AUDIOLOGICAL FINDINGS IN PRESBYCUSIS

AUDIOLOGICAL FINDINGS IN PRESBYCUSIS

A Dissertation

Presented to

the University of Mysore

BABU PUNNAN

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Speech and Hearing

May 1976

Dedicated to my parents

with love

CERTIFICATE

This is to certify that the dissertation entitled "Audiological findings in Presbycusis" is the bonafide work in part fulfillment for M.Sc. in Speech and Hearing carrying 100 marks, of the student with Register No. 59.

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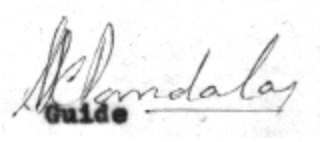
CERTIFICATE

This is to certify that this dissertation has been prepared under my supervision and guidance.



DECLARATION

This dissertation is the result of my own study undertaken under the guidance of Mr. S.P.C. Pandalay, Lecturer in Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other diploma or degree.

Mysore: Reg. No. 59

Date :

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CONTENTS

CHAPTER I

INTRODUCTION

Increasing deafness in the aged is one of the interesting chapter and psychologically perhaps the most important chapter in our Bible of Audiology. Aging, the process of growing nature or old. Occurs in all cells and structures of the body, many structures show only minimal change with age, while others show moderate or marked change.

Zwaardemaker (1899) coined the term "Presbycusis" to denote the poor hearing of elderly people. The threshold sensitivity of hearing for puretone shows a gradual impairment with increasing age, in-spite of the fact that it probably represents the most common auditory deficiency occurring most adults, atleast a part of the neglect is probably due to the complexity of the disorder. Presbycusis has now become generally recognized as a considerably more complicated clinical phenomenon than it was a few years ago. In view of this fact the presbycusis patient should present a fascinating challenge to audiologists and otologists.

We know very little about presbycusis beyond the fact that its progressive it is sometimes but always associated with blood pressure or general arteriosclerosis. High tones are

affected first and foremost and hearing by bone conduction is reduced. Often grossly so, the singing of birds and the ringing of the bells are lost first, but speech is also difficult to follow especially rapid speech.

Normal hearing may be defined as the average hearing of a group of persons between 18 to 30 years with no otologic symptoms or sings, essentially representative of the population – "Average" because normal hearing is not a specific figure but a range extending over 15 dB on either side of the mean value (Glorig 1961).

Presbycusis is the effect of ageing on hearing, although normal hearing may persist with advanced ages. Hence the term presbycusis refers to gradually increasing less of hearing acuity associated with advancing age.

Bunch (1943) noted high tone losses considerably greater in white males than white females. Saxen (1952) believed that two diseases of the auditory apparatus peculiar to the old are:

1. Senil atrophy of spiral ganglian and
2. An angeosclerotic degeneration of the inner ear

Pestalozza and Shore (1955) pointed out that precise pathological changes in this condition are obscure, there may be different lesions which may be responsible for losses at present

grouped as presbycusis. Schuknecht (1955) said that aging is accompanied by degeneration in the basal turn of the cochlea. Hinchcliffe (1959) found in a normal Scottish population ranging from 20 – 70 years that the rate of deterioration increased with frequencies above 500 Hz.

Western (1969) has expressed the difficulty to assesses the incidence, but proved that with advancing age there is gradually progressive loss of hearing.

Need for the study

A definition of the age at which presbycusis begins is lacking in the literature. Several studies have been conducted in other countries to assess the nature and degree of hearing loss incurred during old age.

Glorig and Davis (1951) presented a curve showing the changes in hearing sensitivity as a function of age. A.S.A. (1954) has established a set of hearing sensitivity curves at 5, 1, 2, and 4 Kcls for men and women between the age of 25 – 65 years.

Hinchcliffe (1959) has reported the changes in the auditory threshold, sensitivity for pure tones as function of age. Dayal (1971) reported the changes occurring in pure tone audiograms of patients with presbycusis.

But the literature on the pattern of hearing loss with respect to age on Indian population is scanty – indicating the need for conduction a study on this line.

It is inaccurate to assume that lesions in presbycusis are restricted to cochlea as aging process undoubtedly produces alterations in many areas of the auditory system. Studies concerned with SISI test on presbycusis population show that the results of SISI test are unpredictable. Probably this unpredictability stems from the fact that the test was administered at 20 dB SL. As established by Young and Herbert that 100% SISI score results when the energy reaching cochlea is 60 – 70 dB, here an attempt is made to verify the predictability of SISI in presbycusis population. If presbycusis subjects scores 100% on modified SISI, previous observation that SISI test is unpredictable in cases of presbycusis goes invalid.

It has been said that the cochlear changes in presbycusis patients come about in the nerve cells rather than in the hair cells and for this reason tone decay test was administered to all cases to check if possible, the site of lesion.

To check the phonemic regression or slowness in comprehension which increases as age advances, speech discrimination test was administered to cases whenever it was within the permissible limits of the audiometer.

Hypothesis

1. There is no significant difference in the hearing pattern shown by Indians as a function of age from that existing in the white population as a function of age.
2. There is no significant ear difference for hearing sensitivity as a function of age.
3. The SISI score is not unpredictable in presbycusis.
4. Tone decay, the test for retrocochlear affection fails to provide any information.

Brief Plan

100 subjects were selected randomly from the attendants who brought case to the Institute during the study from different parts of South India, between the age group of 35– 75 years. All of them had ontologically normal ears with no past history of any earache or ear discharge.

All were tested in sound treated rooms of All India Institute of Speech and Hearing using Madsen OB 70 audiometer calibrated to I.S.O 1964, SISI test and tone decay test were administered to all subjects following the administration of speech audiometry. The results were analyzed statistically to establish the presbycusis factor existing at each frequency for different age groups.

Limitations of the study

1. Audiological findings are limited to tone decay speech audiometry and SISI test only.
2. The study is limited to subjects upto 75 years of age.
3. The subjects tested in this study were mainly from south India.

Definitions of terms

Air conduction - The normal process of conducting sound wave through the ear canal to the drum membrane.

Audiogram - A graphic summary of the measurement of hearing loss showing number of decibles loss at each frequency tested.

Frequency - The number of cycles per second of a wave or other periodic phenomenon.

Intensity - The magnitude or degree of tension, activity or energy, refers to the measure of the energy flow acting to produce a sound wave.

Presbycusis - The diminution of hearing acuity associated with old age.

Modified SISI	-	A test designed to determine a patient ability to detect small changes (1 dB) in intensity of a pure tone presented at 70 dB HL.
Speech Audiometry	-	The measurement of hearing in terms of the reception of spoken words presented at controlled levels of intensity.
Tone Decay	-	The loss of ability of a sound produced when the ear is constantly stimulated by a pure tone.

CHAPTER II

REVIEW OF LITERATURE

Gross audiological attributes of presbycusis have been recognized since 1899 after Zwaardemaker had coined the term to denote the poor hearing of elderly people.

Bunch and Raid Ford (1931) reported hearing levels of both males and females of a combined negro and white population in U.S.A. At 50 years of age the white males had the poorest hearing level at 8000 Hz and negro males the best. However, Dadson and King (1952) reported no significant difference in age groups of 18 – 25 years between hearing of males and females.

Glorig (1954) published data from the Wisonsin state fair hearing survey on men and women upto 79 years of age. Their results indicate the following conclusions:

1. Hearing losses for persons in their total sample became greater with increasing age.

2. The onset of hearing loss is more gradual among women than among men except in later years, when the reverse comes true.

3. With each 10 years increase in age for males, the median hearing loss at 6 KHz increases approximately 10 dB as compared with only 3 dB at 1 KHz.

Schuknecht (1955) stated two types of presbycusis, one type beginning in middle age, he called “Epithelial Atrophy” accompanied by degenerative changes starting from the basal end of cochlear duct to the apex. The other type was termed “Neural Atrophy” because of the degeneration of spiral ganglion cells as well as the neurons of higher auditory pathways.

The U.S. national hearing survey 1958 has reported that the incidence of hearing impairment increases sharply with each age group and the values for people 65 years and older far exceed the rate for all age groups. For many years the belief was popularly held that presbycusis was due simply to atrophy of the organ of corti and its associated nerve supply, specifically the spiral ganglion cells. Recent evidence convincingly confirms the fact that subjects with presbycusis do indeed experience degeneration of tissues in the cochlea and spiral ganglion cells, but that they also incur changes in the external and middle ear mechanisms as well as deterioration of tissues in the neuron elements of the central auditory pathways and in the auditory cortex. Hinchlciffe (1959) considers presbycusis as a sensory neural entity as far as auditory physiology is concerned. He has also suggested a convenient outline to describe structural changes that are reported to develop in the ear as a function of age. Over 40 years age Politzer wrote that diminished hearing in presbycusis was due partially to the frequent development of chronic insidious inflammation of the middle ear, thickening of its lining membrane and to rigidity of the Ossicular articulations.

Hinchcliffe in another study (1959) got significant differences in the level of hearing in certain frequencies in younger age group of both the sexes. From his survey he found that in all the groups covering the age range 18 – 54 years the hearing levels of women were significantly lower than those of men at 3000 Hz, 4000 Hz and 6000 Hz while in older age group significant difference were also found tat 2000 Hz and 8000 Hz so they concluded that bone conduction shift could be caused by "inner ear conductive presbycusis" that resulted from a stiffening of the basilar membrane due to ageing.

Magladerg (1959) states that atrophic changes in the elderly occur in the supporting walls of the external auditory meati. Goetzingon (1961) has mentioned that many patients were unable to respond to maximum audiometric stimulation at 8 KHz. Crabbe (1963) concluded that in general presbycusis is the result of total involution of the ear including sclerosis of the formations of the middle ear. Farrior (1963) has shown that geriatric patients are also vulnerable to otosclerosis which is thought by many to be a disease of the younger person. CARSO (1963) investigated the influence of aging of auditory thresholds and demonstrated results similar to presbycusis curves established by the A.S.A.

Glorig and Davis (1964) have also reported data which suggest that some pathological conditions exists in the conductive apparatus of the auditory mechanisms of aged patients. In brief

four major age effects have been identified in presbycusis. One is central presbycusis another is the classical sensory neural presbycusis, a third is middle ear conductive presbycusis and the fourth is inner ear presbycusis which show considerable hightone hearing loss by bone conduction. These age effects may occur in any combination.

Rosen Wasser (1964) lists the structural change in the aged ear as ossicular atrophy particularly in the crura of the stapes, ossification of the incudo malleolar joint with calcification of the articualr cartilage, degeneration and atrophy of the middle ear muscles, a thin and translucent tympanic membrane and atrophy and thinning of the skin that lines the external meatus together with loss of elastic tissue elements.

Schuknecht's (1964) study of human temporal bones helps us to identify atleast four types of presbycusis:

1. Sensory presbycusis which is characterized by atrophy of the organ of corti and the auditory nerve in the basal turn of the cochlea.

2. Neural presbycusis which results from loss of neurons in the auditory pathways and cochlea.

3. Metabolic presbycusis which involves atrophy of the striavascularis, thought to be the site of endolymph production and apparently necessary to sustain bioelectrical and bio-chemical properties of the endolymph and hence cochlear function.

4. Mechanical presbycusis which schuknecht believes results from a disorder in the motion mechanics of the cochlear duct that is caused by a stiffening of the basilar membrane or some other as yet unknown mechanical problem.

Rosen (1964) represents a unique approach to the problem. These investigators sought to assess the hearing behavior of a nose free population in so far as possible. They choose the Mabaan tribe near Ethiopian border as an ideal population. The results were most interesting. It was extremely slight in comparison with even the best of samples in the out side world that were unexpected to noise. In other words hearing in these primitive tribes men remain excellent throughout their lives.

Anderson (1967) has reported that the problems of ageing is the greatest hazard facing medical sciences since the conquest of the infectious diseases. Glorig (1967) terms presbycusis as those impairment resulting from physiologic changes that accompany aging, and losses, stemming from the noise exposure of our social environment he calls sociocusis.

Burn (1968) reported that in presbycusis progressive deterioration of hearing of high tones occurred. From audiological studies on young and old people he found that the higher the frequency of the test tones the greater was the hearing threshold and older the person the greater was the deterioration.

Ward (1969) stated that presbycusis is a loss of high frequency hearing associated with the physiological ageing process, presumably it would processed at the same rate whether noise was present or not. K. Jokinen (1969) determined thresholds employing manual and automatic audiometry in normal and presbycusis groups. In normals the manual and automotive tracings were superimposed but in old age the pulsed tone tracing was clearly better than the steady tone thresholds. The threshold amplitudes were significantly longer in presbycusis than in normals.

It was the studies of Beasley, Steinberg, Montgomery, Gardner, Webster, Himes, Lichtensteir, Glorig, Quiggle-grings and Summerfield which has shaped our present knowledge of auditory sensitivity as a function of age.

Pestalozza and Shore (1955) made the first attempts to detect the presence of recruitment. They employed the Reger technique of monaural bifrequency loudness balancing to assess loudness recruitment and found that 50% had no recruitment 30% had partial recruitment and 20% compete recruitment. They conclude from these findings that damage to the spiral ganglion cells and the nerve fibers is the most common problem in presbycusis.

Jerger Shedd and Harford (1959) used the SISI test on subjects with presbycusis and obtained scores ranging from 0 – 100 %.

These authors note that

" . . . . . .presbycusis appears to be a clinical entity, in which the SISI score is quiet unpredictable. Harbert Young and Menduke (1966) using monaural loudness balance tests, found no recruitment in 70% of their 50 subjects and minimal in 30%".

Hinchcliffe (1968) found that in a British sample population, the average male threshold was poorer than those for the females. This difference was attributed to the cochlear damage due to noise to which men had been exposed.

Y.NOMURA and I. KIRIKAE (1968) studied the cochlea of 30 aged people histologically as well as histochemically to demonstrate the pathology of S.N. elements in the organ of corti. Loss of sensory cells was found to be most severe near the basal end of the cochlea and loss towards the apex.

J. Krmpotic Nemanic Zegerb, Yogoslavia (1968) during their examination of 100 skulls ranging from a fetus to that of an 85 years old, came to the conclusion that very important changes in presbycusis occurs in the region of the spiral tractus and the part of it which corresponds to the basal coil of the cochlea. Hinchcliffe (1975) stated that impairment of hearing advanced age, known by the name of primary idiopathic presbycusis, was a deafness of the perceptive type without recruitment and therefore the changes were not primarily localized

in the organ of corti. It was characterized by a hightone loss of hearing, so that the changes might be localized in the basal coil of cochlea. The longest frequencies of 1000 – 2000 Hz were impaired much earlier, frequencies of 4000 – 8000 Hz disappeared as early as the age of 40 years.

The presence of tone decay in presbycusis was first reported by Goetzinger (1961), who observed tone decay ranging from 0 – 30 dB in patients with presbycusis using carhart method.

Ichiro Kirikae, M.D. Tokyo, Japan (1968) studied the effect of senile changes in the retrocochlear pathway on the auditory function in advanced age. The subjects ranged from 60 – 70 years. In these subjects the pure tone thresholds at 250, 500, 1000 Cps stayed within 10 dB of normal hearing level. Their resulted indicated the presence of retrocochlear lesions in advanced ages showing senile changes are distributed along the auditory pathway from the level of the spiral ganglion to the auditory cortex. Although there is no question that presbycusis is partly caused by lesion of the inner ear, senile changes of the nerve cells in the central auditory pathway must also play an important role as the cuase of presbycusis.

DAYAL and NUSSBAUM (1971) in a retrospective study of the changes occurring in sequential puretone audiogram of patients with presbycusis noted that the subjects retained the patterns of audiogram initially noted. In the majority of ears the

consistency of the pattern of pure tone hearing loss would suggest that the site of pathology causing it has remained unchanged.

The first study on discriminatory skills in aged people was made by Gaeth in 1948. He describes a syndrome for such individuals which he termed “Phonomic regression” which is characterized by slowness in understanding speech. Pestalozza and Shore (1955) have concluded from their data that a phonemic regression syndrome is associated with presbycusis. Studies by Goetzinger, Rousey, Olsen and Herbest Young, Mondake have since offered further evidence of abnormal inability in discriminating speech among older persons. Konig (1957) in his study showed that pitch discrimination deteriorated with age.

Jerry K. Punch and Freeman McConnell (1967) found speech discrimination function at sensation levels of 10, 20, 30 and 40 dB for two groups of geriatric subjects. Results revealed considerable deviations from normals in the ability to discriminate among speech sounds. The results suggest that a considerably narrower intensity range than normal is functional for speech discrimination in the aging population.

Brahe Pederson and Elderling (1973) have reported that abnormal temporal integration has been considered as one of the reasons for reduced discrimination in hearing impaired ears.

The results of short tone audiometry in 46 persons with presbycusis show that the ability to integrate acoustic energy over time in patients with presbycusis is reduced compared to nromals. The difficulty in discrimination for patients with sensory neural hearing loss may to some extent be explained from the reduced temporal integration.

Audiometric studies on geriatric population in India are still lacking. Kapur (1969) carried out a survey on Todas, on hill tribe of Nilgiris, and reported better hearing of these people at higher frequencies than those found in similar studies elsewhere.

Therefore, this is an attempt to establish the pattern of hearing loss existing in the aged population with other audiological manifestations.

CHAPTER III

METHODOLOGY

The aim of the present study is to establish the pattern of hearing loss in Indians as a function of age and to study other audiological manifestations exhibited by the group. The study in brief comprises the following steps:

1. Pure-tone air conduction and bone conduction thresholds
2. Speech discrimination score
3. Administration of Young and Herbert's (1967) modified S.I.S.I. test
4. Administration of complete T.D.T.

A total of 100 subjects between the age of 35 – 74 years from the population of the attendants of the cases who reported to the institute during the study period from different parts of South India were selected. The subjects were divided into four groups on the basis of age with a class interval of 10 and each group contained 25 subjects. All the subjects were ontologically normal and had not otologic complaint to any sort. A sample of the medical history sheet used to gather this information is given at the appendix I.

The subjects were tested using Hughson Westlake ascending procedure to establish pure-tone air conduction and bone conduction thresholds. Air conduction testing ranged from 250 to 10,000 Hz. The subjects were instructed to raise the finger every time they heard a tone. To differentiate the response of the ear they were asked to raise right hand finger when the tone was head in the right ear and left hand when it was heard in the left ear. All the testing were carried out in the sound treated room of All India Institute of Speech and Hearing using Madsen OB 70 two channel clinical audiometer with T.D.H. 39 earphones calibrated to I.S.O. Standard (1964). Noise levels at different octaves in the above sound treated room are given in appendix II.

The calibration of the audiometer was maintained using Bruel and Kjaer calibration unit which consisted of an artificial ear B & K type 1613, in a sound treated room. Periodic checking was employed to keep the unit in calibration throughout the period of the study.

Since it was a prerequisite that the subjects should know English, speech audiometry could be carried out using English test materials standardized by Swarnalatha (1972) for Indian population. Speech Reception Threshold was established using spondee words. Discrimination was measured using P.B. words.

Because of slow integration in the aged as reported by Gaeth live voice presentation was preferred to give them longer time for assimilation. The words were presented at 40 dB above S.R.T. using the carrier phrase "say the word". The subjects were given the following instructions.

"You will hear a list of words through the earphone. Each word will have a carrier phrase say the word ……." Don't repeat the carrier word, but repeat only the last word. If you are not sure guess (Glorig 1965).

For the administration of modified S.I.S.I. test, a continuous tone was presented at 70 dB HL at frequencies at which greater loss in hearing was observed. At regular intervals a short 1 dB increment was superimposed over the continuous tone for approximately 200 m. sec. Each increment had a rise time of 50 m. sec, and a duration at full length of 200 m. sec. and a decay time of 50 m. sec. The subject was simply asked to signal to the examiner each time he heard the increment by means of raising the finger. After presenting 20 such increments the S.I.S.I. score was derived by multiplying the number of increments detected by the subjects by 5 to get the score in term of percentage. If the subject responded to all of the first 10 dB increments the test was terminated. This was decided as per the study report of Yantis and Decker (1964) that S.I.S.I. test can be safely reduced to 10 presentation for it not only

conservers time and reduces fatigue and loss of attention. Initially 5 dB increments were presented to familiarize the subject with the response task. Then the increments were reduced in 1 dB steps for a practice run. Then next five increments were 1 dB in size. If the subject responded to 3 or more of these, the size of the sixth increment was set at 0 dB as a control presentation for checking up the subjects responses. If the patient responded to two or less of the first five 1 dB increments, then the size of the sixth increment was set at 5 dB to enable him once again to respond positively. Thus the possibility of false positive or false negative were controlled.

If the subject responded to the presentation of 0 dB the test was dscarded as invalid because the subject was probably responding to the rhythmic presentation of increments rather than to an increase in intensity, the subject was then re-instructed and testing was repeated. The tests were administered to all subjects by giving the following instructions:

“You will now hear a continuous tone in one of your ears. Sometimes you will hear jumps in loudness. Every time there is a jump indicate by raising your finger”.

Procedure for T.D.T.

Carharts complete tone decay tests was administered to all the subjects. A continous tone was presented at 5 dB SL. If

the subject failed to hear it for one complete minute the tone was raised by 5 dB without interrupting the stimulus but setting the stop watch back to zero. Whenever the tone faded, the intensity of the tone was raised in dB steps, until the subject heard the tone at any one level for one complete minute. The tone was then turned off and amount of decay computed.

Subjects were instructed as follows for the test:

> "You will hear a continuous tone in your ear keep your finger raised as long as you hear the tone. The moment the tone fades away drop your finger and the moment you hear again raise your finger"

The results of all the tests were recorded on an audiogram sheet, a copy of which is given at the appendix III.

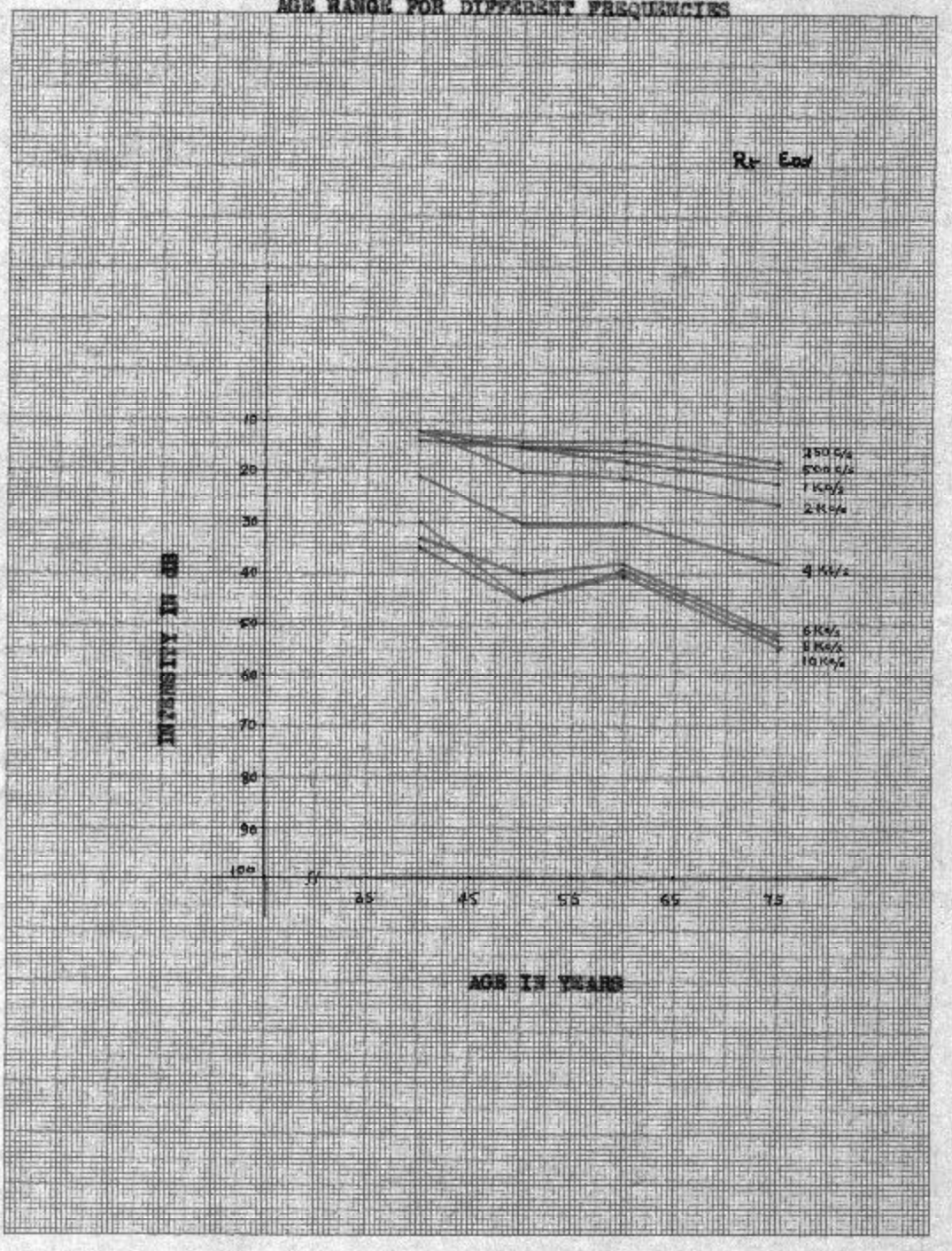
CHAPTER IV

ANALYSIS RESULTS AND DISCUSSIONS

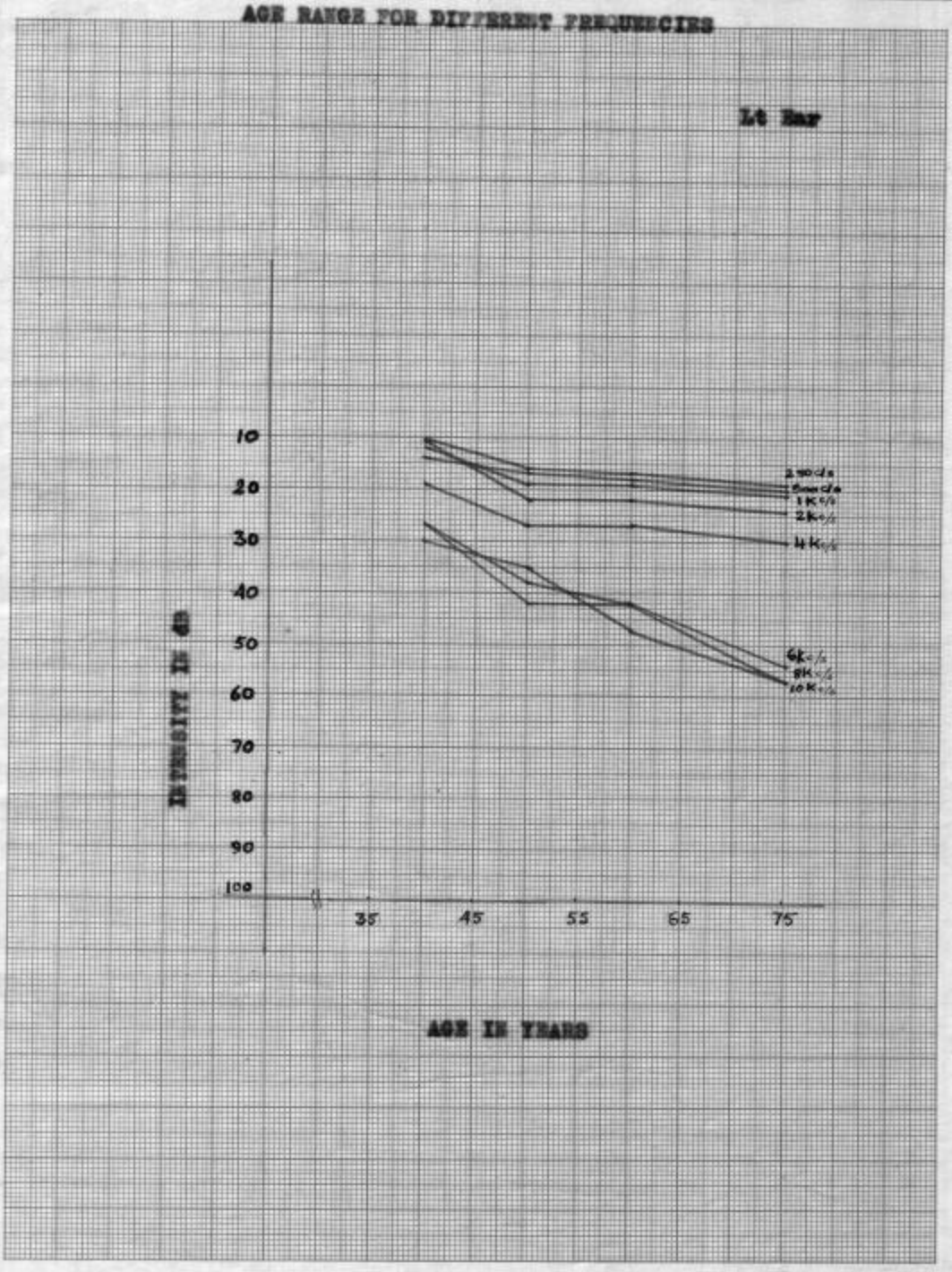
In India there is no detailed study conducted to determine the changes in sensitivity for puretones in aged population. The few available studies on presbycusis do not provide any information on the relationship between age and the audiometric configurations. Only Kappor et al 1967, Abrol et al 1971, Seth and kicker 1971; Chatterjee 1973 have carried out some studies on this line. Therefore this study is designed to obtain information regarding the progressive changes in hearing sensitivity for puretones and performance score for speech in each successive age decades from 35 – 75 years in a representative population. It also focuses upon the auditory behavior for stimuli under conditions which place burden upon the auditory system.

The following are the results obtained while verifying the previously stated hypothesis. The first part, to verify the hypothesis " There is no significant difference in the hearing pattern shown by Indians as a function of age from that existing in the white population as a function of age", 100 subjects were tested with age range of 35 – 75 years. They were divided into four equal groups of 25 each with a class interval of 10. The hearing levels of the subjects to puretones of different frequencies were recorded.

MEAN THRESHOLDS OF THE SUBJECTS AT DIFFERENT AGE RANGE FOR DIFFERENT FREQUENCIES



MEAN THRESHOLDS OF THE SUBJECTS AT DIFFERENT AGE RANGE FOR DIFFERENT FREQUENCIES



The mean hearing levels at different frequencies for different age groups are displayed graphically. Separate graphs are given for right and left ears. The mean thresholds and the standard deviation for different frequencies are given in the appendix IV. There is no significant different between the means of white population and Indians. But thresholds at 8K and 10K couldn't be compared. Since no study has been conducted to assess the thresholds at these frequencies. So the null hypothesis has been retained. The average hearing of the subjects from 35 – 74 years upto 500 Hz was within 20 dB then slight decline of 2 dB at 1K, 5 dB at 2K, 8 dB at 4 K and a sharp decline of 31 dB at 6K, 36 dB at 8 K and 38 dB at 10K.

The threshold of audibility decreases as a function of age, more at high frequencies than at low (Riley et al 1961, Burn 1968). This change of threshold in hearing as a function of age of human beings - may not necessarily to due to physiological ageing, because everyone is exposed to wear and tear of every day living. Therefore this appears to be an open question.

It appears that presbycusis in the Indian Community Starts a little earlier than in the Western Community by five years. Bekesy, Carso, O'Neil and Oyer, Hinchcliffe have reported that presbycusis starts appearing after the age of 45 years where as the present study reveals that for Indians it appears after the age of 40 itself.

According to Nixon and Glorig (1960) presbycusis is the hearing loss as a result of physiological changes with the age. However, it appears that such strict definition would exclude changes in hearing levels resulted from pathological process of ageing. Arteriosclerosis in relation to increasing age of said to be chiefly responsible for hearing loss in old age (Stern 1920). But Bunch found no difference between the hearing levels of arteriosclerotic and non-arteriosclerotic subjects where as Weston (1964) called it a factor determining the hearing level of elderly subjects.

Rosen et al (1966) emphasized the relationship of dietary habits and blood pressure to presbycusis. The same was also observed by Hinchcleffe and Jones. Histological studies done by several authors (Schuknecht 1955, Hinchcliffe and Jones 1966-68, Fabinys 1931) showed that presbycusis was not due to thromboembolic disorder but due to a mixture of atrophic and degenerative changes in the auditory pathway. According to Korenchivesky and Fabi primary cause of ageing is genetic and so it is of presbycusis.

Presbycusis is a factor to be taken into account when attempts are made to evaluate the facts of exposure to industrial noise as commented by Kryter (1970).

To study the possibility of localizing the lesion in presbycusis S.I.S.I. and T.D. were administered.

Studies show that S.I.S.I. is unpredictable indicating that the localization of lesion is not clear. It is not reported in literature about the unpredictability of S.I.S.I. test in cases of presbycusis when the test is administered at 70 dB HL or at higher levels for audibility. The present study showed that all the cases exhibited 80 – 100% score on S.I.S.I. test when presented at 70 dB H.L.

S.I.S.I. Scores obtained in normal and in pathologic samples without abnormal adaptation indicate that the intensity level reaching the inner ear is the determining factor for the perception of 1 dB increment. These findings are in general agreement with those reported by Swisher et al (1966). If the inner ear receivers an audible signal of 70 dB H.L. or higher, there is essentially no difference in the performance on the S.I.S.I. test is ears with normal hearing.

The earlier report that S.I.S.I. is unpredictable may be due to the presentation at 20 dB S.L. which would produce a difference in intensity of sound reaching the cochlea. In this the energy reaching the cochlea might have been less than 60 dB as reported by Young and Herbert (1967). All the ears respond to 1 dB increments when the energy reaching the cochlea is about 60 dB. So from this present study we understand that Young and Herbert's observation holds good even with presbycusis cases. So it is evident that the function of the cochlear in presbycusis is exactly similar to that of normal ear.

The presence of Tone Decay in presbycusis was reported by J. Krmpotic-Namauic Zagreb (1968), they reported very important changes in presbycusis occurring in the region of the spiral fractus and in the part of it which corresponds to the basal coil of the cochlea. So it was decided to test all our subjects for the possible involvement of retrocochlear structures. Complete Tone Decay test by Carhart was administered. All of the subjects except two exhibited 0-10 dB decay at all frequencies which is considered to be negative indicating no detectable abnormalities. Two of them of 57 years old at the age range of 55 – 65 years exhibited positive tone decay at 6 K, 8K and 10K of more than 30 dB indicating some involvement of the retrocochlear structures. Except for the two since the majority exhibits no significant Tone Decay it is conspicuous that the changes in retrocochlear structures are minimal and not detectable.

Our findings are in quite agreement with that of Zinger's (1962). He failed to obtain any significant decay in men and women in the 8^{th}, 9^{th} and 10^{th} decades of life. His conclusion was that degenerative changes in the cochlear and in the neurons are not dominant factors in the development of presbycusis. Goetzinger (1961) has also failed to obtain any significant decay in cases with presbycusis. The possible explanations for the individual variations in the Tone Decay test could be applied to the degenerative changes taking place at various levels of the auditory system.

Gaeth (1948) first reported the phenomenon of phonemic regression in the aged. He observed this only in those subjects who were 50 years of age and older. Pestalozza and Shore (1955) also concluded that phonemic regression syndrome is associated with presbycusis. Goetzinger, Rousy, Olsen and Harbert, Young Menduke have supported the evidence of abnormal inability in discriminating speech among older persons.

To verify the conclusions of the above studies, the present investigator has included the measurement of discrimination skill of all the subjects. The cases of whom the tests could not be administered because of the audiometric limitation were excluded from this part of the study. The speech discrimination of patients between the age range of 35 – 44 years and 45 – 54 years were within normal limits i.e., above 92 percent. A deterioration in discrimination of speech was noticed after 55 years of age. The discrimination score was reduced further for subjects above 65 years. The mean discrimination values of all the subjects for different age ranges are given in Appendix V. The present study therefore supports the findings of the previous studies conducted elsewhere, that the discrimination tends to reduce as age advances.

The explanation given by Gaeth for such a deterioration is the possible lesion to the retro-neural elements i.e., degenerative changes in the brain. Bocca (1958) attributed this phenomenon to the decrease in the cell count of the temporal lobe with

age. Sato and Shitara (1964) have also concluded that the diminished discrimination in the aged may be due to senile changes of the auditory nervous system, such as the reduction and atropy of ganglian cells from the level of spiral ganglian to the auditory cortex.

The findings of the study conclude that there is no detectable pathological changes either in the cochlear or retrocochlear structures. But the physiological changes of the auditory system is clearly reflected by the changes in the audiometric configuration of the subjects. The phonemic regression is also found to be a clear factor in the diagnosis of presbycusis. These consistent reduction in auditory sensitivity of the aged is a factor to be considered when the assessment of hearing loss among workers in an industry is to be done. Histopathological studies of the aged would be desirable to determine the site and exact changes taking place in the system.

CHAPTER V

SUMMARY AND CONCLUSIONS

Increasing deafness in the aged is one of the interesting chapters and psychologically perhaps the most important in our Bible of Audiology. Aging is the process of growing nature or old – occurs in all cells and structures of the body.

The term 'Presbycusis' was (nine) to denote the poor hearing of elderly people. The threshold sensitivity of hearing for puretones shows a gradual impairment with increasing age. Presbycusis has now become generally recognized as a considerably more complicated clinical phenomenon than it was a few years age.

A definition of the age at which presbycusis begins is locking in literature. Several studies have been conducted in other countries to assess the nature and degree of hearing loss increased during old age. But the literature on the pattern of hearing loss with respect to age on Indian population is scanty – indicating the need for conducting a study on this line.

Hundred subjects were selected randomly from the attendants who brought cases to the Institute during the study from different parts of South India, between the age group of 35 – 74 years. All had ontologically normal ears with no history of ear aches or

ear discharge. All were tested in sound treated rooms of All Indian Institute of speech and Hearing using Madson OB 70 audiometer calibrator to I.S.I. 1964.

The aim of this study was to establish the pattern of hearing loss in Indians as a function of age and to study other audiological manifestations.

1. Puretone air conduction and bone conduction thresholds
2. Speech discrimination score
3. Administration of Young and Harberts modified S.I.S.I. test
4. Administration of complete Tone Decay test

From the present study it was seen that sensitivity for puretone decreases as age advances and frequencies increases. As reported in literature presbycusis in white population appearing after the age of 45 years where as the present study reveals that for Indians it appears after the age of 40 years.

Pestalzza and Shore (1955) concluded the phonemic regression is associated with presbycusis Goetzinger et al have supported the evidence of abnormal liability in discriminating speech among older persons. The present study also goes parallel with the above studies showing that the discrimination tends to reduce

as age advances. The possible explanation given by Gaeth for such a deterioration is the possible lesion to the retro-neural elements i.e., degenerative changes in the brain.

Studies of S.I.S.I. on presbycusis shows unpredictability of S.I.S.I. scores. This may be because of the inadequate levels of presentation. So in this study the tone was presented at 70 dB H.L. (Young and Harbert 1967). The results show that no pathology is detectable in the cochlea and the presbycusis ear's behave like normal ears.

Regarding tone decay, the results of the present investigation show that the findings are in quite agreement with that of other studies (Goetzinger, 1961) who failed to obtain any significant decay. The conclusion was that degenerative changes in the cochlear and in the neurons are not dominant factors in the development of presbycusis, and that degenerative changes take place at various levels of the auditory system.

The means thresholds of the subjects at various age range and frequencies are given graphically for right and left ears separately. Mean discrimination scores of the subjects at different age range are also given at the Appendix.

Conclusions are as follows

1. There is a progressive reduction in sensitivity of the subjects as a function of age.

2. It is found that presbycusis starts a little earlier for Indians than it is reported for the white population.

3. Presbycusis is a factor to be seriously considered while assessing the hearing loss of any employee to be considered for compensation.

4. The function of the cochlear in the aged is comparable to that of a normal subject on S.I.S.I. test.

5. The pathological changes at the retrocochlear structures, if present are not detectable according to the result obtained by the investigator on tone decay test.

6. There is a slow reduction in the discrimination ability of the subjects as age advances.

Recommendations for further study

1. Study of a much larger sample would be desirable to prepare a much appropriate correction factor for presbycusis.

2. The middle ear function like, reflex of muscles, compliance of ear drums and change in the impedance of the aged subjects may also be carried out.

3. Histo-pathological studies are also desirable.

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APPENDICISES

APPENDIX – I

MEDICAL RECORD

1 - Ear Infections (Circle 1)

0 No history of

1 Ear aches, not within past year

2 Ear discharge not within year

3 Ear aches, without discharge in past year

4 Ear discharge, within past year

5 Chronic discharge (over 6 weeks active)

6 Chronic discharge (over 6 weeks inactive)

2 – Tinnitus and Vertigo (Circle 1)

0 No history of

1 Tinnitus in/right/left/both ears

SUBJECTIVE/OBJECTIVE VERTIGO

2 Vertigo with loss of balance

3 Tinnitus and vertigo

4 Vertigo without loss of balance

FREQUENCY OF VERTIGO DAILY/ONCE A WEEK/ONCE A MONTH

5 Other (Specify)

3 – Head injury (Circle 1)

0 No history of

1 Head injury only

2 Head injury with unconsciousness

3 Head injury with bleeding from nose

4 Head injury with bleeding from ears

4 – Ear Injury (Describe using one line for each injury (circle 1 for each ear)

Right ear	Left ear
0	0 No history
1	1
2	2
3	3
4	
5	5

5 – Tonsils : (Circle 1)

0 No history suggestive of tonsils

1 Fever, sore throat, swollen neck glands (Not within the past year)

2 Fever with colds in past year

3 Swollen neck glands with colds in past year

6 – Unexplanied high fevers (Circle 1)

0 No history of

1 Present (specify age)

2 High fever without convulsions

3 High fever with convulsion

4 Other

7 – Nose and sinuses (Circle 1)

0 No unusual upper respiratory symptoms

1 5 – 6 colds a year or 2 or 3 lasting weeks or more (not)

2 As in 1 but within past year

3 As in 1 plus chronic nasal obstruction

4 As in 1 plus chronic purulent discharge

5 As in 1 plus chronic productive cough

8 – E.N.T. surgery (Circle 1)

Date By whom

0 None

1 Adenoidectomy

2 Tand A

3 Mastoidectomy : Rt.

4 Mastoidectomy : Lt.

5 Mastoidectomy : Bil

6 Sinus operation

7 Submucous resection

8 Myringotomy

9 Ear surgery : rt/lt/both

10 Lip/Palate repair

12 Laryngectomy

13 other

9 – Infectious – diseases (Circle 1 or more)

0 No history of
1 Meningitis
2 Mumps
3 Whooping cough
4 Pneumonia
5 Small pox
6 Tuberculosis
7 Chicken pox
8 Other : Specify below

10 – Drugs (taken) Treatment

11 – Deficiency diseases (Circle 1 or more)

0 No history of
1 Vitamin A Deficiency
2 Vitamin B complex
3 Hypoproteanemia
4 Anemia
5 Other : specify below

12 – Tropical diseases (Circle 1 or more)

0 No history of
1 Malaria
2 Typhoid
3 Kala-azar
4 Cholera
5 Dysentery
6 Filarial
7 Diarrhea
8 Other: specify below

13 – Exposure to noise

0 No history of
1 Noise trauma (give a brief description)

E.N.T. EXAMINATION

Name No

Date

Principal complaint:

Ears (Circle 1 for each ear)

14 – Rt	15- Lt	
0	0	Normal
1	1	Atresia of Ext. Aud Meatus
2	2	Retracted Drum
3	3	Thickened Drum
4	4	Thickened and Retarded Drum
5	5	Inflamed middle-Ear-Otitis Media
6	6	Dry Perforation
7	7	Perforation with discharge
8	8	External Otitis
9	9	Congenitial-abnormalities
10	10	

16 – NECK – GLANDS (Circle 1)

0	Not palapable
1	Palpable but not markedly enlarged
2	Moderate to severe enlargement

17 – TONSILS (Circle)

0	Normal
1	Cleanly removed
2	Tags not infected
3	Tags infected
4	Hypertrophied

page contd…….

5 Acute infection

6 Scarring and retraction moderate

7 Sings of severe chronic infection

18 – TEETH AND MOUTH

0 Normal

1 Adentia

2 Dental caries; slight

3 Dental caries; severe

4 Severe gingivitis with dental caries

5 Severe gingivitis without caries

6 Pyorrhoea alveolaris

7 Artificial Dentures

19 – PHARYNX (Circle)

0	Normal
1	Acute granular pharyngitis
2	Chronic lymphoid hyperplasia not severe
3	Chronic severe lymphoid hyperplasia

20 – NOSE

Rt	Lt	
0	0	Normal
1	1	Septal obstruction (DNS)
2	2	Mucous membrane thickening
3	3	Purulent discharge
4	4	Acute rhinitis (watery discharge)
5	5	Polyps
6	6	Allergic rhinitis
7	7	Purulent discharge and polyps

21 – NASOPHARYNX (Circle 1)

0	Normal
1	Samll midline adenoids
2	Adenoids encroaching upon tubal orifices
3	Large adenoids, tubal orifices obscured
4	Nasopharynx, full of adenoids
5	Nasopharynx, obscured by pus
6	Tubal orifices edematous

Impression

Advice

Adviser’s remarks:

Signature

APPENDIX – II

Sound Pressure Levels in the Sound Treated Room at various frequencies

	Maximum Allowable noise levels in dB S.P.L. (ISO) re .0002 dyne/cm^2	SPL value in the test room in dB re: .0002 dyne/cm^2
C Scale	30	33
OCTAVE BANDS		
75 – 150 Hz	31	18
150 – 300 Hz	25	17
300 – 600 Hz	26	15
600 – 1200 Hz	30	9
1200 – 2400 Hz	38	11
2400 – 4800 Hz	51	10.5
4800 – 9600 Hz	51	10

Name :

Case No. :

Age :

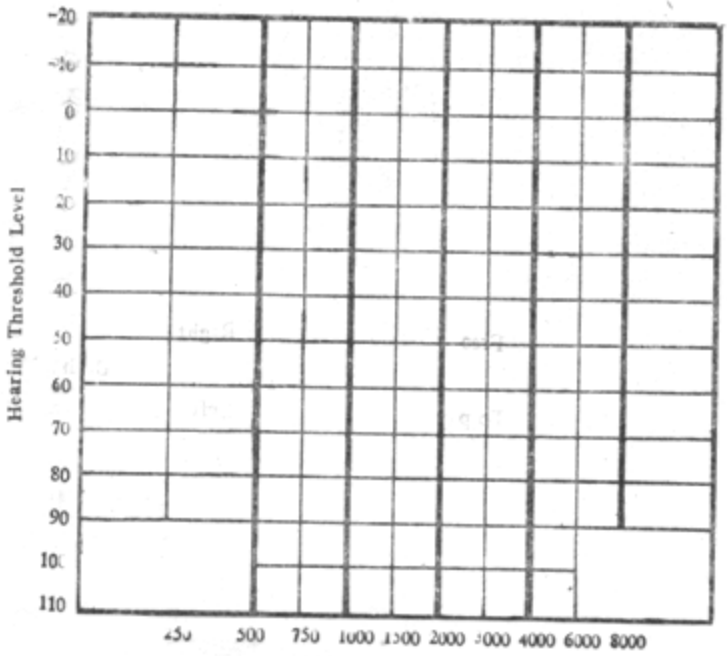
AUDIOGRAM - APPENDIX III

Date :

Test No. :

Tested by :

I.S.O.



	Rt.	Lt.
AIR CONDUCTION		
Un-masked	○	×
Masked	△	▽
BONE CONDUCTION		
Un-masked	[	]
Masked	[	]
A.C. not heard	○↙	×↘
B.C not heard	[↓	↑]

Audiometer used :

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average				
S. R. T.				
Discrimn. (P. B. Max.)				

SPECIAL TESTS

	Right Ear				Left Ear			
	500	1000	2000	4000	500	1000	2000	4000
SISI								
ABLB								
STENGER								
T D T								

APPENDIX IV

The Mean Thresholds of the subjects for different frequencies at different age ranges along with standard deviation (S.D)

		250 c/s	**S.D.**	**500 c/s**	**S.D.**	**1 K**	**S.D.**	**2 K**	**S.D.**	**4 K**	**S.D.**	**6 K**	**S.D.**	**8 K**	**S.D.**	**10 K**	**S.D.**
35 – 44	Rt	12 dB	5.8	14 dB	6.9	13 dB	9.2	11 dB	6.3	19 dB	11.5	29 dB	14.4	28 dB	19.0	34 dB	24.2
	Lt	13 dB	9.1	14 dB	7.1	12 dB	5.7	12 dB	6.6	33 dB	14.2	33 dB	14.4	30 dB	17.0	35 dB	21.0
45 – 54	Rt	16 dB	11.4	17 dB	10	19 dB	13.9	22 dB	13.6	28.6 dB	15.9	41 dB	18.4	38 dB	17.0	35 dB	18.1
	Lt	14 dB	8.6	15 dB	9.8	19 d	14.7	20 dB	17.0	40 dB	18.4	40 dB	19.1	50 dB	18.7	46 dB	16.1
55 – 64	Rt	18.5 dB	5.8	19.4 dB	5.0	20.4 dB	5.19	19 dB	7.9	28 dB	12.9	42 dB	11.1	42 dB	14.2	46.4 dB	14.0
	Lt	13.2 dB	9.1	15.2 dB	11.4	15.4 dB	9.8	20.8 dB	10.8	29.6 dB	11.9	38 dB	11.0	38 dB	11.0	44 dB	10.1
65 – 74	Rt	19.2 dB	10.3	19.4 dB	13.9	23.2 dB	13.6	26.2 dB	12.9	41 dB	18.4	54 dB	19.0	56 dB	19.2	58 dB	19.4
	Lt	18.8 dB	14.0	19.8 dB	14.2	22.2 dB	12.6	26 dB	12.9	39 dB	17.0	52.2 dB	15.2	59.4 dB	14.1	56 dB	14.0

APPENDIX V

The Mean discrimination score of subjects at different age ranges

Age Range	**35 – 44**	**45 – 54**	**55 – 64**	**65 – 74**
Rt	93.1 %	92.1%	90.1%	86.4%
Lt	96.3 %	95.2 %	90.3%	86.3%