OCCUPATIONAL NOISE INDUCED HERAING LOSS

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ABSTRACT

OBJECTIVE: To investigate hearing threshold of industrial workers and correlate between noise exposed and unexposed groups.
STUDY DESIGN: An observational cross sectional study
PLACE AND DURATION OF STUDY: Study was conducted at medical testing and research organization located at Islamabad from January 2010 to May 2010.
METHODOLOGY: 50 industrial workers (Gp A) exposed to constant high level noise were integrated in study and compared with matched control group (Gp B). Pure tone audiometry (subjective test) was carried out to measure the hearing threshold at various frequencies.
RESULTS: Hearing loss was more prevalent in group A. A characteristic dip of hearing threshold was noted at 4000 Hz in Gp A.
CONCLUSION: Industrial workers are at higher risk of developing Sensor-neural hearing loss (SNHL) as compared to general population. These individuals can easily be picked in early stages by audiometry and appropriate protective measures advised to prevent or interrupt the silent progress of disease.
KEY WORDS: Occupational noise induced hearing loss, Pure tone audiometry, Hearing threshold

INTRODUCTION

Hearing loss produced by exposure to loud sounds is common cause of acquired adult SNHL universally. It is incurable but entirely preventable. World Health Organization (WHO) declared in "Guide lines for community noise"-At a global level noise induced hearing impairment is the most frequently encountered irreversible occupational hazard, and it is estimated 120 million people have a significant and important hearing loss. There is increasing evidence pointing to a number of other health effects of too much volume.[1] Noise is any unwanted sound that may not be harmful unless its intensity crosses a certain level or it remains there for certain period. The intensity of sound is measured as sound pressure level (SPL) and expressed in decibel (dB).Conventionally thunderous noise creates an audiometric notch at 4kHz.[2,3]. However a small number of studies demonstrated notch at 6 kHz[4-6]. Occupational noise induce hearing loss(ONIHL) not only bothers the sufferers but also is a nuisance for their families and colleagues[7].It is difficult to determine the first reported cases of this malady(noise induced hearing loss) but Ludwig first cited Roman writers describing effects of noise on human ears. Gaius Plinius Secundus, a Roman statesman described that the dwellers in precinct of Nile River had lost much of their hearing due to the continuous noise of flowing river. Price in 1914 described a cutlery factory in Germany, the noisiest factory of his time, where every worker became deaf to some extent a short time after continual exposure to noise. Taylor et al., 1965 described diminution of hearing in workers exposed to loud noises for considerable time, and observed that the greatest decline was around the 4,000?Hz frequency. Very loud sound can cause injury to the delicate sensory and neuronal components of the cochlea leading to loss of hearing. Such damage often causes the dendrites of the spiral ganglion neurons (SGN), the neurons that provide the afferent innervations of the hair cells, to puff up and degenerate thus damaging the synapse.[8]

Present study was carried out to find out incidence of hearing loss in industrial workers.

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METHODOLOGY

After the informed written consent of individuals(industrial machine operators from an fertilizer establishment) coming to medical testing and research organization located at Islamabad, 50 individuals with age range from 25 -35 yrs, giving history of exposure to loud noise were subjected to screening for hearing loss(group A). Matching control group of 50 individual was also picked from same organization coming for some other problems without history of exposure to loud noise.(group B).Affected workers with at least 7 years of exposure to noise were included in study. Individuals giving history of pre- existing deafness or any other ear disease were excluded from study. Both the groups were subjected to complete clinical examination of ears followed by pure tone audiometry for hearing evaluation.

Statistical analysis was done by using SPSS soft ware version 10.Statistical significance of results was analyzed using chi-square test and t test. P value was calculated and a value less than 0.05 was considered as statistically significant.

RESULTS

In this study audiometrical assessment of hearing was carried

out of, otherwise asymptomatic individuals exposed to noise and were compared with control group. Subjective assessment and objective measurement revealed that hearing loss in subjects was more prevalent in Group A as compared to Group B. The mean duration of exposure (to noise) of the study group was 7 ± 1.5 years.

Self-reported hearing loss (subjective) occurred in 16% (n=8) Study group A workers while hearing loss, as determined audiometrically (objectively), occurred in 44% (n=22). In the control group, self-reported hearing loss occurred in 6% (n=3) of the controls while on audiometric evaluation 4%, (n=1) of controls had a hearing loss (Table-I).

Study of the average hearing threshold in the study group A reveals a much higher hearing threshold in the frequency ranges 3 to 6 kHz (Tables-II). In the control group no such change in the hearing threshold is noted. (Table-III).

A comparison of the mean hearing thresholds of the study and the control groups reveal maximum hearing loss in the frequency ranges of 3 to 6 kHz. (Figure-I).

TABLE-I: COMPARISON OF HEARING LOSS IN THE FREQUENCY RANGE OF 3 TO 6 kHz IN THE STUDY AND CONTROL GROUP

Hearing Assessment	Study Group A (n=50)	Control Group B (n=50)
Normal hearing	34.5% (17)	98% (48)
Bilateral hearing loss	44% (22)	1 (4%)

P=<.01

TABLE-II: AVERAGE HEARING THRESHOLDS AT DIFFERENT FREQUENCIES IN STUDY GROUP (A) (n=50)

Hearing Threshold	Frequencies in kHz							
	0.25	0.5	1	2	3	4	6	8
Mean	5dB	10dB	10dB	25dB	30dB	35dB	25dB	20dB
SD	.23	.5	.5	1	2	2.5	1	.5

P=<.05

TABLE-III: AVERAGE HEARING THRESHOLDS AT DIFFERENT FREQUENCIES IN CONTROL GROUP (B) (n=50)

Hearing Threshold	Frequencies in kHz							
	0.25	0.5	1	2	3	4	6	8
Mean	10dB	5dB	10dB	15dB	15dB	15dB	12dB	10dB
SD	.2	.3	.5	1	3	2.5	1.5	.4

P=<.05

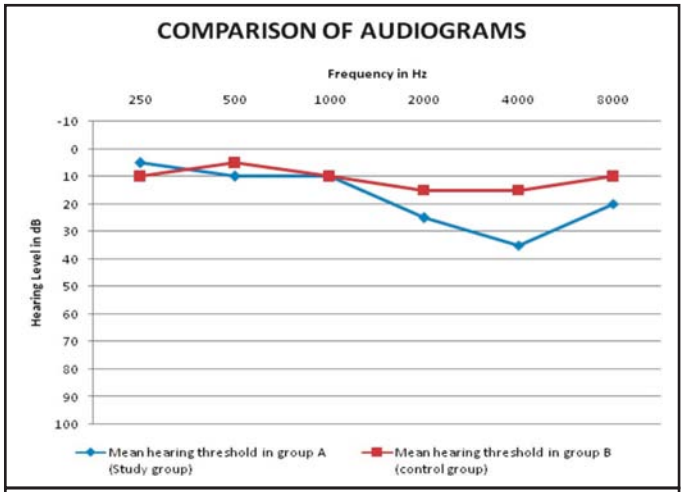

FIGURE-I: SHOWING MAXIMUM OF HEARING LOSS IN THE FREQUENCY RANGE OF 3 TO 6 kHz.

DISCUSSION

As globally accepted noise exposure is associated with hearing loss depending on duration and character of noise. Hearing loss is of sensori-neural type and generally involves higher frequencies, largely concentrated at 4 or 6 kHz[9]. Hair cells in the inner ear are usually affected simultaneously therefore mostly the hearing loss is typically bilaterally symetrical[10]. On pure tone audiometry the notch has for a long time been recognized as a clinical hallmark of noise exposure. Although the typical association is between ceaseless noise exposure and a notch at 4 kHz, notches have indeed been observed at 6 kHz in people exposed to impulse noise and at 3 kHz with low frequency noise[11]. We found an audiometric notch in 30 individuals (60 %) at 4kHz. In a study by Hong O, over 60% of OE (occupationally exposed) showed hearing loss in the noise-sensitive higher frequencies of 4 and 6 kHz[12] The prevalence of hearing loss among noise-exposed factory workers was 42% (where hearing loss was defined as >25 dB loss at the OSHA (Occupational safety and health administration)-recommended frequencies of 2, 3, and 4 kHz in either ear).[13]

Noise exposure per se ordinarily does not produce a decrement more than 75 decibel (dB) in high frequencies and 40 dB in lower frequencies. However, persons with added age-related losses may have hearing threshold loss levels exceeding these values[14]. In our study bulk of individual (64%) with in age bracket of 25-35 were having hearing loss between 20 to 40 dB

Individual vulnerability to the acoustic effects of unwanted loud sounds varies widely. Similarly organic basis for this also

remains unclear[15].If a person employed in industry is being exposed to other factors like ototoxic agents and tobacco simultaneously, he becomes more vulnerable to hazardous effects of noise due to their synergistic action.

It also emphasized the importance of personal protective measures, it was also established that determining daily occupational noise exposure (inside hearing protection) with continuous administrative feedback apparently diminishes the risk of occupational NIHL in industrial workers. Prolonged follow up of these workers will determine the value of the intervention done. Intervention studies for the prevention of NIHL need to include appropriate control groups[16]

Although noise-induced hearing impairment is completely preventable, it still has a high prevalence rate among the construction workers. Hearing protection devices (HPDs) are frequently used for reducing noise exposure in construction workers, but their use is complicated by episodic and fluctuating noise, insufficient administrative will (in industrial set-ups) for 'hearing health', and loose regulatory enforcement[17]. A longitudinal study done over a period of thirteen years in Austria showed that permanent threshold shift was predicted by noise years, frequency of wearing noise protectors, but also by the initial TTS (temporal threshold shift) as that individual susceptibility plays an important role. The TTS peak at 4 kHz occurring independent of exposure frequency but especially after low-frequency exposure is a predictor of long-term hearing loss[18]

Two recent studies were done in the third world scenario (one in Ghana on Mill Workers and one in Zimbabwe in the mining industry). The duration of noise exposure in the studies was similar to our study i.e. 7+- 1.6 years. Similarly the audiometric notch was at 4 kHz .[19,20]

Another comparative cross-sectional study was done in Ghana recently on 140 workers from the stone crushing industry (compared with a control group of 150 health workers). The mean age of subjects in this study was slightly older than our study i.e 42.58±7.85 and 42.19±12 year (stone workers and controls respectively.) Subjective hearing loss occurred in 21.5% of the workers and in 2.8% of the controls (percentage of affected workers are in a similar range to our study).[21]

CONCLUSION

Industrial workers are at higher risk of developing Sensori-neural hearing loss (SNHL) as compared to general population. These individuals can easily be picked in early stages by audiometry and appropriate protective measures advised to prevent the silent progress of disease.

RECOMMENDATIONS

Occupational physicians can have an important part in the prevention of noise induced hearing impairment by playing their role as professional overseers of hearing conservation programs. The charge assigned to such an overseer include over guiding the audiometric technician, reviewing the suspected audiogram, determining the need for further evaluation, establishing the occupational relevance of any shift in the hearing threshold , revision of an audiometric baseline, and monitoring the effectiveness of the hearing protection programme. The professional manger should be a promoter of "hearing health" of at risk noise-exposed persons, and should endeavor to make sure that noise hazards are decreased both at work and during leisure activities through prevention of excessive noise levels and sufficient use of hearing protection when required.

REFERENCES

1. Chepesiuk, Decibel H. The effects of living in anoisy world. Environ health perspect.2005; 113(1):34-41.
2. Satal off RT. The 4000 Hz audiometric dip. Entechnology 1980;59:251-7.
3. McBride DI, Williams S. Audiometric notch as a sign of NIHL. Occup Environ Med 2001;58:46-51.
4. Rao AB, Rao BN, Soodan KS, Kapur R. Study of noise environment and audiometric survey of technical airmen at various fighter bases in IAF. Armed Forces Med J India 1990;46:187-92
5. Dancer A, Buck K, Parmentier G, Hamery P. The specific problem of noise in military life. Scand Audiol 1998;27:123-30
6. Jaruchinda P, Thongdeetae T, Panichkul S, Hanchumpoi P. Prvelance and an analysis of noise induced hearing loss in army helicopter pilots and air craft mechanices. J Med Assoc Thai 2005;88:232-9.
7. Hetu R, Getty b L, Waridel S, Attitudes towards co –workers affected by occupational hearing loss II: Focus group interviews. Br J Audiol 1994;28:313-25.
8. Fryatt AG, Mulheran M, Egerton J, Gunthorpe MJ, Grubb BD. Ototrauma induces sodium channel plasticity in auditory afferent neurons. Mol Cell Neurosci. 2011 ;48(1):51-61.
9. Morata TC. Assessing occupational hearing loss: beyond noise exposures. Scand Audiol Suppl. 1998; 48: 111–16.
10. Charles. K, Paul. J, Warren. W. ACOM Noise and Hearing Conservation Committee. Occupational noise-induced hearing loss. J Occup Med. 1989; 31: 996.
11. Türkkahraman S, Gök U, Karlidað T, Keleº E, Oztürk. Findings of standard and high-frequency audiometry in workers exposed to occupational noise for long durations. Akulak Burun BogazIhtis Derg. 2003 10(4):137-42.
12. Hong O, Chin DL, Samo D. Hearing loss and use of hearing protection among career firefighters in the United States. G. J Occup Environ Med. 2013;55(8):960-5.
13. McCullagh MC, Raymond D, Kerr MJ, Lusk SL. Prevalence of hearing loss and accuracy of self-report among factory workers. Noise Health. 2011 :13(54):340-7.
14. Rosenhall U, Pedersen K, Svanborg A. Presbycusis and noise-induced hearing loss. Ear Hearing. 1990; 11: 257–63.
15. Ward WD. Endogenous factors related to susceptibility to damage from noise. Occup Med. 1995; 10: 561–75.
16. Peter. R, Deron. G, Sharon. K, Mark . C, Martin . Slade, Christine. D. Effect of daily noise exposure monitoring on

annual rates of hearing loss in industrial workers. l Occup Environ Med. 2011; 68(6): 414–18.
17. Edelson J, Neitzel R, Meischke H,, Sheppard L, Stover B, Seixas N. Predictors of hearing protection use in construction workers. Ann Occup Hyg. 2009 ;53(6):605-15.
18. Moshammer H, Kundi M, Wallner P, Herbst A, Feuerstein A, Hutter HP. Early predictors of noise-induced hearing loss. Occup Environ Med. 2014 Jun;71Suppl 1:A62
19. Kitcher ED, Ocansey G, Atule A. Occupational hearing loss of market mill workers in the city of Accra, Ghana. Noise Health;2014;16(70):183-8.
20. Chadambuka A, Mususa F, Muteti S. Prevalence of noise induced hearing loss among employees at a mining industry in Zimbabwe. Afr Health Sci. 2013 ;13(4):899-906.
21. Kitcher ED, Ocansey G, Tumpi DA. Early occupational hearing loss of workers in a stone crushing industry: our experience in a developing country. Noise Health. 2012;14(57):68-71.