THE BRAIN-STEM EVOKED RESPONSES IN GERIATRIC POPULATION.

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KRISHNAMURTHY B.N.

AN INDEPENDENT PROJECT WORK SUBMITTED IN PART
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(SPEECH AND HEARING) TO THE
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ALL INDIA INSTITUTE OF SPEECH AND HEARING
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To

my beloved parents

CERTIFICATE

This is to certify that the Independent Project entitled THE BRAIN-STEM EVOKED RESPONSES IN GERIATRIC POPULATION is the bonafide work done in part fulfillment for FIRST year M.Sc., (SPEECH & HEARING) of the student with Register Number. 8405

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CERTIFICATE

This is to certify that the Independent Project entitled THE BRAIN-STEM EVOKED RESPONSES IN GERIATRIC POPULATION has been prepared under my supervision and guidance.

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DECLARATION

This Independent Project is my own work done under the guidance of Dr.M.N.Vyasamurthy, Lecturer in Audiology, All India Institute of Speech and Hearing, Mysore-6, and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore

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ABBREVIATIONS

ABR	...	Auditory Brain-stem Response.
BSER	...	Brain-stem Evoked Response.
dB	...	Decibel
HL	...	Hearing Level
KHz	...	Kilo He-rtz
mS	...	Millisecond.
μV	...	Microvolt
Rt.	...	Right, Lt ... Left
S.D	...	Standard Deviation
SL		Sensation Level
SPL	...	Sound Pressure Level
x	...	Mean
Yrs.		Years

C H A P T E R - I

INTRODUCTION

The audiotory brain-stem response (ABR) audiometry is of great interest today in the field of audiology, otology, neurology, neuro-otology and is probably one of the most exciting advances in Electric Response Audiometry. (ERA)

It is an objective way of assessing hearing in all types of cases including difficult to test because, it is not affected by sleep & sedation.

The pioneer investigators in this field - LEV & SOHMER (1972), JEWETT & WILLISTON (1971) draw kind attention to the series of six or seven small waves during the first 10 ms which could be recorded from earlobe - vertex electrodes in response to a series of small stimuli, either wide band clicks or high frequency tone bursts. A large series of stimuli (usually 2000) is used and the response is extracted by means of 'on-line' averaging.

JEWETT (1971) named first 5 waves using Roman numerals from I to V and the some waves have been numbered by SOHMER (1972) 1 to 3, then 4a & 4b.

The five waves are generally agreed to have the following provenance:

- I from the Auditory trunk;
- II from cochlear nucleus;
- III from the superior olivary complex;
- IV from the nucleus of the lateral lemniscus and the permanent wave;
- V from the Inferior colliculus.

Following the JEWETT & WILLISTON report in 1971, numerous investigators have studied the ABR in subjects with normal hearing and a range of Otologic and Neurologic disorders. The developmental aspects of the ABR in neonates, infants, and young children are also well established.

Changes of latency of wave V with age in very young infants, indicating maturation of the responses (SHULMAN, GALAMBOS & GALAMBOS, 1975), with advancing age there will be changes in response latency in the case of adults.

As cited by JAMES JERGER & JAMES HALL: (1980)

> "In contrast to the interest in the developmental changes in the ABR, the potential influence of aging in adults has received remarkably little attention. Age is an important factor in behavioural audiometry. The age related decrease in pure tone sensitivity for higher frequencies and in some patients, lower frequencies is well documented. Depressed performance in speech understanding for both single words and especially sentences in competition is associated with aging. Age is also a factor in impedance audiometry static compliance decreases as a function of age. With increasing age, acoustic reflex thresholds usually improve slightly for pure tone signals and are elevated for noise signals even in subjects with normal hearing. Consequently, the noise-tone difference (NTD) is decreased as a function of age. Recently, GERSDORFF reported decreased amplitudes for crossed and uncrossed acoustic reflexes again in subjects with normal hearing sensitivity. In view of these documented age effects in other aspects of auditory function, it seems reasonable to suspect an age factor in the ABR".

The avaialble data have been controversial about the role of age. ROWE (1978) and BEAGLEY & SHELDRAKE (1978) investigated the effects of age upon wave latencies. ROWE demonstrated significant differences between old and young subjects, while BEAGLEY & SHELDRAKE (1978) did not find significant differences in regard to age.

STATEMENT OF THE PROBLEM: The present study was conducted to examine the changes in laterncies and amplitudes in the geriatric population with nearly normal hearing.

The present study was carried out and find answers to the following questions:

1. Does the latency of brainstem response in geriatric subjects differ from that of adults?

2. Does the amplitude of brainstem responses in geriatric subjects differ from that of adults?

C H A P T E R - II

REVIEW OF LITERATURE_

The effects of aging process on Hearing sensitivity.

MARSHALL (1981) has reviewed the studies which show that the aging process affects hearing sensitivity and the following are the excerts from his article:

"The incidence of hearing loss in the elderly population is significantly high and the most common cause of hearing loss is presbycusis, or the loss of hearing due to aging process (SATALOFF 1966). Presbycusis manifest changes in the entire auditory system (SCHUKNECHT, 1955). Presbycusic defict seen in many cases is gradually sloping, gradually progressive, high frequency sensorineural hearing loss. The loss increases gradually at first and then accelerates more rapidly with increasing ages, especially for the higher frequencies (BERGER el al., 1977, CORSO, 1963? GLORIG & NIXON, 1960; GLORIG & NIXON, 1962; GLORIG & ROBERTS, 1965? ROBINSON AND SUTTON, 1979? SPOOR, 1967) & is bilaterally symmetrical (DAYAL, KANE, & MENDELSOHN, 1970? KLOTZ & KILBANE, 1962? SATALOFF & MENDUKE, 1957). But not all presbycusic hearing losses follow the typical audiometric configuration. DAYAL et al (1970) found a 31% incidence of flat audiometric congigurations in the presbycusic sample. SCHUKNECHT (1964, 1974, 1975) has described 4 different types of presbycusis (sensory, metabolic or strial, mechanical or cochlear conductive & neural). Sensory presbycusis is characterized by an abrupt high frequency loss; metabolic presbycusis is characterized by a flat audiomettric patterns; mechanical presbycusis is assocated with a gradually sloping high frequency loss; and neural presbycusis is implicated when speech discrimination ability is poorer than would be expected from the audiogram. An individual's audiometric pattern does tend to staty the same over time, even as the hearing loss progresses (DAYAL & NUSSBAUM, 1971).

The aging person may have hearing loss from presbycusis, noise induced hearing loss (NIHL), & chronic middle ear disorder (SURJAN, DEVALD, & PALFAL I, 1973). PLOMP (1978) suggested that 24% of the population is handicapped at the age of 65, over 30% by age 70; & 50% by age 75. LIDEN (1967) & ANIANSSON (1974) have demonstrated that persons with high frequency hearing losses are handicapped in noisy situations, even if their hearing for 500, 1000 & 2000 Hz is essentially normal.

CARHART (1958) described BERNERO EFFECT AND he suggests that reduced bone-conduction response at 500 Hz is more likely a reflection of central auditory dysfunction. GLORIG & DAVIS (1961) described a high frequency air-bone gap that they ascribed to an age—related increase in stiffness of the cochlear partition. The air-bone gap was in evidence at 4000 Hz and increased from 10 dB at 50 years of age group to 40 dB by 80 yea s of age group. NIXON, GLORIG, & HIGH (1962) have found airbone gap at 4000 Hz only and it was not due to noise exposure and they suggested that the conductive component was related to pathologic changes in the connective tissues of the middle ear*

ROSEN et al., (1962) suggested that the presbycusic changes were related to genetic factors, vascular reactions and differences in metabolism and nutrition. Increased stress & environmental noise associated with modern civilization play a role in the age-related changes in hearing sensitivity.

The peripheral sensitivity loss differs for men and women in terms of age of onset (CORSO, 1963a, 1963b) - where reduction in hearing sensitivity developed in males between the ages of 26 & 32 years and in females at about the age of 37; rate of progression (CORSO 1963 a, 1963 b) where the rate of progression was greater in females and audiometric configuration CORSO 1963a, 1963b) - where women exhibited poorer low frequency hearing than men where as men showed better hearing for the low frequencies. This was supported by GOETZINGER et.al (1961).

ACCOUNSTIC IMMITANCE:

Middle ear system become increasingly compliant upto middle age and then stiffens with further aging (ALBERTT & KRISTENSEN, 1972? JERGER, JERGER & MAULDIN, 1972). BLOOD & GREENBERG (1977) found decreasing admittance with increasing age in subjects age 50 and older. BEATTIE & LEAMY (1975) found admittance to be higher in their elderly (age 60-78) as compared to their younger (age 17-29) group. Some investigators have shown no immitance changes as a function of aging (NERBONNE et.al 1978? THOMPSON, SILS, RECKE, & BUI, 1979). In all these studies, subjects had normal hearing or sensorineural losses.

JERGER et.al (1978) found decreased acoustic reflex thresholds for pure tones and no change in acoustic reflex thresholds for white noise with increasing age in normal hearing subjects. SILMAN (1979a) found no differences in acoustic reflex thresholds for puretones between young and elderly normal hearing adults, but found increased acoustic thresholds for white noise in the elderly subjects. THOMPSON, SILS,RECKE, & BUI (1980) found no changes in acoustic relex thresholds for either puretones or filtered white noise as a fun-ctionof age for normal hearing adults, but did find decreased growth of the acoustic reflex to these stimuli with increasing age.

Little is known concerning changes in tympanograms that might be related to the ag-ing process. An increased incidence of tymponogram types associated with osscicular abnormalities (i.e., stapes fixation) is observed with advancing age (JERGER, 1970).

LOUDNESS & ADAPTATION:

the alternate binaural loundness balance (ABLB) test cannot be used for listeners with presbycusis since their hearing is bilaterally symmetrical. Recruitment was meqsured by PESTALOZZA & SHORE (1965) & HARBERT, YOUNG & MENDUKE (1966) in elderly subjects using the monaural bi-frequency loudness balance (MLB) test. They found many elderly subjects who did not show recruitment on this particular test.

JERGER, SHEDD, & HARFORD (1959) found a wide range of short increment sensitivity index (SISI) scores in presbycusic patients. Young & Harbert (1967) have not found differences between presbycusis and various cochlear etiologies for SISI scores across a range of sound pressure levels or at high levels. BERGHOLTZ, HOOPER, & MEHTA (1977) have found little agreement between the recruitment indices of acoustic reflex SL & electro-cochleographic input-output curves and also found no. consistent pattern of recruitment in listeners with presbycusic hearing loss. JERGER (1973) have found no differences in the speech discrimination scores of re-crutting and non-recruiting elderly listeners, using SL level of the acoustic reflex as the recruitment measure.

ADAPTATION:

Many investigators have used BEKESY audiometry or tone decay tests to measure adaptation. Bekesy tracings are usually Type I or II (normal or cochlear site of lesion) for presbycusic subjects (HARBERT et.al 1966; JERGER, 1960? JOKINEN, 1969, 1970)and show no abnormal fatigue. Forward vs.backward Bekesy tracings didnot show evidence of abnormal fatigue (JOKNEN & KARJA, 1970). The amount of adaptation usually seen on clinical tone decay tests is 30 dB or less (GANG, 1976; GJAEVENES & SOHOEL, 1969; GOETZINGER, PROUD, DIRKS, & EMBREY, 1961; HARBERT, YOUNG & MENDUKE, 1966; OLSEN & NOFFSINGER, 1974), again consistent otheretiologies associated with a cochlear site of lesion. WILLEFORD (1971) reported abnormal tone decay for only a small number of elderly subjects. Thus, presbycusic subjects usually do not show the abnormal fatigability that would be expected with a retrocochlear site of lesion, but it is important to measure rate as well as amplitude of adaptation (WILEY & LILLY, 1980).

FREQUENCY ANALYSIS: Auditory analysis of speech signals clearly is dependent upon frequency analysis without good frequency analysis abilities. Speech discrimination abilities are impaired (GENGEL, 1973; LINVILLE & BRANDT, 1980).

Frequency discrimination tends to be poorer as the hearing loss increases (ROSS, HUNTINGTON, NEWBY & DIXON, 1965; ZUREK & FORMBY, 1979), in case of cochlear pathology both for frequency modulated (FM) signals (FILLING, 1958; MEURMANN, 1954; ZUREK & FORMBY, 1979) pulsed sinusoids (BUTTER & ALBRITE, 1956; GENGEL, 1973; ROSS et., al., 1965).

MEURMANN (1954) & FILLING (1958) have studied frequency discrimination with FM techniques in elderly hearing impaired listeners. MEURMANN have found that the DLFs at 20 dB SL for 125-4000 Hz were larger than normal in aging listeners, but certainly were no larger that the DLFs for listeners with meniere's disease or young listeners with sensorineural hearing loss who had poorest hearing sensitivity. Filling have hound that the DLFs at 20 dB SL for 125-8000 Hz were worse for older listeners. FILLING have concluded that the DLFs may show adverse effects on aging even before a loss of hearing sensitivity is observed. KONIG (1957) has found the same thing as FILLING for pulsed sinusoids that 40 dB SL for 125 - 4000 Hz with constant stimulus method.

Psychophysical tuning curves (another measure of frequency analysis) show abnormal broadening, abnormal shape, and loss of the tip in regions of hearing loss (FLORENTINE, 1978; HOEKSTRA & RITSMA, 1977; LESHOWITZ & LINDSTROM, 1977; LESHOWITZ, SINDSTROM & ZUREK, 1976; TYLER, FERNANDES & WOOD, 1980) (WEIGHTMAN, McGEE, & KRAMER, 1977? ZWICKER & SCHORN, 1978). They can also show abnormalities in regions of normal hearing sensitivity (MILLS, GILBERT, & ADKINS, 1979? WIGHTMAN et., al, 1977), especially if there is a sizeable loss for higher frequencies (NELSON, 1979). Tuning curves for hearing impaired listeners showed greatly reduced frequency selectivity (ZWICKER & SCHORN, 1978).

Loudness measure of critical band width (CBW) (another measure of frequency analysis) in 20 presbycusic listeners who had fairly flat audiograms showed normal CBWs (BONDING 1979 d). The magnitude of loudness summation was reduced in sensorineural hearing loss, especially in ears with recnitment, and the magnitude of loudness summation varied inversly with hearing loss (BONDING, 1979).

SIMULTANEIOUS MASKING:

Two aspects of simultaneious masking have been assessed in experiments with elderly listeners. One of these, the critical radio (CR), is the signal to noise ratio at measured threshold; and the second, upward spread of masking, is the extent to which the influence of the masker spreads to higher frequencies.

Critical ratios are usually found to be normal for listeners with cochlear hearing losses (JERGER, TILLMAN & PETERSON, 1960; RITTMANIC, 1962), and appear largly unaffected by a level in either normal listeners or listeners with cochlear hearing loss (DE BOER & BOWMEESTER, 1974; PALVA, GOODMAN & HIRSH, 1953). BILGER (1973) found critical ratios to increase with level for high frequencies for normal hearing listeners. MARGOLIS & GOLDBERG (1980) have measured CR in five presbycusic listeners for a 1000 Hz tone at 50 dB SPL, where 4 subjects showed abnormal critical ratios.

Abnormally broad upward spread of masking has been observed for some but not all listeners with sensorineural hearing losses (De BOER & BOWMEESTER, 1974; JERGER et.al., 1960; LESHOWITZ & LINDSTROM, 1979; RITTMANIC, 1962; TYLER et.al., 1980)

JERGER et.al., (1960) found abnormal spread of masking for adult listeners with sensorineural hearing loss (cochlear hearing loss) and the elderly listeners with presbycusis. However, the elderly listeners did not show greater spread of masking effects than their young counterparts. JERGER (1973) stated that the problem is attributed to impaired central auditory pathways in the elderly.

TEMPORAL ANALYSIS:

Many elderly listeners have difficulty in understanding temporally-degraded speech. Temporal processing is often affected by sensorineural hearing loss (BRANDT & CASKEY, 1978; CUDAHY, 1975, 1977; CUDAHY & ELLIOTT 1975, 1976; ELLIOTT, 1975; FITZGIBBONS & WIGHTMAN, 1979; HAUSLER, MARR & COLBURN, 1979; NILSSEN & LIDEN, 1976; HAWKINS & WIGHTMAN, 1978).

Temporal integration: Short duration signals (less than 200 m sec) requiring increasingly greater intensity with decreasing duration in order to be detected (Brief Tone Audiometry). Listeners with cochlear hearing losses generally show reduced temporal integration (Elliott,1963; HARRIS, HAINES & MEYERS, 1958; OLSEN et. al, 1974; PEDERSEN, 1973, SANDERS & HONIG, 1967, WRIGHT, 1968; TYLER et.al,1980). Normal hearing listeners also show shorter time constants at higher frequencies (WATSEN & GENGEL, 1969), inviduals with high frequency hearing loss may not have smaller than normal time constants (GENGEL & WATSON, 1971). The data from presbycusic listeners (CORSO, WRIGHT & VALLERIO, 1976; PEDERSEN & ELBERLING, 1973) are indistinguishable from data on younger listeners with cochlear impairments.

SPEECH DISCRIMINATION:

a) Speech discrimination in ideal listening conditions: JERGER (1973) have found decrease in P B max.,with aging is similar to the decrease in absolute sensitivity with aging. JERGER also examined mean P B max., scores as a function of age (Eor groups with varying degrees of hearing loss (grouped by PT average) and he observed slight decrease in PB max., with age when the presentation level was sufficiently intense to overcome the attenuating effect across all frequencies.

LUTERMAN, WELSH, & MELROSE (1966) have found more errors for elderly than for young listeners on W-22 word list at 40 3B SL. SURR (1977) didnot find any difference in speech discrimination scores across age groups with mild high frequency hearing losses for NU-6 word lists at 40 dB SL. KASDEN (1970) didnot find any difference between young and elderly listeners with mild - moderate gradually sloping hearing losses, at any presentation level.

BESS & TOWNSEND (1977) found age effects in the speech discrimination abilities of 556 subjects with flat hearing losses, age 14-98. For mild hearing losses, the speech discrimination ability at 40 dBSL, decreased very slightly with age. For greater amounts of hearing loss, speech discrimination decreased dramatically with age.

b) Speech discrimination for altered speech: Elderely people generally experience diffculty with all types of altered (i.e., frequency related altered, or temporally related altered) speech (SCHOW et.al, 1978), but there are many inconsistencies across studies.

Discrimination of LP-filtered speech has been measured by KIRIKAE et.al (1964), and MARSTON & GOETZINGER (1972) and discrimination of band pass filtered speech by HARBERT et.al (1966) and PALVA & JOKINEN (1970), MARSTON & GOETZINGER did not find differences between young and older listeners.

The elderly have demonstrated decreased performance on fast speech (BERGMAN, BLUMENFELD, CASCARDO, DASH, LEVITT, and MARGULIES, 1976? CALEARO & LABBARONI, 1957), interrupted speech (BERGMAN, 1975; BERGMAN et.al., 1976; KIRIKAE et.al., 1964; & MARSTON & GOETZINGER, 1972), & reverberated speech (BERGMAN, 1971; BERGMAN et.al., 1976). There is disagreement about the effects of time - expanded and time compressed speech. LUTERMAN et. al., (1966) & SCHON (1970) found that discrimination of time - expanded speech was affected by hearing loss but not by age. KORABIC, FREEMAN, & CHURCH (1978) found poorer performance for elderly listeners in comparison with young listeners, where the elderly listeners had high frequency sensorineural hearing losses and poorer speech discrimination scores for unaltered speech and the test words were presented at relatively low SLs.

Perception of time - altered speech for elderly listeners with normal hearing sensitivity (Threshold $\leq$15 dB ISO at 250 - 4000 Hz) has been assessed by STICHT & GRAY (1969). Intelligibility deteriorated progressively in comparison with young listeners for increasing time compression.

LUTERMAN et.al., (1966) found no differences between young and elderly listeners with similar high frequency hearing losses, but used relat-ively low levels of alteration. SCHON (1970) found similar performances among older listeners with typical sloping presbycusic hearing losses, older listeners with sizeable hearing losses, and younger listeners with sizeable hearing losses. STICHT & GRAY, (1969); & KONKLE, BEASLEY, & BESS (1977), however, both found that with increasinntime - compression the elderly hea ing impaired subjects showed on increasingly larger decrement in speech discrimination in comparison to young hearing impaired subjects.

, In listeners with peripheral hearing losses, the problem is much more complex. HARRIS (1960) demonstrated in young normal listeners that combinations of various types of distortion resulted in worse speech intelligibility. Thus, the results of many of the altered speech studies using elderly listeners are difficult to interpret because the peripheral hearing loss could have accounted for these effects. KONKLE et.al., (1979) matched audiograms across age groups, & they found large effect of age on the intelligibility of time compressed speech, especially in the more diffciult listening conditions.

c) Speech discrimination in noise: SMITH & PRATHER (1971) found a decrement for elderly listeners in comparison to young listeners for speech discrimination of consonant - vowel (CV) nonsense syllables across a range of SLs & signal-to-noise (S/N) ratios using broad-band noise. ORCHIK & BURGESS (1977) found a decrement for their older listeners in comparison to young listeners only for their more difficult S/N ratios using synthetic sentence identification (SSI) with a competing speech masker across a range of message - to - competition ratios (MCRs). ORCHIK & BURGESS found poor performance for increasingly difficult listening conditions as was found by STICHT & GRAY (1969) and KONKLE et.al., (1977) for time compressed speech whereas SMITH & PRATHER (1971) didnot find increasing difficulty in the more diffcult conditions for elderly subjects when compared to young listeners.

SURR (1977) found no difference in speech discrimination scores in noise among 100 listeners, age 30-90, with matched audiograms, and similar results were reported by OLSEN & CARHART (1967) & TILLMAN et.al., (1970) for a smaller sample of listeners whose audiograms were not matched. HAYES & JERGER (1979) found that not all elderly listeners show problem with the speech-in-noise task. Similarly, LESHOWITZ & LINDSTROM (1979) found that most but not all listeners with presbycusic hearing losses required increased S/N ratios to understand connected discourse.

Peripheral & Central factors are difficult to differentiate - LESHOWITZ & LINDSTROM (1979) attributed the difficulty with speech-in—noise that was seen in listeners with hearing losses due to presbycusis, ototoxicity, and noise trauma to a loss of frequency selectivity as measured by upward spread of masking. Presbycusic subjects showed an increased upward spread of masking in comparison to other listeners and concomitantly to need a greater S/N ratio for speech intelligibility. PLOMP & MIMPEN (1979) found that the SRT in noise relative to the SRT in quiet may even better for listeners with presbycusis than for listeners with other sensorineural impairment. JERGER & HAYES (1979), however, attribute the elderly's relative difficulty on the SSI - ICM task to a central auditory nervous system deficiency since the descrepancy between PB max., and SSI max., follows the same pattern as seen for listeners with central auditory disorders.

d) Binaural hearing for speech: Binaural fusion has been assessed by Harbert et.al., (1966), & PALVA & JOKINEN (1970) using listeners upto age 90. Even though the elderly listeners showed decreased speech discrimination ability on the monaural filtered speech test in comparison to young listeners, binaural synthesis created no additional problem. In fact PALVA & JOKINEN (1970) commented that the elderly often performed better on the binaural test than on the monaural test, which is suggestive of a peripheral problem. FRANKLIN (1975) found similar results with young (age 13-23) hearing impaired listeners.

Binaural interaction was assessed by measuring the masking level difference (MLD) by many investigat-ors (BOCCA & ANTONELLI, 1976; FINDLAY & SCHUCHMAN, 1976; OLSEN, NOFFSINGER, 19 & HERMAN, 1978). Persons with presbycusic hearing losses show smaller mean MLDS than do normal hearing listeners, although there is considerable overlap in MLD size between the two groups. While abnormal MLDs are seen in persons with brain stem lesions, OLSEN et.al., (1976) demonstrated that persons with peripheral impairments showed reduced MLDs, & QUARANTA, CASSANO, & CERVELLERA (1978) concluded that MLDs (for 500 Hz tones) were not useful diagnostically to detect central impairment unless paripheral hearing sensi-tivity was normal. On both studies 40% to 60% of listeners with presbycusic hearing losses obtained MLDs within normal limits. MLDs have not been measured systematically in elderly listeners with normal hearing sensitivity or in young listeners with slight hearing losses".

ELECTRO COCHLEOGRAPHIC FINDINGS:

Latency, amplitude and wave form of the action potential (AP) were studied in a group of patients with presbycusis, noise induced hearing loss (NIHL), Sensorineural hearing loss of unknown etiology & conductive loss. As the maximum stimulus intensity of 75 dBHL, patients with moderate to severe high frequency sensorineural hearing loss had the longest latencies. Smaller amplitudes with increasing hearing loss and when steep amplitudes - intensity curves were found, the amplitude often reached larger than normal values at the maximum stimulus intensity. These patients showed th-e same amplitude - intensity & latency - intensity patterns, i.e., slowly sloping amplitude - intensity curves, some times with a tendency toward a plateau. The latency at the AP "thresholds" was larger than that for a normal subject at the same stimulus level. (BERGHOLTZ, HOOPER, & MEHTA, 1977).

In case of mild or moderate sensorineural hearing loss, PORTMANN, ARAN & LAGOURGUE (1973) have reported "recruiting" response for clicks.

The recruiting aspect of the response is that it will grow in amplitude very rapidly, and it will not show the gradual increase in amplitude with near - threshold signal levels as seen in the normal hearing or conductive hearing loss patients.

ARAN et.al., (1971) also obtained 'dissociated' response with high frequency(except for 8 KHz) sensory-neural hearing loss subjects when clicks are used.

PORTMAN & ARAN (1972) have observed "larges" responses which are characterized by broadened wave forms in case of hearing loss due to retro-cochlear lesions.

EVOKED RESPONSES:

1. Middle - latency components: Mc RANDLE, SMITH & GOLDSTEIN, 1974; GOLDSTEIN & Mc RANDLE, 1976; MENDEL, ADKINSON, & HARKER, 1977 have reported that there is little difference between adult & infant morphology for middle components as a function of intensity, or rate of stimulus presentation. Neonates demonstrate slightly shorter latencies and smaller amplitudes than do adults.

When hearing impaired individuals are compared. Mc FARLAND et.al., 1977; VIVION et.al., 1979 have found few systematic and reliable differences in the middle latency wave forms compared to normals at the same suprathreshold intensity levels.

2. Late - Latency components: Maturation & Maturity affect the latency of these components. They decrease in

latency from birth to about 10 years of age, and lengthen there after. The amplitude increases in childhood and then becomes stable, eventually decreasing with advancing age (CALLAWAY & HALLIDAY, 1973; ELLINGSON, DANAHY, & NELSON et.al-. 1974; CALLAWAY, 1975; DUSTMAN, SCHENKENBERG, & BECK, 1976; GOODIN, SQUIRES, & HENDERSON, et.al., 1978 b, OHLRICH, BARNET, & WEISS et.al., 1978, PFEFFERBAUM, FORD, & ROTH et.al., 1980 a, 1980 b) .

3. Long - latency components: Latency of the P_3 component has been found to increases as a function of age of subject (GOODIN, et.al., 1978 a; SQUIRES, CHIPPENDALE, & WREGE, et.al., 1980). Latency differences between young and older subjects after the N_1 component, but not before (GOODIN, et.al., 1978a).

4. Evidences to show that age affects the ABR: The peak of wave V can be measured from the peak to wave I. The usual time difference between I & V is about 4 m sec., and is remarkably consistent, especially in normal subjects (DAVIS, 1976).

Changes of latency of wave V with age in very young infants, indicating maturation of the responses (SCHULMAN-GALAMBOS & GALAMBOS, 1976). There has been some conjecture that with advancing years the response latency in the case of adults might change systematically.

There was appreciable prolongation of latency with increasing age. The amplitude was also diminished with age until in the 8th decade 50% of the cases had $\geq$0.20 uV (medium) and 50% of them had <0.20 uV (small). There are at least two possible explanation given by BEAGLEY & SHELDRAKE (1978).

1. Lack of synchrony between individual responses following indivdual click stimuli. The mean latency of wave V from trial to trial and subject to subject didnot show very great changes, so it is necessary to postulate a greater scatter of individual response latency, and thus poor synchrony, with increasing age.

2. Increased tissue impedance may have played a part in the diminution of amplitudes noticed in the older subjects. Scalp resistance valves of 2-4 K were noted in most of the cases.

The BSERs were measured in respect to peak latencies (I, III, V) and interpeak intervals (I-III, III-V, I-V). Wave replicability was seen to deterorate with age. In older subjects (50 yrs & above) the individual III-V interval exhibited a significant increase with reduction of click intensity from 80 to 60dBSL of the order of 0.1 m.sec (ROSEN HAMER, LIND-STROM & LUNDBORG, 1980).

ROWE (1978), & BEAGLEY & SHELDRAKE (1978) investigated the effects of age and sex upon wave latencies. ROWE (1978) demonstrated significant differences between old and young subjects, while BEAGLEY & SHELDRAKE (1978) found significant differences in regard to sex, but not in regard to age.

ROSENHAMER et.a;., (1980) found no significant latency differences between males and females among the old subjects. Shorter peak latencies in females who are below 50 years- than men and it was not significant above the age of 50.

BEAGLEY & SHELDRAKE (1978) found only a minimal increase in latency of wave V as a function of age and obviously did not find any significant difference in latency for any wave.

THOMSEN et.al., (1978) state that age has some influence, with latency (of wave V) increasing approximately 0.1 m.sec/decade.

ROWE (1978), who devides his material into two age groups of mean age 25.1 years and 61.7 years respectively, finds (in response to clicks at 60 dBHL and at a rate of 30/sec.) a difference between means of 0.2 m sec. for wave 1, 0.44 m.sec. for wave III, and 0.36 m.sec for wave V, old subject showing longer latencies than young ones.

Generally, his interpeak internal differences between old & young subjects are smaller than his peak latency differences.

To sum up, older subjects seem to exhibit longer peak latencies than the younger ones (ROWE 1978) but - BEAGLEY & SHELDRAKE (1970) have found no significant differences, considering interpeak intervals as a function of stimulus intensity, ROWE (1978) found shortening of the I - III, III-V, and I-V intervals when the click intensity is reduced from 60 to 30 dBHL (click rate 30/sec.) in both old and young subject.

ROSENHAMER et.al., (1980) found an increase of the III - V (& I - V) intervals that was significant within old subjects but not in young ones, when the click intensity is reduced from 80 to 60 dBSL (click rate 22.5/sec.).

The possible reason for latency differences between old and young subjects to consider aging of the nervous system and its coverings.

In subjects with normal hearing, latency increased by 0.2 m.sec. over the age range from 25 to 55 yrs. In the same group amplitude of wave V was decreased about 10% (i.e., 0.050 µV) (JERGER, & HALL, 1980).

BEAGLEY & SHELDRAKE (1978) noted a similar but smaller effect in 70 normal subjects. They say that age effect must be taken into consideration in ABR audiometry. Slightly delayed wave V latency, and smaller wave V amplitude must be expected in older patients.

JERGER & HALL (1980) reports: "The age effect on the ABR was not unexpected, Anatomic and physiologic changes in the peripheral and central auditory system have long been associated with aging. It is not unreasonable to expect that the ABR would reflect such changes".

Evoked potentials are used to verify particular changes within the auditory system (VON WEDEL, 1979).

The percentage differences between young & older subjects show a decreasing wave occurrence with growing age. There will be an absence of the 2nd, 3rd, & 5th wave complexes with increasing age at low intensity level (30 dBHL). There was growing wave latency with age. The amplitude values show no significant age dependency (VON WEDEL, 1979).

VON WEDEL concludes that a reduction of excited nerve fibres and reduced transport processes, in all regions in the pathways up to the nucleus of the lateral lemniscus with growing age.

Age related changes in the auditory evoked brain stem potentials of albino and pigmented guinea pigs were done by SCHMIDT, DUM, & VON WEDEL (1981). They report: "The auditory evoked brainstem responses of guinea pigs in 2 age groups were recorded and examined for evidence of age - dependent changes at peripheral stations in the auditory pathway. Because pigmented guinea pigs have been found to be less senstive to sounds than albinos, both groups here included in this study. Old and young animals did not differ in response latency or in the conduction times associated with the individual potentials. By contrast, the amplitudes of the brain stem responses to high frequency stimuli were distinctly reduced in old guinea pigs, with no difference in the dynamic of the amplitude between the two age groups. Within each age group, albino and pigmented animals resembled one another in all parameters studied".

Both infant and geriatric subjects display abnormal

BSER adaptation: wave V latencies increase more rapidly; for a given increament and repetition rate, than in normal (FUJIKAWA, 1976).

CHAPTER - III

METHODOLOGY

The methodology of the present study is described under the following headings:

1) Subjects
2) Equipment
3) Test environment and
4) Procedure

SUBJECTS: Ten hearing (7 males & 3 females) subjects in the age range of 52 to 71 years (mean age 57.15 yrs) were selected for this study. All the subjects had nearly normal hearing (see the table 1 for the thresholds of the subjects). Subjects were selected on the following criteria:

1. They should not have had any history of chronic ear discharge, tinnitus, giddiness, earache or any (other otological complaints.
2. They should not have had any history of epilepsy or other neurological complaint.
3. They should be able to relax and fell comfortable with electrodes on, within 10 - 15 minutes after their placement.

4. Their electro physical input should come below 500 micro volts within 10 - 15 min. after electrode placement.

EQUIPMENTS:

1. Beltone 200-C Audiometer.
2. Electric response Audiometry, Model TA - 1000.

Hearing thresholds were obtained for right and left ears at all octave frequencies (from 250 Hz to 8 KHz) using Beltone 200-C audiometer. The output of the audiometer was given to ear phones TDH-39 housed in ear-cushions mx-41/AR. The audiometer was calibrated for puretones and speech noise objective calibration was repeated once in a month till the study was very stable. Subjective calibration was done everyday.

Brief description of the Electric response audiometer model T A - 1000:

The T A - 1000 system consists of the SLZ 9793 desk top console, the SLZ 9794 preamplifier and an accessory group.

The SLZ 9793 console contains all of the operating controls, indicators and read-outs for the system. It provides the patients an auditory stimulus and accepts patients' electrical responses from the preamplifier. Signal conditioning and digital averaging extract the patients' BSER responses from the background noise. Oscillographic display and ink-on-paper recording provide an ongoing monitor as well as prominent record of responses.

The SLZ 9794 preamplifer is an isolated EEG preamplifer with frequency response and gain specifically designed for ERA. Patient's electrical response is sensed by a set of three electrodes and after amplification it conducted to the console by an interconnecting cable.

Accessory group used was:

1. A binaural air-conduction head set with cord set.
2. Interconnecting cables, chart paper and pens.
3. Sets of electrodes, electrolyte gel and

electrode adhesive pad was substituted by JOHN SENPLAST.

CONTROLS & THEIR FUNCTION: The T A - 1000 is operated with only (1) four knobs and (2) nine push button switches. All kobs are clearly marked to indicate their function.

FOUR KNOBS: (i) The stimulus function switch permits selection of 2 KHz, 4 KHz, or 6 KHz acoustic logon stimulus equivalent frequencies, at repetition rate of 5 or 20 stimuli per second and patient response intervals of 10 ms or 20 ms immediately following the acoustic logon stimulus.

(ii) The stimulus attenuator establish the presentation level, permits selection of acoustic logon stimulus from 0 to +100 dB HL.

(iii) The scale function switch permits selection of system sensitivity and number of averaged response samples. For 1024 stimulus 0.5µV, 1 µV, 2 µV and 5 µV / division sensitivities are available. For 2048 samppes 0.2 µV, 0.5µV, 1 µV and 2µV / division sensitivities are available. For 4096 samples, 0.1 µV, 0.2µV, 0.5 µV and 1µV / division sensitivities are available.

T A - 1000 has a calibrated latency cursor, which appears on the oscilloscope trace as a function of latency control. The latency of a particular peak can be obtained by moving the cursor to the desired peak. Readout of latency is in milliseconds.

(2) PUSH BUTTON SWITCHES:

(i) power switch energizes the system and indicate the system status.

(ii) 'scope' switch controls the oscilloscope display.

(iii) 'clear' push-button clears the microprocessor averaged memory, resets the sample display counter and corrects the microprocessor operating mode to correspond to the current control status.

(iv) 'start & stop' push button indicates the micro-processor average function. The average function is automatically terminated when the selected number of samples has accumulated, or when any average memory channel is full, automatic termination requires a clear, to permit restart.

(v) Record push button initiates the plotter readout.

(vi) 'mask' push button applied broad band noise masking to the contralateral ear only when either airleft or airright stimulus is active.

(vii) Air left applies the stimulus to the desired ear phone.

(viii) Air right applies the stimulus to the desired earphone.

(ix) 'Bone' pursh button applies the stimulus to the bone vibrator transducer.

Besides these there is i) paper advancer thumb wheel when rotated down ward advances the plot chart paper. (ii) the limit indicator in the samples window will light briefly to indicate the presence of excess input to the system. (iii) The TWF/RUN/EEG switch wshould be in 'RUN' for normal opaation. When in the TWF position after a clear the oscilloscope will display a characteristic test wave form to confirm oscilloscope operation. In the EEG position after a clear, the Oscilloscope will display the ongoing EEG activity, the raw signal from which the averaged response is derived.

TEST ENVIRONMENT: The experiment was carried out in sound treated room at the audiology department. All India Institute of Speech & Hearing, Mysore.

a) POWER SOURCE: the main AC current was canalysed to I.T.L. model SVS 200 L stabilizer with input 170 - 270 volts and out put of 230 volts. This was stopped down by Kardio SL 101-110 volts which is the requirement of the instrument to function properly.

b) LOCATION OF THE INSTRUMENT: The instrument was placed inside a large sound treated room.

(i) Humidity was neither too high, or low to the point where either the subject or clinician were un-comfortable.

(ii) It was away from noisy drafty or excessive vibration area.

(iii) away from high brightness area, curtains were drawn to control direct sunlight in the room.

PROCEDURE: Prior to every test the stabilizer output was checked to ensure a constant voltage of

200 volts. The chart paper in the plotter was also checked for its proper position. The tubular pen-holder was uncapped.

INSTRUCTIONS: The subjects were instructed to be in relaxed, recumbent position on an examination table which was co-vered by a cushion bed & a pillow. Subjects were briefed with the information that the electrodes would be placed and t en earphones from which he could hear click like sounds. The subjects were not sedated. They were told to be in a relaxed state and then they could go to sleep.

ELECTRODES: They were checked with a gentle tug on both ends. They were cleaned with cotton soaked in rectified spirit (electrodes are of solid sterling silver).

Cotton soaked in rectified spirit was briskly rubbed on the skin areas where the electrodes were to be placed till pinkish colour indicative of increased vascularity appeared. This was then wiped with dry cotton.

Sufficient quantity of electrolyte gel was placed on the electrodes to fill the recess in the electrodes to the slightly rounded condition and to get applied to the skin. Electrodes were placed on the previously cleaned areas, pressing slightly. The excess of paste which oozed out from the electrode holes & slides was cleaned with dry cotton. Then Johnson adhesive tape was used to hold the electrodes into firm contact all around.

Electrode placement was as follows:

Red: (+) signal, to high forehead.

White: (- ve) reference, at right mastord of the test ear.

Black: Ground, at left mastoid of the nontest ear.

Each electrode was plugged into the correspondingly coloured receptacle on the patient electrode cable from the preamplifier.

Preamplifier was positioned in a convenient location and was plugged with the 3 pin patient electrode cable, plug into the corresponding preamplifier receptable (They have a blue colour code).

Preamplifier and the ERA were interconnected by means of the cable and receptacles which are colour coded (yellow).

Headphones were placed and the headset was positioned in such a way that it was comfortable to the subject.

Setting BSER:

1. TWF/RUN/EEG was kept on RUN.
2. Stimulus frequency on 2 KHz or 4KHz or 6 KHz, 20 pulses per second and 10 ms sample time.
3. The scale switch on 2048 samples and 0.2 μV/D.V.
4. Stimulus intensity 100 dB HL or 80 dB HL.
5. 'CLEAR' was pressed and then AIR - RIGHT was pressed.
6. Start/Stop push button pressed to intiate the microprocessor average function.
7. 'Scope' push button switch pressed to get an oscilloscopic display.
8. 'Record' push button switch pressed to get a graphic readout after the completion of

2048 samples, 20 times/sec.

6 BSER waveforms were taken for each subject at 3 frequencies (2k, 4k & 6KHz) at two intensity levels (80 dB & 100 dB HL) in right ear.

During the process of experiment, following things were noted down:

(i) change in voltage
(ii) glowing of the preamplifier light indicating that the subject is completely relaxed.
(iii) stopping of the samples before the completion of the predetermined number of samples.
(iv) motor movements of the subjects and the subsequent effect on the waveform.

The Latency of wave I through V were noted down from the graphic display for BSER.

The amptitude of BSER was determined for all from the graphic display. The marker amplitude M was noted down either in 1, 2, 3 or 4 division. And amplitude of wage I-V were noted down using the formula.

$\frac{T\ S}{M}$ where T = Trace value

S = sensitivity (o.2 μV/dv)

M = marker hight

Some times the fifth wave (V) inseparably merged with the fourth wave (M). In that case only fifth wave (V) is taken into consideration.

Later the data was compared with the data obtained from normal hearing subjects by GEETHA HERLEKAR (1985) (Age range 18-23 yrs).

CHAPTER - IV

RESULTS & DISCUSSIONS.

The pure tone thresholds of the subjects and mean values of the thresholds (HL) at each test frequency from 250 through 8000 Hz is given in Table 1.

EFFECT OF AGE ON LATENCY;

The means and standard deviations (SDs) of all 10 cases, each tested at 80 dBHL and 100 dBHL (using 20 stimuli/sec.), at 2k, 4k, & 6 KHz are shown in Tables 2, 3, and 4 respectively.

There was increase in latency in all five waves with reduction of stimulus intensity from 100 dB to 80 dB HL. The increase in latency of all five waves was greater than 0.2 m.sec. at 2k, 4k, & 6KHz with reduction of stimulus intensity from 100 dB to 80dBHL. These differences are almost same for all the tested frequencies for all five waves i.e., greater than 0.2 ms and less than 0.5 ms.

EFFECT OF AGE ON AMPLITUDE:

Amplitude is rather difficult to measure in the case of BSER as it is necessary to make dicisions as to which deflection to measure and which criteria to accept in respect of the features particular deflections. Amplitude was measured for a particular wave from the crest to the following though. The amplitude was measured using graph scale where each division was divided into 4 parts and using the formula $\frac{TS}{M}$.

The means and standard deviations of all 10 cases, each tested at 80 & 100 dBHL (20 stimuli/sec.) at 2, 4, and 6 KHz are shown in Tables 2, 3, & 4 respectively.

The amplitudes were grouped as large (greater than 0.4 µV), medium (0.2 - 0.4 µV), and small (less than 0.2 µV). More than 50% of the cases showed small amplitudes.

EFFECTS OF INTENSITY:

There was no effect of reduction of intensity from 100 to 80 dBHL for all five waves the above three frequencies.

Large (greater than 0.4 µV) amplitude was observed for V wave at 80 & 100 dBHL at all frequencies tested. (except at 80 dBHL at 6 KHz).

There was no effect of frequency on amplitude.

INTERPEAK LATENCY:

The means and standard deviations of all 10 cases each tested at 80 and 100 dBHL (20 stimuli/sec), at 2, 4, and 6KHz are shown in Table 5. The interpeak latency (I - V) was almost same at 80 dBHL and 100 dBHL.

The interpeak latencies are not affected by the frequencies of the stimulus at 80 orl00 dBHL.

MEAN LATENCY DIFFERENCES BETWEEN ADULT & GERIATRIC GROUPS:

The means, Standard deviations and the ranges of all 10 cases, each tested at 80 & 100 dBHL (20 stimuli/sec) at 2, 4, & 6 KHz are shown in Table 6. The mean differences are shown in the graphs 1, 2, & 3 for 2, 4, & 6 KHz respectively.

There was a latency delay ranging from 0.1 to 0.4 ms at all the waves (except in IV wave at 100 dBHL at 2 KHz) in geriatric group.

The difference was independent of frequency and intensity.

MEAN AMPLITUDE DIFFERENCES BETWEEN ADULT AND GERIATRIC GROUPS:

The means, standard deviations and the ranges of all 10 cases, each tested at 80 & 100 dBHL (20 stimuli/sec), at 2, 4, & 6KHz are shown in Table 7. The mean differences are shown in the graphs 4, 5, & 6 for 2, 4, and 6 KHz respectively.

The amplitude decrement of greater than 0.08 µV for the I wave, and greater than 0.11 µV for the III wave at 80 dBHL was observed in the geriatric group.

The amplitude decrement of greater than 0.12 µV for the I wave and greater than 0.1 µV for the III wave at 100 dBHL was observed in the geriatric group.

For other waves there was not much difference between adult and geriatric groups.

It is clear from this study that the latency values obtained in geriatric group are longer than those obtained in the adult group. The overall latency difference exceeds 0.1 ms.

BEAGLEY & SHELDRAKE (1978) have found only a minimal increase in latency of V wave as a function of age. Table 8 shows the latency shift for 20 dB increase in intensity between adult & geriatric group.

The average latency in geriatric group was at least 0.2 ms. longer than the average latency in the adult group with reduction in intensity from 100 dBHL to 80 dBHL.

More than 50% of the cases showed small (less than 0.2 uV) amplitude in geriatric group. BEAGLEY & SHELDRAKE (1978) have found the same thing.

Amplitude values of I & III waves obtained in geriatric group were smaller than those obtained in the adult group (at both 80 & 100 dBHL levels).

T A B L E - 1.

THE PURE TONE THRESHOLDS OF 10 SUBJECTS (in dBHL)

SL.NO	250 Hz		500 Hz		1000 Hz		2000 Hz		4000 Hz		6000 Hz		8000 Hz	
SUBJECTS	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
1.	10	5	10	5	15	15	15	5	20	20	20	15	20	20
2.	15	10	l5	10	15	5	10	5	5	5	20	10	25	15
3.	20	10	25	10	30	15	15	10	30	30	30	35	30	40
4.	25	20	20	25	20	25	20	20	25	25	30	15	35	20
5.	15	15	15	20	20	25	30	30	25	35	30	35	30	40
6.	20	20	25	25	20	15	15	10	30	15	30	30	25	20
7.	15	15	15	15	10	10	20	15	20	10	30	25	20	15
8.	5	5	15	5	5	15	5	15	15	5	15	15	10	10
9.	25	25	20	10	30	35	25	35	30	35	35	40	35	45
10.	15	15	10	15	20	15	20	20	25	25	25	25	15	30
MEAN	16.5	14	17	14	18.5	17.5	17.5	16.5	22.5	20.5	26.5	24.5	24.5	25.5

TABLE - 2.

PEAK LATENCY MEANS AND STANDARD DEVIATIONS OF ALL 10 CASES, EACH TESTED AT 80 & 100 dBHL (20 STIMULI/SEC) AT 2 KHz.

SUBJECTS	I		II		III		IV		V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	1.6	1.3	2.4	2.2	3.4	3.3	4.9	4.5	5.5	5.2
2.	1.5	0.9	2.4	2.2	3.3	3.2	4.7	-	5.6	5.3
3.	1.6	1.1	2.6	-	3.6	3.2	-	-	5.5	5.2
4.	1.2	0.8	2.3	2.0	3.3	3.0	4.5	4.0	5.2	5.1
5.	1.7	1.6	-	2.1	3.3	3.0	4.6	4.2	5.6	5.0
6.	1.5	1.3	2.3	-	3.5	3.2	4.7	4.3	5.2	5.0
7.	1.5	1.0	2.3	2.0	3.5	3.0	4.8	4.3	5.5	4.9
8.	1.4	1.0	2.5	2.1	3.6	3.2	4.6	4.1	5.4	5.0
9.	1.2	1.2	2.2	2.3	3.4	3.3	4.7	4.2	5.2	4.8
10.	1.0	1.1	2.2	2.1	3.4	3.2	4.7	4.7	5.3	4.8
MEAN:	1.42	1.13	2.35	2.13	3.43	3.16	4.69	4.21	5.40	5.03
STANDARD deviation	0.21	0.23	0.13	0.10	0.11	0.11	0.11	0.15	0.15	0.16

TABLE - 2.

PEAK AMPLITUDE MEANS AND STANDARD DEVIATIONS OF ALL 10 CASES, EACH TESTED AT 80 AND 100 dBHL (20 STIMULI/SEC.) AT 2 KHz.

SUBJECTS	I		II		III		IV		V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	0.06	0.16	0.08	0.02	0.25	0.06		0.06	0.90	0.64
2.	0.10	0.12	0.06	-	0.22	0.32	-	-	0.38	0.22
3.	0.02	-	0.07	-	0.06	0.11	-	-	0.18	0.40
4.	0.14	-	0.04	-	0.28	0.36	0.02	-	0.72	0.88
5.	0.15	0.02	-	-	0.06	0.02	-	-	0.19	0.10
6.	0.05	0.06	-	-	0.26	0.22	-	-	0.45	0.44
7.	0.04	0.16	0.04	0.14	0.16	0.26	-	0.02	0.40	0.38
8.	0.04	0.28	0.20	0.12	0.30	0.30	0.02	0.26	0.60	0.48
9.	0.02	-	0.02	-	0.22	0.22	0.02	0.02	0.70	0.52
10.	0.14	-	0.02	0.04	0.32	0.16	-	0.16	0.66	0.72
MEAN:	0.08	0.13	0.07	0.08	0.21	0.20	0.02	0.10	0.50	0.48
S.D.:	0.05	0.08	0.05	0.05	0.09	0.11	0	0.09	0.20	0.22

TABLE - 3.

THE PEAK LATENCY MEANS AND STANDARD DEVIATIONS OF ALL 10 CASES, TESTED AT 80 and 100 dBHL (USING 20 STIMULI/SEC) AT 4 KHz.

SUBJECTS	I		II		III		IV		V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	1.3	1.3	2.5	2.2	3.5	3.3	4.9	-	5.5	5.4
2.	1.6	1.1	2.6	2.5	3.3	3.0	4.7	4.5	5.6	5.4
3.	1.6	1.3	2.8	2.3	3.6	3.4	4.5	4.5	5.7	5.3
4.	1.3	1.1	2.3	2.2	3.3	3.1	4.7	-	5.4	5.2
5.	-	1.2	2.9	2.7	3.7	3.3	4.8	4.3	5.3	5.0
6.	1.5	1.3	2.5	2.3	3.5	3.3	4.9	4.7	5.3	4.9
7.	-	1.2	2.4	2.2	3.4	3.2	4.8	4.6	5.3	4.9
8.	1.6	1.1	2.7	2.2	3.7	3.3	4.6	4.5	5.4	5.1
9.	1.1	1.1	2.6	2.2	3.8	3.4	4.9	4.6	5.3	5.0
10.	1.2	1.2	2.6	2.5	3.4	3.3	4.9	4.5	5.4	5.1
MEAN:	1.4	1.19	2.59	2.33	3.52	3.26	4.77	4.53	5.42	5.13
S.D.:	0.19	0.08	0.17	0.17	0.17	0.12	0.13	0.11	0.13	0.18

T A B L E - 3.

THE PEAK AMPLITUDE MEANS AND STANDARD DEVIATIONS OF ALL 10 CASES TESTED AT 80 & 100 dBHL (BSING 20 STIMULI/SEC.) AT 4 KHzl

SUBJECTS	I		II		III		IV		V	
	30 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	0.20	0.04	0.02	0.14	0.20	0.24			0.44	0.48
2.	0.02	0.08	-	-	0.18	0.34	0.14	0.14	0.44	0.42
3.	0.02	0.04	-	0.02	0.10	0.14	-	-	0.20	0.19
4.	0.06	0.06	-	-	0.36	0.54	-	-	0.60	0.84
5.	-	0.04	0.02	-	0.05	0.05	0.02	0.05	0.14	0.14
6.	0.04	0.04	0.02	0.02	0.24	0.32	-	-	0.40	0.50
7.	-	0.08	0.10	0.10	0.22	0.20	-	-	0.50	0.48
8.	0.26	0.44	0.04	0.18	0.20	0.12	0.04	0.04	0.56	0.58
9.	0.12	0.12	0.02	-	0.04	0.28	-	-	0.50	0.66
10.	0.04	0.08	0.14	0.04	0.22	0.18	0.04	-	0.54	0.40
MEAN:	0.10	0.10	0.05	0.08	0.18	0.24	0.06	0.08	0.43	0.47
S.D.:	0.08	0.12	0.05	0.06	0.09	0.13	0.05	0.04	0.14	0.20

T A B L E - 4.

PEAK LATENCY MEANS AND STANDARD DEVIATIONS OF ALL THE 10 CASES, TESTED AT 80 & 100 dBHL (USING 20 STIMULI/SEC.) AT 6 KHz!

SUBJECTS	I		II		III		IV		V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	1.6	1.2	2.6	2.5	3.6	3.4	4.9	4.7	5.6	5.4
2.	1.8	1.3	2.7	2.6	3.6	3.4	4.9	4.7	5.8	5.3
3.	1.6	1.3	2.9	2.3	3.6	3.3	4.9	4.6	5.8	5.2
4.	1.4	1.1	2.4	2.1	3.4	3.2	4.8	4.5	5.5	5.1
5.	1.7	1.6	-	-	3.9	3.4	-	-	5.5	5.1
6.	1.3	1.3	2.8	2.3	3.6	3.3	4.9	4.8	5.4	5.2
7.	1.5	1.0	2.7	2.2	3.5	3.2	4.8	4.6	5.4	5.1
8.	1.5	1.2	2.4	2.3	3.7	3.4	4.8	4.5	5.8	5.2
9.	1.3	1.1	-	2.2	3.6	3.4	4.8	4.5	5.3	5.1
10.	1.3	1.4	2.5	2.3	3.6	3.3	4.9	4.5	5.6	5.3
MEAN:	1.5	1.25	2.63	2.31	3.61	3.33	4.86	4.60	5.57	5.20
S.D.:	0.17	0.16	0.17	0.14	0.12	0.08	0.05	0.11	0.17	0.10

T A B L E - 4.

PEAK AMPLITUDE MEANS AND STANDARD DEVIATIONS OF ALL 10 CASES, TESTED AT 80 & 100 dB HL (USING 20 STIMULI/SEC.) AT 6 KHz.

SUBJECTS	I		II		III		IV		V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	0.01	0.22	0.02	-	0.18	0.54	0.02	-	0.48	0.56
2.	0.08	-	0.03	0.08	0.27	0.08	0.10	0.02	0.28	0.52
3.	0.20	0.04	-	0.04	0.06	0.20	-	-	0.11	0.15
4.	0.04	0.16	-	-	0.20	0.42	-	-	0.68	0.78
5.	0.04	0.12	-	-	-	0.05	-	-	0.21	0.25
6.	0.02	0.12	-	0.03	0.17	0.30	-	-	0.30	0.42
7.	0.06	0.08	0.02	0.10	0.10	0.26	-	0.02	0.28	0.32
8.	0.22	0.42	0.20	0.08	0.04	0.42	0.04	-	0.36	0.56
9.	-	0.16	0.10	0.04	0.16	0.28	0.02	-	0.30	0.38
10.	0.10	0.08	0.04	0.04	0.06	0.20	—	—	0.34	0.54
MEAN:	0.09	0.16	0.07	0.06	0.14	0.28	0.05	0.02	0.33	0.45
S.D.:	0.07	0.11	0.06	0.03	0.07	0.15	0.03	0	0.15	0.17

TABLE - 5.

INTERPEAK LATENCY INTERVAL MEANS & STANDARD DEVIATIONS OF ALL 10 CASES, EACH TESTED AT 80 & 100 dB HL (USING 20 STIMULI/SEC.) AT 2 KHz.

SUBJECTS	III-I		V-I		V-III	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	1.8	2.0	3.9	3.9	2.1	1.9
2.	1.8	2.3	4.1	4.4	2.3	2.1
3.	2.0	2.1	3.9	4.1	1.9	2.0
4.	2.1	2.2	4.0	4.3	1.9	2.1
5.	1.6	1.4	3.9	3.4	2.3	2.0
6.	2.0	1.9	3.7	3.7	1.7	1.8
7.	2.0	2.0	4.0	3.9	2.0	1.9
8.	2.2	2.2	4.0	4.0	1.8	1.8
9.	2.2	2.1	4.0	3.6	1.8	1.5
10.	2.4	2.1	4.3	3.7	1.9	1.6
MEAN:	2.01	2.03	3.98	3.90	1.97	1.87
S.D.:	0.22	0.24	0.15	0.30	0.20	0.19

T A B L E - 5.

INTERPEAK LATENCY INTERVAL MEANS AND STANDARD DEVIATIONS OF ALL 10 CASES, EACH TESTED AT 80 & 100 dBHL (USING 20 STIMULI/SEC.) AT 4 KHz.

SUBJECTS	I-III		I-V		III-V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	2.2	2.0	4.2	4.1	2.0	2.1
2.	1.7	1.9	4.0	4.3	2.3	2.4
3.	2.0	2.1	4.1	4.0	2.1	1.9
4.	2.0	2.0	4.1	4.1	2.1	2.2
5.	-	2.1	-	3.8	1.6	1.7
6.	2.0	2.0	3.8	3.6	1.8	1.6
7.	-	2.0	-	3.7	1.9	1.7
8.	2.3	2.2	3.8	4.0	1.7	1.8
9.	2.7	2.3	4.2	3.9	1.5	1.6
10.	2.2	2.1	4.2	3.9	2.0	1.8
MEAN:	2.14	2.07	4.05	3.94	1.90	1.88
S.D.:	0.27	0.11	0.16	0.20	0.24	0.26

TABLE - 5.

INTERPEAK LATENCY INTERVAL MEANS & STANDARD DEVIATIONS OF ALL 10 CASES, EACH TESTED AT 80 & 100 dBHL (BSING 20 STIMULI/SEC.) AT 6 KHz.

SUBJECTS	I-III		I-V		III-V	
	80 dB	100 dB	80 dB	100 dB	80 dB	100 dB
1.	2.0	2.2	4.0	4.2	2.0	2.0
2.	1.8	2.1	4.0	4.0	2.2	1.9
3.	2.0	2.0	4.2	3.9	2.2	1.9
4.	2.0	2.1	4.1	4.0	2.1	1.9
5.	2.2	1.8	3.8	3.5	1.6	1.7
6.	2.3	2.0	4.1	3.9	1.8	1.9
7.	2.0	2.2	3.9	4.1	1.9	1.9
8.	2.2	2.2	4.3	4.0	2.1	1.8
9.	2.3	2.3	4.0	4.0	1.7	1.7
10.	2.3	1.9	4.3	3.9	2.0	2.0
MEAN:	2.11	2.08	4.07	3.95	1.96	1.87
S.D.:	0.16	0.15	0.16	0.17	0.20	0.10

T A B L E - 6.

PEAK LATENCY MEANS, STANDARD DEVIATIONS AND RANGES IN ADULT & GERIATRIC GROUPS AT 2KHz.

		ADULTS		GERIATRIC GROUP AGE 52-71 YRS.		DIFFERENCE AT	
	PEAKS (1)	80 dB (2)	100 dB (3)	80 dB (4)	100 dB (5)	80 dB (4-2)	100 dB (5-3)
I	MEAN	1.32	0.98	1.42	1.13	0.10	0.15
	S.D.	0.15	0.12	0.21	0.23		
	RANGE	(1.0-1.5)	(0.90-1.2)	(1.0-1.7)	(0.80-1.6)		
II	MEAN	2.22	1.92	2.35	2.13	0.13	0.21
	S.D.	0.17	0.20	0.13	0.10		
	RANGE	(2.0-2.5)	(1.7-2.3)	(2.2-2.6)	(2.0-2.3)		
III	MEAN	3.26	3.01	3.43	3.16	0.17	0.15
	S.D.	0. 18	0.16	0.11	0.11		
	RANGE	(2.9-3.5)	(2.8-3.3)	(3.3-3.6)	(3.0-3.3)		
IV	MEAN	4.49	4.23	4.69	4.21	0.02	-.02
	S.D.	0.16	0.16	0.11	0.15		
	RANGE	(4.2-4.7)	(3.9-4.4)	(4.5-4.9)	(4.0-4.5)		
V	MEAN	5.02	4.84	5.40	5.03	0.38	0.19
	S.D.	0.22	0.20	0.15	0.16		
	RANGE	(4.7-5.3)	(4.5-5.2	(5.2-5.6)	(4.8-5.3)		

* Adult norms from GEETHA HERLEKAR 1985)

T A B L E - 6.

PEAK LATENCY MEANS, STANDARD DEVISTIONS AND RANGES IN ADULT & GERIATRIC GROUPS AT 4 KHz.

		ADULTS*		GERIATRIC GROUP AGE 52-71 YRS.		DIFFERENCE AT	
	PEAKS (1)	80 dB (2)	100dB (3)	80 dB (4)	100 dB (5)	80 dB (4-2)	100 dB (5-3)
I	MEAN	1.27	1.04	1.40	1.19	0.13	0.15
	S.D.	0.13	0.11	0.19	0.08		
	RANGE	(1.1-1.5)	(0.9-1.3)	(1.1-1.6)	(1.1-1.3)		
II	MEAN	2.29	2.11	2.59	2.33	0.30	0.22
	S.D	0.18	0.26	0.17	0.17		
	RANGE	(2.0-2.6)	(1.8-2.6)	(2.3-2.9)	(2.2-2.7)		
III	MEAN	3.31	3.14	3.52	3.26	0.21	0.12
	S.D.	0.18	0.14	0.17	0.12		
	RANGE	(3.1-3.7)	(2.9-3.4)	(3.3-3.8)	(3.0-3.4)		
IV	MEAN	4.44	4.40	4.77	4.53	0.33	0.13
	S.D.	0.15	0.26	0.13	0.11		
	RANGE	(4.3-4.7)	(4.0-4.7)	(4.5-4.9)	(4.3-4.7)		
V	MEAN	5.03	4.87	5.42	5.13	0.39	0.26
	S.D.	0.25	0.24	0.13	0.18		
	RANGE	(4.6-5.4)	(4.7-5.3)	(5.3-5.7)	(4.9-5.4)		

* Adult norms from GEETHA HERLEKAR (1985).

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T A B L E - 6.

PEAK LATENCY MEANS, STANDARD DEVIATIONS AND RANGES IN ADULT & GERIATRIC GROUPS AT 6 KHz.

		ADULTS		GERIATRIC GROUP AGE 52-71 YRS.		DIFFERENCE AT	
PEAKS (1)		80 dB (2)	100 dB (3)	80 dB (4)	100 dB (5)	80 dB (4-2)	100 dB (5-3)
I	MEAN	1.33	1.08	1.50	1.25	0.17	0.17
	S.D.	0.16	0.10	0.17	0.16		
	RANGE	(1.1-1.5)	(0.9-1.2)	(1,3-1.8)	(1.0-1.6)		
II	MEAN	2.21	2.07	2.63	2.31	0.42	0.24
	S.D.	0.16	0.14	0.17	0.14		
	RANGE	(2.0-2.5)	(1.8-2.3)	(2.4-2.9)	(2.1-2.6)		
III	MEAN	3.4	3.15	3.61	3.33	0.21	0.18
	(S.D.	0.21	0.16	0.12	0.08		
	RANGE	(3.1-3.8)	(3.0-3.5)	(3.4-3.9)	(3.2-3.4)		
IV	MEAN	4.6	4.41	4.86	4.60	0.26	0.19
	S.D.	0.22	0.14	0.05	0.11		
	RANGE	(4.3-4.9)	(4.2-4.6)	(4.8-4.9)	(4.5-4.9)		
V	MEAN	5.18	4.88	5.57	5.20	0.39	0.32
	S.D.	0.25	0.28	0.17	0.10		
	RANGE	(4.8-5.5)	(4.5-5.3)	(5.3-5.8)	(5.1-5.4)		

* Adult norms from GEETHA HERLEKAR (1985).

TABLE 7.

PEAK AMPLITUDE MEANS, STANDARD DEVIATIONS, AND RANGES IN ADULT & GERIATRIC POPULATION (MEASUREMENTS IN UV). at 2 KHz.

		ADULTS*		GERIATRIC GROUP AGE 52-71 YRS.		DIFFERENCE AT	
PEAKS (1)		80 dB (2)	100 dB (3)	80 dB (4)	100 dB (5)	80 dB (2-4)	100 dB (3-5)
I	MEAN	0.21	0.25	0.08	0.13	0.13	0.12
	S.D.	0.08	0.07	0.05	0.08		
	RANGE	(0.05-0.34)	(0.15-0.35)	(0.02-0.15)	(0.02-0.28)		
II	MEAN	0.08	0.13	0.07	0.08	0.01	0.05
	S.D.	0.03	0.07	0.05	0.05		
	RANGE	(0.04-0.14)	(0.02-0.22)	(0.02-0.20)	(0.02-0.14)		
III	MEAN	0.32	0.32	0.21	0.20	0.11	0.12
	S.D.	0.17	0.17	0.09	0.11		
	RANGE	(0.10-0.60)	(0.15-0.68)	(0.06-0.32)	(0.02-0.36)		
IV	MEAN	0.03	0.12	0.02	0.10	0.01	0.02
	S.D.	0.01	0.09	0	0.09		
	RANGE	(0.02-0.04)	(0.04-0.28)	(0.02)	(0.02-0.26)		
V	MEAN	0.51	0.49	0.50	0.48	0.01	0.01
	S.D.	0.12	0.11	0.20	0.22		
	RANGE	(0.40-0.80)	(0.35-0.62)	(0.18-0.72)	(0.10-0.88)		

* Adult norms from GEETHA HERLEKAR (1985) unpublished independent project.

T A B L E 7.

PEAK AMPLITUDE MEANS, STANDARD DEVIATIONS, AND RANGES IN ADULT & GERIATRIC POPULATION (MEASUREMENTS IN uV) AT 4 KHz.

		ADULTS*		GERIATRIC GROUP AGE 52-71 YRS.		DIFFERENCE AT	
PEAKS (1)		80 dB (2)	100 dB (3)	80 dB (4)	100 dB (5)	§ 80 dB (2-4)	100 dB (3-5)
I	MEANS	0.22	0.26	0.10	0.10	0.12	0.14
	S.D.	0.07	0.08	0.08	0.12		
	RANGE	(0.15-0.37)	(0.12-0.44)	(0.02-0.26)	(0.04-0.44)		
II	MEAN	0.07	0.10	0.05	0.08	0.02	0.02
	S.D.	0.03	0.07	0.05	0.06		
	RANGE	(0.02-1.2)	(0.02-0.20)	(0.02-0.14)	(0.08-0.18)		
III	MEAN	0.33	0.39	0.18	0.24	0.15	0.15
	S.D	0.17	0.21	0.09	0.13		
	RANGE	(0.11-0.58)	(0.12-0.90)	(0.04-0.36)	(0.05-0.54)		
IV	MEAN	0.03	0.04	0.06	0.08	-0.03	-0.04
	S.D.	0.01	0	0.05	0.04		
	RANGE	(0.02-0.04)	(0.04)	(0.02-0.14)	(0.04-0.14)		
V	MEAN	0.44	0.51	0.43	0.47	0.01	0.04
	S.D.	0.14	0.14	0.14	0.20		
	RANGE	(0.20-0.65)	(0.30-0.76)	(0.14-0.60)	(0.14-0.84)		

*Adult norms from GEETHA HERLEKAR (1985).

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TABLE 7.

PEAK AMPLITUDE MEANS, STANDARD DEVIATIONS AND RANGES IN ADULT & GERIATRIC POPULATION (MEASUREMENTS IN uV) at 6 KHz.

PEAKS		ADULTS		GERIATRIC GROUP AGE 52-71 YRS		DIFFERENCE AT	
		80 dB (1)	100 dB (2)	80 dB (3)	100 dB (4)	80 dB (1-3)	100 dB (2-4)
I	MEAN	0.07	0.28	0.09	0.16	0.08	0.12
	S.D.	0.08	0.10	0.07	0.11		
	RANGE	(0.06-0.38)	(0.10-0.44)	(0.01-0.22)	(0.04-0.42)		
II	MEAN	0.06	0.10	0.07	0.06	-0.01	0.04
	S.D.	0.04	0.07	0.06	0.03		
	RANGE	(0.02-0.16)	(0.04-0.22)	(0.02-0.20)	(0.03-0.10)		
III	MEAN	0.29	0.38	0.14	0.28	0.15	0.10
	S.D.	0.16	0.18	0.07	0.15		
	RANGE	(0.06-0.58)	(0.15-0.76)	(0.04-0.27)	(0.05-0.54)		
IV	MEAN	0.04	0.05	0.05	0.02	-0.01	0.03
	S.D.	0.02	0.02	0.03	0		
	RANGE	(0.02-0.06)	(0.04-0.08)	(0.02-0.10)	(0.02)		
V	MEAN	0.39	0.48	0.33	0.45	0.06	0.03
	S.D.	0.11	0.11	0.15	0.17		
	RANGE	(0.25-0.60)	(0.30-0.70)	(0.11-0.68)	(0.15-0.78)		

* Adult norms from GEETHA HERLEKAR (1985).

TABLE 8.

LATENCY SHIFT FOR 20 dB increase in intensity in adult & geriatric groups at 2 KHz.

	ADULTS* (X)			GERIATRIC GROUP (x)		
PEAKS	80 dB (1)	100 dB (2)	DIFFERENT (1-2)	80 dB (1)	100 dB (2)	DIFFERENCE (1-2)
I	1.32	0.98	0.34	1.42	1.13	0.29
II	2.22	1.92	0.30	2.35	2.13	0.22
III	3.26	3.01	0.25	3.43	3.16	0.27
IV	4.49	4.23	0.26	4.69	4.21	0.48
V	5.02	4.84	0.18	5.4	5.03	0.37

* Adult norms from GEETHA HERLEKAR (1985).

contd....

TABLE 8.

LATENCY SHIFT for 20 dB increase in intensity in adult & geriatric groups at 4 KHz.

	ADULTS (x)			GERIATRIC GROUP (x)		
PEAKS	80 dB (1)	100 dB (2)	DIFFERENCE (1-2)	80 dB (1)	100 dB (2)	DIFFERENCE (1-2)
I	1.27	1.04	0.23	1.4	1.19	0.21
II	2.29	2.11	0.18	2.59	2.33	0.26
III	3.31	3.14	0.17	3.52	3.26	0.26
IV	4.44	4.40	0.04	4.77	4.53	0.24
V	5.03	4.87	0.16	5.42	5.13	0.29

Adult norms from GEETHA HERLEKAR (1985)

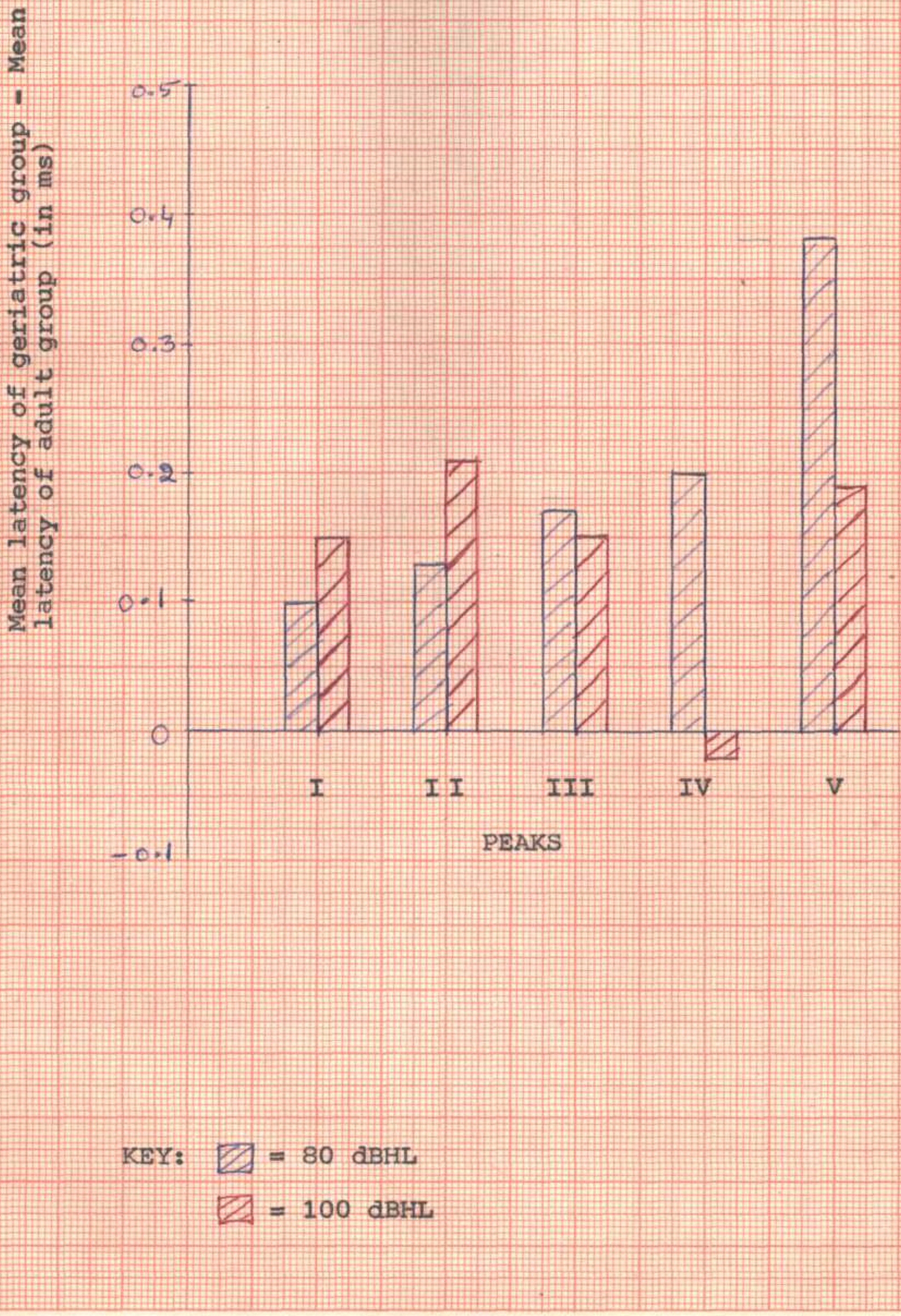
TABLE 8.

LATENCY SHIFT for 20 dB increase in intensity in adult & geriatric groups.

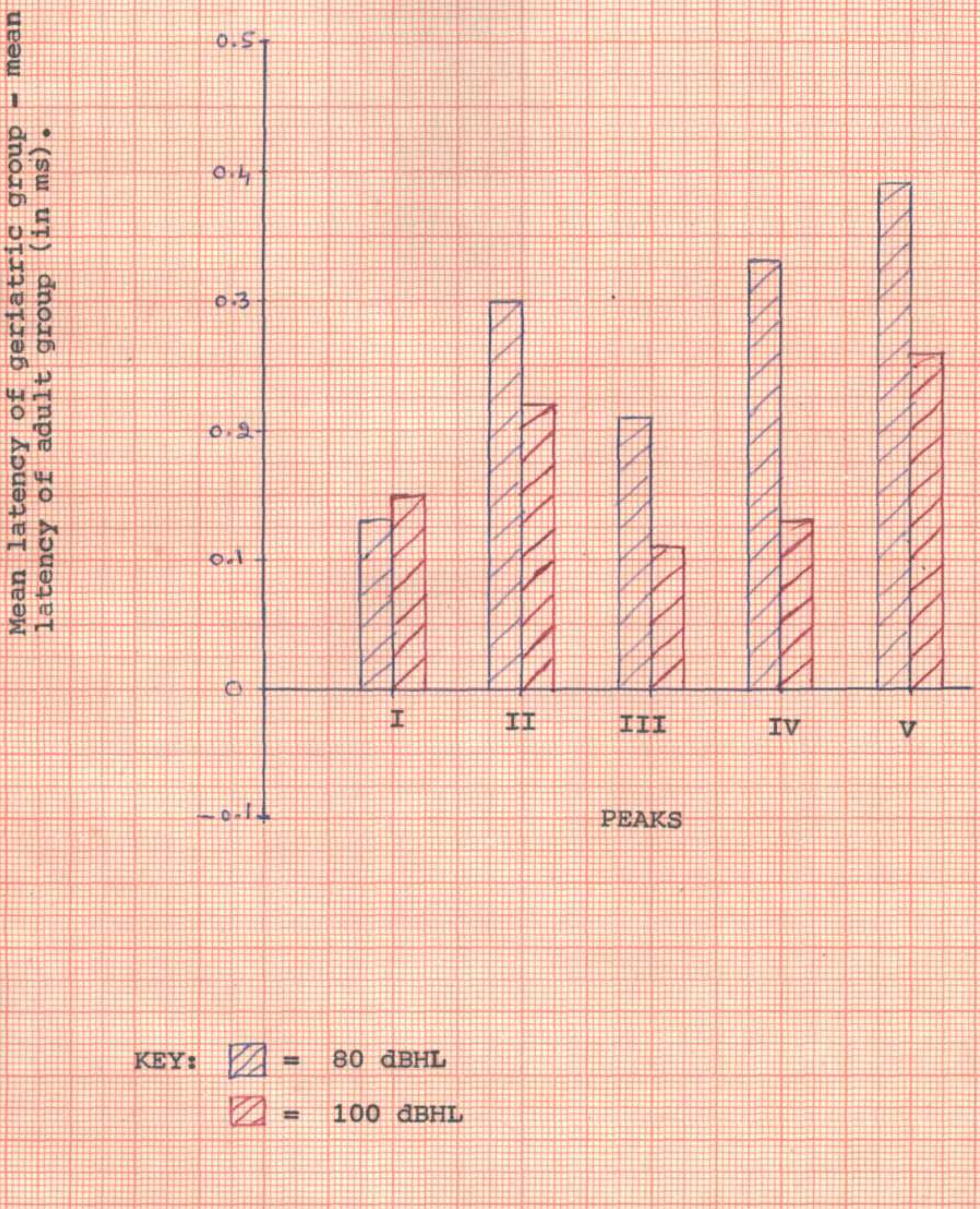
	ADULTS* (x)			GERIATRIC GROUP (x)		
PEAKS	80 db (1)	100 dB (2)	DIFFERENCE (1-2)	80 dB (1)	100 dB (2)	DIFFERENCE (1-2)
I	1.33	1.08	0.25	1.50	1.25	0.25
II	2.21	2.07	0.14	2.63	2.31	0.32
III	3.40	3.15	0.25	3.61	3.33	0.28
IV	4.60	4.41	0.21	4.86	4.60	0.26
V	5.18	4.88	0.30	5.57	5.20	0.37

*Adult norms from GEETHA HERLEKAR (1985).

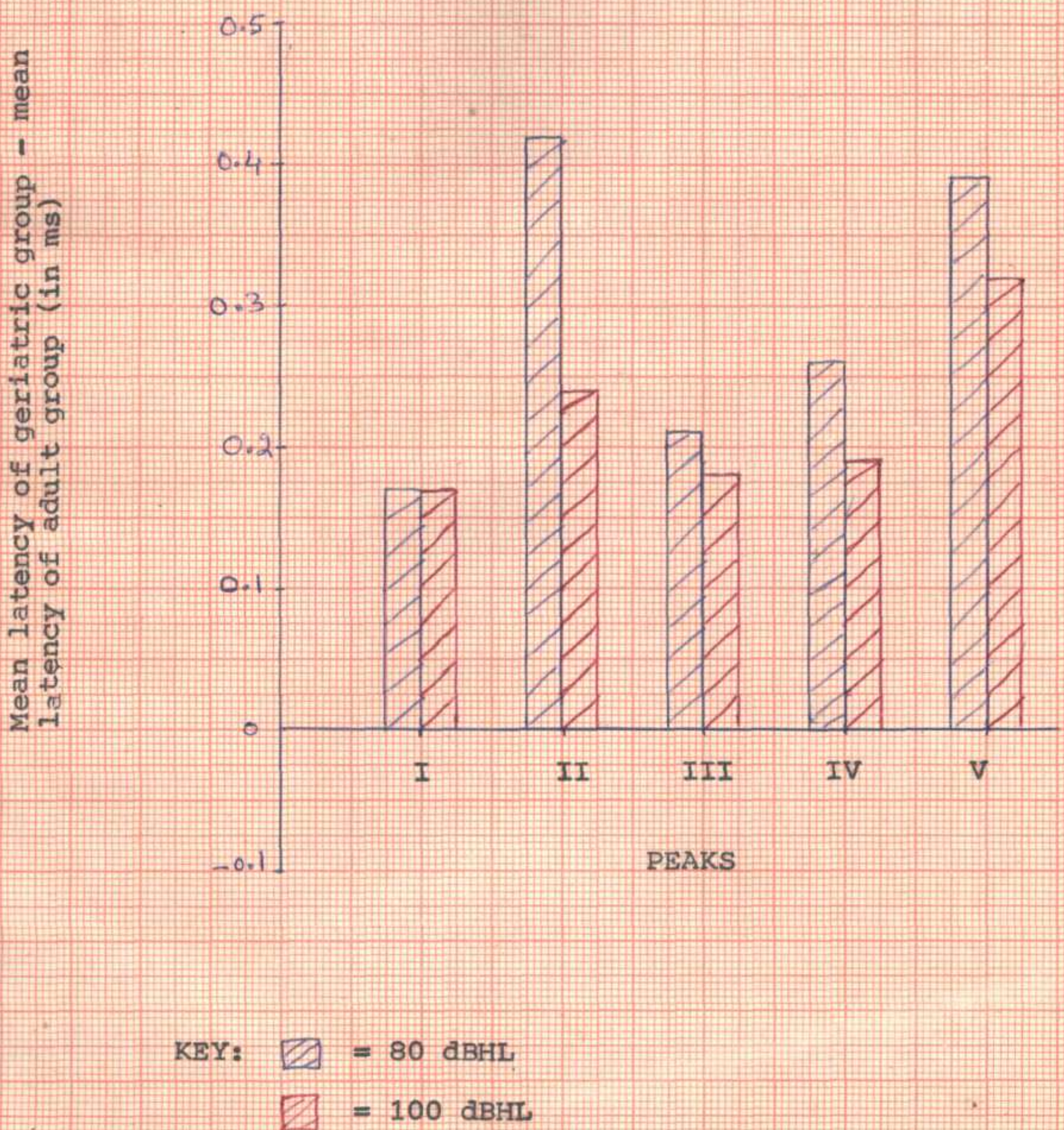
Graph 1: Mean difference in latency between adult and geriatric group: at 2 KHz.



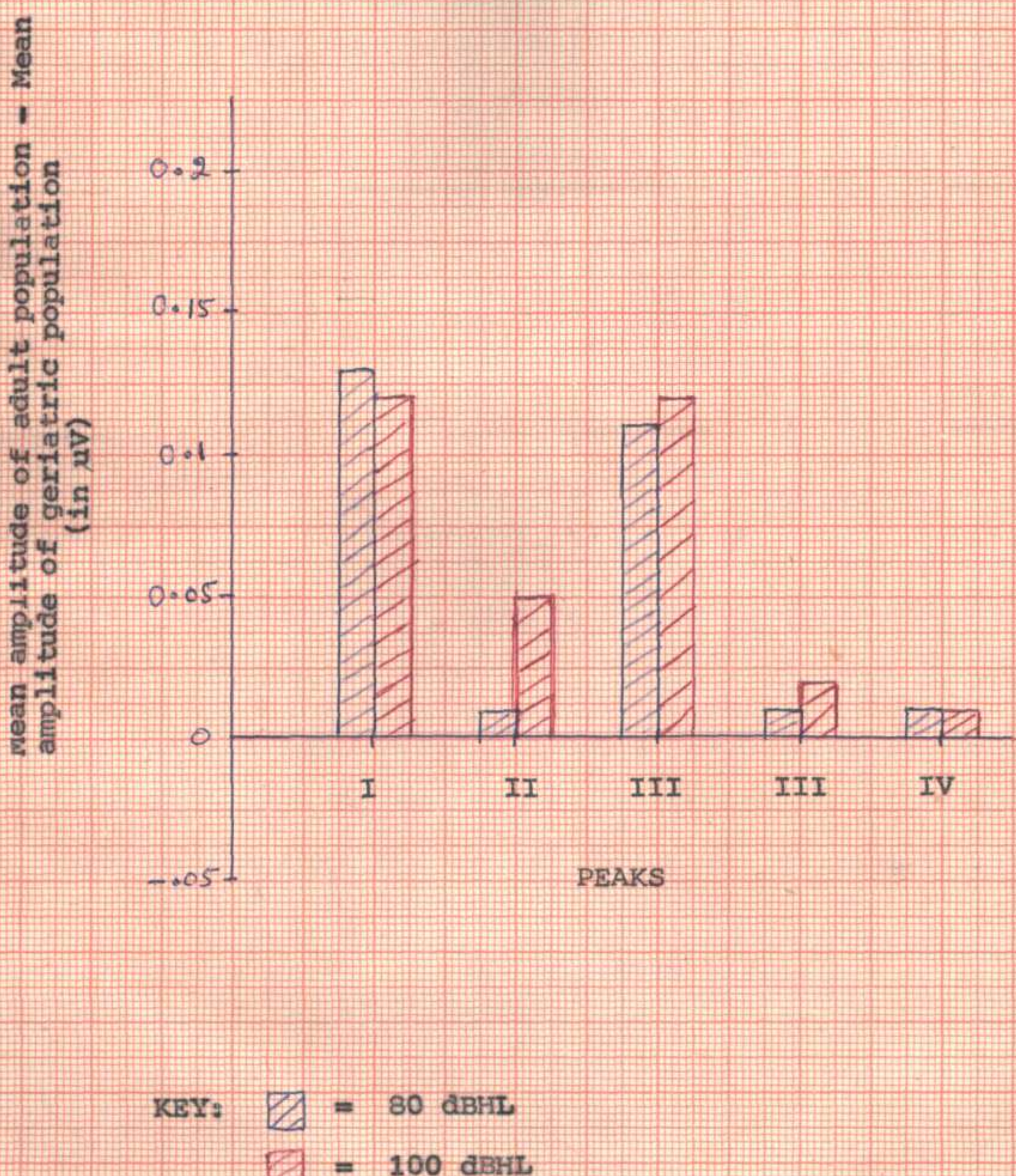
Graph 2: Mean difference in latency between adult & geriatric groups : at 4 KHz.



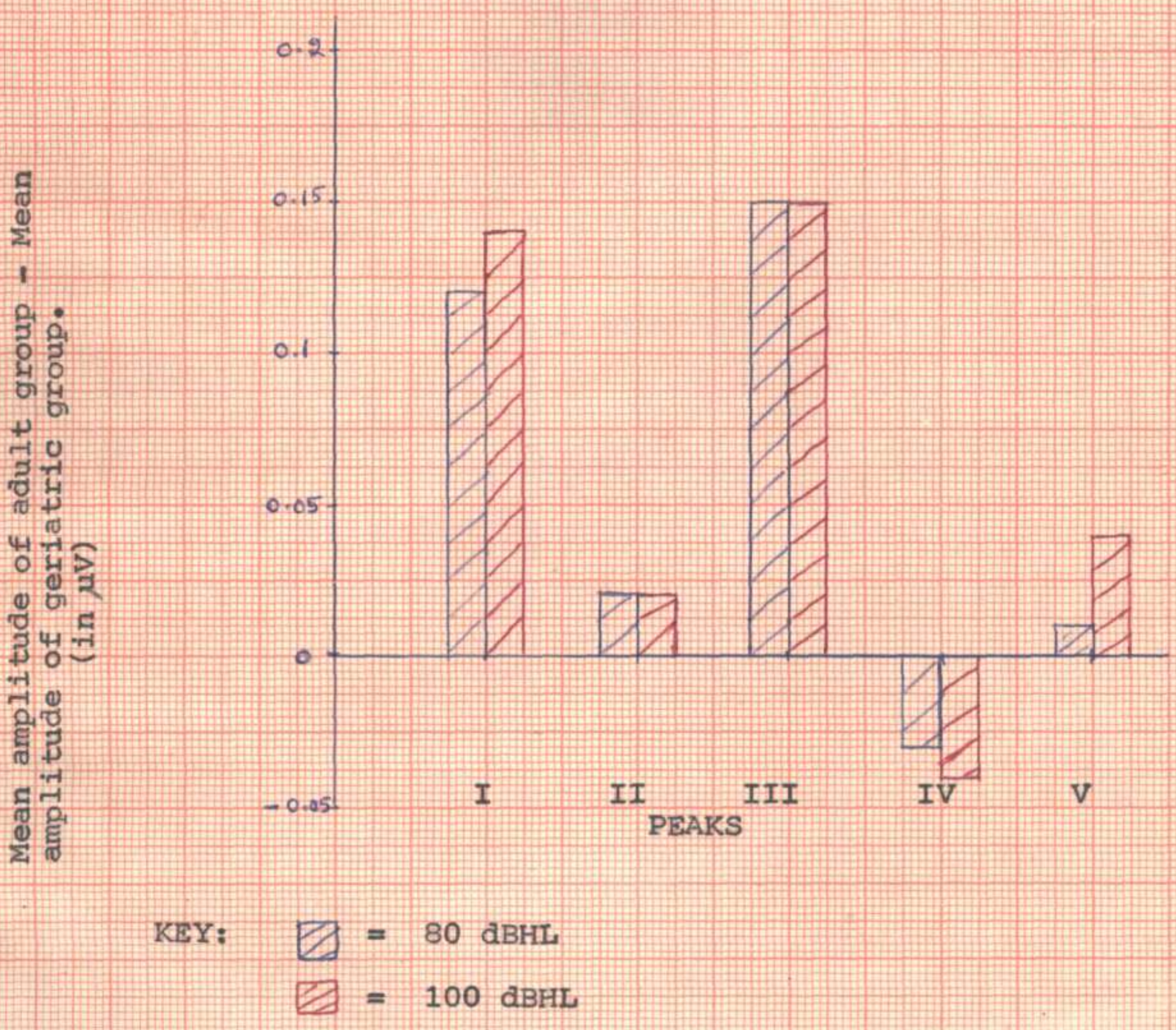
Graph 3: Mean difference in latency between adult & geriatric groups: at 6 KHz.



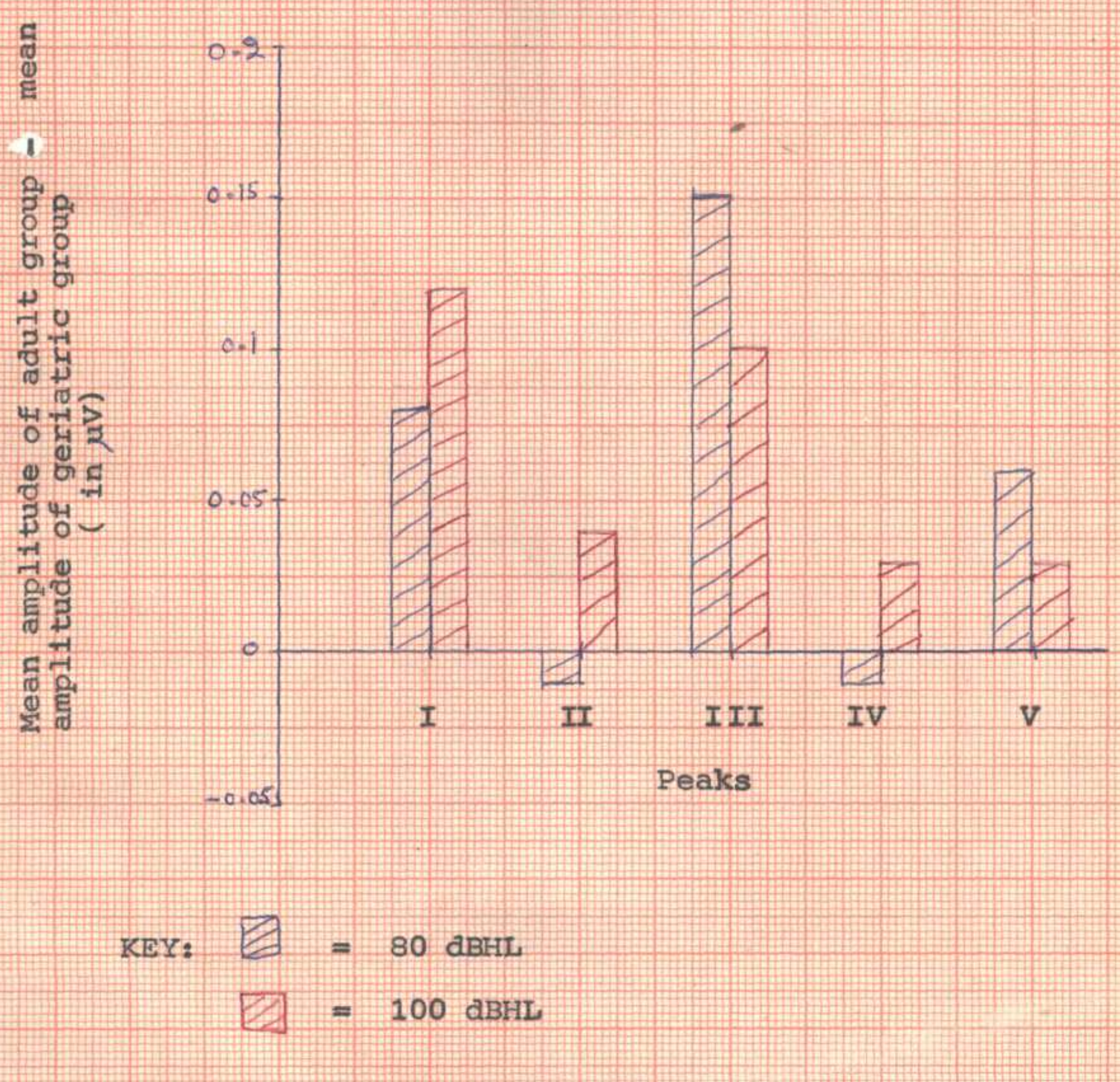
Graph 4: MEAN DIFFERENCE IN AMPLITUDE
BETWEEN ADULT & GERIATRIC
GROUP: at 2 KHz.



Graph 5: MEAN DIFFERENCE IN AMPLITUDE BETWEEN ADULT AND GERIATRIC GROUPS: at 4 KHz.



GRAPH 6: MEAN DIFFERENCE IN AMPLITUDE BETWEEN ADULT & GERIATRIC GROUPS: at 6 KHz.



C H A P T E R - V.

SUMMARY AND CONCLUSION

The present study was conducted to examine the changes in latencies and amplitudes in the geriatric population with nearly normal hearing.

Ten subjects (7 males and 3 females) with age ranging from 52 to 71 years (Mean 57.15 yrs) were taken for the present study. Their hearing thresholds were determined (less than 30 dB) using BELTONE 200-C Audiometer. These subjects were tested for brain stem evoked responses (BSER) using ERA model TA-1000 at 80 and 100 dBHL logon stimuli for 2, 4, and 6 KHz in RIGHT ear for 2048 samples at the rate of 20 stimuli/seconds.

The latency (in ms) and amplitude (in µV) of each identifiable wave (I through V) were obtained for all the subjects.

The latencies and amplitudes of wave I through V were noted down from the graphic, display for BSER. The amplitude of BSER was determined for a particular wave from the crest to the following through by means of graph scale using the formula $\frac{TS}{M}$.

The data obtained were analysed statistically to

C H A P T E R - V.

SUMMARY AND CONCLUSION

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Ten subjects (7 males and 3 females) with age ranging from 52 to 71 years (Mean 57.15 yrs) were taken for the present study. Their hearing thresholds were determined (less than 30 dB) using BELTONE 200-C Audiometer. These subjects were tested for brain stem evoked responses (BSER) using ERA model TA-1000 at 80 and 100 dBHL logon stimuli for 2, 4, and 6 KHz in RIGHT ear for 2048 samples at the rate of 20 stimuli/seconds.

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__

M

The data obtained were analysed statistically to determine mean and standard deviation.

The data obtained for geriatric population was compared with that of normal adult population (GEETHA HERLEKAR, 1985).

All these studies were carried out in a sound treated room at Audiology Department, All India Institute of Speech and Hearing, Mysore.

From the results obtained the following conclusions can be drawn.

1) There was increase in latency in all the five waves as the intensity of the stimulus was reduced from 100 to 80 dBHL. The increase in latency of all the five waves was greater than 0.2 m.sec. at 2,4, and 6 KHz when the stimulus was reduced from 100 to 80 dBHL.

2) The latency values obtained in the geriatic population are longer than those obtained in the adult population. The overall latency difference exceeds 0.1 m.sec.

3) More than 50% of the cases showed small (less than 0.2 µV) amplitude in geriatric group.

4) Amplitude values of I & III waves obtained in geriatric group were smaller than those obtained in the adult group (at both 80 & 100 dBHL levels).

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