Original Article

A study of hearing function in power-loom workers

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Abstract

Context: Continuous noise exposure damages the delicate Organ of Corti, the hearing apparatus, causing permanent threshold shift of hearing, producing noise induced hearing loss [NIHL]. **Aims**: The present study was aimed at investigating hearing loss in power loom workers and its correlation with duration of exposure to noise. **Settings and design:** Ichalkaranji, a small town is a hub of small scale power loom industry, which unfortunately is not a planned city with scattering of units all over the town. This is a cross sectional study done in power loom units for estimating the hearing thresholds of workers using conventional pure tone audiometry. **Materials and methods:** The hearing threshold of 178 otologically normal randomly selected subjects in age group 18 -50 years were estimated. The subjects were divided into three groups according to the duration of exposure. **Statistical analyses used:** Analysis Of Variance (ANOVA), Chi-square test and Correlation test. **Results:** The mean noise level was 95.33 dBA [above safety limits]. Prevalence of hearing loss increased with duration of exposure from group I (33.84 %) to group III (99 %) which was statistically significant ($p < 0.001$). Highest mean threshold levels for hearing were observed at 4000 Hz frequency in all the three groups. **Conclusions:** Noise exposure above safety limits for extended shift hours shows significant correlation between hearing loss and duration of exposure. Moderate to severe hearing loss develops within the first ten years of exposure to noise progressing slowly thereafter.
Key Words: audiometry, hearing loss, noise, power loom.

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INTRODUCTION

Power loom industries in the town of Ichalkaranji manufacture cotton cloth on a large scale. In India, the occupational permissible noise exposure limit for eight hours time weighted average is 90 dBA.[1,2,3] But the regulations are not taken into consideration by the industries. Hence, workers are exposed to the hazards of excessive noise [4].

Noise exposure for long durations produce noise induced hearing loss [NIHL] [5] along with other hazardous effects on the body. Considering the possibility of exposure of workers in these units, study of the hearing impairment using conventional pure tone audiometry was undertaken and correlated with duration of exposure to noise.

MATERIALS AND METHODS

The present cross-sectional study was conducted on randomly selected 178 workers from small scale power loom industry units. The subjects included were otologically normal, in the age group 18 to 50 years with history of exposure to high intensity sound.

Exclusion criteria were: i] Age above 50 years.
ii] History of otorrhoea, vertigo, head injury, trauma to ear, ear surgery.iii] Past history of typhoid, meningitis, intake of ototoxic drugs (aspirin, gentamicin, streptomycin).

The data was analyzed using Analysis Of Variance (ANOVA), Chi-square test and Correlation test.

OBSERVATIONS AND RESULTS

The subjects included in our study were in the age-group 18- 50 years in all the three groups.

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Table 1: Distribution of subjects according to age and sex

Age (yrs)	Group I (n= 52)		Group II (n=31)		Group III (n=95)	
	Male	Female	Male	Female	Male	Female
18 -30	30	2	14	--	6	--
31 -40	9	3	7	1	28	1
41 -50	7	1	9	--	57	3
Total	**46**	**6**	**30**	**1**	**91**	**4**

The number of female workers was very less, 11.5% in group I, 3.2% in group II and 4.2% in group III.

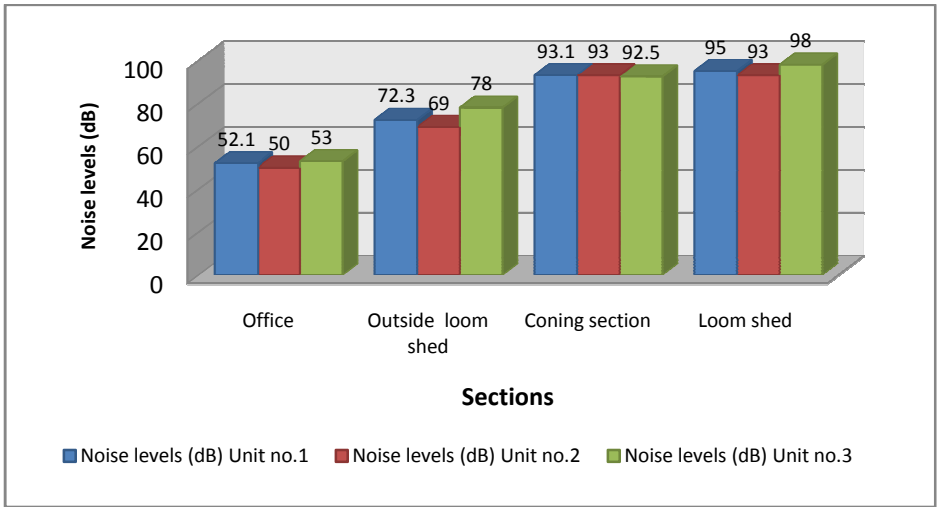

Figure 1: Noise levels in three powerloom units

Noise levels in different worksites in three power loom units are shown in figure 1.

The noise levels measured at various work sites show highest level inside the loom-shed with a mean value of 95.33 dBA (± 2.52) and at this work site 116 (61 % of total) workers are engaged. The coning section showed a mean 92.86 dBA (± 0.3) noise level. Outside the loom shed where looming and folding activities are performed, a sound level of 73.10 dBA (±4.55) was recorded. The lowest sound level was observed in the offices with a mean value of 51.70 dBA (± 1.53).

By applying statistical test (Chi-square test) we have found that there is no significant difference between hearing loss in right and left ear (P value = 1.0, 0.51 and 0.99 in groups I, II and III respectively).This shows that hearing loss is bilateral. Therefore worst ear in case of hearing loss was considered for further statistical analysis.

Table 2: Hearing threshold levels at different frequencies of sound in three groups

Frequencies (Hz)	Group			ANOVA F test	P value
	Group I Mean (SD)	Group II Mean (SD)	Group III Mean (SD)		
500	28.27 ± 6.48	40.97 ± 14.86	44.16 ± 2.94	30.84	<0.001*
1000	28.27 ± 6.92	40.32 ± 13.78	44.79 ± 12.98	33.63	<0.001*
2000	30.10 ± 8.99	41.45 ± 14.39	49.79 ± 15.12	35.96	<0.001*
3000	33.08 ± 10.85	46.13 ± 14.70	55.79 ± 15.44	43.62	<0.001*
4000	36.44 ± 13.52	53.71 ± 15.86	61.79 ± 15.96	46.33	<0.001*
6000	34.71 ± 12.77	48.87 ± 14.59	58.53 ± 15.72	44.03	<0.001*
8000	27.88 ± 10.54	39.68 ± 16.63	47.63 ± 16.31	29.49	<0.001*

*Highly significant

The mean threshold levels at different frequencies were compared in the three groups [Table 2] and found to be statistically highly significant. The highest threshold mean was in the 4000 Hz frequency in all the three groups, but the level in 6000 and 8000 Hz was lower in each group. This gives the 'acoustic notch' or dip at 4000 Hz followed by recovery at higher frequencies on an audiogram.

Table 3: Pure tone average of 500,1000,2000, 3000 Hz

Group	Mean of PTA	S.D
Group I	30.00*	7.78

Group II	41.98*	13.73
Group III	48.62*	12.96

ANOVA F test = 41.54 ; *P value < 0.001 highly significant

Table 3 shows comparison of pure tone average of hearing thresholds considering the worst ear in case of hearing loss. Analysis of variance showed significant difference of means in the three groups indicating that degree of hearing loss increases with duration of exposure to noise. Correlation of the different variables, i.e. type of job, duration of job and hearing loss is shown in table 4. Duration of job shows significant correlation with hearing loss.

Table 4: Correlation of different variables

Variable	Pearson correlation	Job	Duration of job	Hearing loss
Job	r value	1	-0.167*	-0.227**
	P value	-	0.026	0.002
Duration of job	r value	-0.167*	1	0.573**
	P value	0.026	-	0.001
Hearing loss	r value	-o.227**	0.573**	1
	P value	0.002	0.001	-

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

DISCUSSION

The noise levels recorded show that the picking action of the looms was the highest source of noise. The loom shed had a mean value of 95.33 ± 2.52 dBA noise, which was above the limits of 90 dBA for eight hours laid down in the Factory Act -1948.[3] The shift was of twelve hours adding extra hours to the exposure. The weavers are the most susceptible of all workers to the high sounds produced by the looms. The observation of noise levels in our study are consistent with those obtained by Bhatt *et al*[8], An Luong Nguyen *et al*[9] and Raman Bedi.[10] Tables 2 and 3 show statistically highly significant difference between the groups. From the tables we can make an inference that as duration of exposure increases, the hearing threshold level increases leading to higher degrees of hearing losses. Only two subjects had normal hearing thresholds in group III. Statistically highly significant difference was found between the groups ($p<0.001$). This can be explained as follows: as duration of exposure increases, the degree of hearing loss increases progressively with the stimulus, duration and intensity of noise. Initial damage producing noise-induced temporary threshold shift progresses to permanent threshold shift with longer durations of exposure to noise. Rising trend of hearing loss with increasing duration was observed by Rini Tekriwal *et al*[11], A.Dasgupta[12] There was no statistical difference between threshold levels in the two ears. That is the hearing loss when present was bilateral. This is characteristic of noise-induced hearing loss. The threshold levels at 4000 Hz were compared in the three groups and found to be statistically highly significant. This finding is similar to that of Ilhami *et al* [13], Bauer *et al*[14], Celik O *et al*[15] and Osiboqun *et al*[16] Probable explanation for this is as follows: industrial noise has a broad spectrum and as it travels through external auditory canal acoustic energy is amplified creating a band pass centered at 3200 Hz at the tympanic membrane. The dip at 4000 Hz in audiograms is observed at ½ to 1 octave above centre frequency of noise. Also another reason could be that the attenuating action of acoustic reflex is lacking because it is limited to sounds below 2000 Hz. When this high frequency sound reaches the inner ear, it produces maximum disturbance near the oval window owing to property of tonotopic encoding of frequency by the basilar membrane. Repeated stimulations affect the sensory cells (IHC and OHC) by mechanical trauma and metabolic stress leading to their damage.[17] Two subjects in group III show normal hearing in spite of having twenty years of exposure to noise. Probable explanation for this can be based on the concept of 'tough ears'. Some people have tough ears who seem to be able to withstand higher levels of exposure better than the normal and others have 'tender ears' which are easily damaged. In our study hearing loss became evident within the first five years of exposure to noise (33.84 %) , increasing to 88.8% in the next five years and reached 99.9 % with more than 10 years of exposure. Most of the workers (66.2 %) have mild to moderate HL (26-55 dB HL). Inspite of having hearing loss, these workers do not come forward for counseling, preventive and therapeutic measures. This may be due to lack of awareness among the workers. Even though uncomfortable with this level of hearing threshold, they continue with their daily activities.

CONCLUSION

Hearing loss is evident in workers exposed to high noise levels for 72 hours per week without using personal protective devices. The workers engaged in loom shed

and coning section are highly prone to NIHL. There is significant correlation between the duration of exposure and the degree of hearing loss.

Motivation of workers to use personal protective devices is the need of the hour. Efforts should be made to inculcate preventive and corrective measures in the national health policies, effective immediately. Also strict regulations need to be in place against long working hour shifts in noise producing units in power loom industry.

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