AUDIOMETRY STUDY IN BLIND AND NORMAL SIGHTED INDIVIDUAL

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Background and Objectives: According to Cross Modal Plasticity theory, the blind people in order to compensate their blindness use their other senses and as a result they develop their hearing, taste, touch and smell senses. Indeed, many studies have confirmed that blind persons have superior abilities for non-visual perceptual tasks, such as pitch-change direction discrimination verbal memory, speech discrimination sound localization or tactile discrimination. **Methodology**: The study was carried out in 50 healthy sighted volunteers and 50 congenital blind subjects. Audiometric testing was conducted in dedicated room that met the audiometer manufacturer's specifications. The exact hearing threshold was obtained when one gets at least 3 out of five responses correct. For Simple Audiometry reaction time**,** Time taken between hearing of sound and pressing of spacebar was recorded. **Result:** Hearing threshold at each frequency was lower in both ear among blind subjects as compared to sighted subjects and it was statically significant. Nearly half of blind subjects (24, 48% and 23, 46%) were able to hear sound at 10 to 15.9 for 250 Hz, 26 to 29.9 for 500 Hz respectively. Auditory reaction times in blind subjects was 28 msec faster as compare to sighted individuals. **Conclusion**: Based on our study, we concluded that hearing threshold and auditory reaction time was lower for congenitally blinds compared to sighted controls.

Key Words: Hearing threshold, Auditory reaction times

Abbreviation: ATR - Auditory reaction times, PTA - Pure tone Audiometry

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Introduction:

Pure tone Audiometry (PTA) is the most commonly used hearing test to identify hearing threshold levels, and also determine the degree, type and configuration of a hearing loss. Thus, providing the basis for diagnosis and management. PTA is a subjective method for measurement of hearing threshold, as it relies on patient response to pure tone stimuli[1].

According to Cross Modal Plasticity theory, the blind people compensate their blindness by using their other senses and they develop their hearing, touch, taste and smell senses. In 2007, the Belgian police recruited blind people as detectives because of superior auditory skills. The blind detectives segregate individual voices when listening to a large mixture of sounds and voices of a number of people very precisely [2]. Many studies have reported that blind persons have superior abilities for non-visual perceptual tasks, such as pitch-change direction discrimination, speech discrimination, verbal memory, sound localization or tactile discrimination [3].

In order to review its impact on auditory compensation in blind, we conducted this study to compare threshold of hearing at different frequency and auditory reaction time between congenitally blind subjects and sighted control subjects.

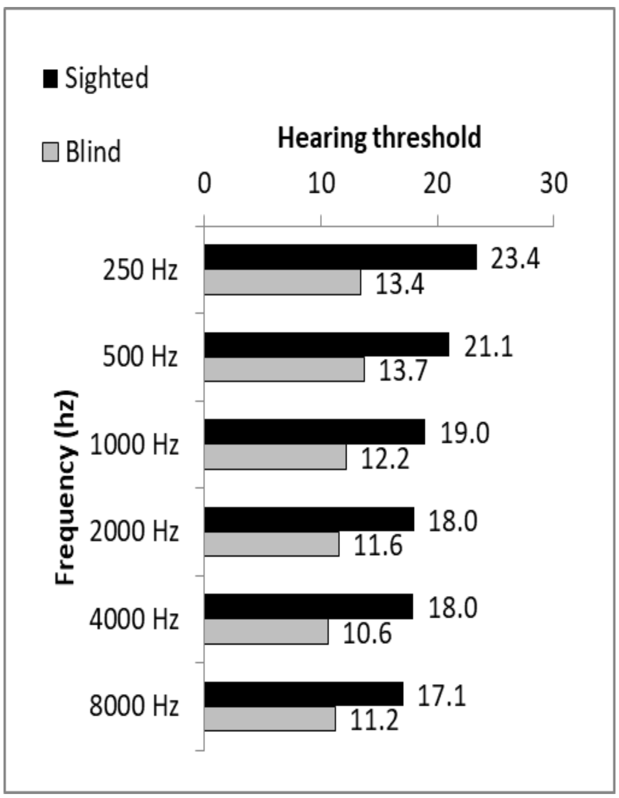
Material and Methods:

The study was carried out in 50 healthy sighted volunteers and 50 congenital blind subjects from Physiotherapy college of blind, Navarangpura, Ahmedabad. All 100 subjects underwent a pure tone audiometry (PTA) after taking consent. Audiometer used was Proton Sx-3. Audiometric testing was conducted in dedicated room that met the audiometer manufacturer's specifications. The examiner first familiarizes the subject with the tone by delivering the sound at an arbitrarily presumed supra-threshold level of testing frequency. When the subject hears the tone, the tone is reduced by 10 dB till subject stops hearing or fails to give a response. Once this stage is reached the tone raised by 5 dB. If the subject hears this tone, the sound is again decreased by 10 dB. If he does not hear it, the tone was again raised by 5 dB. In this way by several threshold crossings (between 10-110 dB).The exact hearing threshold was obtained when one gets at least 3 out of five responses correct. For Simple Audiometry reaction time**,** A 3000 Hz of 90 db was presented randomly through headset provided to them. Time taken between hearing of sound and pressing of spacebar was recorded. Initial10 reaction time were provided for practice and last 10 reaction times records were included in study. Subjects having smoking habits, diabetes mellitus, hypertension, ear drum perforation, acute or chronic suppurative otitis media, wax and suffering from ear diseases were excluded from the study.

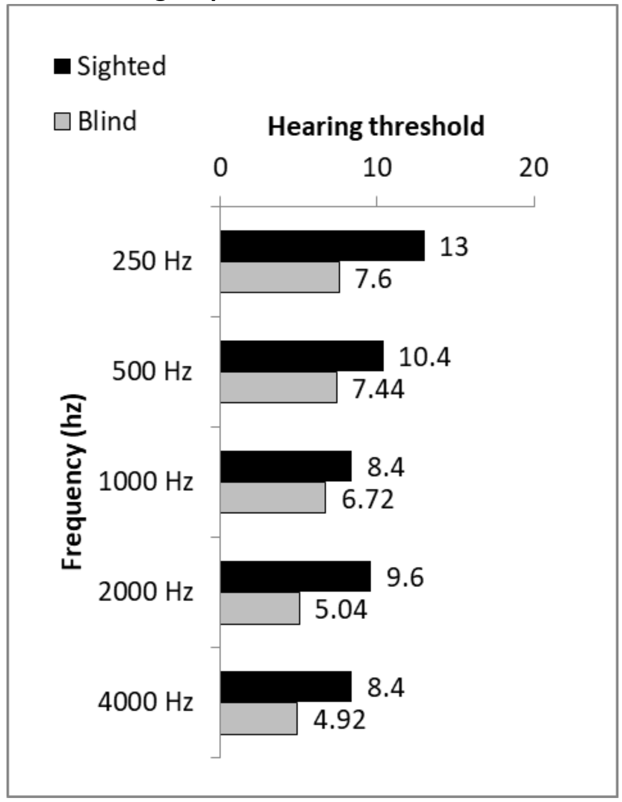
Statistical analysis: The data was entered in "Microsoft Excel" and analyzed using the Epi info 7. The collected audiometry data was analyzed by using Z test and Chi-square (X2). The values were expressed as mean ± SD. P-value of less than 0.05 was taken as significant.

Result: Age and gender matched subjects were included in the study in which mean age in blind and sighted is 20 ± 1.7 years. There were 30 (60%) male and 20 (40%) female in both groups. The height, body weight and BMI in both groups were comparable (p > 0.05).

Graph 1: Average hearing threshold of right ear at different frequencies for Air conduction in study and control groups



Graph 2: Average hearing threshold of right ear at different frequencies for Bone conduction in study and control groups



Hearing threshold for air conduction and bone conduction at each frequency was lower in right ear among blind subjects as compared to sighted subjects and it was statically significant (p value < 0.05). Same result was observed in left ear.

Table 1: Comparison of intensity of sound of Air conduction in Right ear at each frequency among study population

Intensity of Sound		0 to 5.9	6 to 9.9	10 to 15.9	16 to 19.9	20 to 25.9	26 to 29.9	X^2 * (p value)
250 Hz	Sighted	0 (0.0)	0 (0.0)	2 (4.0)	2 (4.0)	13 (26.0)	33 (66.0)	73 <0.001
	Blind	0 (0.0)	0 (0.0)	24 (48.	22 (44.	4 (8.0)	0 (0.	

				0)	0)		0)	
500 Hz	Sighted	0 (0.0)	0 (0.0)	0 (0.0)	6 (12.0)	31 (62.0)	13 (26.0)	56.2 <0.001
	Blind	0 (0.0)	2 (4.0)	21 (42.0)	19 (38.0)	8 (16.0)	0 (0.0)	
1000 Hz	Sighted	0 (0.0)	0 (0.0)	4 (8.0)	13 (26.0)	26 (52.0)	7 (14.0)	54.5 <0.001
	Blind	0 (0.0)	4 (8.0)	25 (50.0)	21 (42.0)	0 (0.0)	0 (0.0)	
2000 Hz	Sighted	0 (0.0)	0 (0.0)	6 (12.0)	16 (32.0)	24 (48.0)	4 (8.0)	36.4 <0.001
	Blind	0 (0.0)	12 (24.0)	20 (40.0)	13 (26.0)	5 (10.0)	0 (0.0)	
4000 Hz	Sighted	0 (0.0)	0 (0.0)	6 (12.0)	15 (30.0)	26 (52.0)	3 (6..0)	54.3 <0.001
	Blind	0 (0.0)	16 (32.0)	23 (46.0)	8 (16.0)	3 (6.0)	0 (0.0)	
8000 Hz	Sighted	0 (0.0)	0 (0.0)	8 (16.0)	21 (42.0)	18 (36.0)	3 (6.0)	35.6 <0.001
	Blind	2 (4.0)	8 (16.0)	24 (48.0)	11 (22.0)	5 (10.0)	0 (0.0)	

Nearly half of blind subjects (24, 48%) were able to hear sound of 250 Hz at intensity of 10 to 15.9 db which was significantly higher than sighted subjects (33,66% subjects at 26 to 29.9 Hz). Nearly half of blind subjects (23, 46%), Hearing threshold for 500 Hz in right ear was between 6 to 15.9 dB which also significantly higher than sighted subjects (44, 88% at 20 to 29.9dB).

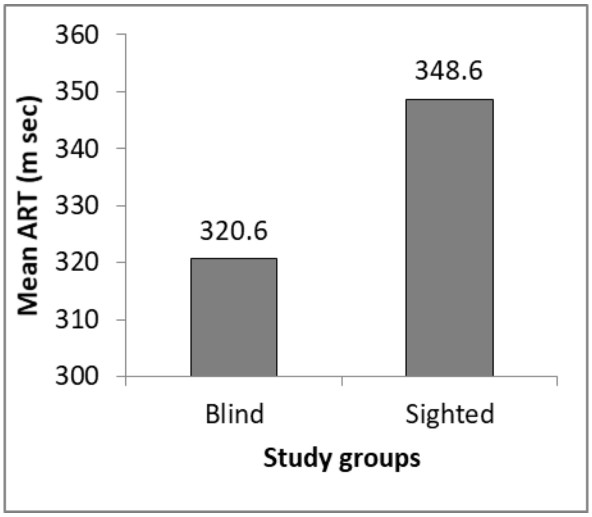
Table 2: Comparison of intensity of sound of Bone conduction in Right ear at each frequency among study population

Intensity of Sound		0 to 5.9	6 to 9.9	10 to 15.9	16 to 19.9	20 to 25.9	X^2 * (p value)
250 Hz	Sighted	2 (4.0)	0 (0.0)	21 (42.0)	25 (50.0)	2 (4.0)	59.0 < 0.0001
	Blind	0 (0.0)	30 (60.0)	20 (40.0)	0 (0.0)	0 (0.0)	
500 Hz	Sighted	0 (0.0)	4 (8.0)	40 (80.0)	6 (12.0)	0 (0.0)	26.4 < 0.0001
	Blind	4 (8.0)	22 (44.0)	24 (48.0)	0 (0.0)	0 (0.0)	
1000 Hz	Sighted	4 (8.0)	13 (26.0)	31 (62.0)	2 (4.0)	0 (0.0)	10.1 0.17
	Blind	6 (12.0)	26 (52.0)	18 (36.0)	0 (0.0)	0 (0.0)	
2000 Hz	Sighted	0 (0.0)	14 (28.0)	30 (60.0)	6 (12.0)	0 (0.0)	35.4 < 0.001
	Blind	14 (28.0)	27 (54.0)	9 (18.0)	0 (0.0)	0 (0.0)	
4000	Sighted	4 (8.0)	13 (26.0)	31 (62.0)	2 (4.0)	0 (0.0)	24.8 < 0.001

Hz	Blind	16 (32.0)	25 (50.0)	8 (16.0)	1 (2.0)	0 (0.0)	

*If more than 5% cell have expected count less than 5 than Chi square was calculated after adding yet correction or pooling of 2 or more cell count.

Graph 3: Mean ART for Blind and Sighted subjects



Above graph is revealing that congenital blind had faster reaction time (320.6 ± 60.6 milliseconds) than sighted control (348.6 ± 98.4) with significant value $p<0.05$

Discussion:

The present study was conducted among 50 healthy sighted volunteers and 50 congenital blind subjects. In our study, Hearing threshold for air conduction and bone conduction at each frequency was lower in both ear among blind subjects as compared to sighted subjects and it was statically significant. Nearly half of blind subjects (24, 48% and 23, 46%) were able to hear sound at 10 to 15.9 for 250 Hz, 26 to 29.9 for 500 Hz respectively. Total 29 (58%), 32 (64%) and 39 (78%) blind subjects were able to hear sound at 6 to 15.9 for 1000 Hz, 2000 Hz and 4000 Hz respectively and this hearing threshold was significantly lower than sighted subjects. Study conducted by Collignon O et al[4] shows that blind people have exceptional auditory processing abilities due to recruitment of occipital areas. Auditory reaction times in blind subjects was 28 msec faster as compare to sighted individuals. Mario Liotti group showed that reaction times in blind subjects was 91msec faster as compare to sighted individuals [5]. Though study conducted by John Bernard[6] showed insignificant reaction time between blind and sighted individuals.

Conclusion: Based on findings of pure tone audiometry and simple auditory reaction time, we concluded that hearing threshold and auditory reaction time was lower for congenitally blinds compared to sighted controls.

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