SELF-ASSESSMENT OF HEARING HANDICAP: A FEW AUDIOLOGICAL AND NON-AUDIOLOGICAL CORRELATES

THESIS

By

C.S. Vanaja

under the guidance of

Dr. S. Nikam

Submitted to the University of Mysore in 2000

TO ALL THOSE WHO MADE THIS PROJECT A REALITY

CERTIFICATE

This is to certify that the thesis entitled Self-Assessment of Hearing Handicap: A few Audiological and Non-audiological Correlates submitted by C. S. Vanaja, for the degree of Doctor of Philosophy in speech and hearing to the University of Mysore, Mysore, was carried out at All India Institute of Speech and Hearing, Mysore under my guidance.

Dr. S. Nikam

Formerly Director,

AIISH, Mysore

Place: Mysore

Date:21/06/2000

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Place: Mysore

Date: 22/06/2000

Director

AIISH, Mysore

DECLARATION

I declare that this thesis entitled Self-Assessment of Hearing Handicap: A few Audiological and Non-audiological Correlates, which is submitted herewith for the award of the degree of Doctor in Philosophy in the field of speech and hearing to the University of Mysore, Mysore, is the result of the work carried out by me at the All India Institute of Speech and Hearing, Mysore, under the guidance of Dr. S. Nikam, formerly Director of All India Institute of speech and hearing, Mysore. I further declare that the results of this work have not been previously submitted for any degree.

Place: Mysory

Date: 21/06/2000

C. S. Vanaja

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TABLE OF CONTENTS

LIST OF TABLES

List of Figures

List of Appendices

CHAPTER I

INTRODUCTION

World Health Organisation (1980) defined hearing impairment as abnormal functioning of the auditory system, disability as the functional consequences of an impairment and handicap as the social consequences of an impairment or disability (Saunders and Cienkoswki, 1996). Various tests are available to assess hearing impairment in an individual. Historically, assessment of hearing began with tuning fork tests in the eighteenth century. The first audiometer was invented in 1920's. Since then pure tone audiometry has become the basic tool for assessment of one's hearing. Over the years, a number of tests have been developed for identification and differential diagnosis of auditory disorders.

Audiologists use behavioral tests such as pure tone audiometry and speech audiometry to quantify the degree of hearing loss. Electrophysiological measures such as auditory evoked potentials are used to assess hearing sensitivity in difficult-to-test patients. Measurement of acoustic reflexes and otoacoustic emission are also valuable in identifying hearing loss in subjects who cannot be tested using conventional audiometry. Tympanometry is a physiological measure used in the detection and differential diagnosis of middle ear disorders. Behavioral, physiologic and electrophysiologic tests are available to differentiate between cochlear and retrocochlear pathology and to detect central auditory disorders. Though these hearing tests can quantify sensitivity loss, speech hearing difficulty, site of lesion, they are not suited for quantifying the effect of hearing-impairment on a person's everyday function (Ventry and Weinstein, 1982). In other words these tests do not measure the hearing handicap if any, consequent to hearing loss.

The extent to which a hearing loss poses problem in everyday communication varies from person to person and cannot be predicted from the audiogram alone. Individuals with identical audiograms and word identification experience different degrees of handicap. Some of these differences can be attributed to differences in frequency resolution (Florentine et al., 1980) and temporal resolution (Irwin and Purdy, 1982). Apart from these audiological factors, several non- audiological factors such as age of the affected individual, age at onset of hearing loss, individual communication needs and support received from others can contribute to hearing handicap. To evaluate the degree of handicap an individual with hearing impairment experiences in the real world, a self-assessment tool is used. The self-assessment data provide insight about an individual's response to hearing-impairment, an insight that cannot be gleaned from audiometric data alone (Giolas, 1982).

Self-assessment of hearing loss was introduced in the 1930's and received considerable attention in the seventies and eighties and shows promise for continued application (Schow and Gatehouse, 1990). A number of audiologists in United Satates are urging that the professionals extend the typical pure tone and speech discrimination test battery to include a measure of hearing handicap/communication functions (Schow et al., 1989). Some of the hearing handicap scales that have been developed are the Hearing Handicap Scale (High, Fairbanks and Glorig, 1964), the Hearing Measurement Scale (Noble and Artherly, 1970), the Hearing Performance Inventory (Giolas, Owens, Lamb and Schubert 1979), the Self-Assessment of Communication and Significant other Assessment of Communication (Schow and Nerbonne, 1982), the Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982), the McCarthy-Alpiner Scale of Hearing Handicap (McCarthy and Alpiner, 1983) and the Communication Profile for the Hearing Impaired (Demorest and Erdman, 1986,1987),

Correlates of Self-perceived Handicap

Factors that account for variability in the self-perceived handicap scores as measured by the various inventories have been investigated. As handicap is defined as the disadvantages imposed by impairment (WHO, 1980, as cited in Erdman, 1993), initial attempts aimed at correlating the findings of audiological tests with self-perceived handicap. Later, studies were carried out to correlate the non-audiological variables such as age, gender, intelligence and personality with the self-perceived handicap.

Self-perceived hearing handicap and its audiological correlates:

Some of the audiological measures chosen as independent variables were pure tone thresholds, speech identification scores obtained in quiet and in the presence of noise. Both young adults as well as geriatrics have served as subjects. Correlation coefficient between the pure tone threshold and self-perceived hearing handicap range from 0.5 to 0.8 (Berkowitz and Hochberg, 1971; McCartney, Maurer and Sorensen 1976; Weinstein and Ventry 1983 a; Weinstein and Ventry, 1983 b; Mathews et al., 1990; Coren and Hakstain, 1992) whereas speech identification scores in quiet showed lower correlation (-0.3 to -0.6) with self- assessment scores (Mc Cartney et al., 1976; Ewerstein and Birk-Neilsen, 1973; Weinstein and Ventry, 1983a, 1983b). These results indicated that speech identification scores obtained in quiet conditions might be a poor indicator of performance in everyday listening situation.

In order to assess measures besides pure tone thresholds and speech identification scores obtained in quiet, some investigators have used speech identification-in-noise as a dependent variable. Mathews, Lee, Mills and Scheem (1990) reported that correlation between scores on Speech Perception in Noise test and scores on Hearing Handicap Inventory for the Elderly were higher than the correlation coefficients between word recognition scores and self- perceived handicap (0.47 to 0.63 vs. 0.39 to 0.47). Earlier, Tyler and Smith (1983) had reported similar results. They compared the performance on a task of sentence identification in the presence of noise and scores on hearing handicap scales. Weinstein and Ventry (1983b) also reported that tests using less intelligible speakers showed higher correlation than tests of clearly articulated monosyllables. However, these measures i.e. speech identification in noise and speech identification of poorly articulated monosyllables did not show any superiority over pure tone thresholds. Hence more studies are required to find out factors contributing to self- perceived hearing handicap.

Self-perceived hearing handicap and its non-audiological correlates:

It has been suggested that variability in self-reported handicap scores may also be due to a number of extra-audiologic variables such as age, gender, socioeconomic status, personality, general health and life style (Noble, 1978). However, non-audiological correlates of hearing handicap have not been studied in depth.

Ewerstein and Birk-Nielson (1973) observed that the duration of hearing impairment and the age of the subject did not affect the degree of hearing handicap whereas the capacity for lip-reading had a definite influence. Schow and Tannhill (1977) reported that age had only a small influence on HHS findings. An anomalous effect of age was found, however, in an investigation by Lutman, Brown and Coles (1987).

Lutman, Brown and Coles (1987) also studied the effect of gender and reported that only in the subgroup with sensori-neural sloping audiometric configuration, men had slightly higher disability/handicap scores than women.

Results of a study by Berkowitz and Hochberg (1971) suggested interdependence between age and gender. The relationship between self-perceived handicap and audiological measures were different for males and females and subjects in different age groups. However, a systematic relation was not observed.

The results of these studies also indicated that only non-audiological variables or non-audiological variables in combination with audiological variables fail to account for the complete variability in the handicap scores. Hence there is a need to further evaluate the contributions of non-audiological variables to the self-perceived handicap.

Applications of Self-assessment Scales

Though the self-assessment scales were initially used to gain insight about an individual's response to hearing-impairment, the scales have also served various other related purposes as detailed below:

1. Self-assessment scales have been used for hearing screening programs (Ventry and Weinstein, 1983; Weinstein, 1986, Lichtenstein, Bess and Logan, 1988; Sever, Harry and Rittenhouse, 1989; Schow and Gatehouse, 1990; Murlow, Tuley and Aguilar, 1990; Schow, 1991; McCarthy, 1994). Using a hearing-handicap scale, screening can even be done through magazines and newspapers or through mail.
2. Information collected from a self-assessment scale has been used while recommending the use of amplification devices (Demorest and Erdman, 1984; Ventry and Weinstein, 1982; Schow and Gatehouse, 1990;

Kochkin, 1997). Such information has also been used to identify patients who might benefit from attending a program of aural rehabilitation (Demorest and Erdman, 1984, Much, 1999).

3. Some of the scales are prognostic. They have been used to predict adjustment to amplification or ability to benefit from certain types of rehabilitation (Demorest and Erdman, 1984). Self-assessment scales have been used to measure hearing aid benefit, consumer satisfaction and quality assurance as well as treatment efficiency (McCarthy, 1994).
4. Hearing handicap scales have also been found useful in demographic and research studies (Schow and Gatehouse, 1990, McCarthy, 1994). For example, Stephens (1980) used self-assessment scale to chart the most common and most troublesome hearing complaints whereas Schow, Brockett, Sturmak and Longhurst (1989) employed self-assessment scale to develop guidelines for pure-tone cut-off in hearing screening of adults.

NEED FOR THE STUDY

Several reasons justify the need for the present study, which aimed at developing a self-assessment scale and investigating some correlates of self-perceived handicap.

Hearing handicap scale in hearing screening

Self-report measures have proved useful in hearing screening. The following reasons justify the need to use hearing handicap scale in hearing screening programs in India:

Screening procedures should be cost effective. It is essential that test facilities and manpower used for screening for hearing impairment be easily accessible. With the availability of a hearing handicap scale, grass-root level workers such as anganwadi workers, health workers with minimal training can utilize self-assessment scale to identify individuals with hearing impairment.

In India, test facilities, - sophisticated instruments and sound-treated rooms meeting specifications to test-are available in a few urban areas. Facilities for calibrating the instruments are even more limited. Self-assessment scales can be utilized for hearing screening in places where the facilities available for hearing evaluation are not optimal. Self-assessment scales are also useful in testing patients who are not able to avail of the facilities due to financial constraints or poor transport facilities. Screening for hearing loss by means of a self-assessment scale is cost-effective from a management perspective because extensive assessment need not be conducted for individuals who pass the test (Erdman, 1993).

Factors affecting self-perceived handicap

Hearing handicap is defined in terms of the effect of hearing-impairment on an individual's everyday activities such as communication and social interaction (Giolas et al., 1979). Factors that affect communication include auditory capacity of the individual, language of the speaker/listener and environment in which communication is carried out.

a) Auditory capacity

It is an established fact that sensorineural hearing loss results not only in a simple loss of audibility but also results in a complex series of detrimental changes in the functioning of the auditory system such as the loss in frequency selectivity, poor temporal resolution, recruitment and poor identification scores (Henderson, Salvi, Boettcher and Clock, 1994). The effect on speech identification scores depends on the configuration of the audiogram and the intensity and frequency characteristics of the various formants of a given speech sound.

Not all speech sounds are equally affected by hearing loss. In general, vowels are more resistant to distortion than consonants and among consonants, fricative sounds are the most affected sounds (Sanders, 1982). An individual with mild-moderate sensorineural hearing loss may hear the louder portions of speech such as vowels (a, o) but the voiceless consonants

(t. p, k, f ,s, sh and ch) may be distorted or may not be heard (Newby and Popelka, 1992).

b) Language of the speaker/listener

The following experimental evidence suggests that language of the speaker/listener play an important role in speech perception:

i. It has been shown that a difference exists in communication efficiency of languages. Ramakrishna et al. (1962) reported that some of Indian languages were more redundant than English. For the hearing impaired listener perception may be easier in a more redundant language than in a language with less redundancy.

ii. Some of the languages are found to be less visible compared to others. Among English, Tamil, Malyalam and Hindi, Oyer, Richard, Rajaguru and Kapoor (1972) concluded that English was the most visible language. Fourcin (1990) also observed that Hindi has more number of invisible consonants when compared to English. It would be expected that a hearing impaired individual with poor speech identification scores will have more difficulty in understanding speech when the speech sound in the language used are less visible.

iii. It has been reported in literature that acoustic cues aiding for speech perception are not the same in all languages (Abramson, 1968; Williams, 1974; Williams, 1977; Flege and Eefting, 1986; Caramazza, Yeni-Komoshian, Zurif and Carbone 1973). Based on the studies carried out on English speaking and Spanish speaking subjects, it is reported that cues indicative of voice/voiceless distinctions were different in English and Spanish (Williams, 1974, 1977; Fledge and Eefting, 1986; Sapon and Carol, 1957 as cited in Nikam, 1974). Similarly, it has also been reported that the cues used to differentiate between voiced/voiceless sounds in French are different from those used in English (Caramaza et al., 1973; Simon and Fourcin, 1978; Gottfried and Beddor, 1988). Singh (1966) reported that acoustic cues that facilitated perception of distorted stimuli also varied depending on the native language of the listener.

c) Environment

Speech intelligibility is affected by the reverberation and the noise in the listening environment.

i) Reverberation: Reverberation time increases with the volume of the room and decreases with the amount of sound absorption of the surfaces (Nabalek and Nabelek, 1994). A variation in reverberation time would be expected when there is a difference in terms of the size of the rooms, material used for construction and/or furniture in the room.

It has been demonstrated that even in quiet rooms, speech intelligibility decreases with an increase in reverberation time (Heifer and Wilber, 1990). Experimental evidence showed that in subjects with normal hearing, reverberation affected the identification of vowels more than the consonants (Nabalek and Robinson, 1983). Among vowels, perception of monophthongs

Wilber, 1990). Experimental evidence showed that in subjects with normal -earing, reverberation affected the identification of vowels more than the consonants (Nabalek and Robinson, 1983). Among vowels, perception of monophthongs with similar formants were affected more and diphthongs were perceived as their beginning monophthongs (Nabelek,Czyzewski and Krishnan, 1992). The consonant and the vowel errors made by the hearing impaired were qualitatively similar to that of the normal hearing adults but they were quantitatively more (Nabelak, 1988).

ii) Noise: Understanding speech is affected by the environmental noise. Sources of noise in the environment can be traced to people, machines, appliances, traffic etc. Like other acoustic signals, speech is susceptible to deleterious effect of noise.

In noise, monophthongs which have similar formants are confused and dipthongs are perceived as their beginning monophthong (Nabelek, et al., 1992). Being less intense and more transient than vowels consonants are more easily confused in noise than vowels (Nabelek and Nabelek, 1994). It has been indicated that the frequency transitions such as those which contribute to identification of consonants in syllables are masked at lower signal-to-noise ratios than consonants (Nabelek, 1978). Speech perception by the hearing impaired is adversely affected by signal-to-noise ratio that do not alter speech perception of normal hearing listeners (Finitzo-Hieber and Tillman, 1978).

handicap (Berkowitz and Hochberg, 1971; McCartney, Maurer and Sorensen 1976: Weinstein and Ventry 1983 a; Weinstein and Ventry, 1983 b; Mathews et al., 1990). Some of these scales translated into Swedish have been evaluated on Swedish speaking population (Coren and Hakstain, 1992; Barrenas and Holgers, 2000). There is dearth of such studies on speaker/listeners of Indian languages. It stands to reason that tools developed for assessing the communication difficulties of the hearing impaired individuals of one linguistic group/region will not yield valid results on members of another linguistic group/region when there is a difference in terms of the language of the speaker/listener and/or the environment in which communication is carried out. Lower literacy rate may increase one's demand on oral-aural communication.

Therefore, the present study was designed to develop a self-assessment scale and answer the following questions:

1) Is there a relationship between the degree of hearing loss and self-perceived hearing handicap?
2) Is there a relationship between speech identification scores and self-perceived hearing handicap?
3) Is there a relationship between age of the subject and self-perceived handicap?
4) Is the self-perceived handicap similar in males and females with comparable degree of hearing loss?
5) Is there an interaction between age, gender, and degree of hearing loss and self perceived handicap?
6) Is it possible to predict hearing loss from self-perceived handicap scores?

CHAPTER II

REVIEW OF LITERATURE

In this chapter, the review of literature is discussed under the following titles:

1 Review of self-assessment scales

II. Correlates of self-perceived handicap

a) Correlation with audiological findings

i) Peripheral hearing loss and self-perceived handicap

ii) Central auditory processing and self-perceived handicap

b) Non audiologic correlates of hearing handicap

III. Assessment of hearing handicap by self and family member

IV. Self-assessment of hearing handicap as a screening tool

REVIEW OF SELF-ASSESSMENT SCALES

Self-assessment of hearing handicap was introduced in the 1930's but became popular as a method for gaining information about hearing handicap only in the 1980's. Some of the early measures of self-assessment included the scales used in national surveys such as the 1935-36 United States Public Health Survey Scale, Rating Scale for Each Ear (Schow and Gatehouse, 1990). Social Adequacy Index developed by Davis (1948) was an attempt to measure the hearing handicap based on the relationship between speech reception thresholds and identification scores. Subsequent to the advocacy of the concept of Social Adequacy Index, attempts to assess hearing handicap moved away from computations based on quantified measures of hearing. Researchers aimed at investigating the degree of handicap an individual had while meeting the communication demands in his daily life. Such an approach permitted the generation of an individualized picture of difficult situations as perceived by the hearing impaired. A number of such self-assessment scales have been devised for diagnostic and rehabilitative purposes in audiology. The major differences among these instruments lie in their purpose, their scope, the number of items, mode of test administration and the method of scoring. They all share one common goal, that is, to assess hearing handicap more directly and systematically than is possible through informal interviews and psychophysical audiometric measures (Giolas, 1983).

Various kinds of handicap information assessed by the self-assessment scales has been summarised by Schow (1988) (cited in Schow and Nerbonne, 1989) as follows:

1. Speech communication: general speech; estimates of communication ability in various settings such as home, work, social, one-on-one, small and large groups.
2. Speech communication: special; while listening to TV, a telephone; with and without visual cues; and in adverse listening conditions.
3. Emotional reactions/feelings, behavior and attitude about hearing impairment and hearing aids including response to auditory failure, acceptance of loss.
4. Reactions and behavior of others with reference to hearing loss.
5. Non-speech communication such as response to door and phone bell, warning traffic, localization of sounds.
6. Other related symptoms; fluctuating hearing loss, reactions to tinnitus and limited tolerance for loud sounds.

An ideal instrument should provide information regarding all the above aspects. It should be objective, quantifiable and easy to administer. However, there is no single questionnaire that is universally accepted. Many of the proposed measures of handicap have been criticized for being too narrow in scope, including items more correlated to loss of sensitivity than to loss in speech identification, using questions susceptible to falsification or being derived solely from measures of impairment (Davis and Hardick, 1981). Some of the self-assessment inventories that have been used frequently for research regarding assessment of hearing loss are discussed in this chapter. The scales have been listed in the chronological order.

The Hearing Handicap Scale (HHS)

High, Fairbanks and Glorig (1964) developed a self-report scale to measure the self-perceived handicap in adults. The scale consisted of forty items that pertain to hearing experiences likely to have been encountered by a majority of the individuals in an urban environment. It was designed to assess hearing handicap in four content areas: speech perception, localization, telephone communication and noisy situations. The scale was divided into two forms, Form A and Form B, each consisting of twenty items. Each form could be used independently as an alternate form as they were well matched in terms of their mean and standard deviation. High et al. (1964) reported a high internal consistency reliability (0.96) for the 20 item forms. A five point rating scale was used to elicit a response. Scores obtained from the total scale or form A and B were converted into percentage of the respective scale. Schow and Tannhill (1977) reported that scores less than 20% indicated no handicap, scores in the range of 21% to 40% indicated a slight handicap, a score of 41% to 70% indicated a mild-moderate handicap and scores which were greater than 70% indicated a severe handicap.

High et al. (1964) reported two limitations of the scale:

a) Responses to the questions can be easily falsified. There is no internal means for determining the validity of a response.

b) It focuses only on a single aspect of hearing handicap. It does not assess other areas of experience affected by hearing impairment such as psychological and vocational domains.

The former limitation is probably true of any self-report inventory. Another limitation of the scale is that it was standardized on a test sample with predominantly conductive component.

Hearing Measurement Scale (HMS)

Hearing Measurement Scale developed by Noble and Artherly (1970) for measurement of auditory disability in subjects with sensory-neural hearing loss had forty-two scoring items and several ancillary items covering the following subclasses:

1. Speech hearing
2. Acuity for non speech sound
3. Localization
4. Emotional response
5. Speech distortion
6. Tinnitus and
7. Personal opinion of hearing loss

This scale was initially devised to be used in an interview mode. The interview had to be tape-recorded and in order to increase reliability, it was suggested that the interview be scored by more than one clinician. A scoring criteria was developed to quantify the responses. Each item was weighted in terms of their importance to hearing loss and hearing handicap to give a valid measure of disability. Noble and Artherly (1970) tested the scale on patients with noise-induced hearing loss and a test-retest reliability coefficient of 0.93 was obtained.

Hearing Measurement Scale appears to satisfy the requirements for an acceptable measure of hearing handicap. Its chief limitation was the amount of clinician time required to complete the interview. Weinstein and Ventry (1983a) remarked that Hearing Measurement Scale was not the best scale to use with the elderly due to the following reasons:

1) many of its items were not relevant to the lifestyle of older individuals, who reside in the community,

2) the wording of the questions and the response system was too complicated for the elderly to elicit reliable data,

3) the scale was quite lengthy and

4) the scale did not assess adequately the emotional or social consequences of hearing impairment.

Social Hearing Handicap Index

Ewerstein and Birk-Neilson (1973) developed Social Hearing Handicap Index originally in Danish. It had twenty-one items that sampled conversational situations with one person as well as in noisy surroundings, group conversation, capacity to communicate effectively over telephone and understand speech via a television or radio. Demorest and Erdman (1984) considered this as an adaptation of the Hearing Handicap Scale of High ct al. (1964). To avoid bias, the lest was constructed in such a way that for ten questions the answer 'yes' indicated a handicap and for eleven questions the answer 'no' indicated a handicap. Scores were converted into percentages and were expressed as social handicap index. The subject's reaction to hearing impairment was not assessed through this scale.

Denver Scale of Communication Function (DSCF)

Alpiner (1987) report that Denver Scale of Communicative Function was developed by Alpiner et al. in 1974 as a tool to help the clinician in making a subjective assessment of communication attitudes of adults with acquired hearing loss. The scale consisted of twenty-five statements for which the subject had to answer using a seven-point continuum from "agree" to "disagree". Communication function in the following four categories were assessed:

1. family communicative situations
2. subject's personal feelings about hearing impairment
3. social-vocational situations and
4. general communication experience.

The scale was originally designed to measure in individual's performance

prior to and subsequent to undergoing a program of rehabilitation. Thus each hearing impaired adult's responses prior to and after undergoing aural rehabilitation were compared but not with any normative data. The client's responses (not scores) were recorded on a profile form in which the statements on the questionnaire were plotted on the abscissa and the responses were plotted on the ordinate. This permitted the audiologist to quickly review the patient's responses to individual items. As Sanders (1975) stated this scale was heavily weighted in terms of how the client felt about the effect of hearing loss on his performance and how he felt others reacted to him. Therefore it provided valuable information for purposes of counseling, though it did not provide specific information about communication problems of the hearing-impaired in different situations. Davis and Hardick (1981) contend that the Denver scale may be a useful adjunct to Hearing Handicap Scale (High et al., 1964) because together they provide data not sampled by either one alone.

The Denver Scale of Communicative Function has undergone many modifications. To make it more feasible for use with senior citizens, Kaplan, Feeley and Brown (1978) modified the original Denver Scale in the following ways:

a) An interview mode was suggested instead of the paper-pencil mode.

b) In order to simplify the response task, the seven point rating scale was reduced to five-point scale

c) All the items concerned with vocational adjustment were deleted. The category "family" was substituted by "peer " or family attitudes. The categories "self" and "social" were combined into the single category "localization". "Communication" category was maintained. A fourth category entitled "specific difficult listening situations" consisting of eleven new items was introduced.

Kaplan, Feeley and Brown (1978) evaluated twelve senior citizens using this modified scale and reported that the overall reliability of the scale was 0.88.

Quantified Denver Scale (QDS) was a modification of the original Denver Scale of Communicative Function (Schow and Nerbonne 1980). Quantified Denver Scale allowed comparison of scores with other hearing-impaired individuals. A five-point rating scale instead of a scale with seven-point rating was used. The responses were scored and then converted into percentages. Based on a study carried out on fifty subjects, Schow and Nerbonne (1980), reported that a score of less than 15% indicates no communicative dysfunction, a score between 16 to 30% indicates slight communicative dysfunction and a score which is greater than 31% indicates mild to moderate communicative dysfunction.

Tuley, Murlow, Aguilar and Veten (1990) administered the Quantified Denver Scale on 238 elderly subjects. Factor analysis of the data identified only two subscale constructs as opposed to four originally proposed constructs. The internal reliability of the revised scale was 0.97 and the test-retest reliability was 0.73. The accuracy of the revised Quantified Denver Scale for discriminating between individuals with and without hearing impairment was 73%. Tuley et al. (1990) further modified the scale to generate a five-item short version of the scale and reported that the short version served its purpose as well as the original twenty-five item scale. The short version contained two questions from the long communication subscale and three from the long self-isolation subscale.

To assess hearing handicap among the elderly, 'Denver Scale of Communication Function for Senior Citizens Living in Retirement Centers' was developed by Zaronoch and Alpiner in 1976 (Davis and Hardick, 1981). Administration in an interview mode consisted of seven basic questions with two to eight sub-questions, all answerable "yes" or "no". The scale focused on the unique characteristics of life in retirement centers and in altered family relationships.

Sanders' scale

Sanders (1975) developed three profile questionnaires to rate communicative performance of a subject in domestic, occupational and social environments. The main objective of using this scale was to assess the outcome of a rehabilitation program. Each questionnaire consisted of six to nine statements to which the respondent chose one of the four answers from "little or no difficulty" to "great difficulty". The items were similar to those in the Hearing Handicap Scale (High et aL 1964) in that difficulty experienced in communication was assessed rather than feelings or attitudes of the subject. The unique feature of the scale was that it rated the importance of the each situation based on how well the person got along in that situation. This scale provided useful information for aural rehabilitation program. Sanders (1975) recommended that this scale should be used in conjunction with the Denver Scale Communicative Function (Alpiner et al, 1974) as the two scales provide complementary information.

Nursing Home Hearing Handicap Index (NHHI)

Schow and Nerbonne (1977) developed the Nursing Home Hearing Handicap Index consisting of ten items to measure the hearing handicap in a institutionalized geriatric population. The two versions, a staff-version and a self-version, had the same questions with a change in the pronoun. The staff version was given to a member of the nursing home staff familiar with the resident. A five-point rating scale was used and the score was multiplied by two to make it comparable with that obtained through the Hearing Handicap Scale of High et al. (1964).

Hearing Performance Inventory (HPI)

Hearing Performance Inventory was developed by Giolas, Owens, Lamb and Schubert (1979) to assess the problems faced in every day listening situations. It consisted of 158 questions covering the areas of;

(1) Understanding speech

(2) Intensity

(3) Response to auditory failure

(4) Social

(5) Personal and
(6) Occupational

The answers were scored from one to five, the former indicating least difficulty and the latter indicating maximum difficulty. The scores could then be converted into percentages. A profile could be generated by scoring each scale separately. Giolas (1983) suggested that the scale had the greatest clinical utility in assisting the clinician while planning and assessing non-medical rehabilitative procedures.

Subsequently, Lamb, Owens and Schubert (1983) designed a revised shorter version of the Hearing Performance Inventory preserving the original content of the questionnaire. The revised form consisted of ninety questions that permitted a detailed analysis of an individual's communicative difficulties (Lamb, Owens and Schubert, 1983). Results of the psychometric analysis of the scale by Demorest and

Walden (1984) showed that it could assess both short- and long-term changes in the patient's score.

The major advantage of Hearing Performance Invemtory (both original and revised) was that it provided a description of the difficulties experienced in a wide variety of listening situations. Weinstein (1984) reported that the profile allowed a convenient way of displaying responses for a rehabilitation program but the lack of test-retest reliability data limited its use for the same.

Hearing Problem Inventory (Atlanta) (HPI-A)

Hearing problem inventory was designed by Hutton (1980) for use with veterans who wore hearing aids. The scale had fifty-one questions which elicited information on not only communicative problems in various situations and the subject's reaction to hearing impairment but also on care, maintenance and use of hearing aid and earmolds. It used a five-point rating scale. This scale has been used more in aural rehabilitation program to compare pre and post aural rehabilitation performance.

Another scale which evaluates handicapping effects of hearing loss in terms of attitudes and specific communication situations is the Communication Assessment Procedure for seniors developed by Alpiner and Baker in 1981 (Me Carthy, 1987).

Hearing Handicap Inventory for the Elderly (HHIE)

Ventry and Weinstein (1982) developed an inventory of twenty-five items, divided into two subscales (emotional and social/situational), to assess the effects of hearing impairment in the elderly. The emotional subscale consisted of thirteen items purporting to evaluate the emotional impact of hearing impairment. The twelve items in the social/situational subscale were directed at evaluating the effects of hearing loss on social life. A three point rating scale was used in which 'yes ' and 'no' indicated the presence and absence of handicap respectively. The scores were converted into percentages. The scale was standardized on 100 non-institutionalized individuals over the age of sixty-five years. A high split-half reliability (0.94 to 0.95), a high correlation of 0.87 between the two subscales and high internal consistency for each half was reported (Ventry and Weinstein, 1982).

Weinstein, Spitzer and Ventry (1986) examined the test-retest reliability for Hearing Handicap Inventory for the Elderly for face-to-face interview mode and paper-pencil method on forty-seven non-institutionalized elderly individuals with sensory-neural hearing loss. It was observed that the test-retest reliability was good for total, emotional and social/situational subscales when face-to-face interview was used (r= 0.92 to 0.96). The test-retest reliability for paper-pencil method was also high with Y ranging from 0.79 to 0.84. Newman and Weinstein (1989) further evaluated the test-retest reliability of Hearing Handicap Inventory for the Elderly when the test was administered face-to-face and then followed by paper-pencil method. The subjects in their study received face-to-face administration and approximately after six weeks they received the questionnaire through mail. The test-retest reliability was again found to be high for the total and the subscales.

Newman and Weinstein (1986) modified the Hearing Handicap Inventory for the Elderly (HHIE-Spouse) for use by a spouse in order to evaluate the differences in perception of hearing handicap between the spouse and the hearing impaired individual. The modified version is identical to the original Hearing Handicap Inventory for the Elderly except for the substitution of "your spouse" for "you" in each question.

To identify individuals with hearing problems who require audiological attention, Ventry and Weinstein (1983) developed a screening version of Hearing Handicap Inventory for the Elderly (HHIE-S). The items in the original Hearing Handicap Inventory for the Elderly were reduced to ten and included five situational/social items and five emotional items. They reported that the, the internal consistency of the scale was 0.87. Using a three point rating scale, the scores ranged from zero to forty. Ventry and Weinstein (1983) divided the scores into three categories -

a) 0-8 indicating no handicap

b) 10-22 suggesting mild to moderate handicap and

c) 24-40 indicating a severe handicap.

Newman, Weinstein, Jacobson and Hug (1990) modified Hearing Handicap Inventory for the Elderly for use with hearing-impaired adults. The Hearing handicap Inventory for the Adults (HHIA) was also a twenty-five item scale with emotional and social/situational subscales. The major difference between Hearing Handicap Inventory for the adults and Hearing Handicap Inventory for the Elderly was that the former had questions that assessed the occupational effects of hearing loss. They reported the internal consistency reliability to be 0.93 for the total scale, 0.88 for the emotional subscale and 0.85 for social/situational subscale. Newman, Weinstein, Jacobson and Hug (1991) reported that the test-retest reliability of HHIA between face-to-face and paper-pencil method was good (r=0.93 to 0.97).

Self Assessment of Communication (SAC) and Significant Other Assessment of Communication (SOAC)

The Self-Assessment of Communication was developed by Schow and Nerbonne (1982) as a screening tool. It consisted of ten items that were selected from a diagnostic tool. The scale assessed the communication difficulties in various situations, the subject's feelings about his/her handicap and the individual's perception of the attitudes of others towards his/her handicap. The Significant Other Assessment of Communication had the same ten items but with pronoun changes to collect information from the family member. Schow and Nerbonne (1982) administered this scale on fifty individuals aged twenty to eighty years and reported that the test-retest reliability was 0.80. Lichenstein, Bess and Logon (1991) opined that this scale had similar diagnostic characteristics as that of Hearing Handicap Inventory for the Elderly - Screening version.

McCarthy-Alpiner Scale of Hearing Handicap

McCarthy and Alpiner (1983) developed a questionnaire consisting of thirty-four items to assess the psychological, social and vocational effects of hearing loss in adults. They stated that this scale fulfilled the following objectives:

1) To provide an index of whether the organic hearing loss had manifested itself as a handicap.

2) To provide diagnostic data with rehabilitative implications

3) To provide for a detailed analysis of psychological, social and vocational problem areas.

McCarthy and Alpiner (1983) reported good internal consistency with a Cronbach's alpha of 0.81. The scale consisted of two forms that were designed to be answered by the patient and by a family member who may provide a different perspective of the patient's problem. A comparison of the responses helped the clinician in counseling the subject and the family members. Areas of disagreement reveal issues to be addressed in family counseling whereas the degree of agreement between the patient and various family members reveal facts about family dynamics (Demorest and Erdman, 1986).

Communication Profile for the Hearing Impaired (CPHI)

In connection with the rehabilitation program at Walter Reed Army Medical Center, Demorest and Erdman (1986, 1987) developed the Communication Profile for the Hearing-Impaired. This scale was constructed based on the rationale that the rehabilitative needs of hearing-impaired adults depended on the degree of communication handicap experienced and on many other factors such as environmental, behavioral, emotional and attitudinal. It was designed to provide a comprehensive assessment of the rehabilitative needs of hearing-impaired adults. It consisted of one hundred and forty- five questions that were divided into twenty-five scales. The scales encompassed four areas: communication performance, communication environment, communication strategies and personal adjustment. Some of its unique features included assessment of environmental factors, evaluation of communication importance, extensive description of personal adjustment and inclusion of scales designed to detect denial scales. This inventory differed from the other inventories in its emphasis on personal adjustment.

Based on the preliminary statistical data on the scales of Communication Profile for the Hearing Impaired for the Walter Reed population, Demorest and Erdman (1987), reported that when the scale length was taken into account, the scales compared favorably with other scales such as the Hearing Performance Inventory, the Hearing Handicap Inventory for the Elderly and the Hearing Handicap Scale. The internal consistency reliability, as assessed by Cronbach's alpha varied from 0.67 to 0.89 depending on the length of the scale. Erdman and Demorest (1998 a) analysed data from a heterogeneous clinical population which differed on audiometric measures, gender, race/ethnicity, educational level, employment, marital and hearing aid status. They reported that the internal consistency of the scales was higher than that reported by Demorest and Erdman (1987). This scale has been used extensively to study the adjustment to hearing impairment.

Hearing Screening Inventory (HSI)

Coren and Hakstain (1992) developed Hearing Screening Inventory (HSI) for group testing and survey administration. It consisted of twelve items and a five-point rating scale was used. Seven items were scored as one for 'never' or 'good' and five for 'always' or 'poor'. The other five items were scored as 'five' for never and one for 'always'. Internal consistency coefficient (alpha) was 0.89 and the test-retest stability coefficient was 0.88.

Summary

Thus over the years a number of self-report measures have been developed and field-tried. All the scales are intended primarily to provide information about the impact of hearing disability on the subject's ability to communicate effectively. A majority of the inventories included subsections that focussed on special aspects such as home environment, social environments and vocational settings. A few scales assessed only difficulty in communication whereas others included feelings and behavioral reactions associated with hearing handicap. The subject's responses were scored to enable intersubject comparison. Generally, a five-point rating scale has been used. However, Ewerstein and Birk-neilsen (1973) and Ventry and Weinstein (1982) recommended a three-point rating scale. Some of the scales such as Denver Scale of Communicative Function used a seven-point rating scale. Scales such as Hearing Handicap Scale, Quantified Denver scale, Social Hearing Handicap Index, Self Assessment of Communication/Significant Other Assessment of Communication, Hearing Handicap Inventory for the Elderly yielded one overall score for summarizing the total inventory. Almost all the scales can be used either as self-assessment tools or they may be administered by the clinician.

A few scales (Mc Carthy-Alpiner scale, Hearing Handicap Inventory for the Elderly, Self Assessment of Communication) have been modified to provide a second form to be administered to a family member so that the hearing handicap perceived by the hearing-impaired person and by the family members could be compared. The differences in attitude, if any, must be addressed and resolved through counseling.

The selection of a self-report measure involves careful consideration. Although several scales are available for self-assessment, there are a few comparative studies to suggest which scale performed the best. Tyler and Smith (1983) assessed hearing handicap using two questionnaires, the Social Hearing Handicap Index (Ewerstein and Birk-Nielson) and the Hearing Measurement Scale (Noble and Artherly, 1970). High correlation was observed between the Social Hearing Handicap Index and Hearing Measurement Scale but the former consistently suggested greater handicap than the later. They attributed it to the fact that Social Hearing Handicap Index emphasized on speech hearing whereas Hearing Measurement Scale provided a much broader context to determine the handicap.

Murlow, Tuley and Aguilar (1990) compared the performance of four different scales in ability to assess any change in the perceived handicap with hearing aid use and for screening hearing loss. The four scales included a long and short version of Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982, 1983) and long and short version of Revised Quantified Denver Scale of Communication (Tuley et al., 1990). They concluded that short version of Hearing Handicap Inventory for the Elderly and Revised Quantified Denver Scale were as accurate and sensitive for detecting a change in the perceived handicap as the long versions

In view of the dearth of studies comparing the usefulness of various scales, the choice of a self-assessment scale will depend on the population to be studied and the purpose of the investigation. Demorest and Walden (1984) suggested that the following three questions should be answered before adopting a self-assessment scale:

1) What is to be assessed?

2) Who is to be assesses?

3) Why is the information being obtained?

CORRELATES OF SELF-PERCEIVED HANDICAP

Self-perceived handicap is a complex phenomenon that is dependent on a number of factors. The factors that contribute to hearing handicap can be broadly classified into audiological and non-audiological correlates of self-perceived handicap.

AUDIOLOGICAL CORRELATES OF HEARTING HANDICAP

Researchers have tried to correlate the findings on audiological tests with scores obtained on self-assessment of hearing handicap (High et al., 1964; Berkowitz and Hotchberg, 1971; Speaks et al., 1970; Mc Cartney et al., 1976; Schow and Tannhill, 1977; Hawes and Niswander, 1985; Mathews et al., 1990; Jerger et al., 1990; Erickson-Mangold et al., 1992; Coren and Hakstain, 1992; Newman et al., 1997; Barrenas, and Holgers, 2000). Among the audiological measures, factors related to both peripheral hearing loss (High et al., 1964; Berkowitz and Hotchberg, 1971; Speaks et al., 1970; Mc Cartney et al., 1976; Schow and Tannhill, 1977; Hawes and Niswander, 1985; Mathews et al., 1990; Jerger et al., 1990; Erickson-Mangold et al., 1992; Coren and Hakstain, 1992; Newman et al., 1997) and central auditory dysfunction (Jerger et al., 1990; Chimel and Jerger, 1993) have been studied. These have been discussed here:

Peripheral Hearing Loss and Self-Perceived Handicap

Pure-tone sensitivity, speech identification and self-perceived handicap

Initial investigations focussed on studying the correlation of self-perceived handicap with sensitivity measures (pure-tone threshold and speech reception threshold) and speech identification in quiet. High et al. (1964) studied correlation between scores obtained on Hearing Handicap Scale (High et al., 1964) and audiological measures on fifty hearing impaired adults. The audiological tests included estimation of pure-tone thresholds, speech reception threshold, speech identification scores. A significant correlation (r=0.70) was obtained between the scores obtained on Hearing Handicap Scale and measures of auditory sensitivity for the subject's better ear. The results showed negligible relationship between scores obtained on Hearing Handicap Scale and speech identification measures. However, Berkowitz and Hochberg (1971) reported slightly different results. They also administered a battery of audiological tests along with the Hearing Handicap Scale (High et al., 1964). Their test battery included pure-tone audiometry, speech reception threshold, speech identification for words and sentences. Scores on the Hearing Handicap Scale showed moderate correlation with pure-tone average (average of 500 Hz, 1000 Hz and 2000 Hz) and speech reception threshold (0.57 and 0.56 respectively). The correlation with identification measures were very low, but statistically significant (-0.30 and -0.26)

Similar results were also reported by Speaks et al. (1970) and Schow and Tannhil (1977). Speaks et al. (1970) observed moderately high correlation between the scores for the Hearing Handicap Scale (High et al., 1964) and pure-tone sensitivity about 0.65) but the correlation was very low with measures of speech identification about 0.35). They further reported that using an index, which incorporated information about both hearing sensitivity and speech identification, yielded a correlation that was no higher than sensitivity measures alone. Schow and Tannhil (1977) administered the Hearing Handicap scale (High et al., 1964) on a sample of subjects with normal hearing (pure-tone average less than 10 dB)HL, borderline normal sensitivity (pure-tone average ranging from 11 dB to 25 dB)HL and those with mild to moderate hearing loss (pure-tone average between 27 dB to 65 dB)HL. The results revealed a high correlation between the handicap scores and pure-tone average (r=0.73) but low correlation between handicap scores and speech identification scores (r=0.20).

Investigations were carried out using other self-assessment scales and the results obtained again demonstrated that self-perceived handicap correlated better with pure-tone sensitivity than with a speech identification measure. Ewerstein and Birk-Neilsen (1973) reported a high correlation of 90% between the Social Hearing Handicap Index and the degree of hearing impairment. Weinstein and Ventry (1983 a) investigated the relationship between the scores obtained for Hearing Measurement Scale (Noble and Artherly, 1970) and the audiological findings in eight male veterans. Self-perceived handicap showed moderate correlation (0.5 to 0.62) with sensitivity measures but poorer correlation with speech identification scores. The correlation obtained between scores for PB-50 word list and the Hearing Measurement Scale was stronger than that obtained between the scores for W-22 and the Hearing Measurement Scale. Weinstein and Ventry (1983b) examined the audiometric correlates of hearing handicap as measured by the Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) in one hundred elderly subjects. Pure- tone testing and speech testing were carried out on all the subjects. A score of 16% or less on Hearing Handicap Inventory for the elderly was considered as no handicap, 17% to 42% a mild to moderate handicap and a score in excess of 42% was interpreted as a significant handicap. Analysis of the results demonstrated that the handicap score showed lower but significant correlation with supra threshold speech recognition ability than with sensitivity measures (r=0.38 to 0.45). Among the sensitivity measures, pure-tone average showed better correlation (0.58 to 0.62) than speech reception threshold (0.56 to 0.59). They observed that despite the significant correlation between audiometric variables and hearing handicap, more than 50% of the variance in self-perceived handicap remains unexplained by the audiometric variables studied. They concluded that there was a need to measure handicap using a self-report format rather than inferring hearing handicap from audiometric data.

Ericksson-Mangold, Hallberg and Erlandsson (1992) translated the Hearing Measurement scale (Noble and Artherly, 1970) into Swedish and administered the same on 122 Swedish subjects with slight to moderate hearing impairment. The results showed that handicap scores correlated with the degree of hearing loss, as measured with pure-tones. Earlier, similar findings were reported by Artherly and Noble (1971), Mc Carlney et al. (1976) and Noble (1979). Coren and Hakstain (1992) cross validated the scores obtained on Hearing Screening Inventory against pure-tone testing using 422 subjects. A high correlation of 0.81 was obtained between pure-tone thresholds in the better ear and the handicap scores.

To summarise, the correlation between the pure tone thresholds and self-perceived hearing handicap range from 0.5 to 0.8 whereas speech identification scores in quiet showed lower correlation (-0.3 to -0.6) with self- assessment scores. These results indicate that speech identification scores obtained in quiet conditions might be a poor indicator of performance in everyday listening situation.

Correlation of audiological measures with different subscales of a self assessment scale

Studies have also been carried out to investigate the relationship between audiologic measures and different subscales of a self-assessment scale. One such study was carried out by Mc Cartney, Maurer and Sorensen (1976) who compared the results obtained on Hearing Handicap Scale (High et al., 1964), Hearing Measurement Scale (Noble and Artherly, 1970) and audiological evaluation. Hearing evaluation included estimation of pure-tone thresholds, speech reception thresholds and speech identification ability at the most comfortable level. The self-assessment scales were randomly administered with half of the subjects receiving it before and the other half after the audiological evaluation. Self-perceived handicap as assessed from both the scales showed a significant correlation with the audiometric measures. Three of the seven sections of Hearing Measurement Scale displaying the highest correlation were emotional response, speech hearing and personal opinion. Handicap scores correlated better with pure-tone audiometry (0.62 for HHS and 0.52 for HMS) than with speech identification ability (0.44 for HHS and 0.40 for HMS).

In another study, Demorest and Walden (1984) analyzed data of 250 patients on whom Hearing Performance Inventory (Giolas et al., 1979) was administered. The scores obtained on each subscale were correlated with pure-tone thresholds and speech recognition scores. Among the subscales, speech, intensity, response to auditory failure and occupational subscales correlated significantly with pure-tone threshold in the better ear at 1000 Hz, 2000 Hz and 4000 Hz but the relationship was not strong. The highest correlation was with the intensity subscale (0.39). The same four scales showed significant correlation with speech recognition scores also. Further, it was observed that the speech scale was more highly correlated with speech recognition scores than with pure-tone sensitivity. The intensity subscale that included questions on awareness of signal showed higher correlation with pure-tone sensitivity than with speech recognition.

It can be concluded from these studies that the content of questions used in a scale/subscale determine the relationship between the handicap scores and audiological measures. The variations in the results of different studies can be partially explained by the content of the questionnaire used.

Different combinations of pure-tone average and self-perceived handicap

Even though self-perceived handicap showed higher correlation with pure-tone results than with speech reception threshold or speech identification measures, the variations in the scores obtained on self-assessment scale could not be completely explained. Hence research was carried out to explore the relationship of self-perceived handicap with different combinations of pure-tone average. Noble and

Arhterly (1970) reported that there was a consistent but not a close relationship between scores for Hearing Measurement Scale and the results of the audiological tests. Highest correlation was obtained for speech reception threshold for disyllables in free field followed by speech identification scores for monosyllables and high frequency pure-tone average. Habib and Hinchcliffe (1978) studied two samples (one in London, the other in Cairo) of patients who were suffering from an impairment of hearing and reported that the subjective magnitude of auditory handicap was significantly correlated to the average hearing level at 2000 Hz for the two ears.

Newman, Weinstein, Jacobson and Hug (1990) assessed the correlation between pure-tone sensitivity (based on speech frequency pure tone average and high frequency pure tone average of the better ear) and the scores obtained on the Hearing Handicap Inventory for the Adults. The results showed a weak but statistically significant correlation (r=0.29 to 0.35). But the difference in correlation for the two pure-tone averages was negligible (e.g. 0.34 Vs 0.33 for the total score). Correlation with word recognition scores were even poorer yet statistically significant (r=0.26 to 0.28). On the contrary Barrenas and Holgers (2000) reported that speech was more correlated to high than to mid frequency hearing thresholds whereas no such difference was observed in disability to recognise non-speech sounds.

Brainerd and Frankel (1985) explored the relationship between self-perceived handicap and audiometric data on 430 subjects. They used Denver Scale of Communicative Function and the Social Hearing Handicap Scale for self-assessment of hearing handicap. An overall measure of perceived handicap was obtained by combining the scores of the two measures. Based on pure-tone data, the percentage of handicap was calculated using different formulae. They reported a weak correlation between self-perceived handicap and handicap calculated through arithmetic formula. The highest correlation was observed between better ear pure-tone average (average of 500 Hz, 1000 Hz and 2000 Hz) and the combined scores for self-assessment scales. Also the better ear pure-tone average showed higher correlation with scores obtained on Social Hearing Handicap Index (r= 0.38) than on Denver Scale (r= 0.32). This may be attributed to the fact that the former focused on evaluation of communication through speech and the later focused more on emotional reaction of the subject to his hearing impairment.

Thus, results of a majority of studies show that correlation between better ear pure-tone thresholds and self-perceived handicap is higher than that observed between pure-tone thresholds of the poorer ear and handicap scores. There is no consensus regarding the effect of hearing loss at different frequencies on the self-perceived handicap.

Relationship of the self-perceived handicap with configuration and type of hearing loss

Attempts have also been made to study the relationship of the self-perceived handicap with the type of hearing loss and configuration of the audiogram. Lutman, Brown and Coles (1987) administered a self-assessment questionnaire to 1691 subjects in the age range of seventeen years to eighty-nine years. Best correlation was observed between handicap scores and binaural pure-tone average of 500 Hz, 1000 Hz and 2000 Hz weighted 4:1 in favor of better ear. Audiogram slope did not appear to be an important factor in self-reported disability. Type of haring loss was a highly influential factor for subjects whose hearing threshold was more than 40 dB HL in the better ear. Greater disability and greater handicap was reported by subjects with conductive/mixed hearing loss when compared to subjects with sensory-neural hearing loss.

Newman, Jacobson, Hug and Sandridge (1997) assessed self-perceived handicap in a sample of sixty-three patients ranging in age from eighteen years to sixty-four years. The subjects had either unilaterally normal hearing or bilateral mild hearing loss (pure-tone average less than 40 dB HL). Results revealed that subjects perceived hearing handicap even when the hearing threshold was by less than 40 dB HL. However, there was a large inter-subject variability among subjects indicating that individuals react differently to their hearing impairment. Newman et al. (1997) suggested that subjects with unilateral or mild hearing loss might be considered for audiologic rehabilitation, including at least patient-family counseling regarding communicative strategies and the option to evaluate the potential benefits from amplification.

Hustedde and Wiley (1991) investigated the relationship between self-perceived handicap and consonant-recognition ability. They studied self-perceived handicap using the Hearing Performance Inventory-Revised (Lamb et al., 1983) on subjects whose audiograms were similar but consonant error patterns were different. The results revealed that self-assessment of hearing handicap did not vary with consonant-recognition ability.

It can be concluded from these studies that even subjects with mild hearing loss experience handicap and should be considered for aural rehabilitation. Self-perceived handicap varies depending on the type of hearing loss but audiometric configuration does not affect the handicap scores. However, further studies are required to substantiate these findings.

Speech identification in noise and self-perceived handicap

In order to evaluate other factors besides pure tone threshold and speech

identification-in-quiet that might contribute to hearing handicap, some investigators have used speech identification-in-noise as a dependent variable. Mason and Asp (1976) investigated the relationship between the self-perceived handicap and identification scores on modified rhyme test administered in quiet and at + 5 dB signal-to-noise ratio with a reverberation time of 0.2 seconds and 0.5 seconds. Analysis of the results revealed a significant correlation between the self-assessed hearing handicap and identification scores only when the test words were presented at +5 dB signal-to-noise ratio with a reverberation time of 0.2 seconds. Rowland, Dirks, Dubno and Bell (1985) compared speech recognition performance in conditions of quiet and babble (Speech Perception in Noise Test) with the handicap scores for items from a self-assessment scale concerned with communication ability in quiet and noise ('Understanding Speech' section of Hearing Performance Inventory, Giolas et al., 1979). They found that performance on both the speech recognition and self-assessment tests differentiated between normal listeners and individuals with mild-to-moderate sensory-neural hearing loss. For the hearing-impaired group, correlation between speech recognition scores and ratings on the self-assessment items were poor, suggesting that performance measured with these tests have only a weak relationship.

Hawes and Niswander (1985) correlated the scores obtained on the revised Hearing Performance Inventory (Lamb et at., 1983) with hearing sensitivity and speech identification measures. The study was conducted on thirty-nine subjects with noise-induced hearing loss. Pure-tone average using five different combinations (average of 500 Hz, 1000 Hz and 2000 Hz, average of 500 Hz, 1000 Hz, 2000 Hz and 3000 Hz, average of 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz and 4000 Hz, average of 1000 Hz, 2000 Hz and 3000 Hz and average of 1000 Hz, 2000 Hz and 4000 Hz) and spondee threshold were considered for sensitivity measures. Speech identification was tested using CID W-22 word list at most comfortable level in quiet and in the presence of noise with a signal-to-noise ratio of +10 dB. The results indicated that the handicap scores correlated better with speech identification measures than with sensitivity measures. However, the difference between the two correlation was not statistically significant. Correlation of self-assessment scores with combined measures of sensitivity and identification was also studied. Social adequacy index (Davis, 1948) was determined by entering the identification scores and spondee threshold into the social adequacy index (SAI) table. Identification scores at most comfortable level in quiet, in the presence of noise and identification scores at 45 dB HL were used to calculate SAI-quiet, SAI-noise and SAI at conversational level respectively. Of these three variables, again SAI-noise correlated most highly with the self-perceived handicap scores. Hawes and Niswander (1985) attributed this relatively high correlation with speech identification measures to item content of Hearing Performance Inventory which was heavily weighted with items assessing understanding speech. Weinstein and Ventry (1983 b) reported that tests using less intelligible speakers showed higher correlation than tests of clearly articulated monosyllables. Based on a recent study on subjects with noise induced hearing loss, Barrenas and Holgers, (2000) reported that the handicap scores showed a stronger correlation to pure tone thresholds than to speech recognition scores in noise.

On the contrary it has also been reported that speech identification in noise and pure-tone thresholds show similar correlation with hearing handicap scales. Mathews, Lee, Mills and Schum (1990) compared the results of pure-tone audiometry, speech reception threshold in quiet and word identification scores in quiet and speech perception in noise (SPIN) with the scores obtained on the Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982). They also calculated the amount of handicap based on pure-tone threshold using an arithmetic formula. The results of their study indicated that pure-tone test results and SPIN test results were better predictors of HHIE total scores than word recognition scores or the amount of handicap calculated using arithmetic formula. However, the correlation coefficient was nearly the same for both pure-tone average and speech identification scores in noise (r= 0.39 to 0.63 for pure-tone average and r= 0.47 to 0.63 for SPIN). Earlier, Tyler and Smith (1983) had also reported similar results. In (heir study, (he performance on a task of sentence identification in the presence of noise showed high first-order correlation with scores on hearing handicap scales. They suggested that the intelligibility of sentences in the presence of noise might be a more appropriate task for uncovering handicap than word or synthetic sentences. However, the correlation obtained was not significantly higher than the correlation with pure-tone threshold. Also, further analysis showed that both the questionnaire and sentence identification in noise showed a high dependence upon pure-tone thresholds. Therefore, it is possible that the correlation between the questionnaire and the speech tasks was actually mediated by their common dependency on pure-tone thresholds.

Thus, it can be summarised From the results of these studies that speech identification in the presence of noise is more closely related to self-perceived handicap than speech identification in quiet. However, it does not explain the variation in self-perceived handicap better than that explained by hearing sensitivity.

Central Auditory Processing And Self-Perceived Handicap

The results of various studies indicated that, in general, the audiometric variances such as pure-tone sensitivity and speech identification measures accounted for less than half of the variance in handicap scores suggesting that the traditional hearing evaluation does not accurately reflect the client's perceptual difficulties. Therefore, research was carried out to investigate the effect of central auditory dysfunction on self-perceived handicap. Jerger, Oliver and Pirozzolo (1990) studied the impact of central auditory processing disorder and cognitive deficit on the self-asscssmcnl of hearing handicap nn 122 elderly subjects. All the subjects were tested using an audiological and a neuro-psychological test battery. Audiological test battery included pure-tone audiometry, tympanometry, and measurement of static compliance. Speech identification for PB words, speech identification for SSI list, speech perception-in-noise test and the dichotic sentence identification test were used to check the central auditory dysfunction. The Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) was administered using a paper-pencil method.

A neuropsychologist also examined the subjects to check for cerebral dysfunction and cognitive deficit. It was observed that the elderly subjects with symptoms of central auditory dysfunction rated themselves as more handicapped than did the subjects without symptoms of central auditory processing disorder. However, the cognitive status did not affect the self-perceived handicap.

NON-AUDIOLOGICAL CORRELATES OF HEARING HANDICAP

It has been suggested that variability in self-reported handicap scores may also be due to a number of extra-audiologic variables such as age, gender, socioeconomic status, personality, general health and life style (Noble, 1978). However, non-audiological correlates of hearing handicap have not been studied in depth and the results of the few studies reported are equivocal.

Ewerstein and Birk-Nielson (1973) observed that the duration of hearing impairment and the age of the subject did not affect the degree of hearing handicap whereas the capacity of speech-reading had a definite influence. Habib and Hinchcliffe (1978) also reported that the age and gender of the subject did not influence the estimation of the subjective magnitude of auditory handicap. Schow and Tannhill (1977) reported that age had only a small influence on HHS findings in their study. An anomalous effect of age was found, however, in an investigation by Lutman, Brown and Coles (1987). Analysis of the data obtained from subjects in the age range of seventeen years to eighty-nine years revealed that people with similar hearing impairment reported less disability and handicap as age increased. This was interpreted as over-compensation for the effects of age in a self-report. Separate analysis by hearing loss type indicated that this effect was evident in sensory-neural subgroup but not in the conductive/mixed subgroup. In the same study it was observed that socioeconomic status had no material effect on the self-perceived handicap score. Analysis of the results to study the effect of gender showed that only in the subgroup with sensory-neural sloping hearing loss, men had slightly higher disability/handicap scores than women. This was only partially explained by poorer high-frequency thresholds in men.

Berkowitz and Hochberg (1971) studied the relationship between self-assessment of hearing handicap as determined by the Hearing Handicap Scale and a battery of audiological tests in one hundred individuals ranging in age from sixty to eighty-seven years. The results suggested interdependence between age and gender. The relationship between self-perceived handicap and audiological measures were different for males and females and subjects in different age groups. However, a systematic relationship was not observed.

Gordon-Salant, Lantz and Fitzgibbons (1994) investigated the effects of age on self-perceived hearing disability among young and elderly people with comparable hearing sensitivity. Subjects with normal hearing sensitivity or mild-to-modcrate sloping sensory-neural hearing loss were considered for the study. The Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) was presented to the older subjects and the Hearing Handicap Inventory for Adults (Newman et at., 1990) was presented to the younger subjects. Statistical analyses revealed an interaction between age and hearing loss, in which younger subjects with hearing loss reported more handicapping effects of sensitivity loss than the elderly subjects with hearing loss. Gordon-Salant et al. (1994) reported that this age effect could not be attributed to differences in hearing sensitivity between the young and elderly subjects with hearing impairment. Gender effect was not considered in the study.

Gatehouse (1990) studied the effects of hearing threshold level, age, personality and intelligent quotient (IQ) on indices of self-reported disability/handicap, derived from the Hearing Performance Inventory (Giolas et al, 1979) and a Hearing Disability Questionnaire developed by the Medical Research Institute of Hearing Research, on a sample of 240 individuals in the age range of fifty to seventy-five years. All the subjects had bilateral, symmetrical sensory-neural hearing loss. The results showed significant effects of age, IQ, and, in particular, personality on many aspects of reported disability/handicap. Although an increase in the hearing threshold level led to an increase in disability/handicap, an increase in age led to a decrease. Also individuals with higher neurotic (anxious) scores reported greater disability for a given hearing threshold level and age. IQ variables also exhibited significant correlation with most of the disability/handicap measure. Further analysis revealed that contribution of these factors was different for males and females. It was observed that the contribution of age and IQ to disability/handicap indices was greater for males than for females whereas the contribution of personality aspects was greater for females than for males.

Gender difference in adjustment to acquired, mild-to-moderate hearing loss by older men and women were examined by Garestcki and Erler (1999) using the Communication Profile for the hearing impaired (Demorest and Erdman, 1986, 1987). Results revealed that when the socio-demographic and hearing variables were controlled, group responses to the majority of the scales did not differ significantly.

However, when compared to men, women assigned greater importance to effective social communication, were more likely to use nonverbal communication strategies, reported greater anger and stress, and reported of greater problem awareness and less denial associated with hearing loss.

In a study by Hallberg and Carlsson (1991), years of education showed a weak correlation with perceived handicap in the simple correlation matrix, but in the multiple regression analysis this factor was found to be a significant predictor of perceived handicap. The relationship was negative indicating that the lesser the education, greater the perceived handicap.

Marcus-Bernstein (1986) studied the contributions of audiological and non-audiological factors in one hundred elderly black individuals. Audiological evaluation comprised of pure-tone air and bone conduction testing, spondee threshold measurement and speech intelligibility evaluation under earphones. In addition, speech identification ability was also evaluated in sound field using W-22 word list and sentences, both, in quiet and in the presence of noise. The non-audiological factors were measured using the Multidimensional Functional Assessment questionnaire (MFAQ), a scale that assessed individual functioning on five dimensions: social resources, economic resources, mental health, physical health and activities of daily living. Self-perceived handicap as measured by the Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) and Hearing Handicap Scale (High et al., 1964) was significantly related to each of the audiological variables and the relationship was higher when speech identification was assessed at 50 dB HL in the sound field. However, audiological factors accounted for only 46% of scores on Hearing Handicap Scale and 23% of scores on Hearing Handicap Inventory for the Elderly. Both the handicap scales showed comparable relationship with the dimensions of social resources along with mental and physical health. The self assessed hearing handicap as measured by both the scales showed strongest relationship with the following dimensions: the affective, interaction and dependability dimensions of social support; the lethargy and satisfaction dimension of mental health; perceived economic status and subjective health status, in that general order. Once the hearing status was taken into account, three non-audiological factors (lethargy, dependability and paranoia) emerged as key predictor variables for both the scales. The non-audiological variables explained a greater proportion of the variance in the scores of Hearing Handicap Inventory for the Elderly than those of Hearing Handicap Scale. This may be explained by the nature of the questions used in the two scales. It may be recalled that the former has a situational and emotional subscale whereas the later does not assess the subject's reaction to handicap.

Adjustment to hearing impairment was studied, by Erdman and Demorest (1998 b), from a heterogeneous clinical database with results of audiological tests, demographic information, case history and responses to Communication Profile for the Hearing Impaired (Demorest and Erdman, 1986, 1987). Hierarchical regression analysis revealed that audiological measures were moderately correlated with communication performance, behavioral strategies and personal adjustment. With hearing impairment controlled statistically, age and education effects were evident in many areas of adjustment to hearing impairment. Correlation between adjustment and gender was relatively weak. Marital status, employment status and race/ethnicity were rarely significant correlates.

Thus, the results of the studies on effects of non-audiologicat findings on the self-perceived handicap show equivocal results. Also, non-audiological variables alone or in combination with audiological variables fail to account for the complete variability in the handicap scores.

ASSESSMENT OF HEARING HANDICAP BY SELF AND FAMILY MEMBER

A few self-assessment scales such as Nursing Home Hearing Handicap Index (Schow and Nerbonne, 1977), McCarthy-Alpiner Scale (Mc Carthy and Alpiner, 1983), Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) include a form to collect information from the family member or a significant other person regarding handicapping effects of hearing loss in a hearing-impaired individual. Studies have been carried out to compare the handicap perceived by the hearing-impaired individual and the family member or significant-other. Schow and Nerbonne (1977) administered Nursing Home Hearing Handicap Index (NHHI) on 105 residents of four different nursing homes and compared the scores obtained with the pure-tone average (average of 500 Hz, 1000 Hz and 2000 Hz). The analysis of the results revealed that the staff NHHI scores generally correlated better (r= 0.62) with pure-tone average than did self-NHHI scores (r= 0.49) indicating that the staff was more objective in such evaluations. They suggested NHHI scores of 40% or greater may be viewed as a symptom of serious handicap when reported by the resident or staff.

McCarthy and Alpiner (1983) administered McCarthy-Alpiner Scale to sixty adults with hcaring-impairment and their Family members. The results revealed an overall low level of agreement between the subjects and family members for items representing the psychological, social and vocational parameters. McCarthy and Alpiner (1983) suggested that the disagreement detected, provided valuable information for effective family counseling in the aural rehabilitation process. Similar results were obtained by Newman and Weinstein (1986) who administered Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) and Hearing Handicap Inventory for the Elderly-spouse version (Newman and Weinstein, 1986) in a face to face interview to thirty elderly hearing impaired males and their spouses. Pure-tone audiometry was then carried out on each hearing impaired subject. The results of the study indicated that the hearing-impaired individual tended to perceive their hearing loss as more handicapping than the spouses. There was moderate and statistically significant correlation between the two groups for the total score (r= 0.48) and social/situational scores (r= 0.45), but the relationship between the emotional subscale scores of the two groups was weak (r= 0.27). Further analysis revealed that for the group with normal hearing or mild loss in the better ear, the correlation coefficients was nearly the same for both subscales (r= 0.40 for emotional subscale and r=0.30 for social/situational subscale). In contrast, for those with moderate or severe hearing impairment, the social/situational subscale revealed a higher correlation coefficient (r= 0.53) than the emotional subscale (r= 0.22). The results suggested that situational problems encountered by a hearing impaired individual are more observable and therefore more easily identified by the spouse than the emotional responses.

Findings at variance with that of Newman and Weinstein (1986) were reported by Chimel and Jerger (1993). They compared the patient's self-assessment of hearing handicap with the assessment made by the patient's significant other. All the subjects included in their study had sloping audiograms with mild loss in the mid-frequency range. They administered the Hearing Handicap Inventory for the Elderly (Venlry and Weinstien, 1982) to all their subjects and the Hearing Handicap Inventory for the Elderly-spouse version (Newman and Weinstein, 1986) to the significant others. Audiological test battery included pure-tone audiometry, tympanometry and measurement of acoustic reflex threshold. The dichotic sentence identification test was carried out to assess the central auditory dysfunction. The results revealed a significant discrepancy between the handicap as reported by the patient and as reported by the significant other. The patients reported significantly less impairment than did their significant other. The analysis also revealed that the difference in handicap ratings were not affected by the degree of hearing loss but was affected by the pattern of hearing loss and by the presence of central auditory processing deficit. The significant others appeared to be more aware of the handicapping effects of the central auditory processing deficits than did the patients themselves.

Newman and Weinstein (1988) conducted a study in which eighteen elderly hearing impaired males and their spouses responded to the Hearing Handicap Inventory for the Elderly prior to and following one year of hearing aid use. Post fitting evaluation revealed that regardless of the severity of hearing loss, correlation between spouses' responses and that of the hearing impaired individual was statistically significant for total, emotional and social/situational subscales. However, the correlation prior to hearing aid usage did not achieve statistical significance suggesting that couples had different perceptions of the hearing-impaired individual's handicap. The post fitting correlation coefficients were higher (0.95 to 0.98) for hearing-impaired individuals with moderate to severe hearing impairment in comparison with unilateral hearing loss or mild hearing loss indicating that spouses had greater awareness of their partner's handicap as hearing loss increased.

Thus, the results of the various studies indicated that the spouse / family member can assess the communication problems faced by a hearing impaired individual especially when the degree of hearing loss is moderate or greater than moderate. The discrepancy in the assessment, if any is helpful in counseling the patient/family member.

SELF-ASSESSMENT OF HEARING HANDICAP AS A SCREENING TOOL

The use of self-report in screening for hearing impairment has received considerable attention by investigators (Lichtenstein, Bess and Logan, 1988; Murlow, Tuley and Aguilar, 1990; Newman et al., 1990; Schow, 1991; Ventry and Weinstein, 1983; Weinstein, 1986, Sever, Harry and Rittenhouse, 1989). It has been suggested that self-assessment scales be used as an adjunct to audiometric screening to improve the overall effectiveness of screening program. As self-report measures require no equipment and can be administered by those without specialized training, they can also be used for screening in places where facilities are not available for. hearing evaluation. Ventry and Weinstein (1983) developed a screening version of the Hearing Handicap Inventory for the Elderly (Ventry and Weinstein, 1982) and administered the inventory and pure-tone screening on 162 subjects. They suggested that a combination of pure-tone screening and handicap screening can be used to identify the people who require audiological intervention. Pure-tone screening was carried out at 40 dB HL at 1000 Hz and 2000 Hz. Those who did not hear either of the two stimuli in both ears or both stimuli in one ear failed the pure-tone screening. They described the following priority system to ensure that the people receive the necessary professional services:

	Handicap as assessed by HHHE-S	Pure-tone screening
Priority one	Significant handicap	Fail
Priority two	Significant handicap	Pass
Priority three	Mild handicap	Fail
Priority four	Mild handicap	Pass
Priority five	No handicap	Fail

Weinstein (1986) studied the sensitivity and specificity of screening program when Hearing Handicap Inventory for the Elderly-Screening version (Ventry and Weinstein, 1983) was used alone and when it was used along with pure-tone screening. They screened 106 elderly individuals using the criteria suggested by Ventry and Weinstein (1983). A complete audiological test battery was administered irrespective of the screening results. They observed that the sensitivity of the combined method was 85% and its specificity was 51%. In order to improve the sensitivity and specificity, the pass-fail criteria for HHIE-S was modified. According to the new criteria 0-10 was considered as pass, 10-24 as mild handicap and 26-40 as significant handicap. This revised criteria improved the specificity of the screening procedure to 64% while the sensitivity of the test did not change. In general, the specificity was highest when only HHIE-S was used for screening (83%) and sensitivity was highest while using the combined approach. Thus the results indicated that by using HHIE-S alone for screening, the number of false negatives could be reduced and by using the combined method the number of false positives could be reduced.

Garestecki (1987), who screened 200 individuals at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz, criticized the pure-tone screening procedure used by Ventry and Weinstien (1983) as it did not include a measure of hearing sensitivity beyond 2000 Hz. In this study, the pass-fail criteria were set differently for each test frequency to allow for age appropriate changes in pure-tone sensitivity. A criteria of 25 dB HL was used for 500 Hz and 1000 Hz whereas the criteria for 2000 Hz and 4000 Hz were 45 dB HL and 50 dB HL respectively. The Hearing Handicap Inventory for the Elderly-Screening version (Ventry and Weinstein, 1983) was used for self-assessment of hearing handicap. The results obtained were similar to those obtained by Ventry and Weinstein (1983) in that 71% of those who passed the screening test reported no handicap and 73% of those who failed the hearing screening reported some handicap. Thus irrespective of whether a pure-tone screening procedure incorporates a 40 dB HL pass-fail criteria for a frequency range of 500 Hz to 2000 Hz or an age appropriate hearing level criteria for 500 Hz to 4000 Hz frequency range, approximately 30% of those experiencing hearing difficulty will go undetected and 20-25% of those who fail the screening may not feel handicapped due to their loss.

Lichtenstein et al., (1988) evaluated diagnostic performance of the HHIE-S against five different definitions of hearing loss in 178 subjects. The definitions of hearing loss used were as follows:

1) Criteria of Ventry and Weinstein (1982, 1983): Subjects were considered as hearing-impaired if they had a hearing loss of 40 dB HL or greater for either 1000 Hz or 2000 Hz in both ears or if they had a 40 dB HL loss at both 1000 Hz and 2000 Hz in one ear.

2) Speech frequency pure-tone average (SFPTA): Subjects whose average hearing loss at 500 Hz, 1000 Hz and 2000 Hz was greater than 25 dB HL in the better ear were considered as hearing impaired.

3) High frequency pure-tone average (HFPTA): Subjects whose average hearing loss at 1000 Hz, 2000 Hz and 4000 Hz was more than 25 dB HL in the better ear were considered as hearing impaired.

4) Speech reception threshold (SRT): Subjects were considered as hearing impaired if the SRT in the better ear was equal to or greater than 25 dB HL.

5) Speech recognition: Subjects whose speech identification scores in quiet was less than 90% in the better ear were considered as hearing impaired.

Using cut off point of eight for HHIE-S scores, the sensitivity of HH1E-S for different criteria was as follows:

Criteria	Sensitivity	Specificity
Ventry and Weinstein criteria	72 %	77 %
SFPTA	66 %	79 %
HFPTA	53 %	84 %
SRT	62 %	72 %
Speech recognition	63 %	72 %

They concluded that HHIE-S was a valid test for identifying hearing impairment in the elderly irrespective of the audiometric definition used to diagnose hearing difficulties.

Bess et al., (1989) compared the associations of four of the above criteria (criteria of Ventry and Weinstein, SFPTA, HFPTA and SRT) with two functional outcome measures in 152 elderly individuals. The self-assessment scales used were a Sickness Impact Profile (SIP) to measure the global function and the Hearing Handicap Inventory for the Elderly-Screening version (Ventry and Weinstein, 1983). They observed that prevalence of hearing loss differed markedly depending on the criteria of hearing impairment chosen. Using HFPTA, 62% were considered as hearing impaired whereas only 35% were considered as hearing-impaired when SFPTA was used as the criterion. The prevalence was much lower when the other two criteria were used (30% using SRT and 29% using criteria of Ventry and Weinstein, 1983). However, there was considerable overlap among the four criteria.

The correlation between these criteria and the two functional measures was not the same. HHIE -S correlated best with criteria of Ventry and Weinstein (1982, 1983) followed by HFPTA whereas SIP correlated better with SFPTA. It was also observed that functional impairment increased with an increase in the number of criteria on which the subjects failed. The analysis of the results also revealed that hearing and communicative dysfunction were associated with global dysfunction.

Lichtenstein et al. (1990) carried out further research on 304 subjects to develop specific criteria of hearing impairment for the elderly population using the same functional assessment scales, the SIP and the HHIE-S. Using functional scales as standards, receiver operating curves were constructed for each frequency to select the threshold level that provided the best overall accuracy for categorizing persons as impaired or unimpaired. Analysis of the results showed that poorer ear thresholds were more closely correlated with functional measures than better ear thresholds. Therefore, the poorer ear thresholds were used to determine whether an individual was handicapped or not. Depending on the functional scale used, the frequencies and the threshold level chosen varied.

Poltl and Hickson (1990) investigated the hearing status and self-reported handicap using Hearing Handicap Inventory for the Elderly-Screening version (Ventry and Weinstein, 1983) in the elderly in-patients. They found that 80% of the subjects had pure-tone average of more than 25 dB HL in the better ear and 49% had a significant hearing loss (better ear pure-tone average more than 40 dB HL). They observed a significant correlation between audiologically assessed hearing loss and self-reported hearing handicap (r=0.38). Further analysis of their data showed that prevalence of hearing loss as measured with audiometry (80%) was greater than that reported by the resident themselves (41%). Based on these results they suggested that pure-tone testing is necessary to identify hearing loss as many patients may deny their hearing problem on a self-assessment scale. However, it may be noted that they used a strict definition of hearing loss (pure-tone average of less than 25 dB HL). A closer perusal of results showed that only 49% of the inmates had a significant hearing loss. So the results suggest hearing handicap was perceived only when the hearing loss was greater than 40 dB HL in the better ear. This supports the criteria used by Ventry and Weinstein (1983) for identifying a subject with hearing impairment. Similar suggestions were also made by Schow (1991). Based on the results of 13,000 patients, Schow (1991) concluded that the combination of a 25/30 dB HL pure-tone fence and a handicap screening will yield a very feasible strategy for hearing aid referral.

Jupiter (1989) conducted an investigation to determine whether an elderly person is more likely to proceed with a recommendation for hearing tests and, further, to use a hearing aid when both hearing sensitivity and hearing handicap are screened. The results of the study showed that it did not make a significant difference but slightly greater number of subjects purchased a hearing aid when both pure tone screening and handicap screening was used.

Schow et al. (1990) analyzed data obtained from hearing screening at health fairs over a period of four years to compare the sensitivity and specificity of three different scales in hearing screening. Pure-tone screening was done for all the subjects and self perceived handicap was measured using Rating Scale for Each Ear (Schein, Gentile, and Haase, 1970 as cited in Schow et al., 1990), Hearing Handicap

Inventory for the elderly - Screening version (Ventry and Weinstien, 1983) or Self Assessment of communication (Schow and Nerbonne, 1982). They reported that best overall sensitivity and specificity was obtained by Rating Scale for Each Ear. They opined that this is probably because this scale consisted of questions only relating to hearing problem and did not have questions about the effect of hearing problem on every day situations. They concluded that if self-assessment is used as a substitute for hearing screening, a self-assessment scale similar to Rating Scale for Each Ear should be used. If one wishes to find out the amount of handicap, a scale similar to HHIE-S can be used. They also cautioned that the prevalence of hearing loss may be low when a self-assessment scale is used since some individuals with hearing impairment deny their problem.

Thus, a review of literature shows that self-assessment of hearing loss is an useful adjunct in audiological test battery. Audiological and non-audiological variables fail to account completely for the variability in the self-perceived handicap scores but they are not completely independent of each other. The main factor, which determines the self-perceived handicap scores, is the hearing sensitivity of an individual. Hence it is possible to predict the degree of hearing loss based on the self-perceived handicap scores.

CHAPTER III

METHODOLOGY

SUBJECTS

Males and females ranging in age from eighteen years to eighty years, randomly selected among native speakers of Kannada, served as subjects. The subjects were grouped into three categories based on their age and hearing impairment.

Group-I included thirty young adults (fifteen males and fifteen females) in the age range of eighteen to forty-eight years (mean age = 35.5 years). Only those subjects who met the following criteria were included in this group:

* Pure tone thresholds equal to or less than 25 dB HL (ANSI, 1989) in the frequency range of 250 Hz - 8000 Hz in both the ears
* 'A' type tympanogram in both ears.
* No history of any otologic abnormality or neurological problem

Group - II included thirty-five adults (eighteen males and seventeen females) in the age range of eighteen to fifty years (mean age = 36.5 years). Subjects who met the following criteria were included in this group:

* Pure tone average in the range of 26 dB HL to 80 dB HL in the better ear.
* An air-bone gap equal to or less than 10 dB HL in both ears.
* 'A' type tympanogram in both the ears.

* No history of known neurological problems

* Not a hearing aid user

Group - III included forty geriatric subjects (twenty males and twenty females) in the age range of fifty-one years to eighty years (mean age = 66.35 years). Other criteria for inclusion of subjects were same as that for group -II.

Demographic characteristics

Figure l(a, b, c) showing the demographic characteristics of subjects in different groups indicates that a heterogeneous sample was included for the study. As depicted Figure 1 (a), among thirty subjects in group I, two-third of the subjects were from the urban area and one third were from the rural area. A majority of the subjects included in the hearing impaired groups were also from urban area (twenty in group II and twenty-three in group III).

It can be observed from Figure 1 (b) that the educational background of the subjects also varied. Based on the educational background, the subjects could be grouped into three categories, namely, those who were graduates or post-graduates, those with less than tenth standard education and those with less than seventh standard education. Group I consisted of fifteen graduates or post-graduates, ten with education of less than tenth standard and five whose educational background was less than seventh standard. Group II had fifteen subjects with less than seventh standard education and ten subjects each in the other two categories. Group III had almost equal number of subjects in all the three categories.

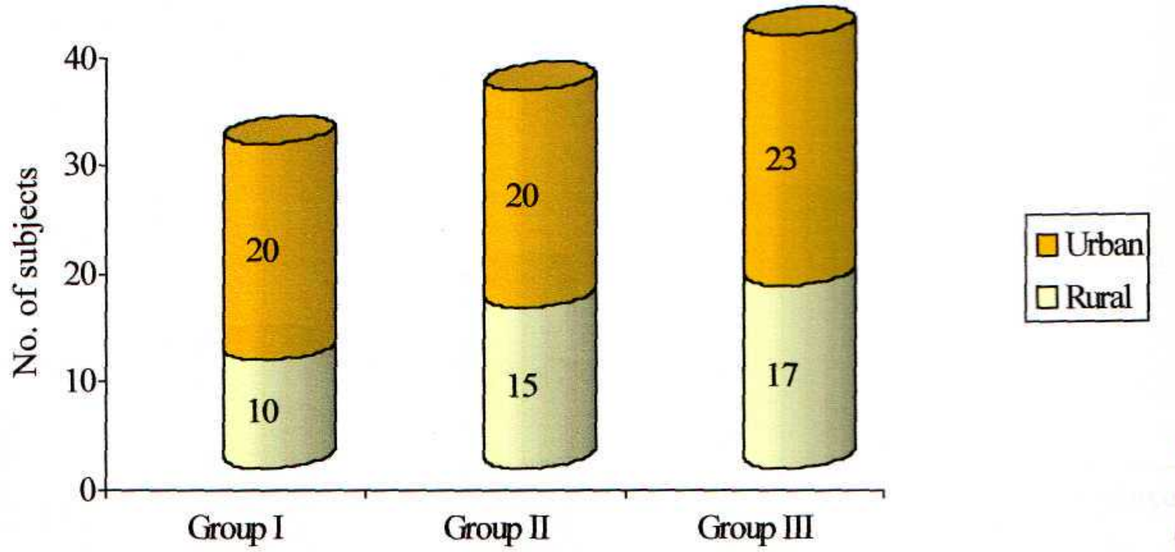


Figure 1(a): Demographic characteristics of subjects: Rural/Urban

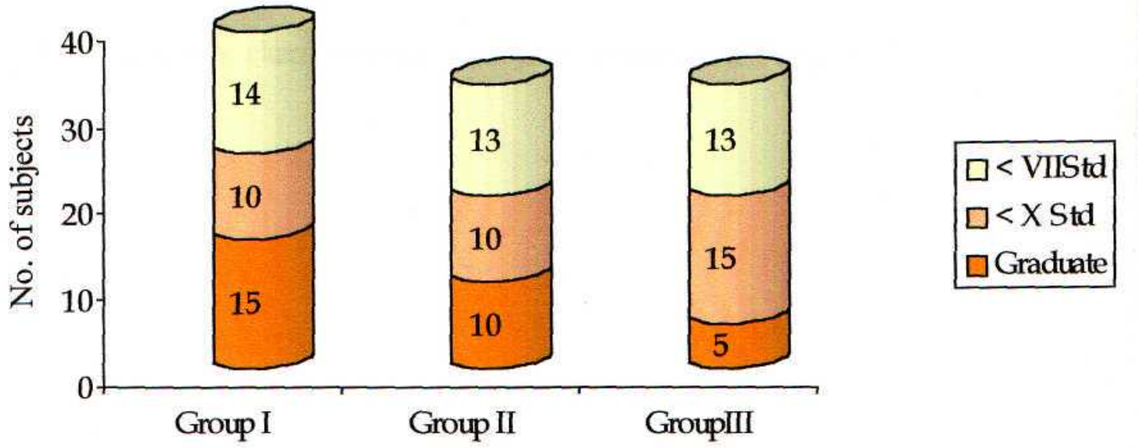


Figure 1 (b): Demographic characteristics of subjects: educational background

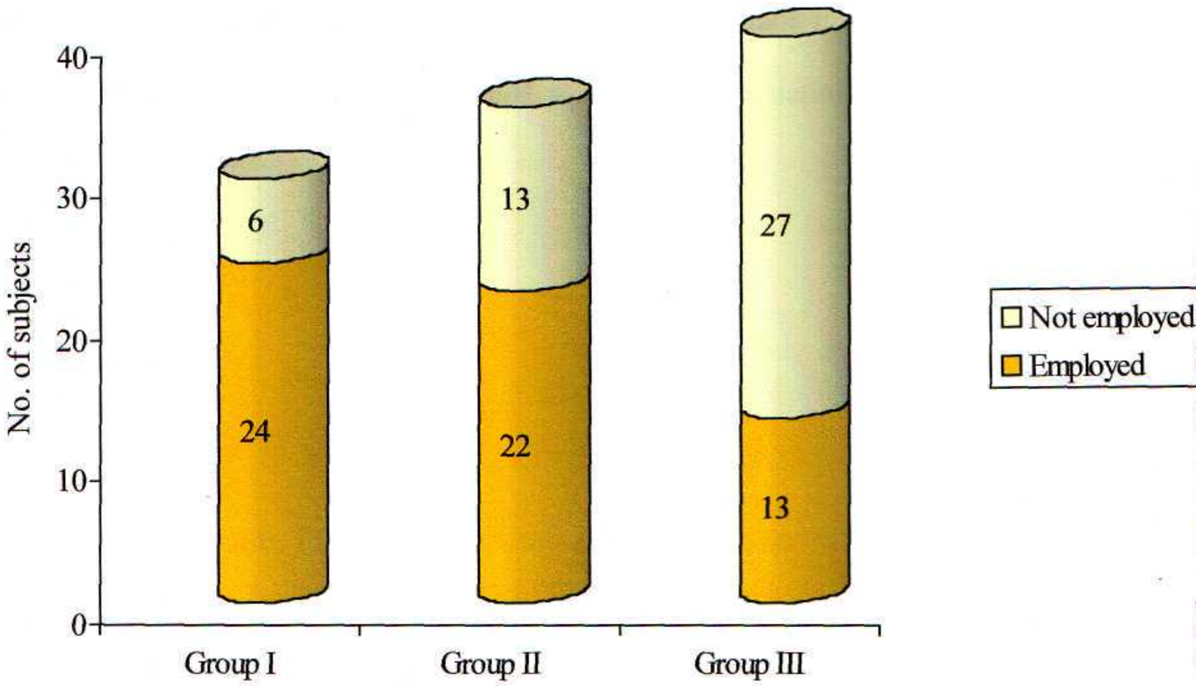


Figure 1 (c): Demographic characteristics of subjects: employed/not employed

A perusal of Figure 1 (c) shows that a majority of the subjects in group II and I, were employed (twenty-four in group I and twenty-two in group II). Most of the subjects in group III had retired.

PROCEDURE

The study was carried out in two phases. Phase -I consisted of development of a scale for self-assessment of hearing handicap and face-to-face interview to record self-perceived handicap scores. In Phase-II audiological evaluation was carried out for all the subjects.

PHASE-I

Test material

A questionnaire for self-assessment of hearing loss was developed in Kannada, the local language, belonging to the Dravidian language family. The individual's difficulty in hearing both verbal and non verbal stimuli were assessed. The fifty items in the questionnaire assessed the hearing handicap of the individual in various situations such as familiar / unfamiliar, noisy / quiet, with / without visual clue.

The questions were chosen based on the review of the literature, the experience of the professionals in the field and the communication needs of the individual in the Indian context. The questionnaire was evaluated by five audiologists and five laymen to check if the questionnaire elicits information regarding difficulties experienced by the hearing-impaired individual. Amended questionnaire was Field tried on equal number (ten) of subjects with and without hearing loss to check for ambiguity. Those questions that were ambiguous were modified. A copy of the questionnaire and its English equivalent is given in Appendix I.

Test Procedure

Initially a detailed case history including information regarding age, literacy, occupation (past/present) and socioeconomic status was taken for all the subjects. For subjects in Group II and III information regarding onset of hearing loss, duration of hearing loss and associated problems was collected.

An interview in Kannada, the language of the subject was conducted to measure the self-perceived degree of handicap. A three-point rating scale was used to quantify the answer given to each question. A score of zero indicated no handicap and a score of two indicated maximum handicap. The score obtained were converted into percentage.

PHASE-II

Audiological evaluation included pure tone audiometry, speech audiometry and immittance evaluation.

Instrumentation

The following instruments were used:

1. A calibrated two-channel clinical audiometer (Madsen OB822) with a headset (TDH 39 housed in MX-41/AR ear cushions) and a bone vibrator (Radio ear B-71)

2. A Stereo cassette player (Philips AW 606). The output of the tape recorder was given to the input of the audiometer. The output of the audiometer was given to the earphone.

3. A calibrated middle ear analyser, GSI33 (version 2)

The instruments were calibrated to ensure valid results. The procedure used for calibration is given in the Appendix-II.

Test environment

All the testing was carried out in a two room test cum control combination. The noise level in the test room measured using a sound level meter (B & k 2209) with an octave filter set (B & K 1613) and a free-field microphone (B & K 4155) is given in Appendix III.

Test material

Paired words in Kannada were used to establish speech reception threshold. Bisyllables in Kannada (Srilatha, 1983) were used for speech identification test. The list of words used for speech identification test is given in Appendix - IV.

A female speaker proficient in Kannada recorded the speech stimuli on a cassette tape using a cassette tape deck. She was given sufficient training to monitor her voice such that the VU meter needle peaked to a constant point while she repeated the test words. The carrier phrase /i:ga he:li/ was said prior to each paired word and bisyllable. A calibration tone was recorded at the beginning of each word list. The intensity level of the carrier phrase was maintained such that the VU meter deflection was within 1 dB as that produced by a 1000 Hz calibration tone on the tape and the test stimulus was allowed to flow in a natural manner. After each paired-word a gap of five seconds was given and between each successive bisyllables, a silent interval of eight second was maintained.

Test procedure

The following tests were carried out for all the subjects:

Immittance evaluation: Immittance evaluation included tympanometry and measurement of acoustic reflexes threshold. Air pressure in the external ear was varied from +200 da Pa to -400 da Pa to obtain a tympanogram. Both ipsilateral and contralateral acoustic reflex thresholds were established for frequencies 500, 1000, 2000 and 4000 Hz.

Pure tone audiometry : Pure tone audiometry included estimation of air-conduction and bone-conduction thresholds. The following instructions were given to the subjects prior to the administration of the test:

"You will hear a sound through the headphones. The sound will be first presented to one ear and later to the opposite ear. Each time you hear the sound raise your finger. The sound will get softer and softer. Raise your finger even when the sound is very soft".

Air-conduction and bone-conduction thresholds were established for all the subjects using the modified Hughson-Westlake procedure (Carhart and Jerger, 1959). Air-conduction threshold was assessed at octave intervals from 250 Hz to 8000 Hz. Bone conduction thresholds from 250 Hz to 4000 Hz were established. The better ear was tested first. Equal number of right and left ears were tested first when the better ear of the subject was not known. The non-test ear was masked whenever indicated. Special tests were carried out, whenever indicated, torule out retrocohlear pathology.

Pure-tone average of the better ear and poorer ear was calculated based on the respective thresholds at 500, 1000 and 2000 Hz. Binaural percentage of hearing handicap was calculated using the formula given by American Academy of Optholmology and Otolaryngology (1959) (as cited in Ncwby and Popclka, 1992). This formula was chosen as the percentage of hearing handicap calculated is based on the thresholds at frequencies that are routinely used for audiometric testing. Percentage of hearing impairment was computed for each ear separately by averaging the air conduction thresholds at 500, 1000 and 2000 Hz, subtracting 26 dB from this average and multiplying the remainder by 1.5%. The binaural percentage of impairment was computed by multiplying the percentage impairment for the better ear by five, adding this product to the percentage impairment of the poorer ear and dividing this sum by six.

Speech audiometry: Speech audiometry included estimation of speech reception threshold, speech identification in quiet and speech identification in noise.

a) Speech reception threshold: Speech reception threshold was established using Kannada paired words. The subjects were instructed as follows:

"You are now going to hear some words. Please repeat the words you hear. The words will be comfortably loud at first, but they will get softer and softer. Sometimes you may not be sure of what you heard. But try to guess and repeat whatever you think you heard".

To obtain speech reception threshold, four words were presented at 20 dB sensation level (re: pure tone average). The intensity was then decreased in 10 dB steps and increased in 5 dB steps to find out the minimum intensity at which the subject could repeat 50% of the words.

b) Speech identification in quiet: Using Kannada bisyllables, speech identification ability in quiet was carried out at 40 dB SL (re: speech reception threshold). If the speech reception threshold of a subject was more than 60 dB HL, speech identification score was obtained at 100 dB HL. Care was also taken to ensure that the testing was done at an intensity that was below the subject's uncomfortable level. The subjects were instructed to give oral/written responses. The number of correct responses was converted into a percentage.

c) <u>Speech identification in noise</u>: The speech identification score was recorded in the presence of speech noise with a signal-to-noise ratio of 0 dB, +10 dB and +20 dB. Eventhough speech in the presence of multi-talker babble represents more closely the speech understanding in everyday listening situation than speech in the presence of speech noise, the later was chosen as this facility is available in a majority of the audiometers. The signal was presented at the same intensity at which speech identification in quiet was done. The subjects were instructed to ignore the noise and repeat/write the words they heard. The number of correct responses was converted into a percentage.

The data obtained was tabulated and subjected to statistical analysis. The results of the study are discussed in the following chapter.

CHAPTER IV

RESULTS

The data collected from one hundred and five subjects who were categorized into three groups, namely, normal hearing adult, hearing-impaired adult and hearing-impaired geriatric subjects was analysed using Statistical Package for Social Sciences (SPSS 7.5 windows version).

The analyses carried out included:

1. Computation of mean and standard deviation for all the audiological measures and self-perceived handicap scores.
2. Principal component analysis (Dunteman, 1994) and item analysis (Demorest and Walden, 1984) of the questionnaire
3. Pearson product-moment correlation (Aron and Aron, 1994) to study the relationship of audiological and non-audiological variables with the perceived handicap.
4. Analysis of Variance - ANOVA (Aron and Aron, 1994) to study the main effects of age, gender and degree of hearing loss and their interaction on self-perceived handicap.
5. Regression analysis (Lewis- Beck, 1993)

   a) to find out the best predictor/s of the self-perceived handicap.

   b) to obtain a regression equation to predict hearing loss from self-perceived handicap.

Descriptive statistics

The results of descriptive statistics, mean, standard deviation and range of audiological measures of normal hearing adults, hearing impaired adults and hearing impaired geriatrics is summarised in Table I. A perusal of Table 1 indicates that audiological characteristics of subjects of Group II and Group III were comparable but differed from that of adults with normal hearing. The pure-tone average and speech reception threshold of the hearing impaired group (both Group II and Group III) was higher than that of normal hearing adults (Group I). Speech identification scores for hearing impaired individuals were poorer than those of the normal hearing adults. Speech identification in the presence of noise was affected more for hearing impaired individuals with scores reaching almost zero percent when the signal-to-noise ratio was OdB.

As expected, the self-perceived handicap score for the hearing impaired group was higher than that for the normal hearing subjects The scores ranged from zero to seven with a mean of 2.23 and a standard deviation of 1.98 for Group I. The mean handicap score was 49.13 with a standard deviation of 26.95 for Group II. Group III had a mean score of 53.25 with a standard deviation of 23.86.

Table 1

Mean and standard deviation (S.D.) for audiolosical measures of subjects with hearing impairment

	Group I				Group II				Group m			
	Right ear		Lefts;ar		Better ear		Poorer ear		Better ear		Poorer ear	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Pure tone average	13.73	3.31	13.84	3.85	50.38	16.70	58.89	18.50	50.41	15.83	61.51	14.58
Speech reception threshold	13.33	3.30	13.08	3.34	47.29	15.91	52.88	16.89	49.15	13.17	60.13	16.67
Speech identification score (quiet)	100	0	100	0	85.95	18.68	80.25	26.13	84.38	16.38	75.79	23.47
Speech identification score (S/N ratio of 20 dB)	99.67	1.83	98.33	4.6	64.72	25.35	57.94	26.58	62.88	22.50	47.89	24.68
Speech identification score (S/N ratio of 10 dB)	92.67	7.85	87.00	11.11	43.33	26.51	35.29	27.01	33.25	23.95	23.55	18.99
Speech identification score (S/N ratio of OdB)	64.63	18.75	58.17	11.78	10	3.45	0.59	2.46	5.38	12.37	1.71	4.96

Note: Pure tone average and speech reception thresholds are in dB HL and speech identification scores are in percentage.

Principal Component Analysis

Principal component analysis with varimax rotation revealed a six factor solution. Table 2 shows the eigen value, percentage of variance explained by each factor and the cumulative percentage of variance that could be explained. These six factors explained 78% of variance in the total score.

Table 2

Eisen values of principal components and percentage of variance explained

Principal Component	Eigen Value	% of Variance Explained	Cumulative %
1	16.44	32.89	32.89
2	8.29	16.58	49.46
3	6.26	12.51	61.96
4	4.15	8.31	70.29
5	2.34	4.72	75.01
6	1.76	3.52	78.53

Questions were grouped into the six factors based on their factor loading. Only those questions that had a factor loading of greater than 0.45 were included. All the questions except one had a loading of more than 0.45 in only one factor indicating that factors were mutually exclusive. The composition of different factors were as follows:

* Factor one (Table 3), which consisted of twenty-six questions, accounted for 32.88% of the total variance. These questions could be grouped under the heading 'speech understanding'.
* Factor two (Table 4) encompassing twelve questions explained 16.58% of variances in the handicap scores. The questions grouped under this factor elicited information regarding awareness of speech and non-speech signals.
* Factor three (Table 5) comprised of eight questions related to emotional aspect. This factor accounted for 12.51% of variance.
* Factor four included two variables dealing with speech understanding with visual clues and recognition of familiar voice.
* Factor five had just one variable with a factor loading of 0.70. However, the same question had a loading of 0.48 with factor two. As the item dealt with the awareness of signals, it was included in factor two instead of factor five.
* Factor six consisted of two of the questions pertaining to localization of signals.

Table 3

Composition of Factor 1

Question No.	Content of the question	Factor Loading
l.a	Conversation with a family member seated beside	0.61
l.b	Conversation with a familiar man from a distance of 6-8 Feet	0.76
l.c	Conversation with a familiar woman from a distance of 6-8 feet	0.75
l.d	listening to a family member speaking in a normal tone of voice from 10-12 feet	0.85
l.e	Conversation over telephone	0.55
l.f	Watching T V program from a distance of 6-8 feet	0.8
1-g	Watching T V news from a distance of 6-8 feet	0.79
l.h	listening to radio from a distance of 3 feet	0.66
1.I	Watching T V program from a distance of 6-8 feet in the presence of noise	0.75
l.j	Conversation with a bus conductor in a crowded bus	0.75
l.k	Conversation with a friend standing beside in a crowded railway platform	0.78
1.1	Conversation with a sales man in a busy shop	0.67
l.m	Listening to public speech from a distance of 6-8 feet from the loudspeaker	0.55
l.n	Conversation with a friend in a restaurant	0.5
1.0	Conversation in a social gathering e.g. wedding hall	0.74
l.p	Conversation while walking in a busy street	0.74
l.q	Conversation with a person seated beside (in the presence of noise)	0.75
l.r	Watching a movie in a theater	0.6
l.s	Listening to whispering from a distance of 6 inches	0.76
l.t	Conversation in quiet - outdoors	0.59
l.u	Conversation with visual clues	0.68
2	Turning down the volume of T V or radio before carrying out a conversation	0.64
3	Understanding speech in a group conversation	0.68
4	Understanding speech when several people are talking at the same time in a large room	0.74
5	Understanding speech when somebody speaks slowly	0.75
6	Asking for repetition when people speak	0.68

Table 4

Composition of Factor 2

Question No.	Content of the question	Factor Loading
18. a	iearing a telephone ring in a quiet room from a distance of 6 - 8 feet	0.79
18. b	bearing a knock on the door in a quiet room from a distance of 6 - 8 feet	**0.67**
18. c	bearing a dog bark in a quiet room from a distance of 6 - 8 feet	0.48
18. d	Hearing sounds of footsteps in a quiet room from a distance of 6 - 8 feet	0.45
18. e	Hearing a tap running in a quiet room from a distance of 6 - 8 feet	0.61
18. f	Hearing **the** hiss of a pressure cooker in a quiet room from a distance of 6 - 8 feet	0.79
19. a	Hearing a bus horn in a quiet situation from a distance of 10 - 12 feet	0.74
19. b	Hearing a telephone ring in a quiet situation from a distance of 10 - 12 feet	0.7
19. c	Hearing the hiss of a pressure cooker in a quiet situation from a distance of 10 - 12 feet	0.71
20	Hearing somebody calling you in a quiet situation from a distance of 6 - 8 feet	0.56
21	Hearing somebody calling you in a quiet situation from a distance of 10 - 12 feet	0.67
22	Hearing somebody calling in the presence of noise	0.5

Table 5

Composition of Factor 3

Question No.	Content of the question	Factor Loading
io	Avoiding conversation with people because of hearing loss	0.71
11	Hesitating to meet people because of hearing loss	0.77
12	Feeling left out of a group of people	0.73
13	Listening to TV/radio less often because of hearing problem	0.58
14	Frustration as it is difficult to understand speech	0.68
15	Family members getting annoyed	0.58
16	Feeling that people leave you out of conversation because of hearing problem	0.58
17	Family members getting annoyed because of the volume of TV/Radio	0.51

Thus, the results revealed that the first three factors explained 61.96 % variance of the total score. The last Ihrcc variables accounted lor a relatively lower amount of variability. The scree plot (Cattell, 1966 cited in Dunteman, 1994) indicated almost a straight line after factor three. Therefore, the first three factors were considered as the major factors.

Pearson product-moment correlation was established to evaluate the relationship between the total scores obtained for each of these major factors with the total scores obtained for the questionnaire. As evident from Table 6, there was a significant correlation between scores obtained for each of these factors and the total score. The factors also correlated with each other.

Table 6

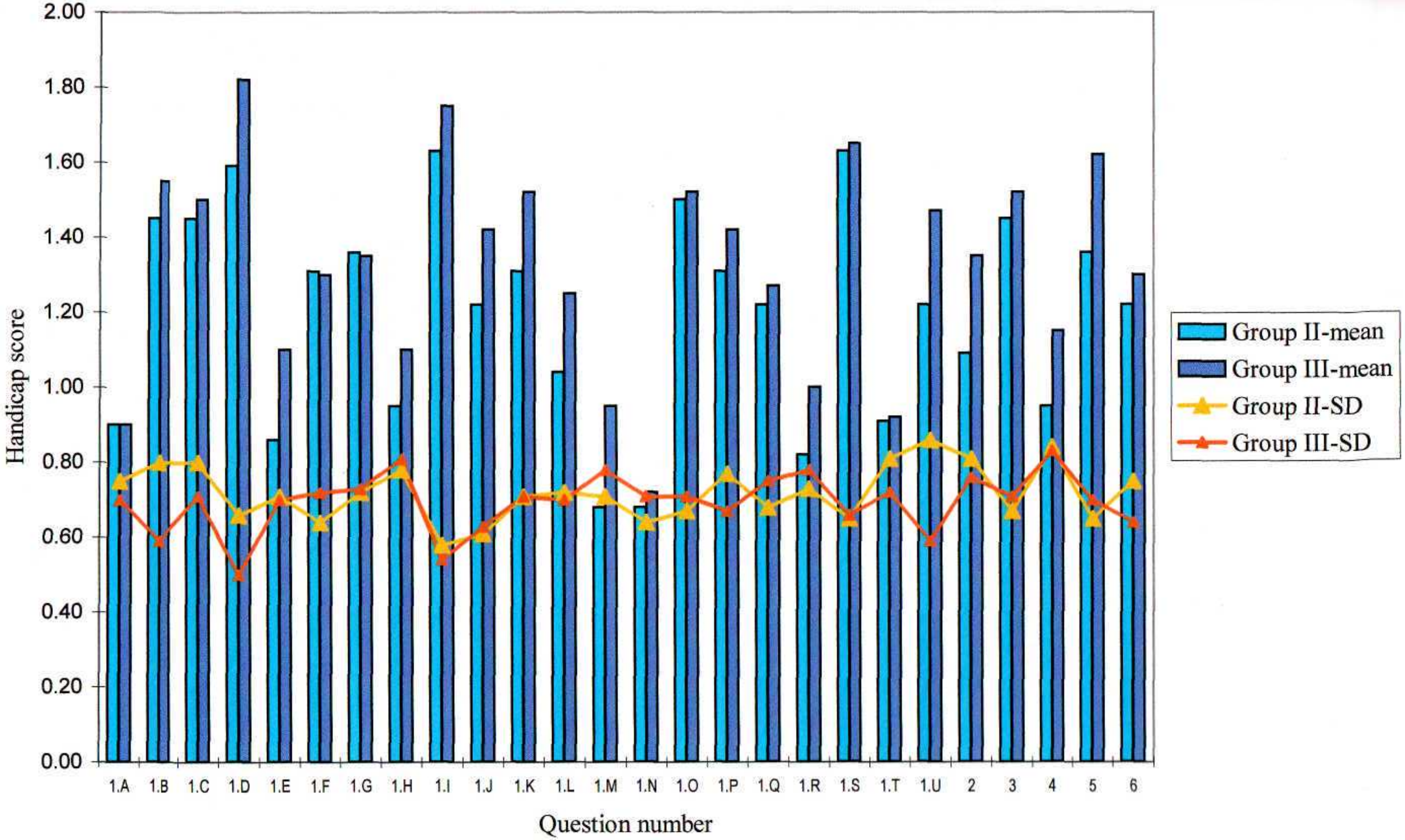
Results of correlation matrix

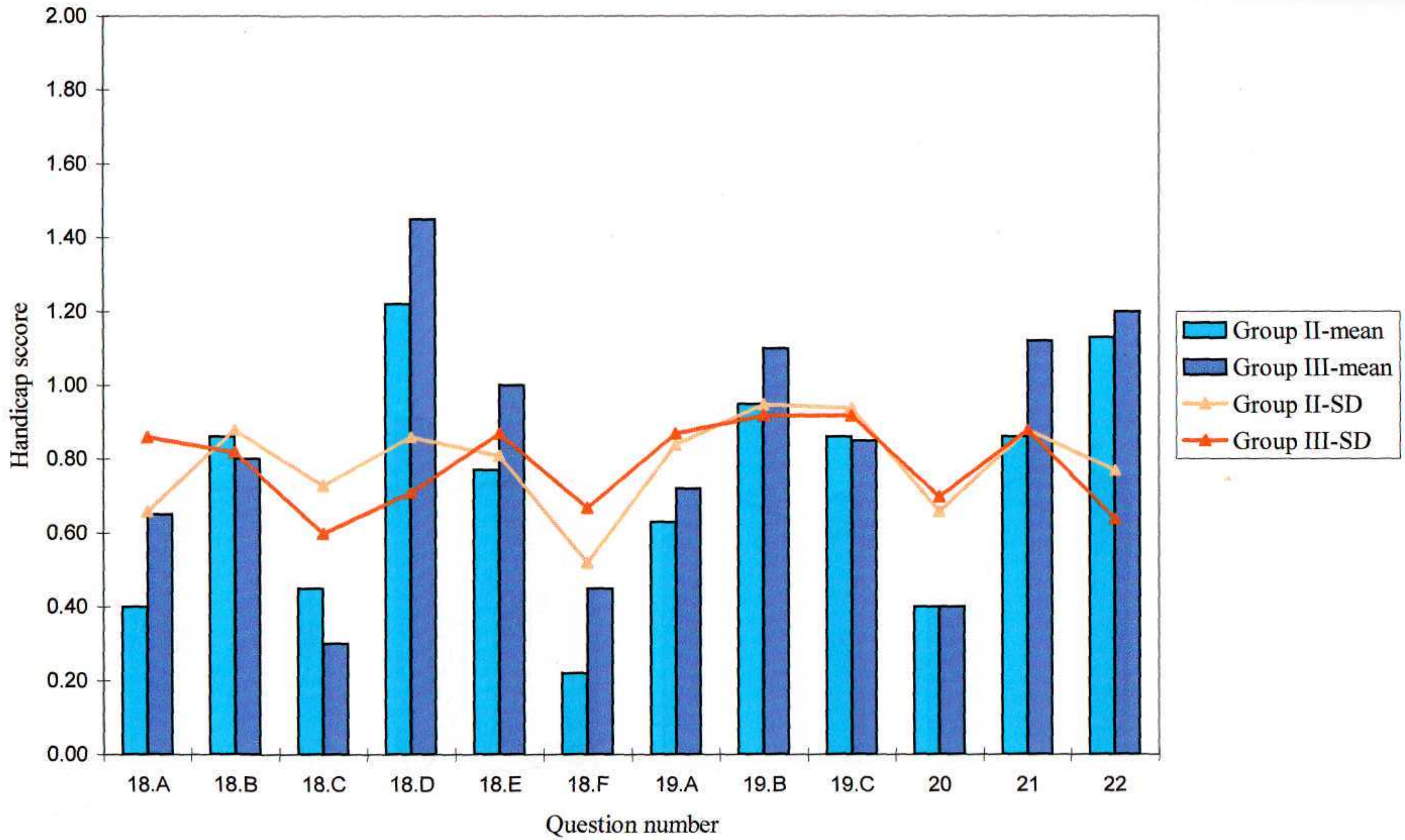
	Factor 1	Factor 2	Factor 3
Total score	**0.93**	0.86	**0.81**
Factorl		**0.70**	0.68
Factor 2			0.60

Results of Item Analysis

Item analysis carried out on the data obtained from the subjects belonging to Group H and HI yielded a Cronbach's alpha of 0.97 indicating high internal consistency. The mean and standard deviation obtained for individual items is presented in Figure 2 (a, b, c and d). A perusal of the figures shows that the mean score for individual questions ranged from 0.5 to 1.5 for a majority of the items for both Group II and Group III. The standard deviation for all the items except one was more than 0.5.

A high mean value (greater than 1.5) was obtained for questions relating to understanding speech without visual clues from a distance of ten to twelve feet, watching television news/program from a distance of six feet in the presence of noise, understanding speech in the presence of noise (e.g. in a wedding hall), listening to a whisper from a distance of six inches, and group conversation (questions l.d, l.i , l.s, l.o and 5). Questions that elicited information regarding understanding speech with visual clues from a distance of three feet, awareness of non speech signals such as dog barking and hiss of a pressure cooker from a distance of six to eight feet (questions l(v), 18 (c), 18 (f)), had a low mean value (less than 0.5).


Handicap score
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.A
1.B
1.C
1.D
1.E
1.F
1.G
1.H
1.I
1.J
1.K
1.L
1.M
1.N
1.O
1.P
1.Q
1.R
1.S
1.T
1.U
2
3
4
5
6
Question number
Group II-mean
Group III-mean
Group II-SD
Group III-SD



2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Handicap sccore
18.A
18.B
18.C
18.D
18.E
18.F
19.A
19.B
19.C
20
21
22
Question number
Group II-mean
Group III-mean
Group II-SD
Group III-SD

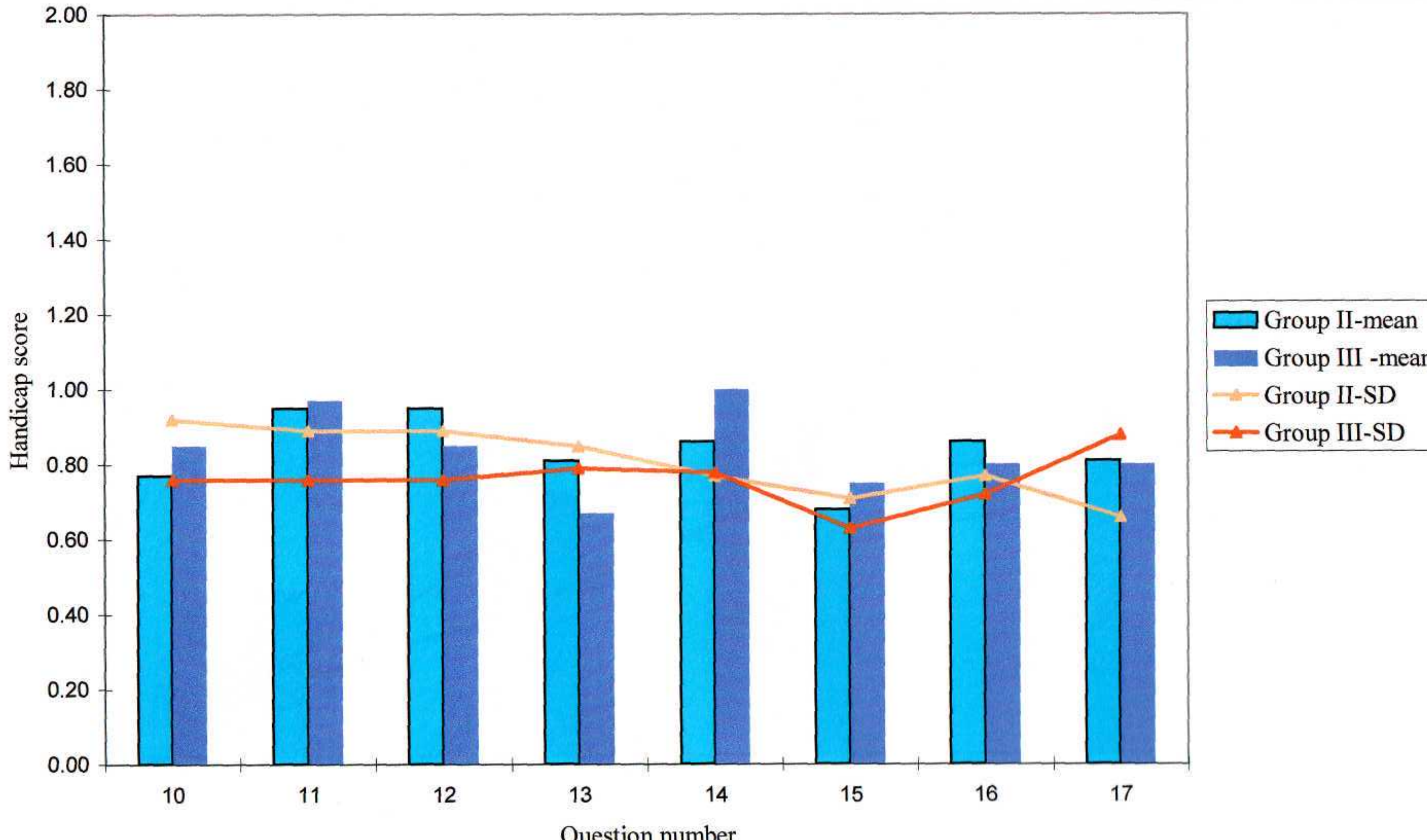
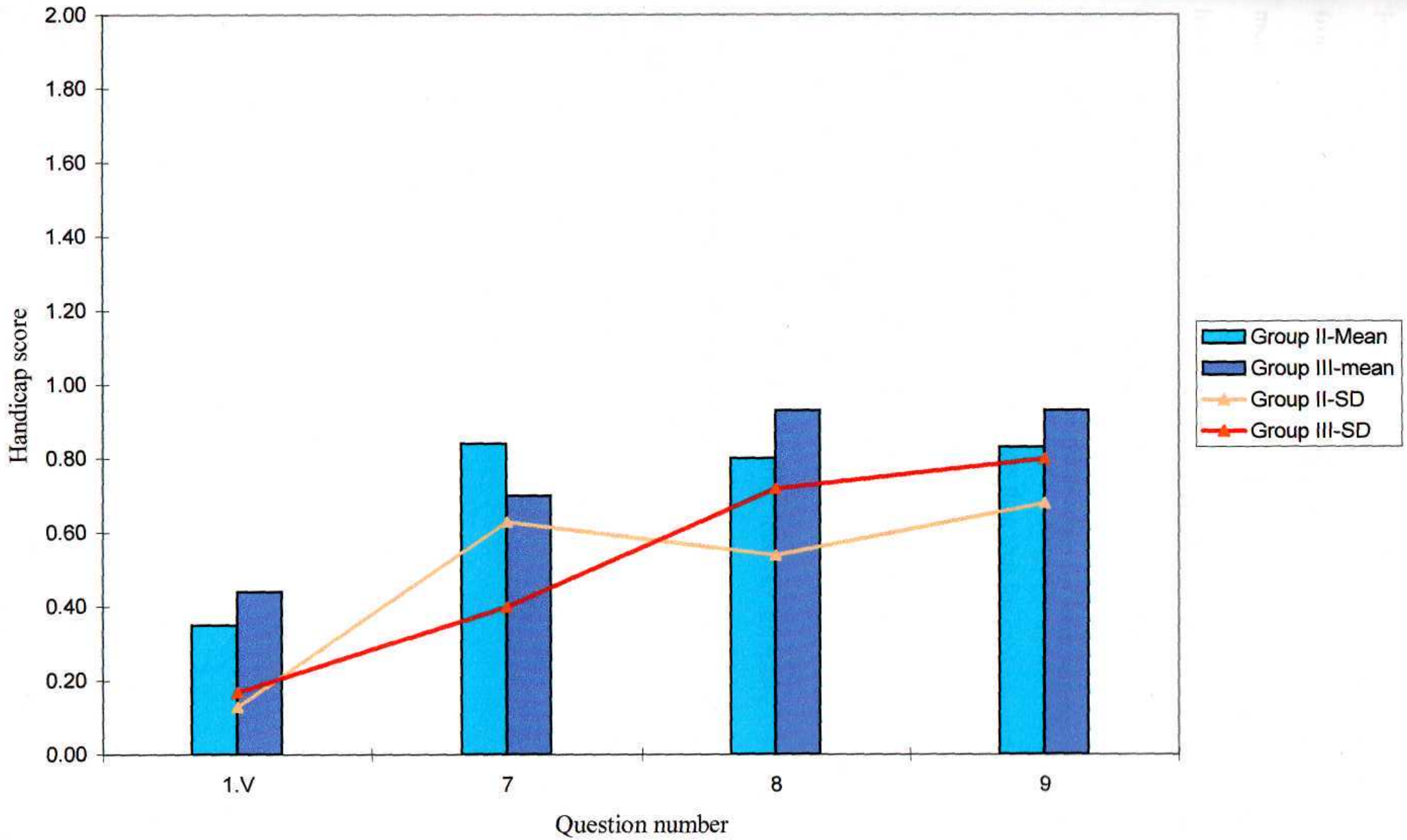

2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Handicap score
10
11
12
13
14
15
16
17
Question number
Group II-mean
Group III -mean
Group II-SD
Group III-SD

Figure 2 (d): Item analysis questions- Factor 4 and 6



Comparison of scores obtained for subjects with different categories of hearing loss, shown in Tables 7, 8, 9 and 10, revealed a steady increase in the mean scores from mild hearing loss to severe hearing loss for a majority of the questions. The mean scores for questions 1(n) and 1 (u) for the group with moderate degree of hearing loss was lower than that for the group with mild degree of hearing loss (0.35 against 0.54 for 1 (n) and 1.00 against 1.54 for 1 (u)). Answers to questions 3 and 4 did not follow a consistent pattern. The mean score for item number 3 for subjects with moderate degree of hearing loss was less than that for subjects with mild degree of hearing loss and the lowest mean score was observed for subjects with severe hearing loss. For subjects with thresholds lower than 70 dB HL, the mean score for question number 4 increased with an increase in hearing loss. However, the mean score was lowest for subjects with severe hearing loss. No difference was observed in the mean score for groups with mild and moderate degree of hearing loss for questions 15 and 16.

Table 7

Mean scores for individual items of factor 1 for subjects with differen degrees of hearing loss

Question no.	Mild loss	Moderate loss	Moderately severe loss	Severe loss
la	0.46	0.76	1.19	1.71
lb	1.23	1.41	1.86	2.00
lc	1.15	1.41	1.85	2.00
ld	1.62	1.82	1.95	2.00
le	0.69	0.82	1.29	1.71
lf	0.85	1.06	1.71	2.00
1-g	0.77	1.29	1.71	2.00
lh	0.54	0.71	1.62	1.71
li	1.62	1.71	1.86	2.00
lj	1.00	1.18	1.62	1.86
lk	1.08	1.18	1.86	2.00
11	0.85	0.88	1.57	1.36
l.m	0.54	0.55	1.14	1.43
ln	0.54	0.35	1.05	1.29
1.0	1.38	1.24	1.86	2.00
lp	1.08	1.24	1.76	1.86
lq	0.85	0.94	1.67	2.00
lr	0.54	0.76	1.14	1.86
ls	1.38	1.71	1.81	2.00
lt	0.46	0.53	1.52	1.43
lu	1.54	1.00	1.62	1.86
2	0.85	1.12	1.67	1.71
3	1.54	1.35	1.86	1.14
4	0.77	0.94	1.52	0.86
5	1.23	1.53	1.71	2.00
6	1.00	1.12	1.57	1.86

Table 8

Mean scores for individual items of factor 2 for subjects with different **degrees** of hearing loss

Question no.	Mild loss	Moderate loss	Moderately severe loss	Severe loss
18.a	0.00	0.41	0.90	1.29
18.b	0.23	0.53	1.33	1.57
18.c	0.08	0.35	0.48	0.71
18.(1	0.62	1.35	1.76	2.00
18.e	0.31	0.88	1.29	1.57
18.f	0.00	0.35	0.52	0.86
19.a	0.08	0.87	1.05	1.57
19.b	0.46	0.76	1.57	1.71
19.c	0.08	0.65	1.33	1.71
20	0.08	0.12	0.62	1.29
21	0.38	0.76	1.62	1.71
22	0.92	0.82	1.57	1.57

Table 9

Mean scores for individual items of factor 3 for subjects with different degrees of hearing loss

Question no.	Mild loss	Moderate loss	Moderately severe loss	Severe loss
10	0.38	0.71	1.24	1.14
11	0.69	0.76	1.29	1.57
12	0.62	0.59	1.19	1.71
13	0.15	0.53	1.05	1.71
14	0.54	0.76	1.24	1.86
15	0.54	0.53	1.00	1.14
16	0.54	0.53	1.14	1.57
17	0.46	0.65	0.95	1.85

Table 10

Mean scores for individual items of factor 4 and 6 for subjects with different degrees of hearing loss

Question no.	Mild loss	Moderate loss	Moderately severe loss	Severe loss
7	0.38	0.06	0.52	1.57
8	0.23	0.41	0.95	1.43
9	0.31	0.65	1.00	1.57
lv	0.08	0.00	0.14	0.85

Short form of the scale

It was felt that a short form of the scale could be prepared as there was high inter-item correlation. Stepwise multiple regression was performed to check the validity of items in predicting the degree of hearing loss. Fifteen items entered the regression equation with an R-square value of 0.94. Decision regarding retaining a question in the short version was made based on the results of stepwise multiple regression equation, item analysis and factor analysis. The questions were selected such that they represented all the major factors of the long form of the scale. An item was deleted if there was a narrow range of scores (less than 0.5), extremely low means (less than 0.5), low item-total correlation (less than 0.5). When a pair of questions had high inter-item correlation (more than 0.8), either one of the items was deleted or reworded to include contents of both questions. It was ensured that the removal of the questions did not alter the R-square value of the regression equation.

The final short form of the scale consisting of ten questions (Appendix-V) had a Cronbach's alpha of 0.89. The Pearson product moment correlation between total scores on short version and long version was 0.96 for the data from Group II and III combined.

Correlates of Self-perceivcd Hearing Handicap

Correlation of the self-perceived handicap with both audiological and non-audiological variables were studied. Relationship of self-perceived handicap with audiological measures and non-audiological variables are discussed separately.

Audiological measures

Audiological measures obtained in the study included pure-tone thresholds from 250 Hz to 8000 Hz at octave intervals, speech reception threshold, speech identification in quiet and with a signal-to-noise ratio of +20 dB, +10 dB and 0 dB. Average of pure-tone thresholds at 500 Hz, 1000 Hz and 2000 Hz was taken as pure-tone average and binaural percentage of hearing loss was calculated using the formula suggested by American Academy of Opthalmology and Otolaryngology (1959) (as cited in Newby and Popelka, 1992). Analysis was carried out to study the correlation of each of the audiological measures with the total score on the hearing handicap scale and the total scores obtained for different factors. Only the first three factors i.e. 'speech understanding', 'awareness' and 'emotional subscale' were considered since the scree plot indicated that these three constituted the major factors.

Pearson product-moment correlation was calculated to determine the relationship between audiologic measures and self-assessed hearing handicap score. The hearing handicap score was significantly (at 0.01 level) related to the pure tone thresholds, speech reception threshold, speech identification scores in quiet and with a signal- to- noise ratio of +20 dB and +10 dB but not to speech identification measure with a signal -to-noise ratio of 0 dB. Table 11 shows that the magnitude of these correlation coefficients varied as a function of the audiological measures.

Pure tone average of the better ear showed highest correlation (r=0.75) with the hearing handicap scores. This was followed by correlation with speech reception threshold of the better ear (r=0.70). A negative correlation was obtained between speech identification scores and self-perceived handicap scores. Though the correlation was statistically significant, it was poorer than that of the pure-tone or speech reception threshold. Among all the speech identification measures, the highest correlation was obtained for speech identification scores with a signal-to-noise ratio of +20 dB (r=0.51). Only speech identification scores with a signal-to-noise ratio of 0 dB showed insignificant correlation with self-perceived handicap scores. Audiological measures of the better ear showed higher correlation with self-perceived handicap scores as compared to that of the contralateral ear.

Table 11

Correlation coefficient (r) between self-perceived handicap and the audiological measures

		Total score	Factor 1 score	Factor 2 score	Factor 3 score
PTA	Better ear	0.75	0.70	0.66	0.60
	Poorer ear	0.55	0.54	0.42	0.42
SRT	Better ear	0.70	0.65	0.64	0.54
	Poorer ear	0.33	0.32	0.27	0.20
SI-Q	Better ear	-0.51	-0.4	**-0.51**	-0.39
	Poorer ear	-0.46	-0.42	**-0.37**	-0.35
SI-20	Better ear	-0.51	-0.44	**-0.51**	-0.43
	Poorer ear	-0.42	-0.36	**-0.35**	-0.43
SI-10	Better ear	-0.43	-0.43	-0.40	-0.33
	Poorer ear	-0.38	**-0.39**	-0.33	-0.28
SI-0	Better ear	-0.21	**-0.19**	-0.15	-0.23
	Poorer ear	-0.22	**-0.26**	-0.14	-0.16

Note:

PTA = pure-lone average of 500 Hz, 1000 Hz and 2000 Hz

SRT = speech reception threshold

SI-Q = speech identification scores in quiet

SI-20 = speech identification scores in noise with a signal-to-noise ratio of 20

SI-10 = speech identification scores in noise with a signal-to-noise ratio of 10

SI-0 = speech identification scores in noise with a signal-to-noise ratio of 0

Further analysis carried out to study the relationship between handicap scores and pure-tone thresholds from 250 Hz to 8000 Hz at octave intervals showed correlation coefficient significant at 0.01 level for all the test frequencies. A glance at Table 12 indicates that the correlation coefficient ranged from 0.52 to 0.72 for the pure-tone thresholds across the frequency range of the better ear and from 0.28 to 0.51 for contralateral ear. It was observed that for the better ear, correlation coefficients at 500 Hz, 1000 Hz and 2000 Hz was 0.70, 0.72 and 0.68 respectively as against 0.65, 0.60 and 0.52 for 250 Hz, 4000 Hz and 8000 Hz respectively . Similarly, correlation coefficients for the poorer ear was 0.47, 0.48 and 0.51 at 500 Hz. lOOOHz and 2000 Hz as opposed to 0.42, 0,28 and 0.39 for 250 Hz, 4000 Hz and 8000 Hz respectively. In other words, the correlation coefficients of 500 Hz, 1000 Hz and 2000 Hz was higher than that of the other frequencies in both the ears.

Table 12

Correlation coefficient (r) between self-perceived handicap and pure-tone thresholds at different frequencies

Frequency in Hz	Better ear	Poorer ear
250 Hz	0.65	0.42
500 Hz	0.70	0.47
1000 Hz	0.72	0.48
2000 Hz	0.68	0.51
4000 Hz	0.60	0.28
8000 Hz	0.52	0.39

Degree of hearing loss and self-perceived handicap: The effects of hearing loss was further examined by computing mean values for the handicap scores as a function of the degree of hearing loss. The subjects were classified into the following live categories (Goodman, 1965) based on the pure-tone average of the better ear:

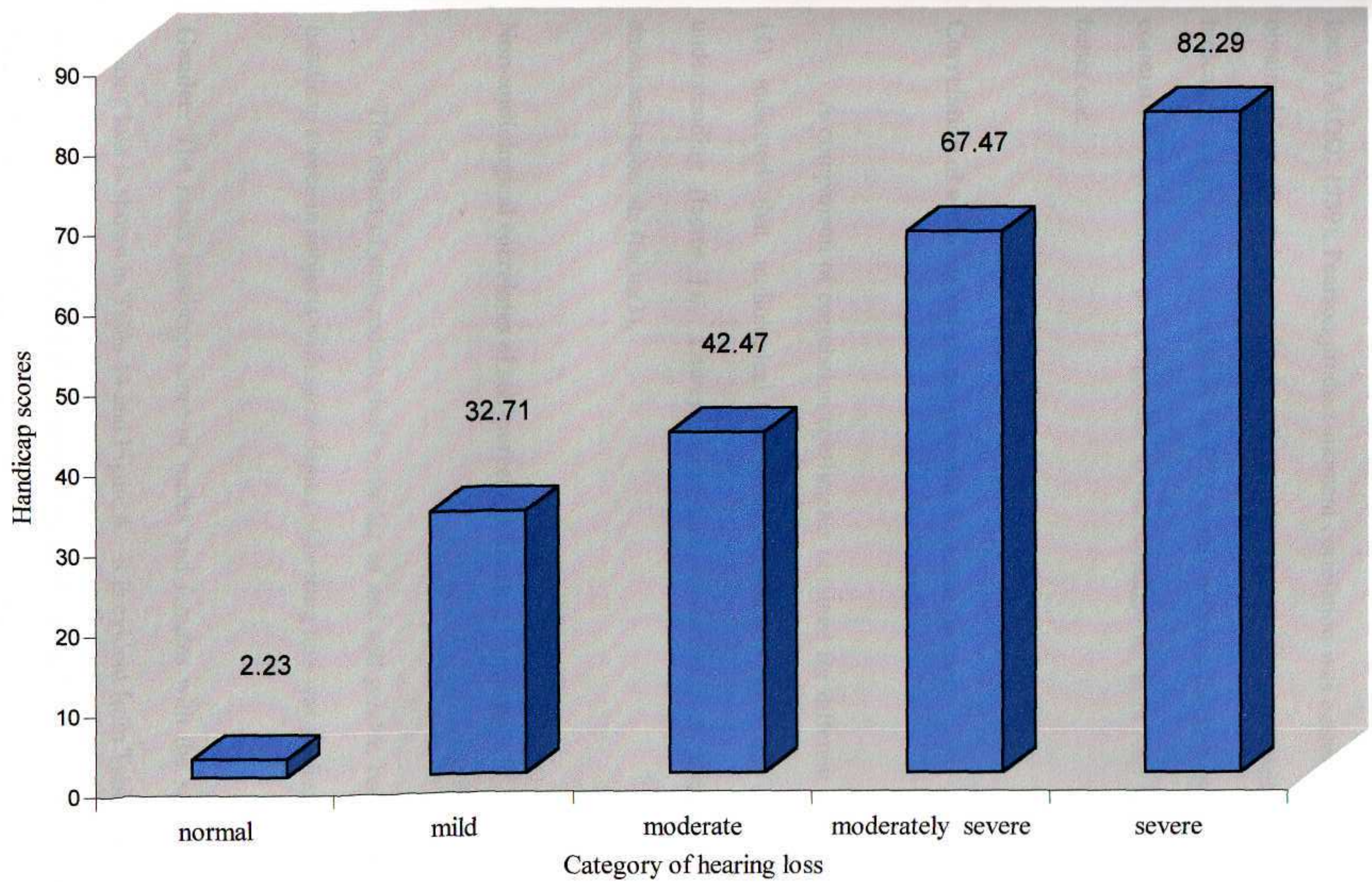
1. Normal hearing (PTA: < 25 dB HL)
2. Mild hearing loss (PTA: 26 dB HL to 40 dB HL)
3. Moderate hearing loss (PTA: 41 dB HL to 55 dB HL)
4. Moderately severe hearing loss (PTA: 56 dB HL to 70 dB HL)
5. Severe hearing loss (PTA: 71 dB HL to 90 dB HL)

As seen in Table 13 and Figure 3, mean handicap scores increased concomitantly with the degree of hearing loss. Variability was large irrespective of the magnitude of hearing loss. One way Analysis of Variance (ANOVA) showed that the main effect of degree of hearing loss was significant at 0.01 level (F ratio of 75.36). Duncan's post-hoc test indicated that there was no significant difference between scores obtained for subjects with mild hearing loss and those with moderate hearing loss whereas the scores obtained for other groups differed significantly from each other.

Table 13

Self-perceived handicap score (total score) as a function of the hearing level

PTA	N	Self-perceived handicap score		
		Mean	S.D.	Range
< 25 dB H L	30	2.23	1.9	0 - 7
26 - 40 dB H L	17	32.71	15.14	4 - 52
41 - 55 dB H L	21	42.47	19.26	5 - 70
56 - 70 dB H L	25	67.47	15.37	43 - 90
71 - 90 dB H L	12	82.29	13.40	58 - 95


82.29
67.47
42.47
32.71
2.23
90
80
70
60
50
40
30
20
10
0
Handicap scores
normal
mild
moderate
moderately severe
severe
Category of hearing loss

Binaural percentage of hearing loss and self perceived handicap: To study the relation between self-perceived handicap scores and binaural percentage of hearing loss (AAOO, 1959), Pearson product-moment correlation was calculated for the data obtained from the subjects of group II and III. Correlation coefficient (r) was 0.74 indicating a significant correlation (at 0.01 level) between the two measures. This correlation coefficient was comparable to that obtained for pure-tone average of the better ear.

Correlation of audiological measures with different factors

A comparison of correlation coefficients obtained for different factors (Table 11) indicated that audiological measures correlated maximally with speech understanding (factor 1). Lowest correlation coefficient was obtained for the emotional subscale (factor3).

Non-audiological correlates of self-perceived hearing handicap

The effect of non-audiological variables of age and gender, on the perceived handicap scores in subjects with same degree of hearing loss was studied.

Gender: The mean handicap score of males and females with the same degree of hearing loss is shown in Table 14 and Figure 4. It is evident from Table 14 that there was not much difference in the self-perceived handicap scores of males and females when the degree of hearing loss was controlled. Among subjects with mild hearing loss, females reported greater handicap than males. One way analysis of variance

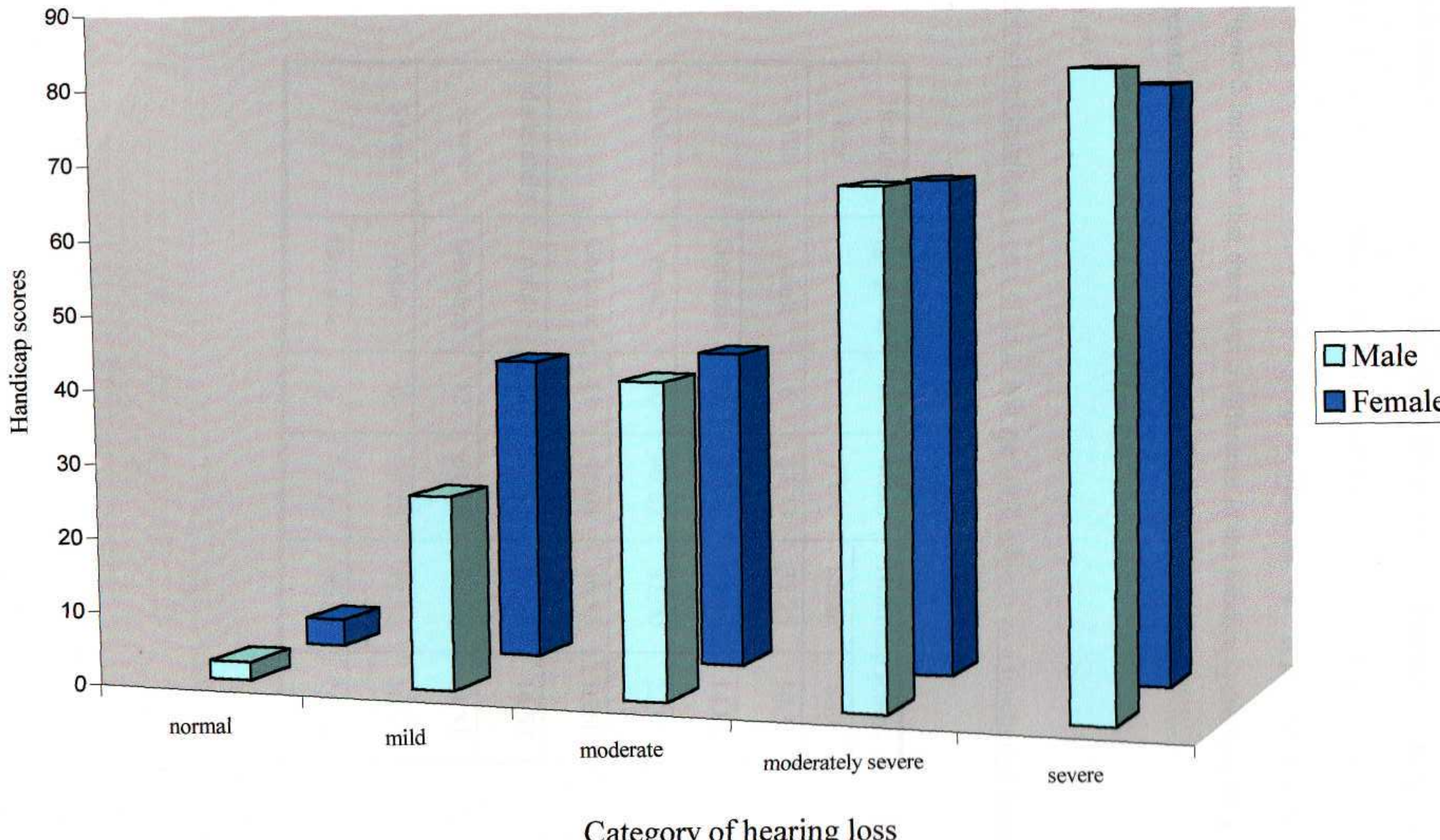
(ANOVA) indicated that the main effect of gender on the self-perceived scores was not significant (F ratio = 1.63).

Table 14

Gender differences in self-perceived handicap score

Hearing level	Gender	N	Mean PTA	Handicap scores	
				Mean	S.D.
Normal hearing	M	15	14.67	2.47	2.26
	F	15	13.44	3.78	5.12
Mild loss	M	9	32.24	26.13	13.04
	F	8	32.99	41.50	14.20
Moderate loss	M	12	48.94	42.17	18.34
	F	9	47.32	43.20	28.63
Moderately severe loss	M	11	60.31	67.80	17.25
	F	14	60.76	67.18	14.30
Severe loss	M	6	74.81	82.67	14.64
	F	6	75.00	80.00	13.45

Figure 4: Gender difference in self-perceived handicap scores



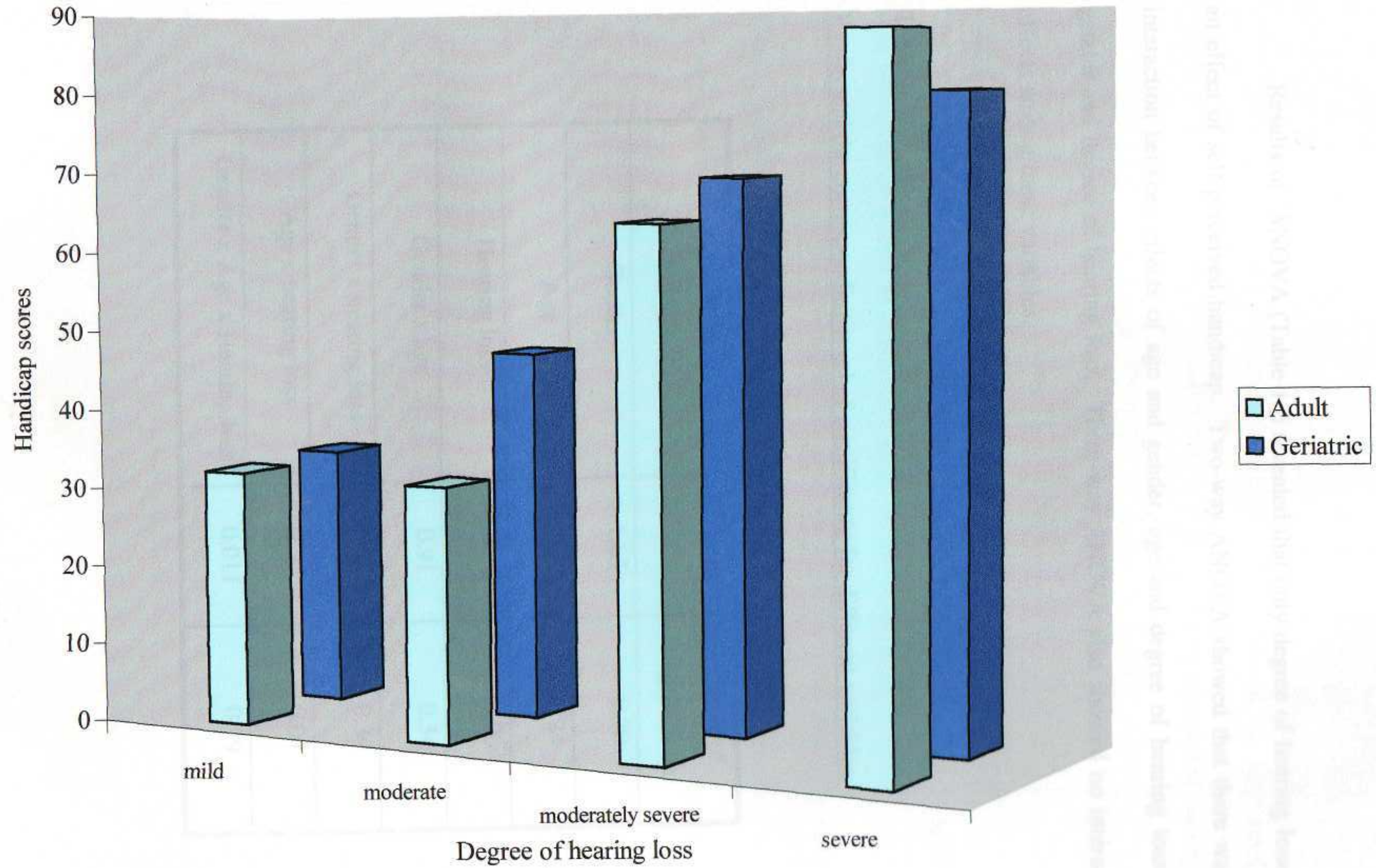
Age: Analysis of variance (ANOVA) indicated that the main effect of age on self-reported handicap scores was not significant (F ratio=1.34). To examine the handicap scores of adult and geriatric subjects more closely, total handicap scores were computed as a function of pure-tone average of the better ear. A perusal of Table 15 and Figure 5 indicates that there was a difference in the handicap perceived by adult and geriatric subjects only among those with moderate hearing loss.

Table 15

Self-perceived handicap scores of adult and Geriatric subjects as a function <Df hearing loss

Hearing loss	Age group	N	Mean PTA	Handicap scores	
				Mean	S.D.
Mild	Adult	6	33.73	32.25	18.37
	Geriatric	11	32.02	32.90	14.89
Moderate	Adult	10	49.52	32.00	22.96
	Geriatric	11	48.03	46.83	16.66
Moderately severe	Adult	13	59.42	64.78	16.57
	Geriatric	12	61.39	69.50	14.81
Severe	Adult	6	78.15	87.50	10.61
	Geriatric	6	73.51	80.20	14.91

Figure 5: Self-perceived handicap scores of adult and geriatric subjects



Effects of interaction among age, gender and degree of hearing loss

Results of ANOVA (Table 16) revealed that only degree of hearing toss had an effect of self-perceived handicap. Two-way ANOVA showed that there was no interaction between effects of age and gender, age and degree of hearing toss and gender and degree of hearing loss. Three-way ANOVA also showed no interaction effects among these variables.

Table 16

F ratio and the corresponding level of significance for different variables

Variables	F ratio	Level of significance
Gender	1.63	0.20
Age	1.34	0.24
Hearing loss	75.35	0.00
Gender x age	0.91	0.34
Gender x hearing loss	1.15	0.34
Age x hearing loss	2.27	0.07
Gender x Age x Hearing loss	0.011	0.99

Predictors of self-perceived handicap

Stepwise multiple regression analyses was performed in two stages to determine the contribution of selected audiological and non-audiological variables to the variance in hearing handicap, measured by the questionnaire.

Stage I: The independent variables studied in the first stage were age, gender, pure-tone average, speech reception threshold, speech identification scores in quiet and with S/N ratio of +20, +10 and 0 dB. Audiological measures of both the ears were included. Results of multiple regression analyses carried out separately for data from Group II, Group III and the combined data (Group I, II and HI) are presented in Tables 17, 18 and 19. Each table has two parts. Part 'a' summarises the model obtained for the group. It includes the independent variable that entered the regression equation and its adjusted R square value that indicates the percentage of variance explained by that variable. Part 'b' provides information regarding weighting (beta) of each independent variable(s) along with its significance level.

Table 17

Results of stepwise multiple regression analyses to predict handle:ap scores for the combined group

a) Model summary

Model	R	R Square	Adjusted R Square	Standard Error of Estimate
1	0.92	0.85	0.85	12.01
2	0.93	0.86	0.86	11.62

Note:

Predictor in model 1: pure-tone average of the better ear

Predictors in model 2: a) pure-tone average of the better ear
b) speech identification scores of the better ear with a signal-to-noise ratio of +20 dB

b) Coefficients of the variables in model 2

Variables	Unstandardised Coefficients		Standardised Coefficients	Significance Level
	B	Std. Error		
Constant	8.16	9.01		0.37
Predictor a	1 .12	0.09	0.79	0.00
Predictor b	-0.20	0.78	-0.17	0.01

Table 18

Results of stepwise multiple regression analyses to predict handicap scores for Group III

a) Model summary

Model	R	R Square	Adjusted R Square	Standard Error of Estimate
1	0.82	0.68	0.67	13.46

Note:

Predictor in the model: pure-tone average of the better ear

b) Coefficients of the variables in the model

Variables	Unstandardised Coefficients		Standardised Coefficients	Significance Level
	B	Std. Error		
Constant	-6.22	7.34		0.40
Predictor	1.21	0.14	0.82	0.00

Table 19

Results of stepwise multiple regression analyses to predict handicap scores for Group II

a) Model summary

Model	R	R Square	Adjusted R Square	Standard Error Of Estimate
1	0.82	0.67	0.64	16.34

Note:

Predictor in the model : pure-tone average of the better ear

b) Coefficients of the variables in the model

Variables	Unstandardised Coefficients		Standardised Coefficients	Significance Level
	B	Std. Error		
Constant	-22.71	7.34		0.13
Predictor	1.38	0.26	0.82	0.00

It can be seen from Table 17 that for the combined group, the variables that entered the regression equation was pure-tone average of the better ear and speech identification scores of the better ear with a signal-to-noise ratio of +20 dB. Pure-tone average of the better ear explained 85% of the variance in the handicap score. Speech identification with a signal-to-noise ratio of +20 dB accounted only for an additional 1% variance. With the addition of the second variable, standard error of estimate decreased from 12.01% to 11.62%.

Tables 18 and 19 show that for the hearing impaired group, only pure-tone average of the better ear entered the regression equation. The model explained 67% of the total variance in the handicap score for adult subjects and 68% of the variance in geriatric subjects. As compared to the combined group, speech identification measure did not enter the regression equation for the hearing impaired group.

Stage II: In the second stage of analysis, pure-tone thresholds of the better and the contralateral ear were used as explanatory, that is, as independent variables. Similar to the first stage, analysis was carried out separately for data from Group II, Group III and the combined group (Group I, II and III). As shown in Table 20, for the combined group, pure-tone thresholds of the better ear at 500 Hz, 1000 Hz and 4000 Hz entered the regression equation. Pure-tone threshold of the better ear at 1000 Hz accounted for 81% of the variance. Pure-tone threshold of the better ear at 1000 and 4000 Hz together explained 83% of the variance. An increase of an additional 1% was observed when pure-tone threshold of the better ear at 500 Hz was added to the model. A decrease in the standard error of measurement was seen with an increase in the number of variables in the equation.

Analysis of the data from the hearing impaired subjects did not show consistent results. That is, for Group IE, the predictors were pure-tone thresholds of the better ear at 250 Hz, 1000 Hz and the threshold of the poorer ear at 4000 Hz. but for Group II, pure-tone thresholds of the better ear at 1000 Hz, 4000 Hz and that of the poorer ear at 8000 Hz were important for predicting the handicap scores. These results are presented in Tables 21 and 22. The final model explained 68% of the variance in geriatric subjects and 75% of the variance in the adult subjects.

Table 20

Results of stepwise multiple regression analyses to predict handicap scores based on pure-tone thresholds (for the combined group)

a) Model summary

Model	**R**	R Square	Adjusted R Square	Standard Error Of Estimate
1	0.90	0.81	0.81	13.63
2	0.91	0.83	0.83	12.88
3	0.92	0.84	0.84	12.57

Note:

Predictor in model 1: Better ear threshold at 1000 Hz

Predictors in model 2: a) Better ear threshold at 1000 Hz
b) Better ear threshold at 4000 Hz

Predictors in model 3: a) Better ear threshold at 1000 Hz
b) Better ear threshold at 4000 Hz
c) Better ear threshold at 500 Hz

b) Coefficients of the variables in model 3

Variables	Unstandardised Coefficients		Standardised Coefficients	Significance Level
	B	Std. Error		
Constant	- 15.26	2.70		0.00
Predictor a	0.59	0.19	0.41	0.02
Predictor b	-0.28	0.11	-0.25	0.01
Predictor c	0.42	0.18	0.29	0.21

Table 21

Results of stepwise multiple regression analyses to predict handicap scores based on pure-tone thresholds (for Group III)

a) Model summary

Model	**R**	R Square	Adjusted R Square	Standard Error Of Estimate
1	0.77	0.60	0.58	15.39
2	0.81	0.66	0.64	14.28
3	0.84	0.71	0.69	13.30

Note:

Predictor in Model 1: Better ear threshold at 1000 Hz

Predictors in Model 2: a) Better ear threshold at 1000 Hz
b) Better ear threshold at 250 Hz

Predictors in Model 3: a) Better ear threshold at 1000 Hz
b) Better ear threshold at 250 Hz
c) Better ear threshold at 4000 Hz

b) Coefficients of the variables in model 3

Variables	Unstandardised Coefficients		Standardised Coefficients	Significance Level
	B	Std. Error		
Constant	15.36	11.80		0.20
Predictor a	0.74	0.21	0.49	0.00
Predictor b	0.70	0.22	0.46	0.00
Predictor c	-0.39	0.15	-0.24	0.01

Table 22

Results of stepwise multiple regression analyses to predict handicap scores based on pure-tone thresholds (for Group II)

a) Model summary

Model	R	R Square	Adjusted R Square	Standard Error Of Estimate
1	0.78	0.61	0.59	16.97
2	0.86	0.73	0.70	14.48
3	0 89	0.79	0.75	13.21

Note:

Predictor(s) in model 1: Better ear threshold at 1000 Hz

Predictors in model 2: a) Better ear threshold at 1000 Hz
b) Poorer ear threshold at 8000 Hz

Predictors in model 3: a) Better ear threshold at 1000 Hz
b) Poorer ear threshold at 8000 Hz
c) Better ear threshold at 4000 Hz

b) Coefficients of the variables in model 3

Variables	Unstandardised Coefficients		Standardised Coefficients	Significance Level
	B	Std. Error		
Constant	-2432	11.06		0.04
Predictor a	1.49	0.29	0.84	000
Predictor b	0.56	0.15	0.70	0.00
Predictor c	- 0.68	032	-0.53	0.05

Prediction of hearing loss from self-perceived handicap

To facilitate the use of the questionnaire for purposes of hearing screening, a regression equation was obtained to predict hearing loss from the self-perceived handicap. Since pure-tone average of the better ear showed the highest correlation with the self-perceived handicap scores, it was used as the predictor variable and self-perceived handicap score served as the criterion variable. The equation obtained was:

Better ear PTA = 15.68 +(0.64 x Total handicap score)

The adjusted R-square value was 0.83 and the standard error of measurement was 8.93. Residual analysis showed that the residuals (difference between actual Y and predicted Y) ranged from -17.57 to +22.72. The predictive error varied from 0.93 to 2.02.

The results of the present study in the context of prior studies on self-perceived handicap reported in the literature are discussed in the following chapter.

CHAPTER V

DISCUSSION

In the present study, a questionnaire for self-assessment of hearing loss appropriate for the hearing impaired in the Indian context was developed. Correlation of self-perceived handicap with audiological and non-audiological variables was investigated.

FACTORIAL STRUCTURE OF THE QUESTIONNAIRE

Results of principal component analysis yielded a six-factor solution. But a scree plot (Cattell, 1966 cited in Dunteman, 1994) showed a straight line after factor three. Therefore, the questionnaire was divided into three major sub-scales that were labeled as 'speech understanding', 'awareness' and 'emotional' subscalc. The high correlation between scores obtained for each scale with the total score suggested that all the three measures contributed to the self-perceived handicap. A review of the literature showed that except for Communication Profile for the Hearing-Impaired by Demorest and Erdman (1986, 1987), the number of subscales in an inventory ranged from one to six. Schow (1988) (cited in Schow and Nerbonne, 1989) summarized the various kinds of handicap information assessed in various inventories as detailed below:

1. Speech communication: general speech; estimates of communication ability in various settings: home, work, social, one-on-one, small and large groups.
2. Speech communication: special; while listening to TV, a telephone; with and without visual cues; and while in adverse listening situations.

3. Emotional reactions/feelings, behaviors and attitudes about hearing impairment and hearing aids including response to auditory failure, acceptance of loss.
4. Reactions and behaviors of others with reference to the hearing loss.
5. Non speech communications; door and phone bell, warning traffic, localization.
6. Other related symptoms; fluctuating hearing loss, reactions to tinnitus and limited tolerance to loud sounds.

The questionnaire developed in the present study included questions that assessed all these aspects except 'other related symptoms'. The subscale on speech understanding dealt with speech communication - both general and special. The one on awareness consisted of questions that elicited information regarding non-speech communication. The emotional sub-scale assessed both emotional reaction of the hearing impaired and behavior of others towards him/her. The questionnaire did not include questions that assessed communication difficulty at work place due to the following reasons:

a) a common questionnaire was required to compare the self-perceived handicap in adult and geriatric subjects but many of the geriatric subjects were leading a retired life.
b) the adult group included women, 60% of who were not employees.
c) Subjects who were employed came from such varied occupational group as farming, business, and office goers in different grade. As such the work environment varied and it may be expected that the handicapping effects varied.

ITEM ANALYSIS

Item analysis of the scale indicated a Chronbach's alpha of 0.97. which suggested that the scale had a high internal consistency. Ventry and Weinstien (1982) reported that Chronbach's alpha is superior to test-retest reliability whereas Allen and Yen (1979) (cited in Demorest and De Haven, 1993) reported that though Chronbach's alpha is not a true measure of reliability, it represents the lower boundary of reliability. In either case, this questionnaire can be considered as a reliable measure for self-assessment of hearing handicap.

In the present study, face-to-face interview technique was used since about two-thirds of the hearing impaired subjects included in the study were either illiterate or had less than higher secondary education. During interview, further explanation was required for some of the questions. For example, actual distance of six to eight feet or twelve feet had to be demonstrated for the subjects to understand the situation. Besides, some of the subjects answered just 'yes' or 'no' to indicate whether they had difficulty in hearing or not. Further probing became necessary to get an answer on a three-point scale. Therefore the results of the present study are valid only when the assessment of self-perceived handicap is carried out employing the face-to-face interview technique.

Item analysis indicated that a majority of the hearing-impaired individuals reported difficulty in watching television from a distance of six feet in the presence of noise, understanding speech in the presence of noise and in group conversation. In an investigation by Newman et al. (1997) also more than 50% of the subjects with mild or unilateral hearing loss reported difficulty in listening in the presence of background noise and when using a television or a radio. It is well documented in literature that hearing impaired individuals experience greater difficulty understanding speech in noisy environments as compared to normal hearing subjects (Hull, 1995). Results of the study carried out on geriatric subjects have revealed that their performance is poor on tasks requiring speech recognition in the presence of noise (Smith and Prather, 1971; Jokinen, 1973; Kalikow, Stevens and Eliott, 1977; Dubno, Dirks and Morgan. 1984). The working Group on Speech Understanding and Aging (1988). however, has stated that in all these studies, researchers disagree about whether older adults have more difficulty with speech understanding in noise than do younger adults with comparable hearing losses. The results of the present study indicated that both adults and geriatrics reported of difficulty in understanding speech in the presence of noise. The mean score for the geriatric group was slightly higher than that for the adults but the difference was not statistically significant.

Difficulty in understanding speech from a distance of ten to twelve feet was an expected finding as the intensity of the signal at the listener's ear reduces with an increase in the distance from the source. Approximate intensity of a normal voice from a distance of ten to twelve feet is 50 dB SPL (Sanders, 1993). Wilber (1991) reported that intensity of a whisper at a distance of three feet varied from 20 dB SPL to 65 dB SPL depending on the talker. It can be interpolated from this that the intensity of a whisper from a distance of six inches is approximately 30 dB SPL to 35 dB SPL. Therefore, even subjects with mild hearing loss have difficulty in understanding speech in such situations. Garestecki (1987) observed that the greatest problem that appears to be linked with emerging hearing handicap was understanding whispered speech.

Results of the item analysis revealed that even subjects with a mild hearing loss obtained a high score on items eliciting information about the above aspects. This indicated that it is possible to judge the presence of hearing loss based on self-report of the hearing-impaired.

A majority of the hearing-impaired (62%) reported that they understood better when the talker spoke slowly. The mean value for this item was higher for Group III (geriatric subjects) as compared to that of Group II (adult subjects) and the difference was significant at 0.05 level. This is probably related to the central auditory processing problems of the geriatrics. A general slowing down is a hallmark of the aging process. It has been reported in literature that some elderly individuals ascribe their speech perception problems to young talkers who speak rapidly (Helfer, 1991). Results of many studies have suggested that aging causes greater distortion of auditory signals than that expected from the presence of a hearing loss (Marshall, 1981). The elderly demonstrated a decreased performance on tasks employing fast speech (Calearo and Lazoroni, 1957). The findings of the present study showed that the auditory system of the elderly is easily overloaded, but when temporal requirements have been reduced, their comprehension improves. Also, self-report of an individual does give some information regarding central auditory processing of acoustic signals. However these results are in contrast to experimental findings that expansion of speech does not improve perception by older adults (Korabic, Freeman and Church, 1978). This discrepancy supports the explanation of Heifer (1991) that electronic expansion used in experimental studies probably causes a distortion of the signal that offsets any benefit from slowing down the rate.

SHORT FORM OF THE SCALE

As there was a high inter-item correlation, a shorter version of the questionnaire with ten questions was constructed. This shorter version had a Cronbach's alpha of 0.89, indicating that it was also a reliable measure of self-perceived handicap. A correlation coefficient of 0.96 between total scores on the short version and the long version for the combined group and the hearing impaired group suggested that the shorter version could be used for screening.

CORRELATES OF SELF-PERCEIVED HANDICAP

AUDIOLOGIC MEASURES AND HEARING HANDICAP

One issue that has received considerable attention in the literature on self-assessment inventories is the relationship between self-reported communication problems and audiological measures. Although one's ability to communicate is not solely a function of the degree or configuration of one's hearing loss, it is reasonable to expect that some relationship exist between the two. Hearing is one of the important senses and naturally any marked interference in its functioning will produce difficulties in communication and in adjusting to the environment. Almost invariably, a hearing impairment produces some communication difficulties, which are proportional to the severity of the hearing impairment (Newby and Popelka, 1992).

This relationship was reflected in the present study. The results of the present study showed a significant relationship between the self-perccivcd handicap and the audiological measures, i.e., the questionnaire proves to be a valuable instrument for evaluating some of the situational difficulties faced by the hearing-impaired individuals. Similar results were presented earlier on other population using various other scales (Berkowitz and Hochherg, 1971; High et al., 1964; McCartney et al., 1976; Schow and Tannhill, 1977; Speaks et al., 1970; Wenstien and Ventry. 1983a; Noble, 1978; Rosen, 1978; Coren and Hakstain, 1992; Barrenas and Holgers, 2000).

Pure-tone sensitivity and self-perceived handicap

Hearing loss has been conventionally diagnosed and classified based on pure-tone thresholds. Though it is not possible to draw firm boundaries between two adjacent categories of hearing loss, speech understanding of a hearing-impaired individual is predicted based on the pure-tone average (Goodman, 1965). The psychological impact of a hearing loss can also be predicted from the magnitude of hearing loss (Eagles, Hardy and Catlin, 1968 as cited in Goetzinger, 1978). A hearing handicap refers to the disadvantage imposed by a hearing impairment on a person's performance in activities of daily living (Newby and Popelka, 1992). Therefore, some relationship is expected between hearing handicap and pure-tone sensitivity.

A significant correlation observed in the present study, between pure-tone sensitivity and self-perceived handicap indicates that the magnitude of hearing loss and the magnitude of hearing handicap are related to each other. The correlation coefficients obtained for pure-tone sensitivity in this study are comparable with that reported in earlier literature (Berkowitz and Hochberg, 1971; High et al.. 1964; McCartney et al., 1976; Schow and Tannhill, 1977; Speaks et al., 1970; Wenstien and Ventry, 1983a; Noble, 1978; Rosen, 1978; Coren and Hakstain, 1992; Barrenas and Holgers, 2000). These results confirm that the sensitivity loss is an integral part of self-perceived handicap, irrespective of age and gender of the subject, the population studied and the self-assessment inventory used. However, pure-tone sensitivity could not explain completely the variability in the self-perceived handicap. This is consistent with what has been reported in the literature. Hearing handicap is a complex phenomenon which must, by definition, involve a lot more than pure-tone sensitivity (Noble, 1978).

Speech identification measures and self-perceived handicap

Speech tests are used to assess the receptive communication ability of an individual. Weinstein, (1994) stated that speech tests yield objective, easily quantifiable information about a) acoustic confusions deriving from hearing loss, b) recognition ability in selected listening situations and c) the ability to recognise selected material. Theortically, this information provides the clinician with information about functioning of a hearing-impaired individual in everyday listening situations. Therefore, investigators have attempted to explain the variability in the handicap scores through speech identification measures. However, a weak relationship between speech identification scores measured at 40 dB SL (re:speech reception threshold) and hearing handicap score has been a recurring finding reported in the literature (Berkowitz and Hochberg, 1971; Blumfield et al., 1969; McCartney et al., 1976; Weinstein and Ventry 1983a; Newman et al., 1990: Speaks et al., 1970). These observations were made for a number of different scales and varying population.

The correlation coefficients reported in the literature for pure-tone thresholds were higher than that for speech identification measures. The highest correlation between self-perceived handicap scores and sensitivity measures reported in literature is 0.81 (Coren and Hakstain, 1992) and that for monosyllabic speech identification scores is - 0.62 (Weinstein and Ventry, 1983a). Tannhill (1979) reported that a combined measure of sensitivity and speech identification yielded a higher a correlation of - 0.73 with self-perceived handicap. Results of the present study were no different from the earlier reports. Although statistically significant, self-percieved handicap showed weaker relationship with speech identification measures than with pure-tone sensitivity.

The weak correlation between speech identification measures and self-perceived handicap scores, a consistent finding across studies, settings and self-assessment scales, suggests that speech understanding tests are not representative of experience in everyday listening conditions (Working Group on Speech Understanding and Aging, 1988; Wenstein and Ventry, 1983; Berkowitz and Hochberg, 1971; McCartney, Maurer and Sorenson, 1976). In the present study, speech identification testing was carried out at 40 dB SL (ref: Speech reception threshold) or at most comfortable level. It is possible that the suprathreshold testing has compensated for the loss in sensitivity. Probably correlation would have been stronger if the testing was carried out at normal conversational level i.e. at 45 dB HL instead of 40 dB SL.

Among all the speech identification measures studied, the highest correlation was found between self-perceived hearing handicap and speech identification scores obtained in the presence of noise with a signal-to-noise ratio of +20 dB. but the correlation coefficient was lower than that for pure-tones. These findings refute the argument that the inclusion of a competing signal is the most critical variable in creating a test environment reflective of daily listening situations (Seattle and Edgerton, 1976; Gerber and Fisher, 1979; Jerger and Hayes, 1976; Orchick and Over, 1972). Though, speech identification in the presence of noise reflects the handicap experienced by an individual better than speech identification measures in quiet, it does not explain completely the variations in the handicap scores. Also it does not explain the variation better than that explained by hearing sensitivity. This is in consonance with the results reported in the literature (Tyler and Smith, 1983; Mathews et al, 1990; Barrenas and Holgers, 2000)

Degree of hearing loss and self-perceived handicap

The mean handicap scores in the present study increased concomitantly with the degree of hearing loss. The large variability seen indicated that the degree of hearing loss is not the only factor determining the self-perceived handicap. All the subjects except two with mild hearing loss reported of handicap. Similar observations were made by Brainerd and Frankel (1985) who reported that subjects with minimal loss of 17 dB HL also considered themselves as handicapped.

Results of one-way ANOVA indicated that the main effect of degree of hearing loss was significant at 0.01 level. However, Duncan's post-hoc test showed that there was no significant difference between scores obtained for subjects with mild hearing loss and for those with moderate hearing loss whereas the scores obtained for the other groups differed significantly from each other. These results indicate that the degree of loss has a greater effect on the self-perceived handicap when the hearing loss is more than 55 dB HL. This supports the hypothesis of Pekney and Hood (1968) (cited in Berkowitz and Hochberg, 1971) that for subjects with a mild degree of hearing loss, degree of impairment is not related to subjective determination of hearing handicap.

Self-perceived handicap and binaural percentage of hearing handicap

In the present study, scores obtained on the self-perceived handicap scale showed higher correlation with the audiological measures of the better ear than that of the poorer ear. Calculation of binaural percentage using an arithmetic formula (AAOO, 1959) did not improve the correlation coefficients. Earlier, Brainerd and Frankel (1985) observed that perceived handicap showed better relationship with the pure-tone average of the better ear than with handicap calculated through different formulae. Lutman, Brown and Coles (1987) reported that everyday speech and speech-in-quiet components were more reliably predicted by the better ear thresholds. Correlation coefficient did not improve when the binaural or worse ear measures from the audiogram were taken. They further stated that the exact weighting of better ear or worse ear in the binaural measure did not influence the degree of correlation substantially. These data suggest that for an average hearing-impaired individual, the use of a complex formula to calculate the percentage of hearing loss is unwarranted.

However, further investigations on subjects with asymmetric or unilateral hearing loss are required to substantiate these results.

Thus, the results of the present study reinforce the consensus in the existing literature that at best, half the variance in handicap scales can be explained by audiometric scores, regardless of the scale used and/or the subject population, i.e.. the self-perceived handicap depends not only on the organic impairment, but, also on other factors. Audiological measures do not investigate all the aspects of communication process. They describe the conditions contributing to the cause of the communicative problems, rather than describing the actual communicative problems experienced (Giolas, 1983). For example, if the distance between the speaker and the hearing impaired is increased, loudness perceived is reduced. It is possible that one hearing impaired individual has compensatory strategies to understand speech whereas another individual does not use any compensatory strategies.

It can be inferred from these results that even though the acoustic cues used for speech perception is not same in all the languages (Williams, 1976,1977; Fledge and Eefting, 1986), the relationship between hearing handicap and pure-tone sensitivity among different linguistic group is comparable. Also, communication efficiency of a language does not affect the self-perceived handicap. Though, the language of the questionnaire and the language used for interview, Kannada, is more redundant than English (Ramakrishna et al., 1962), correlation between hearing handicap scores and audiologic measures among Kannada speakers obtained in the present study is comparable to that reported in the western literature (Berkowitz and Hochberg, 1971; High et al., 1964; McCartney et al., 1976; Schow and Tannhill, 1977; Speaks et al., 1970; Wcnstien and Ventry, 1983a; Noble, 1978: Rosen. 1978 Coren and Hakstain, 1992; Barrenas and Holgers, 2000).

Correlation of audiological measures with subscales of the questionnaire

Though there was a difference in the magnitude, a significant correlation with audiological measures was observed for all the three subscales. Speech understanding and awareness sub-scales showing a high correlation were as expected. A high correlation between emotional subscale and audiological measures suggests that hearing impairment has an effect on the emotional state of the individual. Similar findings were also reported by Weinstein and Ventry (1982), and Weinstein and Ventry (1983 b). The significant correlation most probably derives from the impact of hearing loss on the three psychological levels of hearing i.e. the primitive, the signal and the symbolic levels (Wenstein and Ventry, 1982). Ramsdell (1978) asserted that these functions of audition are crucial for the maintenance of an individual's well being and that obliteration of one or more of these hearing levels may give rise to feeling of depression, insecurity and suspiciousness.

It has long been reported that hearing handicap creates a feeling of embarrassment (Jackson, 1902 cited in Garestecki, 1987). It may also be expected that family members or friends become irritated with hearing-impaired individuals when they have difficulty in communication. This can lead to feelings of being handicapped by hearing loss (Gilhome-Herbst, 1983) and eventually to loneliness and depression. The emotional sub-scale had questions referring to these questions and hence showed significant correlation with audiologic measures. The individual often reacts by withdrawing from situations which will expose hearing loss related problems (Wylde, 1982). Stephens (1980) observed that the hearing-impaired individuals were significantly more introverted and neurotic than the control group. Hull (1982) and Kaplan (1982) have reported that hearing loss may restrict a variety of social activities to varying degrees. The results of the present study confirmed these reports, as increased hearing handicap was associated with decreased social functioning. Garestecki (1987) also observed that those individuals with minimal average hearing loss and those who failed the hearing screening in their study already perceived some of the emotional problems. He further suggested that clinical intervention must be started quite early for individuals who begin to experience hearing loss.

Item analysis revealed that there was no difference in the mean scores for subjects with mild and those with moderate degree of hearing loss for a few questions in the emotional sub-scale. The reaction of family members towards the hearing impaired was the same when the hearing loss was less than 55 dB HL. This supports the report of Weinstein and Ventry (1983b) that for subjects who had better than moderate hearing impairment, the degree of hearing loss was of secondary importance for the experiences of the hearing impairment.

NON-AUDIOLOGICAL FACTORS AND SELF-PRECEIVED HANDICAP

AGE

Age had no effect on the self-perceived handicap in the present study. Previous investigations on the effect of age on self-perceived handicap in other population using different scales have shown equivocal results. Schow and Tannhill (1977) reported that score obtained for the Hearing Handicap Scale (High et al.. 1964) was not strongly related to age whereas it correlated with pure-tone average. A comparison of the scores on Hearing Handicap Scale (High et al., 1964) for the studies of High et al., (1964), Speaks et al. (1970), and Berkowitz and Hochberg (1971) showed that the respective pure-tone averages for their subjects were similar (30.4, 34.0, 36.1dB HL) as were the handicap scores (44.4, 42.0 and 45,3%), but the average age span varied (49, 59 and 70 years). This observation also shows that handicap scores are related to pure-tone average but not age (Schow and Tannhill, 1977). Similar results were also reported by Birk-Nielson and Ewertsen (1974), who compared scores of self-evaluation of hearing handicap of subjects in four age groups (<50, 51-65, 66-75, >75 years). They found that, although younger subjects reported of lesser handicap than the elderly, there was less than 5% difference among subjects comprising all age groups. However, other investigators have observed that older individuals reported less disability /handicap for a given level of hearing impairment (Lutman, Brown and Coles, 1987; Gatehouse, 1990, Gordon-Salant, Lantz and Fitzgibbons, 1994). Hallberg (1998) also found that age correlated significantly with all the factors of hearing disabilities and handicap scale. It is a well-established fact that older individuals show poorer results on performance-based tests such as speech identification scores. Hence, depressed scores of handicap have been attributed to reduced expectations in older subjects in matters related to hearing (Lutman. Brown and Coles, 1987). However, Saunders and Cienkowski (1996) did not find a significant correlation between age of the hearing-impaired and their responses to the "Attitudes toward loss of hearing questionnaire". Information elicited from this questionnaire included self-report on social and emotional impact of hearing loss, loss of acceptance and adjustment to hearing loss and awareness of hearing problem. This would imply that the differences between different age groups in the earlier studies were mainly due to communication difficulties reported by the subjects. It is possible that this difference was observed due to different lifestyle of the subjects in the two age groups.

GENDER

No significant gender difference in self-perceived handicap was observed in the present study when the degree of hearing loss was controlled. Only female subjects with a mild degree of hearing loss reported a greater handicap than males in the same group. Significant gender effects have not been reported in literature. Habib and Hinchcliffe (1978) also reported that the age and gender of the subject did not influence the estimation of the subjective magnitude of auditory handicap. Results of an investigation by Gatehouse (1990) suggested that there were no gender differences on the disability measure after the effects of hearing threshold and age had been accounted for. However, their results indicated that influence of age, personality and IQ on disability/handicap were different in males and females. Lutman, Brown and Coles (1987) observed that gender effects were limited to subjects with a sloping configuration of hearing loss. They reported that the self-perceived handicap was greater in male than in female subjects. However, greater handicap perceived by males in their study could be partially explained by poorer high frequency thresholds in men than in women. Garestecki and Erler (1999) also reported that when socio-demographic and hearing variables were controlled, group responses to the majority of the scales of Communication Profile for the Hearing-impaired (Demorest and Erdman, 1986,1987) did not differ significantly between male and female subjects.

Thus, it can be concluded from results of the present study that the audiological measures, age and gender do not explain completely the variability in the self-perceived handicap scores. Other variables such as physical, social and psychological factors may contribute to extent to which a hearing impairment will manifest itself as a self-perceived hearing handicap.

PREDICTION OF HEARING HANDICAP

Analysis of the results showed that even though hearing threshold averages could only explain a fairly limited proportion of the variance in self-perceived handicap, a multiple regression equation could explain a considerably higher amount of variance and could allow reliable prediction of handicap. Stepwise multiple regression analysis indicated that hearing handicap could be best predicted through pure-tone average of the better ear and speech identification scores in the presence of noise with a signal-to-noise ratio of +20 dB. Pure-tone average of the better ear accounted for 85% of the variance in the self-perceived handicap. An additional 1% of the variance was explained by speech identification measures in the presence of noise. These results are consistent with the findings of Weinstein and Ventry (1983a) that speech identification scores contributed little additional information about the variability of scores for Hearing Measurement Scale (Noble and Artherly. 1970) over and above that obtained with sensitivity measures. Contrary to these findings, Marcus-Bernstein (1986) reported that intelligibility of words in noise at 50 dB HL in a sound field was the best predictor of hearing handicap. However, in the present study speech identification was measured only under earphones at 40 dB SL (re: speech reception threshold) or at most comfortable level. Probably higher correlation would have been obtained if speech identification scores had been obtained under sound-field condition at 45 dB HL as it relates more closely to natural situation. Barrenas and Holgers (2000) also contend that speech signal given at a constant level corresponding to every day speech gives a more accurate picture of the perceived hearing handicap. Speaks et al., (1970) reported that measures of sensitivity served as the best predictors of the amount of handicap when audiological testing was carried out under earphones. They further observed that when prediction of hearing handicap incorporated more information than is provided by simple sensitivity indices, the magnitude of error increased. (Standard error of estimate was 8.4% when predicted from pure-tone average and 9.2% when it was based on speech identification scores). In the present study not much difference was observed in the standard error of estimate. It was 12.01 when the prediction was based only on pure-tone sensitivity and 11.62 when the prediction was based on a combined measure of pure-tone sensitivity and speech identification measures. In the present study, the self-perceived handicap could be predicted using the formula

Handicap = 8.16 +(1.12 x PTA of the better ear)-020 x Speech identification score in noise (signal-to-noise ratio of + 20 dB)]

or

Handicap =1.13 x(PTA of the better ear - 14.26)

Only pure-tone average of the better ear entered the regression equation when data obtained from the hearing impaired subjects were analysed separately. This could be partially explained by the fact that speech identification scores in the presence of noise was poor for all the hearing impaired subjects irrespective of the degree of hearing loss. This is consistent with the results of item analysis, which revealed that the mean score was more than 1.0 for a majority of the questions that elicited information regarding speech understanding in the presence of noise. These results indicate that speech identification scores in the presence of noise is helpful in differentiating individuals with hearing handicap from those with no hearing handicap but it does not reflect the handicap experienced by subjects with varying degree of hearing loss.

Further analysis of the data was carried out with individual thresholds of better ear and poorer ear at different frequencies as the predictors. Of all the pure-tone thresholds the one of the better ear at 1000 Hz was the best predictor of self-perceived handicap. This was followed by thresholds of the better ear at 500 and 4000 Hz. The results obtained from analysis of data from only hearing impaired group were inconsistent but showed that the poorer ear threshold also contributed in predicting handicap. Similar observations were also made by Corthals et al. (1997). Correlation between the averaged poorer ear sensitivity values and the disability ratings of their subjects did not reach significance level and were not selected as suitable predictors in the multiple regression analysis. However, when thresholds at individual frequencies were used for the analysis, threshold of both the better ear and the contralateral ear entered the regression equation. These data suggested that apriori averaging of threshold values actually hinder the predictive power of multiple correlation. This is a result of the properties of multiple regression as a procedure (Haggard el al.. 1986). Inspection of the highest values of the 'beta' coefficients in the present study and data by Corthals et al. (1997) revealed the relatively greater importance of thresholds at frequencies above 1000 Hz as predictors of handicap.

PREDICTION OF HEARING LOSS

The fact that the total mean and the individual item mean increased as a function of the degree of hearing loss suggested that this questionnaire can be used as a valid measure for predicting hearing loss. The total scores on the handicap scale ranged from zero to seven for subjects with normal hearing. The mean total score for subjects with mild hearing loss was 32.71 with a standard deviation of 15.14. As the scores for the mild group ranged from four to fifty-two, a score of ten was arbitrarily chosen as a low fence for hearing loss. It was observed that only three individuals with hearing loss could be classified as normal hearing using this low fence. Inspection of the total scores for the short version of the scale indicated that a low fence of three could be used to differentiate hearing impaired individuals from normal hearing subjects with the same specificity and sensitivity as that of the long version. Among the three hearing-impaired individuals who would have passed the handicap screening test, two subjects were found to have bilateral mild hearing loss and one had moderate hearing loss. Thus, it can be concluded that this questionnaire can be used effectively in screening programs either by itself or in conjunction with pure-tone screening. However, when only the questionnaire is used for screening, it may fail to detect subjects with unilateral hearing loss as the handicap score showed a higher correlation with better ear sensitivity when compared to that of the poorer ear.

Further, an attempt was made to evaluate the efficiency of this scale in predicting the degree of hearing loss. The following equation was obtained through regression analysis:

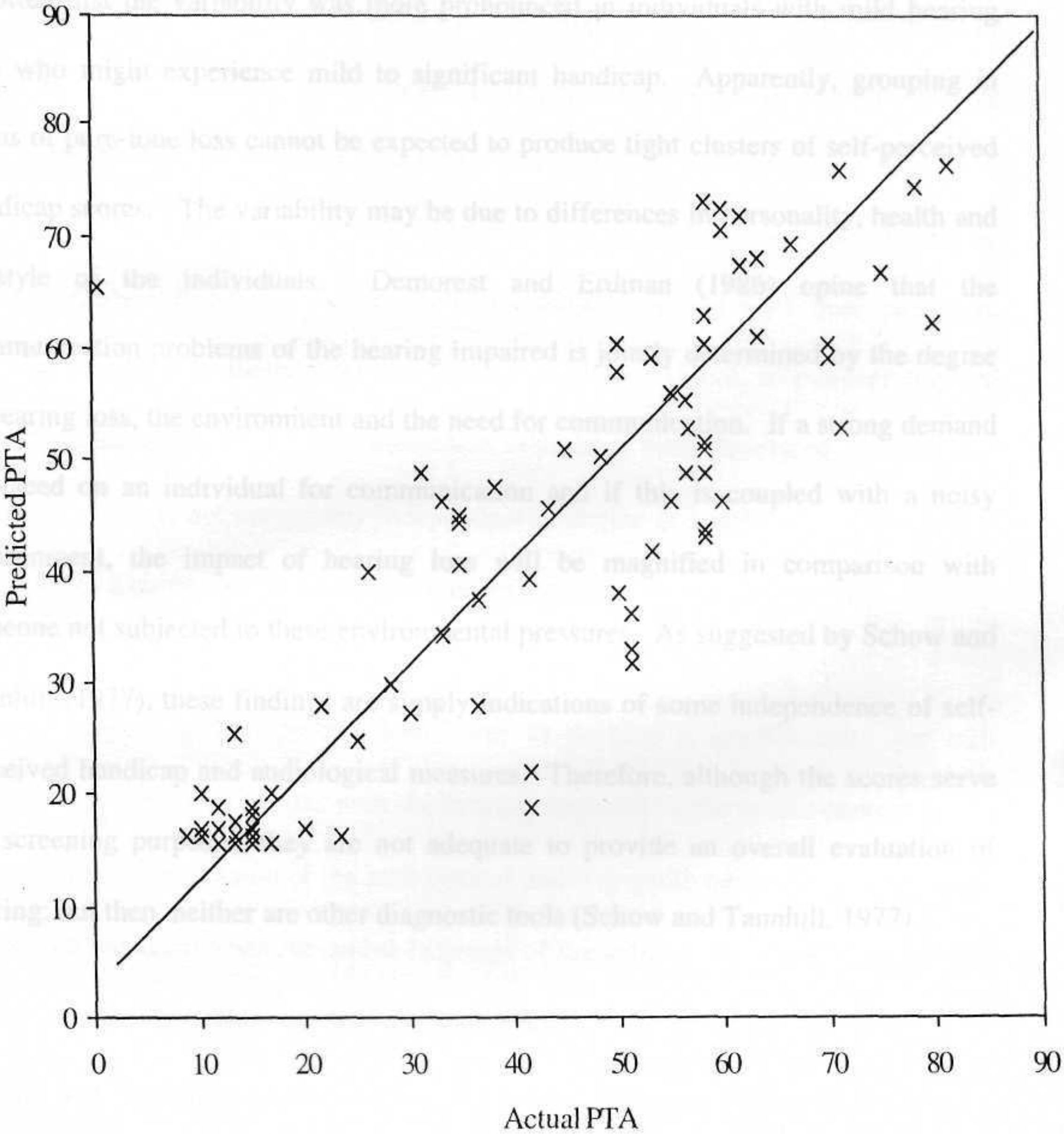
Better ear PTA = 15.68 +(0.64 x Total handicap score)

The standard error of estimate, which quantifies the scatter of the actual pure-tone average around the predictions made from the regression, was 8.92. Figure 6 shows a comparison of the predicted pure-tone average with the actual pure-tone average. It can be observed the pure-tone average predicted was within 20 dB HL of the actual average.

Though it is possible to predict pure-tone thresholds based on the scores obtained for the questionnaire, as with other scales, caution must be exercised in using and making interpretations. It should be remembered that there are persons who may not respond truthfully or objectively to a questionnaire. While some individuals get low scores in an attempt to hide their problems, others may exaggerate their problem. The audiologist must be alert while evaluating such patients.

The results of the present study and a review of literature have demonstrated that the degree of hearing impairment affects the self-perceived handicap but, there is no one to one relationship between the two. Large standard deviations were observed in the present study for subjects with different degrees of hearing loss. These results are not unusual compared to other reported data on various population using different scales. In the present study, standard deviation ranged from 13.40 to 19.26 for the hearing impaired group. Earlier reported standard deviations for the other scales

Figure 6: Relation betwe^e^n predicted and actual PTA



ranged from 8.8% to 29.4% (Schow and Tannhill, 1977; Berkowitz and Hochberg, 1971; McCartney et al., 1971; High et al., 1964, Weinstein and Venlry, 1983b; Brainerd and Frankell, 1985). Large standard deviations for the self-perceived handicap have been reported in literature even when smaller, homogeneous groups are used for the study (Schow and Tannhill, 1977). Weinstein and Venlry (1983a) reported that the variability was more pronounced in individuals with mild hearing loss who might experience mild to significant handicap. Apparently, grouping in terms of pure-tone loss cannot be expected to produce tight clusters of self-perceived handicap scores. The variability may be due to differences in personality, health and lifestyle of the individuals. Demorest and Erdman (1986) opine that the communication problems of the hearing impaired is jointly determined by the degree of hearing loss, the environment and the need for communication. IF a strong demand is placed on an individual for communication and if this is coupled with a noisy environment, the impact of hearing loss will be magnified in comparison with someone not subjected to these environmental pressures. As suggested by Schow and Tannhill (1977), these findings are simply indications of some independence of self-perceived handicap and audiological measures. Therefore, although the scores serve the screening purposes, they are not adequate to provide an overall evaluation of hearing; but then, neither are other diagnostic tools (Schow and Tannhill, 1977).

CHAPTER VI

SUMMARY AND CONCLUSIONS

Several tests are available to assess hearing impairment. Although hearing tests can quantify measures such as loss in hearing sensitivity and difficulty in understanding speech, they are not adequate for quantifying the effect of hearing impairment on a person's everyday function (Ventry and Weinstein, 1982). The extent to which hearing impairment poses difficulty in day-to-day communication might vary from person to person and cannot be predicted from the audiogram alone. Hence, to evaluate the real world difficulties, a number of self-assessment tools have been developed. As the self-perceived handicap is not completely independent of degree of hearing loss, these scales are also used as a quick and inexpensive means of estimating hearing sensitivity.

The purpose of the present study was to develop a questionnaire for self-assessment of hearing loss for use with the hearing-impaired in the Indian context and to study the relationship of some of the audiological and non-audiological findings with the self-perceived handicap when the native language of the subjects was other than English. The study was designed to answer the following questions:

* Is there a relationship between degree of hearing loss and self-perceived hearing handicap?
* Is there a relationship between speech identification scores and self-perceived hearing handicap?

* Is there a relationship between age of the subject and self-perceived handicap?

* Is there a gender difference in the self-perceived handicap?

* Is there an interaction between age and gender, age and degree of hearing loss, gender and degree of hearing loss and age, gender and degree of hearing loss?

* Is it possible to predict hearing loss from self-perceived handicap scores.

A questionnaire was developed to assess the hearing handicap of individuals in various situations such as familiar / unfamiliar, noisy / quiet, with/without visual clue. The fifty items in the questionnaire were chosen based on the experience of the professionals, literature in the field and the assessment of communication needs of individuals.

Data was collected from thirty adults with normal hearing (Group I), thirty-five adults with hearing impairment (Group II) and forty geriatric subjects with hearing impairment (Group III), a total of one hundred and five subjects. Subjects in Group I had pure-tone thresholds less than 25 dB HL from 250 Hz to 8000 Hz. The mean pure-tone average of the better ear was 50.38 dB HL (standard deviation of 16.70) and 50.41 dB HL (standard deviation of 15.83) for Group II and Group III respectively.

The following information was collected from all the subjects:

* Air-conduction and bone-conduction thresholds for pure-tones from 250 Hz to 8000 Hz and 250 Hz to 4000 Hz respectively at octave intervals;

* Speech reception threshold was established using paired words in Kannada;

* Speech identification scores for bisyllables in Kannada in quiet and in the presence of noise with a signal-to-noise ratio of +20 dB, +10 dB and 0 dB;
* Tympanogram and acoustic reflexes thresholds;
* Self-perceived handicap was assessed using the questionnaire developed for the study.

The data collected was analysed using Statistical Package for Social Sciences (SPSS 7.5 Windows version) to answer the questions. The following conclusion seem warranted from the study:

1. Self-perceived handicap scores correlate with the degree of hearing loss as assessed by the pure-tone thresholds and speech reception threshold.
2. Self-perceived handicap scores correlate with speech identification scores in quiet and speech identification scores with signal-to-noise ratio of +20 dB and +10 dB but not with speech identification scores with signal-to-noise ratio 0 dB. Among the measures of speech identification, speech identification scores with a signal-to-noise ratio of +20 dB show highest correlation with self-perceived handicap scores.
3. Age of the subject has no significant effect on the self-perceived handicap scores
4. Gender has no significant effect on the self-perceived handicap scores.
5. There is no interaction between age, gender, degree of hearing loss and self-perceived handicap scores..
6. It is possible to predict the degree of hearing loss based on self-perceived handicap scores,

IMPLICATIONS OF THE STUDY

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

1) The fact that none of the subjects with normal hearing had high scores for the scale suggests that the scale can be used to identify individuals with hearing impairment. Handicap screening using a questionnaire can be the first step in hearing screening in outreach programs where facilities and manpower for carrying out audiological evaluation are limited. It can be used as an adjunct to pure-tone screening to identify potential candidates for rehabilitation services.
2) Information obtained by means of the questionnaire can substantiate an individual's hearing complaints not readily apparent through conventional audiometric testing. The information can be utilized while counseling the hearing impaired individual and his/her family members.
3) The results of the study revealed that subjects with mild hearing loss also report of hearing handicap especially in the presence of noise. These results indicate that it is essential to test speech identification ability in the presence of noise while determining the need for amplification for subjects with mild hearing loss.

Suggestions for future research

1) Further research may be carried out to study the effect of other factors such as personality, age of onset of hearing loss, socio-economic status, occupation and life-style of the individual on the self-perceived handicap scores.

2) Further research may be carried out to study the sensitivity and specificity of the scale in screening for hearing impairment when the scale is administered by a trained anganawadi / health worker.

3) Research may be carried out to evaluate the efficacy of the questionnaire in determining the need for amplification

4) Further research may be carried out to study the usefulness of this questionnaire in assessing benefit derived from amplification.

5) The questionnaire can be modified appropriately and used with a family member of the hearing impaired. Research may be carried out to compare the handicap perceived by the hearing-impaired subject and a significant other.

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APPENDIX – I

ಪ್ರಶ್ನಾವಳಿ

ಕೇಸ್ ನಂ. : ______________________ ತಾರೀಖು : ______________

ಹೆಸರು : ______________________ ವಯಸ್ಸು : ______ ಲಿಂಗ : ________

ವಿಳಾಸ : ____

____

ವಾಸ : ಒಬ್ಬರೇ / ಕುಟುಂಬದವರೊಡನೆ / ನೌಕರಿಯಲ್ಲಿರುವವರು / ನಿವೃತ್ತಿ ಹೊಂದಿರುವವರು

ಉದ್ಯೋಗ : ಈಗಿನ / ನಿವೃತ್ತಿಯ ಮೊದಲು

ಮಾನ್ಯರೇ,

ನಿಮ್ಮ ಶ್ರವಣದೋಷದಿಂದ ನಿಮಗೆ ವಿವಿಧ ಸಂಧರ್ಭಗಳಲ್ಲಿ ಆಗುತ್ತಿರುವ ತೊಂದರೆಯನ್ನು ಗುರುತಿಸಲು ಈ ಪ್ರಶ್ನಾವಳಿಯನ್ನು ತಯಾರಿಸಲಾಗಿದೆ. ದಯವಿಟ್ಟು ಈ ಕೆಳಗಿನ ಸಂಧರ್ಭಗಳಲ್ಲಿ ನಿಮಗೆ 'ಅನೇಕ ವೇಳೆ' (ಶೇಖಡ 75ಕ್ಕಿಂತ ಹೆಚ್ಚು ಸಮಯ) ಅಥವ 'ಕೆಲವು ವೇಳೆ' (25% - 50% ಸಮಯ)ತೊಂದರೆ ಇರುತ್ತದೆಯೋ ಅಥವಾ 'ಒಮ್ಮೊಮ್ಮೆ ಮಾತ್ರ' (25%ಕ್ಕಿಂತ ಕಡಿಮೆ ಸಮಯ)ತೊಂದರೆ ಇರುತ್ತದೆಯೋ ಎಂದು ತಿಳಿಸಿ. ಯಾವುದಾದರೂ ಸಂಧರ್ಭವನ್ನು ನೀವು ಸಂಧಿಸದಿದ್ದರೆ 'ಸಂಬಂಧಪಟ್ಟಿಲ್ಲ' ಎಂದು ತಿಳಿಸಿ.

1. ನಿಮಗೆ ಈ ಕೆಳಕಂಡ ಸಂದರ್ಭಗಳಲ್ಲಿ ಮಾತು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಕಷ್ಟವಾಗುತ್ತದೆಯೇ?

	ಅನೇಕ ವೇಳೆ	ಕೆಲವು ವೇಳೆ	ಒಮ್ಮೊಮ್ಮೆ
i) ನಿಮ್ಮ ಕುಟುಂಬ ಸದಸ್ಯರೊಬ್ಬರು ನಿಮ್ಮ ಪಕ್ಕದಲ್ಲಿ ಕುಳಿತಿದ್ದು ಮಾತನಾಡುವಾಗ, ಅವರ ಮುಖ ಕಾಣದಿದ್ದರೆ			
ii) 6-8 ಅಡಿ ದೂರದಲ್ಲಿರುವ ಪರಿಚಿತ ಗಂಡಸಿನೊಂದಿಗೆ ಸಂಭಾಷಿಸುತ್ತಿರುವಾಗ, ಅವರ ಮುಖ ಕಾಣದಿದ್ದರೆ			
iii) 6-8 ಅಡಿ ದೂರದಲ್ಲಿರುವ ಪರಿಚಿತ ಹೆಂಗಸಿನೊಂದಿಗೆ ಸಂಭಾಷಿಸುತ್ತಿರುವಾಗ, ಅವರ ಮುಖ ಕಾಣದಿದ್ದರೆ			

	ಅನೇಕ ವೇಳೆ	ಕೆಲವು ವೇಳೆ	ಒಮ್ಮೊಮ್ಮೆ
iv) 10-12 ಅಡಿ ದೂರದಲ್ಲಿರುವ ಕುಟುಂಬ ಸದಸ್ಯರೊಬ್ಬರು ಮಾಮೂಲಿ ಧ್ವನಿಯಲ್ಲಿ ಮಾತನಾಡುವಾಗ (ಅವರ ಮುಖ ಗೋಚರಿಸದಿದ್ದರೆ)			
v) ನಿಮ್ಮ ಪರಿಚಯಸ್ತರೊಡನೆ ದೂರವಾಣಿಯಲ್ಲಿ ಸಂಭಾಷಿಸುವಾಗ			
vi) ನಿಶಬ್ಧವಾದ ಕೊಠಡಿಯಲ್ಲಿ, 6-8 ಅಡಿ ದೂರದಿಂದ ದೂರದರ್ಶನದ ಕಾರ್ಯಕ್ರಮವನ್ನು ಸಾಧಾರಣವಾದ ಧ್ವನಿಯಲ್ಲಿ ವೀಕ್ಷಿಸುವಾಗ			
vii) ನಿಶಬ್ಧವಾದ ಕೊಠಡಿಯಲ್ಲಿ, 6-8 ಅಡಿ ದೂರದಿಂದ ದೂರದರ್ಶನದ ವಾರ್ತೆಯನ್ನು ಸಾಧಾರಣವಾದ ಧ್ವನಿಯಲ್ಲಿ ವೀಕ್ಷಿಸುವಾಗ			
viii) ನಿಶಬ್ಧವಾದ ಕೊಠಡಿಯಲ್ಲಿ, 3 ಅಡಿ ದೂರದಲ್ಲಿರುವ ರೇಡಿಯೋವನ್ನು ಸಾಧಾರಣ ಧ್ವನಿಯಲ್ಲಿ ಕೇಳುತ್ತಿರುವಾಗ			
ix) ಇತರ ಶಬ್ಧವಿರುವ (ಉದಾ: ಬೇರೆಯವರ ಮಾತನಾಡುತ್ತಿರುವುದು) ಕೊಠಡಿಯಲ್ಲಿ, 6-8 ಅಡಿ ದೂರದಲ್ಲಿರುವ ದೂರದರ್ಶನದ ಕಾರ್ಯಕ್ರಮವನ್ನು ಸಾಧರಣ ಧ್ವನಿಯಲ್ಲಿ ವೀಕ್ಷಿಸುತ್ತಿರುವಾಗ			
x) ಭರ್ತಿಯಾಗಿರುವ ಬಸ್ಸ್‌ನಲ್ಲಿ ಬಸ್ಸ್ ನಿರ್ವಾಹಕ (ಕಂಡಕ್ಟರ್)ನೊಡನೆ ಮಾತನಾಡುವಾಗ			
xi) ಬಹಳ ಗದ್ದಲವಿರುವ ರೈಲು ನಿಲ್ದಾಣದಲ್ಲಿ ನಿಮ್ಮ ಪಕ್ಕದಲ್ಲಿರುವ ಸ್ನೇಹಿತನೊಡನೆ ಸಂಭಾಷಣೆ ಮಾಡುವಾಗ			

	ಅನೇಕ ವೇಳೆ	ಕೆಲವು ವೇಳೆ	ಒಮ್ಮೊಮ್ಮೆ
xii) ಬಹಳ ಗದ್ದಲವಿರುವ ಅಂಗಡಿಯಲ್ಲಿ, ನೀವು ವ್ಯಾಪರಸ್ಥನೊಂದಿಗೆ ಸಂಭಾಷಿಸುವಾಗ			
xiii) ಸಾರ್ವಜನಿಕ ಸಭೆಯಲ್ಲಿ ಭಾಷಣವನ್ನು ಕೇಳುವಾಗ, ನೀವು ಧ್ವನಿವರ್ಧಕದಿಂದ 6-8 ಅಡಿ ದೂರದಲ್ಲಿದ್ದರೆ			
xiv) ಉಪಹಾರ ಮಂದಿರದಲ್ಲಿ ನಿಮ್ಮ ಎದುರಿನಲ್ಲಿ ಕುಳಿತಿರುವ ಸ್ನೇಹಿತನೊಡನೆ ಮಾತನಾಡುವಾಗ			
xv) ಮದುವೆ ಮನೆಯಲ್ಲಿ ನಿಮ್ಮ ಪಕ್ಕದಲ್ಲಿ ಕುಳಿತಿರುವವರೊಡನೆ ಸಂಭಾಷಿಸುವಾಗ (ಅವರ ಮುಖ ಗೋಚರಿಸದಿದ್ದರೆ)			
xvi) ಬಹಳ ಗದ್ದಲವಿರುವ ರಸ್ತೆಯಲ್ಲಿ ನಿಮ್ಮ ಪಕ್ಕದಲ್ಲಿರುವವರೊಡನೆ ಸಂಭಾಷಿಸುವಾಗ			
xvii) ಸಾಧಾರಣ ಧ್ವನಿಯಲ್ಲಿ ಟಿ.ವಿ./ರೇಡಿಯೋ ಹಾಕಿರುವ ಕೊಠಡಿಯಲ್ಲಿ ನಿಮ್ಮ ಪಕ್ಕದಲ್ಲಿ ಕುಳಿತಿರುವವರೊಡನೆ ಸಂಭಾಷಿಸುವಾಗ			
xviii) ಚಿತ್ರಮಂದಿರದಲ್ಲಿ ಚಲನಚಿತ್ರವನ್ನು ವೀಕ್ಷಿಸುವಾಗ			
xix) ನಿಮ್ಮ ಕಿವಿಯಿಂದ 6 ಅಂಗುಲ ದೂರದಿಂದ ಪಿಸುಮಾತನಾಡಿದರೆ			
xx) ಹೊರಗಡೆ, ನಿಶಬ್ದವಾದ ವಾತಾವರಣದಲ್ಲಿ ನಿಮ್ಮ ಪಕ್ಕದಲ್ಲಿರುವ ಅಪರಿಚಿತರೊಡನೆ ಮಾತನಾಡುವಾಗ			
xxi) ಮನೆಯೊಳಗೆ ಒಂದು ಸಣ್ಣ ಗುಂಪಿನ ಜನರೊಂದಿಗೆ ಮಾತನಾಡುವಾಗ			

	ಅನೇಕ ವೇಳೆ	ಕೆಲವು ವೇಳೆ	ಒಮ್ಮೊಮ್ಮೆ
xxii) ನಿಮ್ಮಿಂದ 3 ಅಡಿ ದೂರದಲ್ಲಿರುವರೊಡನೆ ಮಾತನಾಡುವಾಗ, ಅವರ ಮುಖವು ನಿಮಗೆ ಕಾಣುವಂತಿದ್ದರೆ			
2. ನೀವು ಯಾರೊಡನೆಯಾದರೂ ಸಂಭಾಷಣೆಯನ್ನು ನಡೆಸುವಾಗ ಟಿ.ವಿ./ ರೇಡಿಯೋವಿನ ಧ್ವನಿಯನ್ನು ಕಡಿಮೆ ಮಾಡುವಿರಾ?			
3. ಒಂದೇ ಸಮಯದಲ್ಲಿ ಅನೇಕರು ಒಟ್ಟಿಗೆ ಮಾತನಾಡಿದರೆ ನಿಮಗೆ ಮಾತು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಕಷ್ಟವಾಗುವುದೇ?			
4. ದೊಡ್ಡ ಕೊಠಡಿಯಲ್ಲಿ ಅನೇಕ ಜನರು ಮಾತನಾಡುತ್ತಿರುವಾಗ ನಿಮಗೆ ಸಂಭಾಷಣೆ ನಡೆಸಲು ಸಾಧ್ಯವೇ?			
5. ಜನರು ನಿಧಾನವಾಗಿ ಮಾತನಾಡಿದರೆ ನಿಮಗೆ ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಸುಲಭ ಎನಿಸುವುದೇ?			
6. ಯಾರಾದರು ನಿಮ್ಮೊಡನೆ ಮಾತನಾಡುವಾಗ ಅವರಿಗೆ ಪುನರುಚ್ಚರಿಸಲು ಹೇಳುವಿರಾ?			
7. ಯಾರಾದರೂ ಪರಿಚಯಸ್ಥರು ನಿಮ್ಮ ಹಿಂದಿನಿಂದ ಮಾತನಾಡಿದಾಗ ಅವರ ಧ್ವನಿ ಪತ್ತೆ ಹಚ್ಚಲು ಕಷ್ಟವಾಗುತ್ತದೆಯೇ?			
8. ನೀವು ರಸ್ತೆಯಲ್ಲಿ ನಡೆಯುತ್ತಿರುವಾಗ ಬಸ್ಸ್ ಅಥವಾ ಮೋಟಾರಿನ ಹಾರ್ನ್ ಯಾವ ದಿಕ್ಕಿನಿಂದ ಬರುತ್ತಿದೆಯೆಂದು ಪತ್ತೆ ಹಚ್ಚುವಿರಾ?			

	ಅನೇಕ ವೇಳೆ	ಕೆಲವು ವೇಳೆ	ಒಮ್ಮೊಮ್ಮೆ
9. ಜನ ಸಮೂಹದಲ್ಲಿ ಸಂಭಾಷಿಸಿತ್ತಿರುವಾಗ, ಜನರು ಯಾವ ದಿಕ್ಕಿನಿಂದ ಮಾತನಾಡುತ್ತಿರುವರೆಂದು ಪತ್ತೆ ಹಚ್ಚುವಿರಾ?			
10. ನಿಮಗೆ ಶ್ರವಣದೋಷವಿರುವುದರಿಂದ ಜನರೊಡನೆ ಮಾತನಾಡಲು ಹಿಂಜರಿಯುವಿರಾ?			
11. ನಿಮಗೆ ಶ್ರವಣದೋಷವಿರುವುದರಿಂದ ಅಪರಿಚಿತರನ್ನು ಸಂಧಿಸಲು ಹಿಂಜರಿಯುವಿರಾ?			
12. ನಿಮಗೆ ಶ್ರವಣದೋಷವಿರುವುದಿರಂದ, ನೀವು ಜನರ ಗುಂಪಿನಲ್ಲಿರುವಾಗ ಏಕಾಂಗಿ ಎಂಬ ಭಾವನೆ ಬರುವುದೇ?			
13. ಶ್ರವಣದೋಷವಿರುವುದರಿಂದ ನೀವು ಟಿ.ವಿ./ ರೇಡಿಯೋ ಕೇಳುವುದನ್ನು ಕಡಿಮೆ ಮಾಡಿರುವಿರಾ?			
14. ಬೇರೆಯವರು ಹೇಳುವುದು ನಿಮಗೆ ಸರಿಯಾಗಿ ಅರ್ಥವಾಗದಿದ್ದರೆ, ನೀವು ಚಡಪಡಿಸುವಿರೇ?			
15. ನಿಮ್ಮ ಕುಟುಂಬದ ಸದಸ್ಯರು ಹೇಳುವುದು ನಿಮಗೆ ಸರಿಯಾಗಿ ಅರ್ಥವಾಗದಿದ್ದಾಗ ಅವರಿಗೆ ಬೇಸರವಾಗುವುದೆಂದು ನೀವು ಭಾವಿಸುವಿರಾ?			
16. ನಿಮಗೆ ಶ್ರವಣದೋಷವಿರುವುದರಿಂದ ಜನರು ನಿಮ್ಮನ್ನು ಸಂಭಾಷಣೆಯಲ್ಲಿ ಸೇರಿಸುಕೊಳ್ಳುವುದಿಲ್ಲವೆಂದು ನಿಮಗನಿಸುವುದೇ?			
17. ನೀವು ಟಿ.ವಿ/ರೇಡಿಯೋ ಧ್ವನಿಯನ್ನು ಜಾಸ್ತಿ ಮಾಡುವುದರಿಂದ ನಿಮ್ಮ ಕುಟುಂಬ ಸದಸ್ಯರಿಗೆ ಬೇಸರವಾಗುವುದೇ?			

	ಅನೇಕ ವೇಳೆ	ಕೆಲವು ವೇಳೆ	ಒಮ್ಮೊಮ್ಮೆ

18. ನಿಶಬ್ದವಾದ ವಾತಾವರಣದಲ್ಲಿ, 6-8 ಅಡಿ ದೂರದಿಂದ ನಿಮಗೆ ಈ ಕೆಳಗಿನ ಶಬ್ದ(ಗಳು) ಕೇಳಿಸುವುದೇ?
    - i) ದೂರವಾಣಿ ಗಂಟೆ
    - ii) ಬಾಗಿಲು ತಟ್ಟಿದ (ಕಟಕಾಯಿಸಿದ) ಶಬ್ದ
    - iii) ನಾಯಿ ಬೊಗಳುವ ಶಬ್ದ
    - iv) ಕಾಲಿನ ಹೆಜ್ಜೆಯ ಶಬ್ದ
    - v) ನಲ್ಲಿಯಿಂದ ನೀರು ಬೀಳುವ ಶಬ್ದ
    - vi) ಕುಕ್ಕರಿನ ಶಿಳ್ಳೆ
19. ನಿಶಬ್ದವಾದ ವಾತಾವರಣದಲ್ಲಿ, 18-20 ಅಡಿ ದೂರದಿಂದ, ಈ ಕೆಳಗಿನ ಶಬ್ದ(ಗಳು) ಕೇಳಿಸುವುದೇ?
    - i) ಬಸ್ಸ್ ಹಾರ್ನ್
    - ii) ದೂರವಾಣಿ ಕರೆಗಂಟೆ
    - iii) ಕುಕ್ಕರಿನ ಶಿಳ್ಳೆ
20. ನಿಶಬ್ದವಾದ ವಾತಾವರಣದಲ್ಲಿ, ಯಾರಾದರೂ ನಿಮ್ಮನ್ನು 6-8 ಅಡಿ ದೂರದಿಂದ ಕರೆದರೆ ಕೇಳಿಸುವುದೇ?
21. ನಿಶಬ್ದವಾದ ವಾತಾವರಣದಲ್ಲಿ, ಯಾರಾದರೂ ನಿಮ್ಮನ್ನು 18-20 ಅಡಿ ದೂರದಿಂದ ಕರೆದರೆ ಕೇಳಿಸುವುದೇ
22. ಸಾಧಾರಣ ಧ್ವನಿಯಲ್ಲಿ ಟಿ.ವಿ. ಹಾಕಿರುವಾಗ, ಯಾರಾದರೂ ನಿಮ್ಮನ್ನು 6-8 ಅಡಿ ದೂರದಿಂದ ಕರೆದರೆ ಕೇಳಿಸುವುದೇ?
23. ಮೇಲೆ ತಿಳಿಸಿರುವುದಲ್ಲದೆ, ಇನ್ನಿತರ ಸಂದರ್ಭದಲ್ಲಿ ಕಿವಿ ಕೇಳಿಸುವುದು ಕಷ್ಟವಾಗಿದೆಯೇ? (ನಿರ್ಧಿಷ್ಟವಾಗಿ ತಿಳಿಸಿ)

English equivalent of the questionnaire

SELF-ASSESSMENT OF HEARING HANDICAP

Name: Date:

Case No.: Age: Sex: M/F

Address:

Living alone / with family Employed / Retired

Occupation : Present / prior to retirement

The purpose of this scale is to identify the communication problems caused by your hearing loss. It is possible that your communication problems vary in different situations. The aim of this scale is to assess your problem in different situations. Therefore, please read the following questions and indicate whether you have problem "most of the time (>75% of the time)',sometimes (25% - 75% of the time)' or "seldom (<25% of the time)'. Indicate not applicable' if you have not encountered a particular situation.

Question	Response	Score
l.Do you have difficulty in understanding speech in the following situations?		
a) While conversing with a family member seated next to you, if you cannot see his/her face.	Most of the time	2
	Sometimes	1
	Seldom	0
b) while conversing with a familiar male from a distance of 6 - 8 feet, if you cannot see his face.	Most of the lime	2
	Sometimes	1
	Seldom	0
c) while conversing with a familiar female from a distance of 6 - 8 feet, if you cannot see her face.	Most of the time	2
	Sometimes	1
	Seldom	0
d) While listening to a family member (without visual clue) who is speaking in a normal tone of voice from a distance of 10 -12 feet.	Most of the time	2
	Sometimes	1
	Seldom	0
e) While conversing with a familiar person over telephone.	Most of the time	2
	Sometimes	1
	Seldom	0
f) While watching a TV program, if the TV is turned on at normal volume, at a distance of 6 - 8 feet, in a quiet room.	Most of the time	2
	Sometimes	1
	Seldom	0
g) While watching TV news, if the TV is turned on at normal volume, at a distance of 6- 8 feet, in a quiet room.	Most of the time	2
	Sometimes	1
	Seldom	0

h) while listening to a radio turned on at normal volume, from a distance of three feet in a quiet room.	Most of the time	2
	Sometimes	1
	Seldom	0
i) While watching a TV program, if the TV is turned on at normal volume, at a distance of 6 - 8 feet and there is other noise in the room (e.g. others talking).	Most of the time	2
	Sometimes	1
	Seldom	0
j) While conversing with a bus conductor in a crowded bus.	Most of the time	2
	Sometimes	1
	Seldom	0
k) While conversing with a friend standing beside you in a crowded railway platform.	Most of the time	2
	Sometimes	1
	Seldom	0
1) While conversing with a salesman in a busy shop.	Most of the time	2
	Sometimes	1
	Seldom	0
m) While listening to a speech at a public gathering when you are at a distance of 6 - 8 feet from the loudspeaker.	Most of the time	2
	Sometimes	1
	Seldom	0
n) While carrying out conversation with a friend sitting opposite to you at a restaurant.	Most of the time	2
	Sometimes	1
	Seldom	0
o) While conversing with a familiar person seated next to you in a wedding hall, if you cannot see his/her face.	Most of the time	2
	Sometimes	1
	Seldom	0

p) While conversing with a familiar person who is beside you when you are walking in a busy street.	Most of the time	2
	Sometimes	1
	Seldom	0
q) While conversing with another person seated next to you, if there is a TV or radio playing at normal volume in the same room.	Most of the time	2
	Sometimes	1
	Seldom	0
r) While watching a movie in a theater.	Most of the time	2
	Sometimes	1
	Seldom	0
s) While listening to somebody whispering at a distance of six inches from your ear.	Most of the time	2
	Sometimes	1
	Seldom	0
t) While carrying out conversation with an unfamiliar person standing beside you, when you are outdoors and it is reasonably quiet.	Most of the time	2
	Sometimes	1
	Seldom	0
u) While conversing with a small group of people at home	Most of the time	2
	Sometimes	1
	Seldom	0
v) While conversing with a person seated in front of you at a distance of 3 feet and you are able to watch his face (with adequate light on his face)	Most of the time	2
	Sometimes	1
	Seldom	0
2. Do you turn down the volume of TV or radio before you try to carry on a conversation?	Most of the time	2
	Sometimes	1
	Seldom	0

3. Do you find it hard to understand when several people are talking at the same time?	Most of the time	2
	Sometimes	1
	Seldom	0
4. Can you carry on a conversation when several people are talking in a large room?	Most of the time	0
	Sometimes	1
	Seldom	2
5. Do you feel that you understand better when people talk slowly?	Most of the time	2
	Sometimes	1
	Seldom	0
6.Do you ask for repetitions when people speak to you?	Most of the time	2
	Sometimes	1
	Seldom	0
7. Do you have difficulty in recognising a familiar voice when your back is turned towards the speaker?	Most of the time	2
	Sometimes	1
	Seldom	0
8. Can you identify the direction from which you heard the automobile horn while you are walking on a street?	Most of the time	0
	Sometimes	1
	Seldom	2
9. When you are conversing with a group of people, can you identify the location of the speaker?	Most of the time	0
	Sometimes	1
	Seldom	2
10. Do you avoid talking to people because you have a hearing problem?	Most of the time	2
	Sometimes	1
	Seldom	0

11. Do you hesitate to meet strangers because you have a hearing problem?	Most of the time	2
	Sometimes	1
	Seldom	0
12. Does your hearing problem make you to feel left out when you are with a group of people?	Most of the time	2
	Sometimes	1
	Seldom	0
13. Do you listen to TV or radio less often because you have a hearing problem?	Most of the time	2
	Sometimes	1
	Seldom	0
14. Do you get frustrated when you cannot understand what others say?	Most of the time	2
	Sometimes	1
	Seldom	0
15. Do you feel that your family members get annoyed when you do not understand what they say?	Most of the time	2
	Sometimes	1
	Seldom	0
16. Do you feel that people leave you out of conversation because you have a hearing problem?	Most of the time	2
	Sometimes	1
	Seldom	0
17. Does your family member get annoyed because you raise the volume of TV/radio?	Most of the time	2
	Sometimes	1
	Seldom	0
18. Can you hear the following from a distance of 6- 8 feet, in a quiet room		
a) a telephone ringing	Most of the time	0
	Sometimes	1
	Seldom	2

b) a knock on the door	Most of the time	0
	Sometimes	1
	Seldom	2
c) a dog barking	Most of the time	0
	Sometimes	1
	Seldom	2
d) sounds of footsteps	Most of the time	0
	Sometimes	1
	Seldom	2
e) a tap running	Most of the time	0
	Sometimes	1
	Seldom	2
f) hiss of a pressure cooker	Most of the time	0
	Sometimes	1
	Seldom	2

19. Can you hear the following from a distance of 18-20 feet, in a quiet room

a) bus horn	Most of the time	0
	Sometimes	1
	Seldom	2
b) a telephone ringing	Most of the time	0
	Sometimes	1
	Seldom	2
c) hiss of a pressure cooker	Most of the time	0
	Sometimes	1
	Seldom	2

20. In a quiet situation, can you hear somebody calling you from a distance of 6 - 8 feet?	Most ol' the time	0
	Sometimes	]
	Seldom	2
21. In a quiet situation, can you hear somebody calling you from a distance of 18 - 20 feet?	Most of the time	0
	Sometimes	1
	Seldom	2
22. Can you hear somebody calling you from behind (from a distance of 6 - 8 feet), if the TV is turned on at normal volume?	Most of the time	0
	Sometimes	1
	Seldom	2

23. Mention any other situation you have difficulty in hearing (please specify)

APPENDIX-II

Calibration Procedure

The clinical audiometer (Madsen OB 822) was calibrated to ensure valid results. Both frequency and intensity calibration was done for the pure tones generated by the clinical audiometer.

Calibration of output sound pressure level

Calibration of output sound pressure level for air-conducted tones was carried out with the output of the audiometer set at 70 dB HL (ANSI, 1989) through the earphones (TDH 39 earphones) housed in ear cushion (MX 41/AR). The acoustic output of the audiometer was given to a condenser microphone (B and K 4144) fitted into an artificial ear (B and K 4152). The signal was then fed to a calibrated sound level meter (B and K 2209) attached to an octave filler set (B and K 1613) through a pre-amplifier (B and K 2616). The sound level meter was fitted with a half inch to one inch adapter (B and K DB 0962). The sound level meter was set to slow' response and to external filter. The octave filter set was set to the required frequency i.e. the same frequency as that selected on the audiometer. At each of the test frequencies, i.e. 250 Hz. to 8000 Hz, the output sound pressure level was noted. It was ensured that the difference between the observed sound pressure level value and the expected value was less than 2.5 dB (ANSI, 1989).

Calibration of output sound pressure level for bone-conduced stimuli was done, for test frequencies, from 250 Hz to 4000 Hz. The output of the audiometer was set at 40 dB HL. The signal from the bone vibrator was fed to the artificial mastoid (B and K 4930). This output was then fed via a pre-amplifier (B and K 2616) to the sound level meter (B and K. 2209) attached to an octave filter set (B and K 1613). The settings on the sound level meter and octave filter set was similar to that used for earphones. It was ensured that the difference between the observed and the expected sound pressure level value was less than 2.5 dB (ANSI, 1992).

Calibration of linearity of the audiometer:

The procedure used for checking the linearity of the audiometer was similar to that utilised to check the intensity calibration except that the hearing level dial of the audiometer was set at the maximum level and the frequency dial was set to 1000 Hz. The attenuator on the sound level meter was set at a level corresponding to the maximum level on the audiometer. The attenuator setting on the audiometer was decreased in 5 dB steps till 30 dB and the corresponding reading on the sound level was noted. For every decrease in the attenuator setting the sound level meter indicated a corresponding reduction. The difference between the expected sound pressure level and the observed sound pressure level was less than 2.5 dB.

Frequency calibration

A frequency counter (Radart 203) was utilized to calibrate the frequency of the pure tones. The electrical output of the audiometer was fed to the frequency counter which gave a digital display of the generated frequency. It was ensured that the difference between the dial reading of the audiometer and the digital display on the frequency counter for a given frequency was less than 3% (ANSI, 1989).

Calibration of the tape input

Calibration tone of 1000 Hz that preceded the test words was used to calibrate the tape input. The cassette with the calibration tone was played through the tape recorder (Philips AW 606). The output of the tape was fed to the audiometer. The input intensity was adjusted so that the volume unit (VU) meter of the audiometer deflected to zero. The output from the earphone was given to a condensor microphone (B and K 4144) fitted into an artificial ear (B and K 4152). This output was then fed to the sound level meter (B and K 2209) through a pre-amplifier (B and K 2616). The sound level meter was fitted with a half inch to one inch adapter (B and K DB 0962). The reading on the sound level meter was noted on the linear' response scale. It was ensured that the reading on the sound level meter did not deviate by more than 2.5 dB (ANSI, 1989) of the expected value.

APPENDIX-III

Noise Levels in the Test room

Octave Frequency	Level in dB SPL
250 Hz	22
500 Hz	16
1000 Hz	10
2000 Hz	8
4000 Hz	9
8000 Hz	10
C-scale	35 dB

APPENDIX - IV

Bisyllables in Kannada

	Kannada	IPA		Kannada	IPA
1.	ಜೋಡು	jo:ḍu	26.	ಕಟ್ಟು	kaṭṭu
2.	ಗುಂಡಿ	gunḍi	27.	ಬುದ್ಧಿ	buddhi
3.	ಖೂನಿ	k^{h}u:ni	28.	ದೃಷ್ಟಿ	druʃti
4.	ಶೃತಿ	ʃruti	29.	ಜೇಬು	je:bu
5.	ಪ್ರಾಣಿ	pra:ni	30.	ಅನ್ನ	anna
6.	ಸರಿ	sari	31.	ಗಾಲಿ	ga:li
7.	ಜ್ಞಾನಿ	gna:ṇi	32.	ಅಮ್ಮ	amma
8.	ಖರ್ಚು	k^{h}arču	33.	ಮಸಿ	masi
9.	ಮೂರ್ತಿ	mu:rt̪i	34.	ಅಕ್ಕ	akka
10.	ಮುನಿ	muni	35.	ಕನ್ಯ	kanya
11.	ಭರ್ತಿ	b^{h}art̪i	36.	ಬೇಡಿ	be:di
12.	ತಗ್ಗು	t̪aggu	37.	ಮುಯ್ಯಿ	muyyi
13.	ದಾಸಿ	da:si	38.	ಚೀಟಿ	či:ti
14.	ಹಂಸ	hamsa	39.	ಟೋಪಿ	ṭo:pi
15.	ಚೆಲ್ಲು	čellu	40.	ತ್ಯಾಗಿ	t̪ya:gi
16.	ಋಷಿ	ruʃi	41.	ಕಾಂತಿ	ka:nt̪i
17.	ಕವಿ	kavi	42.	ಗತಿ	gat̪i
18.	ತೀರ್ಪು	t̪i:rpu	43.	ಬತ್ತಿ	bat̪t̪i
19.	ದೇವಿ	de:vi	44.	ಡೇರಾ	ḍe:ra
20.	ಮಂತ್ರಿ	mant̪ri	45.	ಪೈರು	pairu
21.	ನದಿ	nadi	46.	ನೀವು	ni:vu
22.	ಅತಿ	at̪i	47.	ದ್ರೋಹಿ	dro:hi
23.	ಗುಡ್ಡ	guḍḍa	48.	ನಾಡು	na:ḍu
24.	ಕಾಳಿ	ka:ḷi	49.	ಭಾವಿ	b^{h}a:vi
25.	ಟಾಂಗಾ	ṭa:nga	50.	ಪೆದ್ದ	pedda

APPENDIX-V

Short Form of the Self-assessment Scale

1. Do you have difficulty in understanding speech in the following situations:

   a) While listening to somebody whispering at a distance of six inches from your ear.

   b) While conversing with a familiar person from a distance of 6-8 feet, when you cannot see his/her face.

   c) While listening to a family member (without visual clue) who is speaking in a normal tone of voice from a distance of 10-12 feet

   d) While watching a TV program, if the TV is turned on at normal volume, at a distance of 6-8 feet, in a quiet room

   e) While watching a TV program, if the TV is turned on at normal Volume at a distance of 6-8 feet and there is other noise in the room (e.g. others talking)

   f) While conversing with familiar person seated next to you in a wedding hall, if you cannot see his/her face.

2. Can you hear a telephone ring from a distance of 6-8 feet, in a quiet room?
3. Can you hear a bus horn from a distance of 18-20 feet, in a quiet situation?
4. Do you avoid talking to people because you have a hearing problem?
5. Does your hearing problem make you to feel left out when you are with a group of people?