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PREVALENCE OF NOISE INDUCED HEARING LOSS AMONG PEOPLE WORKING IN POWERLOOM INDUSTRIES

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Keywords:
Powerloom, noise induced hearing loss, audiometry.

Abstract

Background : Noise-induced hearing loss (NIHL) is caused by sustained, repeated exposure to excessive sound levels .It accrues progressively and often remains unnoticed until it has reached a certain degree. Noise induced hearing loss is an irreversible and incurable disease. The major industries responsible for excessive noise and exposing workers to hazardous levels of noise are textile, printing, saw mills, mining, etc.

Aim : 1. To assess the noise level in the powerloom industries and to assess the prevalence of hearing loss among the powerloom workers.
2. To study the association between duration of exposure to noise and hearing loss among the powerloom workers

Methodology : A cross-sectional study was done among 200 powerloom workers at Attayampatti village in Salem district between Jan 2015 – May 2015. A pure tone Audiometry for both air conduction (AC) and bone conduction (BC) for the left ear and the right ear was determined by using the ARPHI SERIES 500 portable audiometer, the threshold values of all the subjects at different sound frequencies in the range of 125 – 8000 Hz. Audiometry was preceded by otoscopic examination. For statistical analysis we had considered subjects with normal hearing as not affected and subjects with mild, moderate and severe SNHL as affected. The statistical measures obtained were numbers, percentages and Chi-square values.

Results : The average noise level of the automated powerloom industries in the study area was 125.34±3.26 db. Among the study population for 58% of them the hearing was almost normal, and for about 34% they had a hearing defect ranging fro mild to moderate and for 8% of them they had a severe sensorineural hearing loss. There was a statistically significant association between the years of exposure and the hearing loss (P<.0005) in both the ears.

Conclusion : Pre-employment screening, Periodic audiometric check up, and ear protection, for those who are exposed to the noise above 80 dB are the possible ways to prevent noise induced hearing loss.

INTRODUCTION

Noise-induced hearing loss (NIHL) is caused by sustained, repeated exposure to excessive sound levels .It accrues progressively and often remains unnoticed until it has reached a certain degree. Any form of sound exposure can

lead to NIHL provided there is sufficient intensity and exposure time.[1-4] The main site of impairment is the outer hair cells of the cochlea, where the damage is irreversible .Very high levels of noise exposure can lead to acute mechanical damage to inner and outer hair cells, but this form of damage is rare.[5,6] Occupational Safety and Health Association (OSHA) has set 90 dBA as the time-weighted average (TWA) for an 8-hour work day exposure to noise.[7] This limit according to National Institute of Occupational Safety and Health (NIOSH) is 85 dBA.[8]

Noise-induced hearing loss usually progresses unnoticed until it begins to interfere with communication, posing a serious safety hazard and a decrease in the quality of life.[9]The following categories are widely applied because they correspond to regulatory limits in developed (usually 85 dB (A)) and many developing (usually 90 dB (A)) countries for 8-hour day: Minimum noise exposure: <85 dB (A), Moderately high noise exposure: 85−90 dB (A) , High noise exposure: > 90 dB (A).[10] Noise induced hearing loss is an irreversible and incurable disease.[11] Noise exposure can create permanent threshold shifts (PTS); temporary threshold shifts (TTS), permanent or temporary tinnitus and other physical side effects such as high blood pressure. These types of hearing damage are often referred to as noise induced hearing loss (NIHL).[12] Noise induced hearing loss ranging from an average hearing threshold across 500, 1000, and 2000Hz of 25 dB or for OSHA.[13]The higher frequencies are more commonly the first to be damaged by the hazardous noise. Hazardous noise is generally any noise that is above 85 dBA.[12]

In India, occupational permissible exposure limit for 8 h time weighted average is 90 dBA.[14] The major industries responsible for excessive noise and exposing workers to hazardous levels of noise are textile, printing, saw mills, mining, etc. Studies carried out by the National Institute of Occupational Health, India, showed that the sound pressure levels were very high in various industries of India.[15] Table 1 shows the various noise levels in different industries and in that it is the textile industry which shows the maximum noise level exposure.

AIM

1. To assess the noise level in the powerloom industries and to assess the prevalence of hearing loss among the powerloom workers.
2. To study the association between duration of exposure to noise and hearing loss among the powerloom workers.

METHODOLOGY

A cross-sectional study was done among 200 powerloom workers at Attayampatti village in Salem district between Jan 2015 – May 2015. Attayampatti is a small village in Salem district with a population of 10,000. In Attayampatti the major occupation among the people is working in a powrloom industry. Both males and females of all age group are exposed to this work. There were about totally 80 powerloom industries in that area in which 50 are manual and 30 are automatic. The automatic run powerloom industries are much noisier than the manual powerloom and so in our study we took the workers working in the automatic run powerloom industries for assessing the hearing loss. In the 30 automatic run powerloom industries about 300 people were working and we interviewed all the 300 and in that 200 ofthem gave consent and they were included in the study.

Workers who had worked a minimum of one month in the industry, working for a period of 8-10 hours daily and 6-7 days a week with no gross CVS, RS and CNS abnormalities and any other systemic disease were included in the study after taking informed consent. Those who had a history of past or present ear trauma / infection, history of ototoxic drugs, and evidence of respiratory tract infection including common cold were excluded from the study. A pure tone Audiometry for both air conduction (AC) and bone conduction (BC) for the left ear and the right ear was determined by using the ARPHI SERIES 500 portable audiometer, the threshold values of all the subjects at different sound frequencies in the range of 125 – 8000 Hz. Audiometry was preceded by otoscopic examination. Occluding wax was removed prior to Audiometry. Tinnitus was ruled out. Subjects were asked if they have better hearing in one ear, and if so, testing commenced with that ear. Informal assessment of the extent of their hearing loss was made through general conversation.

Instructions and information about the task were given to the subjects. As soon as the subject heard a sound (tone), instruction was given to raise the finger, keeping it raised for as long as sound (tone). was heard and lowers the finger if the sound (tone) was not heard. Test was started with the better-hearing ear at a frequency of 1000 Hz and then in the order of 2000,

4000, 8000, 500 and 250 Hz. For the first ear only, retest at 1000 Hz. More sensitive threshold was taken as the final value. Opposite ear was tested in the same order.

Test stimuli: The duration and interval between tones were varied by 1-3 seconds. To ensure that the subject is familiar with the task, we presented a tone of 1000 Hz that is clearly audible. If there was no response at 40dB level, we increased the level of the tone in 20 dB steps until a response occurred. If the tone was still inaudible at 80 dB HL, we increased the level of the tone in 5 dB steps until a response occurred, taking care to monitor the subject for discomfort.

Bone conduction pure tone audiometry was performed similar to AC (Air Conduction) pure tone audiometry by using the bone vibrator placed over the mastoid prominence with the required area of the vibrator in contact with the skull. Bone conduction was only being performed in the frequency range 500 to 4000 Hz. For statistical analysis we had considered subjects with normal hearing as not affected and subjects with mild, moderate and severe SNHL as affected. The statistical measures obtained were numbers, percentages and Chi-square values.

RESULTS

The average noise level of the automated powerloom industries in the study area was 125.34±3.26 db. This seems to be relatively high than the sound pressure levels showed by the national institute of occupational health (table 1). The socio-demographic profile of the study population was shown in table 2. It is seen from the table that majority were in the age group between 18 – 25. Males were comparatively higher than females. The years of exposure to the noise in the powerloom industries varied from less than 1 year to more than 20 years. 54% of the study population had exposed to the noise levels between 3 – 12 years. Sensorineural hearing loss in the left ear and the right ear based on their duration of exposure to the noise levels were shown in table 3 and 4. Among the study population 42% of them had SNHL in the left ear and for 39% in the right ear. Hearing loss was directly proprionate to the number of years of exposure. There was a statistically significant association between the years of exposure and the hearing loss (P<.0005) in both the ears. As the duration of hearing loss increases the number of people affected with sensorineural hearing loss was increased. Hearing threshold at 4KHz in both ears based on their duration of exposure was shown in table 5. There was a strong positive correlation between the duration of exposure and the decibels in both the right and left ears. As the years of exposure increases the decibels were increasing in both the ears. The threshold levels in the left ear were comparatively higher than the right ear. The grading of hearing loss among the study population was tabulated in table no.6. It is inferred from the table that for 58% of them the hearing was almost normal, and for about 34% they had a hearing defect ranging fro mild to moderate and for 8% of them they had a severe sensorineural hearing loss.

DISCUSSION

The noise affects mainly the outer hair cells (OHC) but it also affects inner hair cells with other structures like supporting cells and blood vessels. This increased vulnerability of OHC could be due to their location at the point of maximum basilar displacement and the relative lack of supporting cells around OHC. Initially noise causes failure in the regulation of intracellular ionic composition due to changes in the cell membrane of OHC. This results in increased number of liposomes and swelling of cells. Cilia become floppy, disordered and fused. All these changes result in temporary threshold shift (TTS).[16,17]

Noise induced hearing loss (NIHL) is a commonly seen occupational hazard. The sound pressure levels that are required to produce hearing loss are much less compared to what is required to cause discomfort to the exposed individual so the affected person is unaware that his hearing is being damaged.[18]

Hearing loss caused by impact noise /acute noise trauma is an important factor which corresponds well with subjective hearing loss and tinnitus. In contrast to hearing loss from occupational noise, it occurs often in only one ear and predominantly at the frequency of 4 KHz. Having increased hearing threshold due to acoustic trauma might lead people to be more susceptible to noise.[19,20]

The present study deals with the evaluation of exposure of noise to the hearing impairment as detected by audiometry. Results of the study showed a significant association between the hearing loss in both the ears among workers and the duration of exposure to the noise (p<.005). In our study the hearing loss was present in almost 70% of the workers who were exposed to noise for more than 18 years and it was almost in par with the study done by Ighoroje et al,[21] who observed a noise induced hearing impairment in 100% of the workers exposed for a period of

14 years. In our study the right was more affected than the left ear which was almost similar to the study done by Navid Noorali Shah etal.[22] Another study done on Israeli Defense Force (IDF), by Satterfield,[23] who reported hearing impairment asymmetry among the soldiers but In that study the left ear was affected more than the right. This difference was explained by the positioning of the weapons by the soldiers. Whereas in our study the right ear was more affected than the left and the probable reason could be, while working on the machine as right handed person's right ear is more close to the machine.

The left sided asymmetry may also be secondary to biological difference of a less active acoustic reflex on the left ear or may be the higher otoacoustic emission amplitude on the right side due to its more intense auditory efferent system.[24,25] In our study among the people having hearing loss 32 (38.1%) had bilateral hearing loss, 52 (61.9%) had hearing loss in the right ear alone and 46(54.7%) in the left ear. This is comparable to study on Indian air force personnel where most had mild to moderate loss and only 24 % had severe loss.[18]

NIHL is permanent and cannot be cured resulting in significant monetary costs and human suffering. Fortunately, it can be prevented. Using HPD (hearing protecting device) like ear mufflers as advised by other authors,[26-29] restricting the duty hours to < 8 hours / day, decreasing the number of working days a week, avoiding the risk factors like alcohol, smoking, acute noise trauma, ototoxic drugs, taking good ear care and periodically getting hearing evaluated may help in some extent.

CONCLUSION

A significant association was observed between the hearing loss and duration of exposure in both the ears among workers. Pre-employment screening, Periodic audiometric check up, and ear protection, for those who are exposed to the noise above 80 dB are the possible ways to prevent noise induced hearing loss. Further researches / studies could be done on whether hearing impairment progression can be reversed through early detection and how to predict permanent hearing loss in relation to temporary threshold shifts.

Table 1 : Noise levels in different industries

Industries	Range (dBA)
Textile industries	102-114
Pharmaceutical firms	93-103
Fertilizer plants	90-102
Oil and natural gas complex in Bombay high	90-119

Industries	Range (dBA)
Road traffic in Ahmedabad city	60-102
Surface rail traffic	90-102
Metro rail	70-111
Air traffic	90-112

Table 2 : Socio-demographic profile of the study population

Variable		Frequency	Percentage
Age in years	18 – 25	78	39%
	26 – 32	21	10.5%
	33 – 40	20	10%
	41 – 47	38	19%
	48 – 54	22	11%
	>54	21	10.5%
Gender	Male	128	64%
	Female	72	36%
Educational status	Literate	139	69.5%
	Not literate	61	29.5%
Marital status	Married	164	82%
	Unmarried	36	18%

Years of exposure	<1	5	2.5%
	1 – 3 years	24	12%
	3 – 6 years	38	19%
	6 – 9 years	35	17.5%
	9 – 12 years	36	18%
	12 – 15 years	22	11%
	15 – 18 years	24	12%
	>18 years	16	8%
Total		200	100%

Table 3 : Sensorineural hearing loss in left ear and number of years of exposure among the study population

Years of exposure	**Hearing loss present**	**Hearing loss absent**	**Total**	**P value**
<1	0	5 (100%)	5	Chi square value = 31.319 P <.005
1 – 3 years	5 (20.8%)	19 (79.2%)	24	
3 – 6 years	12 (31.5%)	26 (69.5%)	38	
6 – 9 years	14 (40%)	21 (60%)	35	
9 – 12 years	16 (44.4%)	20 (55.5%)	36	
12 – 15 years	12 (54.5%)	10 (45.5%)	22	
15 – 18 years	14 (58.3%)	10 (42.7%)	24	
>18 years	11 (68.7%)	5 (32.2%)	16	
Total	84 (42%)	116 (58%)	200	

Table 4 : Sensorineural hearing loss in right ear and number of years of exposure among the study population

Years of exposure	Hearing loss present	Hearing loss absent	Total	P value
<1	0	5 (100%)	5	Chi square value = 30.296 P <.005
1 – 3 years	5 (20.8%)	19 (79.2%)	24	
3 – 6 years	12 (31.5%)	26 (69.5%)	38	
6 – 9 years	12 (34.2%)	23 (658.%)	35	
9 – 12 years	16 (44.4%)	20 (55.5%)	36	
12 – 15 years	11 (50%)	11 (50%)	22	
15 – 18 years	11 (45.8%)	13 (54.2%)	24	
>18 years	11 (68.7%)	5 (32.2%)	16	
Total	78 (39%)	122 (61%)	200	

Table 5 : Hearing threshold at 4KHz in and duration of work.

Years of exposure	Right (db)(±SD)	Correlation R value	Left (db)(±SD)	Correlation R value
<1	21.32		23.01	
1 – 3 years	21.86	0.897	23.51	0.918
3 – 6 years	22.39		24.42	
6 – 9 years	23.97		25.65	
9 – 12 years	26.31		28.73	
12 – 15 years	28.19		30.15	
15 – 18 years	29.08		31.59	
>18 years	31.78		33.81	

Table 6 : Grading of hearing loss among the study population

Grade	Hearing level	Frequency	Percentage
Normal	<25 db	116	58%
Mild hearing loss	25 – 40 db	30	15%
Moderate hearing loss	41 – 60 db	38	19%
Severe hearing loss	61 – 80 db	16	8%
Total		200	100%

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