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Assessment of hearing threshold and noise induced hearing loss in people engaged in different occupations

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Abstract

Hearing threshold was assessed in subjects engaged in different occupations at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz, for left and right ear. The results revealed that the hearing threshold of truck drivers, auto drivers, traffic policeman, shop keepers, military personals, post office personals are significantly higher than the corresponding value for the normal subjects (persons not engaged in any particular profession). Among the different occupational categories, the truck drivers were found to have maximum hearing loss at higher frequencies which was followed by traffic police, army personals, auto drivers, shopkeepers and tailors.

Key words: *Noise, Occupation, Hearing threshold, Noise induced hearing loss.*

Introduction

Worldwide, noise pollution is an increasing problem and threatens to become particularly acute in developing world (Korfali and Massoud, 2003). The casual relationship between work place noise and hearing loss has been observed for centuries (Franks, 1988). In the developing countries like India, people generally do not follow the standards prescribed for noise exposure. Workers are forced to perform task in an environment having noise levels far greater than the recommended ones (Muzammil, *et al.,* 2004). Noise pollution affects health, comfort and efficiency of the workers. The most immediate and acute effect of noise to the workers is the impairment of hearing which diminished due to damage of auditory system (Madhuri, *et al.,* 2003). Noise Induced Hearing Loss (NIHL), are mainly attributed to the exposure to noise levels beyond the tolerance limit for longer than permissible time (Arutchelvan *et al.,* 2004). Depending on the exposure time loss of hearing ability may be temporary or permanent. Globally, some 120 million people are estimated to have suffered from disability hearing difficulties (WHO, 1999). Various countries of the world and international organizations have formulated ambient and occupational noise standards for safety of the workers. However, till today the problem of noise could not gather wide attention of the public and the authorities, compared to air, water and other pollutions, presumably due to insufficient study and lack of awareness among the general mass. The present study is an attempt to measure the hearing threshold level and to assess the noise induced hearing loss in people engaged in different occupations.

Methodology

A sample size of 94 subjects engaged in different occupations (namely, truck driving, auto driving, military, shop keeping, Post office employee, traffic police, tailors and persons without any particular profession (normal) was taken for the study. The selected subjects for the study were in the age group of 30-55 years and had no past records of hearing disabilities and were continuously in the same profession for more than 15 years when the test was conducted. For each subject, hearing threshold (*HT*) was measured separately for left and right ear in the frequency range of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000

Hz and 8000 Hz. A portable audiometer (Arphii, 500 MK IS) was used for the study. Information about the age, occupation, working hours and medical history of each subject, was also obtained by filling up a questionnaire designed for this purpose. The data pertaining to the hearing threshold level of the subjects thus obtained was stored into a personal computer and analyzed with the help of statistical tools provided within the software SPSS.

Results and Discussion

The results of the study indicated that the hearing threshold level of the subjects varies widely with respect to (i) occupation engaged, (ii) the frequency of clear tone exposed and (iii) the individual ear exposed (whether left or right) of the subject (Table 1). The average hearing thresholds of subjects engaged in the various occupations were found to be consistently higher for all the tested frequency ranges compared to that of the normal subjects. The recorded average *HT* of the left ear at the frequency range of 1000 Hz for the persons involved in truck driving, auto driving, military, shop keeping, post office employee, traffic police and tailoring by profession respectively, were 31.88, 31.11, 22.11, 30.63, 30.00, 28.75 and 28.33 dB, whereas the corresponding value was 22.00 dB for a normal person. Among the different occupations categories, the truck drivers are found to have maximum hearing loss at higher frequencies that are followed by traffic police, army personals, auto drivers, shopkeepers and tailors. This higher hearing loss among the truck drivers might have been attributed to the long working hours under high level noise. Prolonged exposure to noise levels above 85 dBA can damage inner ear cells and lead to hearing loss. At first, hearing loss is usually temporary and recovery takes place over a few days. After further exposure, people may not fully recover their initial level of hearing causing deafness (Korfali and Massoud, 2003). All the truck drivers were in the same occupation for more than 15 years. Noise induced hearing loss typically affect the higher frequencies first. Melnick (1979) reported that usually the permanent threshold shift occurred at 4000 Hz and it becomes more pronounced at this frequency. With further increase in the noise exposure duration the hearing loss spread over a wide frequency range extending to 500, 1000, 2000 and 8000 Hz (Pondhe, *et al.,* 1998). If the average hearing level at 500, 1000 and 2000 Hz exceeds 25 dB, it is indicative of hearing loss, *i.e.* Noise induced deafness (Madhusudan , 1991). In the current study, it was found that the hearing threshold of the normal people was below 25 dB in all the frequencies tested for both the ears except at the 4000 Hz where the left ear HT was recorded 27.00 dB. This showed that among the normal people the hearing threshold shift is negligible. In contrast, people in occupation under high level noise environment have higher hearing threshold shift, crossing 25 dB. The average hearing thresholds among the military personals were within 25 dB in the lower frequency ranges (250 – 2000 Hz). This might be attributed to the comparatively noise free working environment in the army. In all the subjects tested the hearing threshold shift was found to be larger in the higher frequencies (4000 and 8000 Hz), but the shift was larger among the people with truck driving by profession followed by the post office employee. The recorded average hearing threshold of the truck drivers at the frequency range of 8000 Hz was 51.88 dB for the left ear and 50.00 dB for the right ear and is the highest hearing loss recorded among the subjects under study.The correlation matrix of hearing threshold levels at different frequencies for the left and right ear of the total number of subjects are illustrated in the Figure 1. It can be inferred from the figures that the correlation coefficient between hearing threshold level at neighbouring frequencies was much higher in comparison to the frequencies which were very different from each other. The pattern observed in these figures confirms the fact that specific hearing cells are present in different areas of the cochlea (inner ear) for different frequencies. This, in other words, means that the hearing cells corresponding to neighbouring frequencies occur

adjacent to each other in the cochlea. On the other hand, the hearing cells corresponding to frequencies that are wide apart occur in distant and distinct areas of the inner ear. Hence, the more is the difference in the frequencies the less will be the correlation between the hearing thresholds at those frequencies. The correlation coefficient between the hearing threshold level of left and right ear at different frequencies is shown in Table 2. On comparing the figures in the table it can be clearly seen that the correlation coefficients between the hearing thresholds of the same ear at two given frequencies are relatively higher in comparison to that between the hearing thresholds of different ears in the same two frequencies. This can possibly be explained on the basis of subtle difference in the noise environment to which the left and right ear of the subjects was exposed.

Suggestions to abate noise

During the course of the study it had been observed the *HT* for all the occupational categories exceeds 25 dB almost in all the frequency ranges tested. Hence, precaution and protection measures to reduce noise exposure become inevitable. Some of the suggestions that could reduce noise level are: (i) In working places such as shops, offices and cloth tailors the noise from the adjoining street can be minimize by constructing enclosures, shields and barriers. (ii) Treatment of working rooms with suitable sound absorbing materials such as acoustical tiles, perforated plywood on walls, *etc*. (iii) The noise exposed to the truck/auto drivers and traffic police includes honking of horns, vehicle body rattling and faulty designed silencers. Possible options to reduce the noise include maintenance of roads and vehicle and proper traffic management. (iv) Use of protective devices such as muffs and earplugs should be encouraged to the traffic policeman, truck/auto drivers and the military personals in the firing range. (v)

Workers should have periodic audiometric tests to check the effectiveness of the noise controls.

Conclusion

From the results of the current study the following three conclusions can be safely drawn: (i) the correlation coefficient between hearing threshold level at neighbouring frequencies was much higher in comparison to the frequencies which were very different from each other. (ii) the correlation coefficient between the hearing threshold of the same ear was relatively higher in comparison to that between the hearing threshold of different ears at any two frequencies and (iii) with regards to occupation, the hearing threshold of subjects engaged in different occupation are significantly higher than the corresponding values of the normal subjects. Among the different occupation categories the maximum hearing loss at higher frequencies was found to be in truck drivers. An attempt was also made to explain the *HT* level on the basis of occupation and other parameters influencing the subjects hearing but the model was discarded since its explanatory power was not found to be good enough for the predictive purposes. This indicates that exposure to noise pollution was just one of the factors which effects the hearing capability of the subjects. There may be a number of other factors, which were not explored in the present study, but may be responsible for the overall *HT* of the subjects. Therefore there is need of further studies before coming to a logical conclusion.

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Table 1. Average *HT* for the left and right ears in subjects from different occupations

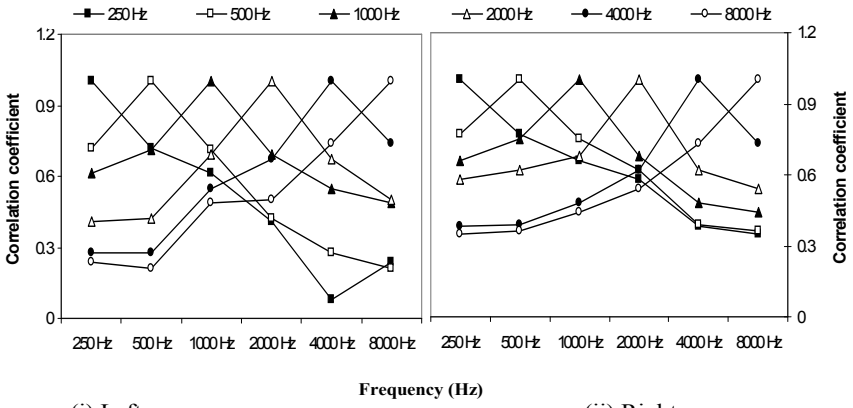
OCCUPATION		Average hearing threshold (dB) at					
		250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
NORMAL	LHT	13.00	13.00	22.00	13.00	27.00	24.00
	RHT	16.00	15.00	23.00	11.00	24.00	22.00
TRUCK DRIVERS	LHT	28.13	26.88	31.88	30.26	45.63	51.88
	RHT	30.63	33.13	36.25	31.25	46.25	50.00
AUTO DRIVERS	LHT	29.44	32.22	31.11	19.47	32.22	34.44
	RHT	36.11	33.89	38.89	23.89	36.67	30.00
MILITARY PERSONELS	LHT	22.25	20.56	22.11	17.22	29.06	35.00
	RHT	25.56	21.30	26.94	18.89	37.78	36.39
SHOP KEEPERS	LHT	29.06	27.81	30.63	21.25	29.38	36.39
	RHT	31.88	29.06	35.31	21.56	31.25	34.38
POST OFFICE EMPLOYEE	LHT	32.50	28.75	30.00	28.75	38 .75	40.00
	RHT	32.50	27.50	35.00	30.00	48.75	36.25
TRAFFIC POLICE	LHT	29.36	27.50	28.75	30.63	36.80	42.50
	RHT	35.00	31.25	36.25	23.13	40.63	40.63
TAILORS	LHT	28.33	23.33	28.33	18.13	26.67	22.50
	RHT	31.67	28.34	31.67	19.17	31.67	26.67

Table 2. Correlation between *HT* of the left and right ear at different frequencies

		RIGHT EAR					
		250 Hz	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**
LEFT EAR	**250 Hz**	0.540 (0.000)	0.570 (0.000)	0.440 (0.000)	0.460 (0.000)	0.270 (0.009)	0.280 (0.035)
	500 Hz	0.520 (0.000)	0.565 (0.000)	0.430 (0.000)	0.430 (0.000)	0.160 (0.133)	0.075 (0.473)
	1000 Hz	0.460 (0.000)	0.555 (0.000)	0.634 (0.000)	0.570 (0.000)	0.270 (0.009)	0.330 (0.001)
	2000 Hz	0.390 (0.000)	0.330 (0.001)	0.440 (0.000)	0.640 (0.000)	0.380 (0.000)	0.410 (0.000)
	4000 Hz	0.290 (0.005)	0.310 (0.002)	0.480 (0.000)	0.550 (0.000)	0.550 (0.000)	0.630 (0.000)
	8000 Hz	0.280 (0.007)	0.270 (0.008)	0.400 (0.000)	0.410 (0.000)	0.500 (0.009)	0.710 (0.000)

**Figures in the numerator represent the correlation coefficient; **Figures in the denominator represent the significant levels of the corresponding correlation coefficient.*

Figure 1. Correlation between the *HT* of individual ear at different frequencies



(i) Left ear (ii) Right ear