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NOISE INDUCED HEARING LOSS AMONG FACTORY WORKERS OF EASTERN NEPAL

Objective:

To study effect of noise in hearing among the factory workers of eastern Nepal.

Material and Method:

Cross sectional comparative study was conducted between January 2010 to June 2011 in one of factory of eastern Nepal enrolling 445 subjects out of which 224 were exposed to loud noise and 221 were normal individuals of same geographical area. The intensity of noise of working environment was measured by digital sound level meter (SLM) prior to the study. The workers of factory were assessed on the basis of history, clinical examination, otological examination, and hearing status by pure tone audiometry. Data were analyzed on the basis of duration of exposure and intensity of exposed noise and compared with control groups.

Results:

The frequency of noise induced hearing loss was more among factory population (41.5%) as compared to normal population (18.5%). It had linear relationship with duration of exposure and age of person. The odds ratio of hearing loss among factory workers and normal population was 2.5.

Conclusion:

Factory workers have high risk of high frequency hearing loss as compared to normal population.

Key words: Hearing loss, Noise, Factory worker.

INTRODUCTION:

Noise is unwanted sound that doesn't carry useful information and is usually undesirable or unpleasant and is an environmental hazard that causes physiological and psychological effect interfering with the well-being of an individual.¹ The term noise induced hearing loss refers to reduction in auditory acuity associated with noise exposure.² 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. For unprotected ears, the allowed exposure time decreases by one half for each 5 dB increase in the average noise level. For instance, exposure is limited to 8 hour at 85 dB, 4 hour at 90 dB, 2 hour at 95 dB, and 1 hour at 100 dB, taking the exchange rate of 5dB.^{3,4} The highest permissible noise exposure for the unprotected ear is 115 dB for 15 minutes/day. Any noise above 140 dB is not permitted.⁵ Regarding the prevalence, hearing impairment is the most frequent sensory deficit in human populations, affecting more than 250 million people in the world.⁶ According to Health Report 2001, Worldwide 16% of the disabling hearing loss in the adults (over 4 million DALYs) is attributed to occupational noise, ranging from 7% to 21% in the various sub-regions.^{6,7}

MATERIALS AND METHODS:

It was a comparative cross-sectional study conducted in the one of the factory of eastern Nepal, between January 2010 and June 2011. Ethical clearance was obtained from institutional ethical review board and consent from both employer and employees obtained prior to the study. Adult population between 15 to 60 years of age and who were exposed to loud noise (>85 dB) at least 8 hour a day for period of >5 years were included in the study. Person with hearing loss prior to the factory work or person with conductive hearing or with systemic illness were excluded. Two hundred twenty four case who met the inclusion criteria were included in the study. Two hundred-twenty one people (±5) matched normal population were also included in the study. Detailed clinical history and physical examination including meticulous otological assessment was carried out in all the subjects according to Performa. Complete birth and developmental history was taken to exclude congenital and other causes of acquired hearing loss. Detail drug history was taken, especially the ototoxic drugs. Past history of ear trauma and head injury was taken to rule out the prior hearing loss. Pure tone audiometry was done in each case or control/participant in a quiet room. Audiological assessment in all cases was carried by ARPHI 500 MKIIS portable pure tone audiometer. A single trained audiologist and a clinician carried out screening audiological examination in a quiet room inside the factory but away

from the machine. Calibration of the pure tone audiometer was done regularly. Severity of hearing loss was graded on the basis of frequency of 500, 1000, 2000, 4000, 8000 Hz. Graph was plotted on the basis of PTA finding. Hearing threshold of cases were compared with those of control group. All the findings were filled up in preformed Performa. The sound level of factory and screening room were measured prior to the study. Measurements of noise were taken with a calibrated Lutron SL- 4001 digital Sound Level Meter. The noise level of wire drawing area was 91.4 dB (Max 93.7 and min 85.2 dB), Processing house was 99.5 dB (Max 100.8 and min 97.7 dB) and that of examination room was 30 dB. The data were analyzed using SPSS version 16. Mean and standard deviation of variables in both case group and control group were also calculated. χ^2 test and logistic regression were used to analyze the data. Comparison of hearing loss was done in between case and control, in different age groups and duration of exposure. Logistic regression was applied to find odd ratio of noise induced hearing loss among cases and controls.

RESULTS:

The mean age of case in this study was 32.05 and of control 31.95 year and age distribution was similar in both groups. Most of the cases were in age group of 15-29 accounting 45.5% and most of controls were of same age group (15-29 yrs) accounting 45.2%

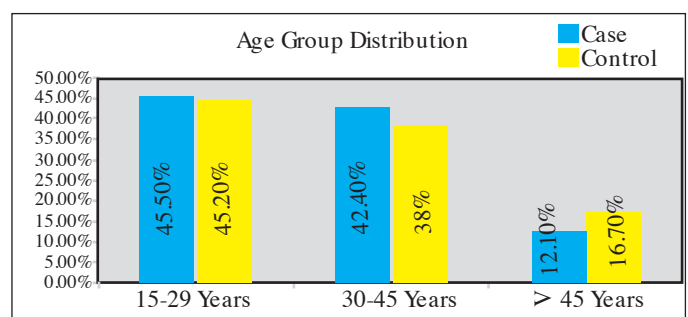


Fig. 1 : Showing distribution of age group

The prevalence of noise induced hearing loss was 41.5% among the factory workers as compared to 18.5% of normal population which was statistically highly significant ($P < 0.01$). In relation to age NIHL was more in older age group in both the factory workers and normal population and in each group the difference was significant. Among factory workers Noise Induced Hearing Loss was present among 22.5%

in 15-29 year of age group, 56.8% in 30-45 year of age group and 59 % in more than 45 year of age group. The prevalence of NIHL among the control was more in older age group. In normal population (Control) it was 10%, 23.9% and 29.7% respectively.

Table 1: Prevalence of noise induced hearing loss among Case and Control Group

Age	Case	Control	P value
15-29	22.5%	10%	<0.01
30-45	56.8%	23.9%	<0.01
>45	59.3%	29.7%	<0.01

The prevalence of NIHL was more in workers who were exposed to sound for longer duration. It was 21.75% in person who were exposed to 6-10 years, 33.3% among workers exposed to 11-15 years and 67.9% in workers exposed to more than 15 year and the difference was significant.

Table 2: Showing duration of exposure to noise and prevalence of NIHL

Duration of works in years	Noise Induced Hearing Loss	P Value
6-10 Yr	21.7 %	<0.05
11-15 Yr	33.3 %	
>15 Yr	67.9 %	

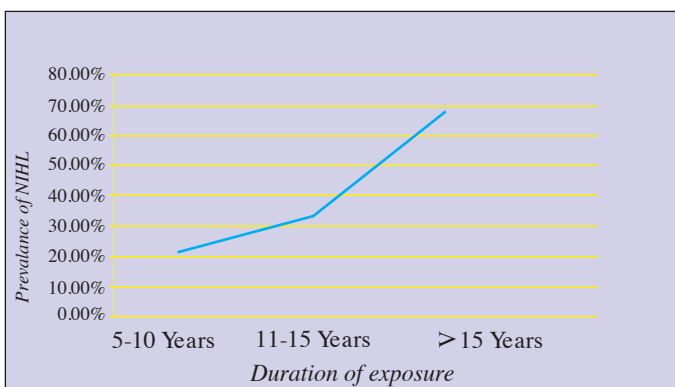


Fig 2: Showing relation of duration of exposure to noise and hearing loss

	Odd ratio	95% Confidence interval	Significance (p value)
Factory Workers	9.626	4.919-18.84	<0.01
Normal Population	1		
Age group of Factory workers			
15-30year	0.194	0.089-0.425	<0.01
31-45 year	0.492	0.235-1.031	0.06
>45 year	1		
Duration of exposure			
1-5 year	0.190	0.083-.433	<0.01
6-10 year	0.262	0.111-.616	<0.01
>11 year	1		

Multivariate logistic regression analysis showed exposure to loud noise is the most important contributing factor for NIHL, risk of NIHL in exposed population was 9.626 times more than that of normal population. We also considered the influence of age factor in NIHL, the risk of hearing loss in age group >45 year was 5.15 times more than age group of 15-30 year and 2.03 times that of 31-45 year age group. Finally the relationship between duration of exposure and NIHL was calculated, the risk of NIHL was 5.26 times more in group

who were exposed to >11 year than those who were exposed to 1-5 years and 3.82 times more than those exposed to 6-10 year. Noise for longer duration is well known entity. With this background we conducted the present study to assess the hearing loss among the factory workers who were working in the factory which produced the sound more than 85 dB. The workers were working more than 8 hours a day and more than 5 days in a week. Noise level of the factory ranged from 86 dB to 91 dB, with peak measurement of 97 dB to 101 dB. This factory had regulation that workers in production division had to use ear protection, but almost all of them were reluctant to use it due to lack of awareness of hazardous effect of noise pollution.

Chang SJ, Chang CK did the study of prevalence and risk factors of noise-induced hearing loss among liquefied petroleum gas (LPG) cylinder infusion workers in Taiwan. Male in-field workers exposed to noise taken as case and administrative staffs as controls. A total of 75 subjects were involved in research and 56.8% of in-field workers had NIHL. Between the in-field and administration groups, hearing thresholds on the worse ear showed significant differences at frequencies of 4 kHz, 6kHz, and 8 kHz with aging considered.⁸ The prevalence of NIHL in our study was almost similar to the previous study. Dasgupta A, Manna N, Sau M had done the study in noise induced hearing loss in a heavy engineering industry in Kolkata, he took 235 employees who were exposed above the permissible occupational noise level out of whom 82 (34.90%) employees were deaf which was much more than the deafness among the non-exposed workers 3 (6.98%). Hearing impairment increased as exposure level increased and this was statistically significant (chi2 = 17.97, df = 2, p = 0.0001). Hearing impairment also increased with duration of exposure (chi2 = 7.12, df = 2, p = 0.0284).⁹ Our study showed the overall prevalence of 41.5% noise induced hearing loss among cases and 18.5% in control. The results were comparable to the study done by Hendarmin (1971) who reported 50 % of workers at a manufacturing plant and two ice factories in Jakarta had NIHL.^{10,11} Noise induced hearing loss was recorded in 22.5% of cases of aged between 15-29 year as compared to 10% of same age of control group, the difference was statically significant. Similarly noise induced hearing loss was 56.8% and 59.3% of cases of age group 30-45 and above 45 years, as compared to 23.9% and 29.7% respectively of same age control group, again the difference was statically significant. The relationship between duration of exposure and prevalence of noise induced hearing loss is proven fact. Hidayat (1991) reported incidence of NIHL on workers of textile factory to be 17.20 % with 10 years working period and 46% with 15 years working period.¹² Suheryanto (1994) reported 44.44 % with 5-9 years working period, 66.67 % with 10-14 years and 85.91% with 15 -19 years.¹³

Noise induced hearing loss can only be prevented by eliminating or lowering noise exposure levels. Where the source of the noise cannot be eliminated workers have to rely on hearing protective devices. There are other causes of hearing loss which mimic the audiogram of noise induced hearing loss. We tried to rule out such factors from our study based on detail history and thorough clinical examination but exclusion of all of these couldn't be possible. The screening room at factory site was not ideal room for audiometric evaluation though time to time calibration was made. Temporary threshold shift was tried to be ruled out by allowing 16 hours of noise free period to factory workers but totally couldn't be ruled out.

Recommendation

NIHL is preventable. Health education and public awareness against NIHL should be advocated. People working in factories of Nepal are at risk of NIHL. Protective measures against noise should be mandatory in noise producing factory

CONCLUSION:

Prevalence of noise induced hearing loss is significantly more in factory workers and increases with increase in duration of exposure.

Conflict of interest:

It was presented in Geneva on 06/12/2011 in GHF 2012, implementation project.

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