A study of exposure to noise and hearing loss among textile workers

Navid Noorali Shah[a], Mirza Nisar H.Baig[a], S R Vaidya[b]

[a]Associate Professor, Department of Physiology, Prathima Institute of Medical Sciences, Karimnagar, Andhra Pradesh, India.

[b] Professor, Department of Physiology, Bharati Vidyapeeth, Deemed University, Sangli, Maharashtra, India

Address for correspondence: Dr. Navid Noorali Shah, Associate Professor, Department of Physiology, Prathima Institute of Medical Sciences, Karimnagar, Andhra Pradesh, India.

Email: drnavid23@gmail.com

ABSTRACT

Background: In developing countries people suffer more from noise induced hearing loss. Occupational noise produces hearing loss which is 100 % preventable by using safety measures. Considering the paucity of studies, a cross sectional comparative study was conducted among 256 textile industrial workers.

Methods: A semi-structured questionnaire was used to assess the baseline characteristics of the workers. Pure tone audiometry was performed on all the workers to assess the degree of hearing loss.

Results: A significant association was observed between the duration of exposure and hearing loss in left ear (X^2 =22.39, P<0.01) and in right ear (X^2 =30.31, P<0.01) among workers exposed to low level of noise (<80dB) whereas significant association between the duration of exposure with hearing loss was observed only in left ear (X^2=18.12, P<0.01) among workers exposed to high level of noise.

Conclusion: Association between the hearing loss and duration of exposure was significant in both the ears among workers exposed to low level of noise(<80dB) and only in the left ear among workers exposed to high level of noise.

Key words: Developing countries, textile industry, Pure tone Audiometry, Noise induced hearing Loss.

Please cite this article as : Shah NN, Baig NM, Vaidya SR. A study of exposure to noise and hearing loss among textile workers. Perspectives in medical research 2013; 1: 16-21

Source of Support : Nil, Conflict of Interest : None Declared.

INTRODUCTION

Noise is defined physiologically as a signal that bears no information and whose intensity varies randomly in time. Noise Induced Hearing Loss (NIHL) is the second most common form of sensorineural hearing deficit after presbycusis (age related hearing loss). NIHL has been recognized since industrial revolution.[1, 2] In textile workers the prevalence of NIHL is around 33.46%.[3] In most developing countries, industrial noise levels are higher than those in developed countries. This is an irreversible elevation of the auditory threshold produced by noise exposure and is associated with permanent pathological changes in the cochlea.[1] Noise affects mainly the outer hair cells (OHC). Noise causes increased number of liposomes and swelling of cells. Cilia become floppy, disordered and fused resulting in a temporary threshold shift (TTS).[4,5]

Habitual exposure to noise above 85 dB will cause a gradual hearing loss in a significant number of individuals, and louder noises will accelerate this damage. Workmen exposed to higher intensity of noise are irritable, short tempered and impatient.[6] Celik O et al, in 1998 carried out a study in Noise-exposed workers in hydro-electric power plant. The hearing loss was developed within the first 10 years of noise exposure and associated with slight progress in the following years.[7] Türkkahraman S et al, in 2003 determined the hearing thresholds by standard and high frequency audiometry and found increase in hearing thresholds significantly correlated with the noise level and duration of exposure to noise.[8]

NIHL is permanent and only partially treatable, yet

virtually 100 percent preventable. Present study is conducted to find the noise level causing hearing loss and to study association between duration of exposure to noise and hearing loss.

MATERIAL AND METHODS

A cross sectional comparative study among 256 textile industrial workers was conducted after IRB approval for the period of nine months in Kupwad village, district Sangli. Noise levels at each work station were measured with a Quest (Quest technologies; Oconomowoc, WI USA) 1200 precision integrating sound level Meter. Subjects were divided into two groups of 128 workers each based on their exposure to the noise. Group A constitute workers working outside the power loom department in less than 80 decibels sound and Group B constitutes workers those working inside the power loom department in more than 80 decibels sound.

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. The ambient noise was not more than 35 dB (A). Before testing daily checks were performed regarding the functioning of audiometer. 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. Care was taken not to fatigue the subject as this can affect the reliability of the test results. If the test time exceeds 20 minutes, subjects were benefited for a short break.

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.

Method for finding TTS: Following a satisfactory positive response, we reduced the level of the tone in 10 dB steps until no further response occurred then increased the level of the tone in 5 dB steps until a response occurred. These steps were repeated 3-4 times and findings were noted. If the response is same for 50% of time on the ascent then that is considered as Temporary Threshold Shift (TTS). TTS was determined for all other frequencies.

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 and mild SNHL as not affected and subjects with moderate, severe and profound SNHL as affected[1]. The statistical measures obtained were numbers, percentages and Chi-square values.

RESULTS

Table 1 describes the baseline characteristics of the study subjects. Most of the respondents 110 (42.96%) belonged to 18-25 years age group followed by 70 (27.34%) between the age of 26-32 years. Males accounted for a total of 250 (97.65%) and 92 (35.93%) were illiterate. A total of 210 (82.03%) workers were married and most of them 72 (28.12%) were working in industry for 1-3 years and 50 (19.53%) between 3-8 years.

Table 1: Baseline characteristics of the respondents

Variables		Numbers
Age in years	18-25	110
	26-32	70
	33-40	34
	41-47	22
	>47	20
Gender	Male	250
	Female	06
Educational status	Illiterate	92
	Literate	164
Marital status	Married	210
	Unmarried	46
Years of exposure	<1	48
	1-3	72
	3-8	50
	8-14	44
	>14	42
Total		256

Table 2 reveals the relationship between years of exposure and SNHL in right ear in group A. Most of the workers 35 (27.34%) were exposed to the noise for 1-3 years whereas 26 (20.31%) were exposed for 3-8 years and 22 (17.18%) were exposed to the noise for more than 14 years as well as less than a year. Majority of respondents 70(54.68%) were belonging to not affected group and 58 (45.31%) were affected by hearing loss. Among the affected group most of the respondents 20 (15.62%) were exposed to noise for more than 14 years followed by 15 (11.71%) exposed for 1-3 years. A highly significant statistical association was observed between years of exposure and SNHL in right ear in group A ($X2 = 30.31$, $P<0.01$).

Table 2: Relationship between years of exposure and SNHL in right ear in group A

Years of exposure	Affected	Not affected	Total	Significance
<1	2	20	22	
1-3	15	20	35	Chi square value
3-8	11	15	26	= 30.319
8-14	10	13	23	P value < 0.01
> 14	20	2	22	
TOTAL	58	70	128	

A relationship between years of exposure and SNHL in left ear in group A is shown in Table 3. A total of 62 (48.43%) were in the affected group. Among them 18 (14.06%) were exposed to noise for more than 14 years followed by 15 (11.71%) for 1-3 years. The association is highly significant as revealed by chi square and p value (X^2 *=22.39, P<0.01).*

Table 3: Relationship between years of exposure and SNHL in left ear in group A

Years of exposure	Affected	Not affected	Total	Significance
<1	3	19	22	
1-3	15	20	35	Chi square value
3-8	12	14	26	= 22.399
8-14	14	9	23	P value < 0.01
> 14	18	4	22	
TOTAL	62	66	128	

Table 4 shows the relationship between years of exposure and SNHL in the right ear in group B. A total of 37 (28.90%) workers were exposed to the noise for 1-3 years followed by 26 (20.31%) exposed for less than 1 year. Only 20 (15.62%) were exposed to the noise for more than 14 years. Majority of respondents 89(69.53%) were affected by noise induced hearing loss. Among the affected group most of the respondents 25(19.53%) were exposed to noise for 1-3 years followed by 18 (14.06%) exposed for more than 14 years. No statistical significance was observed between the years of noise exposure and SNHL in right ear in group B (X^2 *=7.892, P>0.05).*

Table 4: Relationship between years of exposure and SNHL in right ear in group B

Years of exposure	Affected	Not affected	Total	Significance
<1	14	12	26	
1-3	25	12	37	Chi square value
3-8	16	8	24	= 7.892
8-14	16	5	21	P value > 0.05
> 14	18	2	20	
TOTAL	89	39	128	

Table 5 depicts the relationship between years of exposure and SNHL in left ear in group B. It has been observed that more number of respondents 71 (55.46%) were belonging to affected group, whereas 57(44.54%) did not show noise induced hearing loss on examination. Among the affected group 18 (14.06%) were exposed to noise for 1-3 years and 17 (13.28%) for more than 14 years. A highly significant statistical association was observed between years of exposure and SNHL in left ear in group B (X^2 *=18.12, P<0.01).*

Table 5: Relationship between years of exposure and SNHL in left ear in group B

Years of exposure	Affected	Not affected	Total	Significance
<1	8	18	26	
1-3	18	19	37	Chi square value
3-8	12	12	24	= 18.12
8-14	16	5	21	P value < 0.01
> 14	17	8	20	
TOTAL	71	57	128	

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). [4,5]

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 exposed to low level of noise (group A <80dB) and significant association with hearing loss only in the left ear among workers exposed to high level of noise (group B >80dB).

The findings of our study are similar to the findings of Ighoroje et al, who observed a noise-induced hearing impairment in 100% of the workers exposed for a period of 14 years as well as asymmetrical involvement of right and left ear air-conduction pathway.[9] The results of the study in group B shows that as the years of exposure to sound increases the degree of deafness increases only in the left ear. This is probably because as the right ear was affected in the initial period only (53.85 % Affected in < 1 year period), the damage was asymmetrical, right ear was more affected. The finding is similar to that of Israeli Defense Force (IDF), Sallerfield et al, who reported hearing impairment asymmetry among the soldiers but which affected the left ear more. This difference relative to the findings can be explained by the positioning of the weapons by these soldiers. The probable reason for asymmetrical hearing loss in our study for group B could be because of the position of the subjects, while working on the machine as right handed person's right ear is more close to the machine.

CONCLUSION

A significant association was observed between the hearing loss and duration of exposure in both the ears among workers exposed to low level of noise (<80dB) and only in the left ear among workers exposed to high level of noise (>80dB). We recommend Pre-employment screening, Periodic audiometric check up, and ear protection, for those who are exposed to the noise above 80 dB. We also suggest 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.

REFERENCES

1. Alberti P. W, Dafyd Stephens. Scott Brown's Otolaryngology, Adult Audiology, Vol. 2. London: Butterwoth International Edition; 1988. Noise and ear; pp. 594–641.
2. Rabinowitz PM. Noise induced hearing loss. Am Fam Physician 2000; 61:2749-2756.
3. Yusuf MH, Taous A, Rahim M, Zahurul Haq AHM, Abdullah M. Noise induced hearing loss among the textile industry workers.Bangladesh J of Otorhinolaryngology 2008;14(2):39-45.
4. Dobie, R.A. Medical-Legal Evaluation of Hearing Loss. Von Nostrand Reinhold, 1993.
5. Henderson, D., Hamernik, R.P. Biologic Bases of Noise-Induced Hearing Loss. Occupational Medicine: State of the Art Reviews. 1995, 10; 3: 513-534.
6. K Park. Park's Textbook of Preventive and Social Medicine, 16th ed. Jabalpur: Bhanot Publishers; 2011. p 512.
7. Celik O, Yalcin S, Ozturk A. Hearing parameters in noise exposed industrial workers. Auris Nasus Larynx 1998 ; 25 : 369-75.
8. Türkkahraman S, Gök U, Karlidağ T, Keleş E, Oztürk A. Findings of standard and high-frequency audiometry in workers exposed to occupational noise for long durations. Kulak Burun Bogaz Ihtis Derg 2003; 10:137-42.
9. Ighoroje AD, Marchie C, Nwobodo ED. Noise induced hearing impairment as an occupational risk factor among Nigerian traders. Niger J Physiol Sci 2004;19:14-9.