Is the Hearing Threshold of Blind different from Normal Sighted Subjects

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Original Research Article

ABSTRACT

It is a common observation that when one sensory modality is lost or compromised other modalities improve in compensation as is true for tactile sensibilities of the blind persons which they use in their day to day activity. Hearing threshold of 25 male blind persons was assessed with aims to investigate whether hearing threshold of blind subjects was better than that of normal sighted subjectsby pure tone audiometry and was compared with that of 20 normal sighted subjects. The mean hearing threshold at frequency 250, 500, 1000, 2000, 4000 and 8000 Hertz was 16.5, 22.2, 17.4, 9.8, 13.8 and 16.3 in blind subjects and 15.13, 20.5, 16.13, 9.0, 10.25 and 12.0 in normal sighted subjects. Statistical analysis done by 't'-test showed no significant difference in the mean values of hearing threshold of the two groups. Although statistically there was no significant difference in the hearing threshold of the blind and the sighted, there is an increase in the hearing threshold of the both the groups. The cause could be rising levels of noise over the years. The loudness analysis is the function of the cochlea, thus this study tested the cochlear functions, which was not significantly different in the two groups. Individuals who become blind at an early life are better at localizing sounds than individuals with normal sight. Thus there could be significant difference in other auditory functions like discrimination of sound direction, pitch, tone, sequential sound patterns etc., which need to be studied.

KEY WORDS: audiometry, blind, decibels, hearing threshold

INTRODUCTION:

It is a time honoured belief that the other sensory modalities of the blind persons are better developed to compensate for their loss of vision. Their increased tactile sense is used in reading Braille and their daily routine activities. There have been literary and music gems who have been blinded early in life, Helen Keller, Keats and Steve wonders to name a few.

The Indian king Prithviraj Chauhan, a skilled archer had the capability of using 'Shabdbhedi Ban'. Muhammad Ghori blinded Prithviraj and challenged him to use his special capability and shoot the arrow at him. Prithviraj succeded in shooting him by using the verbal cues and hints given by his poet, Chandabardai. Now numerous evidences have accumulated on proving this fact of superior sound source localizing and echolocation abilities of the blind.[1,2,3] Studies have shown increased sound localizing capability in horizontal and vertical planes in blind persons Localization of the source of sound depends on the time lag between sound entry in the two ears and the difference of sound intensities in the two ears. Hence both normal ears are needed for it. Nilsson et al detected better echolocation in blind subjects by superior inter-aural level difference[2].

PET Scan have shown increased activity in the visual cortex of blind persons trying to localize sound[4]. Lore Thaler has widely studied echolocation in blind. Ecolocaters use mouth-clicks, finger snaps etc to emit sound and use echolocation like bats, making them more mobile and independent. In a study of fMRI in blind experts in echolocation it was observed that there was enhanced brain activity in visual cortex rather than auditory cortex[5]. Both types of studies thus show that brain plasticity and recruitment of visual cortical areas occurs for sound processing.

Intensive search has not revealed any study on audiometric assessment of the blind in comparison to the normally sighted subjects. However, a study on loudness perception by blind through loudness contours constructed by loudness perception

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concluded that it appears doubtful that any physiological differences exist between the blind and the sighted[6].

Thus this study is one of its own kind where we have tested and compared the audiometric study of blind and sighted subjects.

MATERIALS AND METHODS:

The study group comprised of 25 blind males in the age group between 15 and 25 years selected from a blind school in Bhopal. The control group comprised of 20 normal sighted males between the age group 18 and 21. The study was conducted under Department of Physiology, Gandhi Medical College, Bhopal. 42 blind and 22 sighted subjects were examined. They were screened to exclude all causes, which could have damaged their hearing by exhaustive history taking and clinical examination. History was taken regarding otalgia, ottorhoea, decreased hearing, tinnitus, vertigo, abnormal auditory perception and injury. Then both the ears were examined with an otoscope. Those with visible ear pathology were rejected. Those with wax were instilled Waxolve eardrops. The ear was cleaned and allowed to dry. Tunning fork tests were done using tunning fork of frequency 256 Hz. Individuals with Rinne's negative were rejected. Thus those selected for the study were individuals with clinically normal ears and presumably normal hearing. Thus 17 blind and 2 normal sighted subjects were rejected on the basis of impaired hearing.

Pure tone audiometry of the selected subjects i.e. 25 blind and 20 sighted subjects was done using 'Diagnostic Audiometer ELKON EDA-3N3'. The study was carried out in an acoustically treated room which was sound proof and noise free. The room had non vibrating surfaces. The subjects were seated comfortably in the room and were familiarized with the test procedure .

Pure tones at frequencies 250, 500, 1000, 2000, 4000 & 8000 Hertz were presented to the subject and their air conduction hearing threshold was recorded according to the standard procedure. First an intensity level well above the hearing threshold was chosen and the subject was instructed to respond with the help of patient response switch, when the sound signal was heard. The sound signal was then reduced in steps of 10 decibels until there was no response. It was then increased in steps of 5 decibel until the sound signal was heard. This was recorded as the threshold for hearing. The test was started by the better hearing ear (as related by the subject) in the following order: 1000, 2000, 4000, 8000, 500 and 250 Hz. The other ear was then tested. Care was taken not to give any visible or tactile clues to the patient, which would suggest the presentation of an auditory stimulus or change in hearing level or frequency control.

t – test was performed to compare the mean and modal values of hearing threshold of the blind and the sighted.

RESULTS:

The mean hearing threshold at frequency 250, 500, 1000, 2000, 4000 and 8000 Hertz was 16.5, 22.2, 17.4, 9.8, 13.8 and 16.3 in blind subjects and 15.13, 20.5, 16.13, 9.0, 10.25 and 12.0 in normal sighted subjects respectively. Statistical analysis was done by 't' test. The mean values of hearing threshold at different frequencies of blind and sighted was not significantly different (p >2).

Table 1: Comparison of mean of hearing threshold of blind and sighted.

Frequency (Hertz)	Mean of hearing threshold of blind (decibel) (n1 = 50)	Mean of hearing threshold of sighted (decibel) (n2 = 40)
250	16.5	15.13
500	22.20	20.50
1000	17.4	16.13
2000	9.8	9.0
4000	13.8	10.25
8000	16.3	12.0

n1 = Number of ears of the blind subjects
n2 = Number of ears of the sighted subjects

Table 2 : Comparison of modal value of hearing threshold of blind and sighted.

Frequency	Mode of hearing threshold of blind (decibel) n1 = 50	Mode of hearing threshold of sighted (decibel) n1 = 40
250	20	20
500	25	25
1000	20	15
2000	0	0
4000	15	0
8000	20	0

n1 = Number of ears of the blind subjects
n2 = Number of ears of the sighted subjects

Table 3: Comparison of mean of hearing threshold in right and left ear of blind and sighted.

Frequency	Right ear of blind (n1R)	Left ear of blind (n1L)	Right ear of sighted (n2R)	Left ear of sighted (n2L)
250	15.5	17.60	11.25	8.05
500	20.4	23.75	10.89	10.35
1000	16.4	18.40	10.56	10.18
2000	7.2	12.40	7.92	8.67
4000	12.6	15.00	10.62	10.80
8000	13.6	18.20	12.37	11.89

n1R = 25; n1L = 25; n2R = 20; n2L = 20

DISCUSSION:

In our study statistically there was no significant difference in the hearing threshold of the blind and the sighted. The comparison of the mean values of the present study with those of Wheeler and Dickson's Study (1952) reveals a higher threshold amongst both blind and sighted persons in the present study, except at frequency 250 Hertz[7]. The cause could be rising levels of noise over the years.

Earlier Studies show conflicting results. Helen et al[8] reported that the pure tone hearing threshold of the blind and sighted subjects were comparable and within normal limits, whereas Hsin His Lai reported that the average pure tone threshold of the blind were higher than that of the sighted reaching the level of significance[9]. The results of primary auditory abilities by Curtis and Winer indicated that expert travellers exhibit an increased sensitivity to differences in intensity as compared with the normal sighted and home bound blind travellers[10].

Individual who become blind at an early life are better at localizing sounds than individuals with normal sight. Detection thresholds showed that blind participants could detect the object at longer distances, similarly auditory obstacle sense has been demonstrated in blind but normal sighted blindfolded subjects can learn the same with practice. Some sighted individuals can be trained in echolocation to a level of precision that approaches that of early blind expert echolocators[11]. Evaluation of interaural time differences for directional hearing and acoustic reflex thresholds showed no differences between the blind and sighted[12,13]. Testing the spatial hearing abilities of blind and sighted individuals, Ashmead et al found blind subjects only marginally better than the sighted. Thus there is a difference between having better hearing, and using auditory information more effectively, which some blind people do to an extraordinary degree[14].

Still Blind subjects are superior in a variety of auditory tasks viz. speech discrimination in noise, pitch discrimination, auditory long and short term memory but not in intensity discrimination and auditory reflex threshold. Blind may be equal or even superior to the sighted when performing spatial tasks within the body space, they may be deficient, either developmentally or absolutely, in tasks which involve events at a distance from the body, principally in auditory localization[15].

The loudness analysis is the function of the cochlea and is by temporal and spatial summation by increasing the rate of firing of the hair cells and an increase in the number of hair cells being stimulated. Thus this study tested the cochlear function which was not significantly different in the two groups. Our study is in agreement with most of the earlier studies assessing more peripheral functions which found no significant differences between blind and sighted subjects in varied tasks such as loudness perception and hearing thresholds[10,12,13]. However, the results of a variety of tests attempting to assess central auditory functioning more often than not show a superiority of functioning for the blind subjects. For example, the blind perform better than sighted subjects do in a variety of dichotic and speech discrimination tests [12,13,16], have decreased N1 latencies[12,13] and decreased P1 latencies[17] on brain stem auditory evoked response(BAEP), steeper response gradients[18] and better gap detection[16].

PET scanning documents plasticity in the cortex, eg. tactile and auditory stimuli increase metabolic activity in the visual cortex of the blind individuals.[19] Gougoux et al in their PET study reported that those blind persons who perform better than sighted persons recruit occipital areas to carry out auditory localization under monaural conditions.[20]

Thus there could be significant difference in other auditory functions like discrimination of sound pitch, tone, sequential sound patterns etc., which need to be tested.

Since in this study the hearing threshold was tested for frequencies from 250 to 8000 Hertz, there is scope for comparison over a wider range of frequencies. Zachariae and Wurtman reported that blindness was found to be associated with acceleration of menarche[21]. Magee et al compared two groups of girls one with minimal or no light perception and other with shadow vision and guiding sight[22]. They found statically significant difference in the two groups with the former group reaching menarche earlier. Thus again there is a need to study the blind in two groups, one with light perception and the other without light perception.

Ahmed et al found significant hearing loss in blind persons mostly due to conductive deafness. In our study we also found hearing impairment in 17 subjects out of 42 examined[23].

CONCLUSION:

The observations of this study did not find any significant difference in the hearing threshold of the blind and the normal sighted. Since the blind persons have to rely on other sensory faculties for their interaction with the environment and hearing ability is the most important mechanism employed, it is important to preserve their hearing with utmost care and caution.

LIMITATION OF THE STUDY:

Inter group and Intra group comparison of the blind subjects could not be done due to limited case availability as per research protocol and constraint of resources.

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Cite this article as: Gumashta J, Gumashta R, Kaul A: Is the Hearing Threshold of Blind different from Normal Sighted Subjects. PJSR ;2018:11(1):12-16.
Source of Support : Nil, Conflict of Interest: None declared.