Public Health*. 65, 1304–1310.

Giolas, T. G., Owens, E., Lamb, S. H., & Schubert, E. D. (1979). Hearing performance inventory. *Journal of Speech and Hearing Disorders*, *44*(2), 169-195.

Gussekloo, J., De Bont, L., Von Faber, M., Eekhof, J., De Laat, J., Hulshof, J., . . . Westendorp, R. (2003). Auditory rehabilitation of older people from the general population--the Leiden 85-plus study. *British Journal of General Practice, 53*(492), 536-540.

Hartley, D., Rochtchina, E., Newall, P., Golding, M., & Mitchell, P. (2010). Use of hearing aids and assistive listening devices in an older Australian population. *Journal of the American Academy of Audiology, 21*(10), 642-653.

Harrell, M. C., & Bradley, M. A. (2009). *Data collection methods: Semi-structured interviews and focus groups*. Rand Corporation, CA: Santa Monica.

Hétu, R., Getty, L., & Waridel, S. (1994). Attitudes towards co-workers affected by occupational hearing loss II: Focus groups interviews. *British Journal of Audiology*, *28*(6), 313-325.

Henrichsen, J., Noring, E., Christensen, B., Pedersen, F., & Parving, A. (1988). In-the-ear Hearing Aids the Use and Benefit in the Elderly Hearing-Impaired. *Scandinavian Audiology, 17*(4), 209-212.

Hickson, L., Hamilton, L., & Orange, S. (1986). Factors associated with hearing aid use. *Australian Journal of Audiology,* 8, 37-41

Hickson, L., Timm, M., Worrall, L., & Bishop, K. (1999). Hearing aid fitting: Outcome for older adults. *Australian Journal of Audiology, 21*(1), 9-21.

Hickson, L., & Worrall, L. (2003). Beyond hearing aid fitting: Improving communication for older adults. *International Journal of Audiology, 42*(sup2), 84-91.

Humes, L. E. (1999). Dimensions of hearing aid outcome. *Journal of the American Academy of Audiology, 10*(1), 26-39.

Humes, L. E., Ahlstrom, J. B., Bratt, G. W., & Peek, B. F. (2009, May). Studies of hearing-aid outcome measures in older adults: A comparison of technologies and an examination of individual differences. In *Seminars in Hearing* (Vol. 30, No. 02, pp. 112-128). © Thieme Medical Publishers.

Humes, L. E., Halling, D., & Coughlin, M. (1996). Reliability and stability of various hearing-aid outcome measures in a group of elderly hearing-aid wearers. *Journal of Speech, Language, and Hearing Research, 39*(5), 923-935.

Jerram, J., & Purdy, S. C. (2001). Technology, expectations, and adjustment to hearing loss: predictors of hearing aid outcome. *Journal-American Academy of Audiology, 12*(2), 64-79.

Kaplan, H., Bally, S., Brandt, F., Busacco, D., & Pray, J. (1997). Communication scale for older adults (CSOA). *Journal-American Academy of Audiology*, *8*, 203-217.

Keidser, G., O'Brien, A., Carter, L., McLelland, M., & Yeend, I. (2008). Variation in preferred gain with experience for hearing-aid users. *International Journal of Audiology*, *47*(10), 621-635.

Kelly, T. B., Tolson, D., Day, T., McColgan, G., Kroll, T., & Maclaren, W. (2013). Older people's views on what they need to successfully adjust to life with a hearing aid. *Health & social care in the community, 21*(3), 293-302.

Killion, M. C., Niquette, P. A., Gudmundsen, G. I., Revit, L. J., & Banerjee, S. (2004). Development of a quick speech-in-noise test for measuring signal-to-noise ratio loss in normal-hearing and hearing-impaired listeners. *The Journal of the Acoustical Society of America, 116*(4), 2395-2405.

Kirk, K. I., Pisoni, D. B., & Osberger, M. J. (1995). Lexical effects on spoken word recognition by pediatric cochlear implant users. *Ear and Hearing, 16*(5), 470.

Kochkin, S. (1996). Marketrak IV: 10-year trends in the hearing aid market-has anything changed? *The Hearing Journal, 49*, 23-36.

Kochkin, S. (2000). MarkeTrak V:"Why my hearing aids are in the drawer" The consumers' perspective. *The Hearing Journal, 53*(2), 34-36.

Krueger, R. A., & Casey, M. A. (2002). Designing and conducting focus group interviews.

Lamb, S. H., Owens, E., & Schubert, E. D. (1983). The revised form of the Hearing Performance Inventory. *Ear and Hearing, 4*(3), 152-157.

Laplante-Lévesque, A., Hickson, L., & Worrall, L. (2013). Stages of change in adults with acquired hearing impairment seeking help for the first time: application of the transtheoretical model in audiologic rehabilitation. *Ear and Hearing, 34*(4), 447-457.

Laroche, C., Garcia, L.J., and Barrette, J. (2000). Perceptions by persons with hearing impairment, audiologists, and employers of the obstacles to work integration. *Journal of the Academy of Rehabilitative Audiology, 23*, 63-90.

Lupsakko, T. A., Kautiainen, H. J., & Sulkava, R. (2005). The non-use of hearing aids in people aged 75 years and over in the city of Kuopio in Finland. *European Archives of Oto-Rhino-Laryngology and Head & Neck, 262*(3), 165-169.

Mäki-Torkko, E. M., Sorri, M. J., & Laukli, E. (2001). Objective assessment of hearing aid use. *Scandinavian Audiology, 30*(1), 81-82.

Martin, F. N., Champlin, C. A., & Chambers, J. A. (1998). Seventh survey of audiometric practices in the United States. *Journal of the American Academy of Audiology, 9*(2), 95-104.

Meister, H., Lausberg, I., Kiessling, J., von Wedel, H., & Walger, M. (2005). Detecting components of hearing aid fitting using a self-assessment-inventory. *European Archives of Oto-Rhino-Laryngology and Head & Neck*, *262*(7), 580-586.

Mendel, L. L. (2007). Objective and subjective hearing aid assessment outcomes. *American Journal of Audiology*, 16, 118-129.

McCarthy, P. A., & Alpiner, J. G. (1983). An assessment scale of hearing handicap for use in family counseling. *Journal of the Academy of Rehabilitative Audiology*, *16*, 256-270.

McCormack, A., & Fortnum, H. (2013). Why do people fitted with hearing aids not wear them? *International Journal of Audiology, 52*(5), 360-368.

Mueller, G. H., & Palmer, C. V. (1998). The profile of aided loudness: A new "PAL" for'98. *The Hearing Journal*, *51*(1), 10-12.

Mulrow, C. D., Tuley, M. R., & Aguilar, C. (1992). Correlates of successful hearing aid use in older adults. *Ear and Hearing*, *13*(2), 108-113.

Newman, C. W., & Weinstein, B. E. (1986). Judgments of perceived hearing handicap by hearing-impaired elderly men and their spouses. *Journal of the Academy of Rehabilitative Audiology*.

Newman, C. W., Weinstein, B. E., Jacobson, G. P., & Hug, G. A. (1990). The Hearing Handicap Inventory for Adults: psychometric adequacy and audiometric correlates. *Ear and Hearing*, *11*(6), 430-433.

Noble, W., & Atherley, G. (1970). The Hearing Measurement Scale: A questionnaire for the assessment of auditory disability. *Journal of Auditory Research*.

Norman, M., George, C. R., & McCarthy, D. (1994). The effect of pre-fitting counselling on the outcome of hearing aid fittings. *Scandinavian Audiology, 23*(4), 257-263.

Olusanya, B. (2004). Self-reported outcomes of aural rehabilitation in a developing country. *International Journal of Audiology*, *43*(10), 563-571.

Ovegard, A., & Ramström, A. B. (1992). Individual Follow-Up of Hearing and Fitting. *Scandinavian Audiology*, *23*(1), 57-63.

Popelka, M. M., Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E., & Klein, R. (1998). Low prevalence of hearing aid use among older adults with hearing loss: the Epidemiology of Hearing Loss Study. *Journal of the American Geriatrics Society, 46*(9), 1075-1078.

Powell, R. A. & Single, H. M. (1996). Focus groups. International Journal for quality in Health Care, 8(5), 499-504.

Ringdahl, A., Eriksson-Mangold, M., & Andersson, G. (1998). Psychometric evaluation of the Gothenburg Profile for measurement of experienced hearing disability and handicap: Applications with new hearing aid candidates and experienced hearing aid users. *British Journal of Audiology, 32*(6), 375-385.

Rosen, J. K. (1979). An evaluation of the English language version of the social hearing handicap index. *Scandinavian Audiology, 8*(2), 111-115.

Santos, S. N. d., Petry, T., & Costa, M. J. (2010). Acclimatization effect in speech recognition: evaluation without hearing aids. *Pró-Fono Revista de Atualização Científica*, *22*(4), 543-548.

Saunders, G. H., Chisolm, T. H., & Abrams, H. B. (2005). Measuring hearing aid outcomes - Not so easy as it seems. *Journal of Rehabilitation Reseach & Development*, 42(4), 157-168.

Schow, R. L., & Nerbonne, M. A. (1982). Communication screening profile: Use with elderly clients. *Ear and Hearing*, *3*(3), 135-147.

Schum, D. J. (1992). Responses of elderly hearing aid users on the hearing aid performance inventory. *Journal of the American Academy of Audiology*, *3*(5), 308-314.

Schumacher, D., & Carruth, J. (1997). Long-term use of hearing aids in patients with presbyacusis. *Clinical otolaryngology and allied sciences, 22*(5), 430-433.

Simon, J. S. (1999). How to conduct focus groups. *Nonprofit World*, *17*, 40-43.

Smeeth, L., Fletcher, A. E., Ng, E. S.-W., Stirling, S., Nunes, M., Breeze, E., . . . Tulloch, A. (2002). Reduced hearing, ownership, and use of hearing aids in elderly people in the UK–the MRC Trial of the Assessment and Management of Older People in the Community: a cross-sectional survey. *The Lancet, 359*(9316), 1466-1470.

Smits, C., Kramer, S. E., & Houtgast, T. (2006). Speech reception thresholds in noise and self-reported hearing disability in a general adult population. *Ear and Hearing, 27*(5), 538-549.

Sorri, M., Luotonen, M., & Laitakari, K. (1984). Use and non-use of hearing aids. *British Journal of Audiology, 18*(3), 169-172.

Stephens, S. D. G. (1977). Hearing aid use by adults: a survey of surveys. *Clinical Otolaryngology & Allied Sciences*, *2*(4), 385-402.

Stika, C. J. (1997). Living with hearing loss-focus group results Part II: Career development and work experiences. *Hearing Loss*, *18*(6), 29-32.

Taubman, L., Palmer, C., Durrant, J., & Pratt, S. (1999). Accuracy of hearing aid use time as reported by experienced hearing aid wearers. *Ear and Hearing, 20*(4), 299-305.

Thammaiah, S., Manchaiah, V., Easwar, V., & Krishna, R. (2016). Translation and adaptation of five English language self-report health measures to South Indian Kannada language. *Audiology Research, 6*(1).

Tomita, M., Mann, W., & Welch, T. (2001). Use of assistive devices to address hearing impairment by older persons with disabilities. *International Journal of Rehabilitation Research, 24*(4), 279-290.

Tye-Murray, N., Spry, J. L., & Mauzé, E. (2009). Professionals with hearing loss: Maintaining that competitive edge. *Ear and Hearing*, *30*(4), 475-484.

Uriarte, M., Denzin, L., Dunstan, A., Sellars, J., & Hickson, L. (2005). Measuring hearing aid outcomes using the Satisfaction with Amplification in Daily Life (SADL) questionnaire: Australian data. *Journal of the American Academy of Audiology*, *16*(6), 383-402.

Ventry, I. M., & Weinstein, B. E. (1982). The hearing handicap inventory for the elderly: a new tool. *Ear and Hearing*, *3*(3), 128-134.

Ventry, I. M., & Weinstein, B. E. (1983). Identification of elderly people with hearing problems. *ASHA*, *25*(7), 37.

Vestergaard Knudsen, L., Öberg, M., Nielsen, C., Naylor, G., & Kramer, S. E. (2010). Factors influencing help seeking, hearing aid uptake, hearing aid use and satisfaction with hearing aids: A review of the literature. *Trends in Amplification, 14*(3), 127-154.

Walden, B. E., Demorest, M. E., & Hepler, E. L. (1984). Self-report approach to assessing benefit derived from amplification. *Journal of Speech & Hearing Research,* 27, 49-56.

Walker, E. A., Spratford, M., Moeller, M. P., Oleson, J., Ou, H., Roush, P., & Jacobs, S. (2013). Predictors of hearing aid use time in children with mild-to-severe hearing loss. *Language, Speech, and Hearing Services in Schools, 44*(1), 73-88.

Walden, T. C., & Walden, B. E. (2004). Predicting success with hearing aids in everyday living. *Journal of the American Academy of Audiology*, *15*(5), 342-352.

Ware, J.E. Jr. & Sherbourne, C.D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selections. *Medical Care*. 30, 73–83.

Weinstein, B. (1986). Validity of a screening protocol for identifying elderly people with hearing problems. *ASHA, 28*(5), 41-45.

Wilson, R. H. (2003). Development of a speech-in-multitalker-babble paradigm to assess word-recognition performance. *Journal of the American Academy of Audiology, 14*(9), 453-470.

Wilson, R. H. (2004). Adding speech-in-noise testing to your clinical protocol: Why and how. *The Hearing Journal, 57*(2), 10-12.