Prevalence of Onihl in Manufacturing Industry

Abstract

Objective: To find out the prevalence of occupational noise induced hearing loss (ONIHL) among the workers in a manufacturing engineering industry and to observe the effect of duration of noise exposure on hearing of workers.

Study design: Observational case control study.

Study sample: Of 236 subjects, 118 cases each in noise (>85dB) exposed (group A) and control (group B). All the subjects were subjected to audiometry and pure tone averages for frequencies 500Hz, 1kHz, 2kHz and 4kHz were calculated and compared.

Results: Showed an overall prevalence of 41.5% hearing loss in the exposed study group A out of which 77.5% had mild while 22.5% had moderate hearing loss as compared to only 2.5% overall prevalence in unexposed group B, which was found to be statistically significant ($p<0.005$).The present study also compared the audiometry results with duration of exposure which revealed a hearing loss of 3.7% among workers exposed for duration of 5-9yrs, 51.6% for duration of 10-14yrs and 100% for duration of ≥15yrs.

Conclusion: ONIHL is prevalent in form of mild to moderate hearing loss within the manufacturing industry.

Keywords: Noise; Hearing loss; Pure tone audiometry; Audiometer; Noise exposure; Leisure noise

Research Article

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Abbreviations: KHz: kilo Hertz; ONIHL: Occupational Noise Induced Hearing Loss; HPD: Hearing Protection Devices; AAOO: American Academy of Ophthalmology and Otolaryngology; NIHL: Noise-Induced Hearing Loss; SPL: Sound Pressure Level; NITTS: Noise-Induced Temporary Threshold Shift; NIPTS: Noise-Induced Permanent Threshold Shift; ICMR: Indian Council of Medical Research

Introduction

NIHL is relatively new public health problem of industrial society. Development of automatic machines in industries reduces the physical burden of workers and increase the productivity of industrial enterprises but produces noise as one of the most undesirable and unavoidable byproduct [1]. Noise is defined as sound due to acoustic waves of random intensities and frequencies. As found in industry, it represents unwanted sound and wasted energy [2]. Noise sources can be controllable like community noise e.g. recreational, leisure noise or uncontrollable like environmental noise [3]. Prolong exposure to noise can result into permanent sensory hearing loss refers to Noise-induced hearing loss (NIHL). Noise induced hearing loss is generally defined as hearing loss that develops slowly over a long period of time (several years) as the result of exposure to continuous or intermittent loud noise [4]. This result in bilateral sensorineural hearing loss often with a pathognomonic notch of decreased hearing on an audiogram at 4,000Hz. Continuous exposure to sounds greater than 85dB for 8 hours has been shown to cause NIHL [5,6]. Furthermore, this damage is more with continuous noise than with intermittent noise of similar intensity [4,6]. Occupational Hearing loss can be defined as a hearing impairment of one or both ears, partial or complete, arising in, during the course of, and as the result of one's employment. It includes both noise induced hearing loss (NIHL) and acoustic trauma. ONIHL is most prevalent and preventable occupational disease. It is bilaterally symmetrical usually affecting higher frequencies 3k, 4k, 6 kHz at early stages, then spreading to lower frequencies 0.5k, 1k, 2 kHz [7]. By affecting hearing, noise exposure can have a negative impact on quality of life and personal wellbeing, resulting to impaired communication skills [8]. Louis Hagen, MD said, slowly, insensibly, we seem to accept the effects of noise as normalcy [9]. The consequence of hearing impairment is severe and permanent and is preventable.

In 1946 the committee on conservation of hearing of the American Academy of Ophthalmology and Otolaryngology (AAOO) established a subcommittee on noise in industry to study various aspects of noise problem, its relation to hearing and to set up recommendations on how the hearing loss can be prevented or minimized. The committee published the guide for conservation of hearing in noise which is used for establishment of industrial hearing conservation programmes [10]. In a landmark decision, US Department of labor issued specific safety and health regulations under the Walsh Healey Act in 1969 and subsequently under the Occupational safety and Health Act in April 1971 [11,12]. These regulations specified noise criteria pertaining to permissible noise exposure limit for all employees working in noisy occupations. Violation of the federal noise criteria could

result in severe penalties and even closure of the plants. The prime objective of both these acts was hearing conservation.

As there are no case control study reported on ONIHL from India which tell us about the prevalence in heavy noise producing industries and where the loss is compared with duration of noise exposure. Hence, we conduct this study on prevalence of ONIHL in one of manufacturing plant with respect to time and duration of noise exposure. In this study we have taken person from two different setting that is persons from high noise area where noise is above 85dB as cases and where noise levels is 0 less than 70 dB as controls. This gives us a clear picture of time and amount of hearing loss in workers working in relatively similar conditions.

Materials and Methods

Study design

Observational, Case Control Study, Duration: 2years.

Study area

Manufacturing plant in Jamshedpur city of Jharkhand, India.

Study sample

A total 236 subjects were enrolled in study which was divided into two groups each having 118 subjects who were selected methodologically and assigned respectively to case and control groups after strictly following study criteria. Group A comprised of 118 Male workers in the age group 30-50 years, exposed to high noise ≥85dB occupied for ≥8hrs daily duration for ≥5 years as cases and 118 ages matched male controls not exposed to high noise during routine daily 8 hours working duration as group B. The study was carried out on OPD basis at ENT department of Tata motors hospital. Workers in age group <30yrs and >50 years and those with h/o diabetes mellitus, hypertension, symptomatic grossly deviated nasal septum or conductive or mixed hearing loss were excluded from the study through history taking and clinical evaluation. All the cases were subjected to pure tone audiometry after a recommended gap of 16 hours from last exposure to noise using audiometer ALPS model 2100 for frequencies 250hz to 8khz at intensities 0 to 120dB and subsequently, pure tone averages for frequencies 500hz, 1khz, 2khz and 4khz were calculated and compared with controls working in non-noisy area for the same duration of time. The exposed group was further divided into three subgroups according to time slab.

Data analysis

Data was summed up in the excel sheet and analyzed using the software SPSS 16. Student t-test & chi square test were used for data analysis and p value <0.05 was taken to be significant.

Results

Result showed that out of 118 patients in group A, 49 (41.5%) patients had sensorineural hearing loss that could be attributed to noise due to definitive history of exposure while 69 (58.5%) had no loss. In group B out of 118 only 3 (2.3%) had SNHL while 115 (95.7%) had no loss as shown in Figure 1. This difference was statistically significant (p value <0.005). The two age groups both Exposed (group A) and Control (group B) were statistically comparable with no significant statistical difference for age (p value >0.05). The Group A mean age 37.47 years and in Group B, it was 37.17 years.

On further analysis when all the subject of noise exposed group were studied against duration time period we found a direct relationship between duration of exposure and amount and prevalence of hearing loss. Group A was further stratified for duration period into three subgroups of durations 5-9 years (A1), 10-14 years (A2), and ≥15yrs (A3) for comparison. Out of 55 subjects falling in subgroup A1, 2 out of 55 (3.7%) had hearing loss. In sub group A2 17 out of 33 subjects (51.6%) had hearing. In sub group A3 all 30 (100%) had some degree of hearing loss (mild to moderate) as seen in Figure 2. In this study the average pure tone hearing threshold of patients having been exposed to high noise for 5-9 years was 26.88dB, it was 30.63dB in those exposed between 10-14 years and 36.55dB in cases exposed for ≥15 years. These differences in hearing loss among sub groups A1, A2 and A3 were found to be statistically significant (p value<0.05).

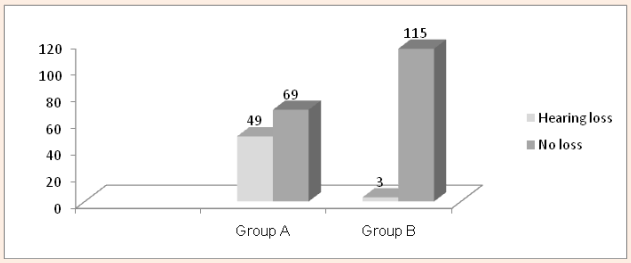

Figure 1: Significant hearing loss (41.5%) in group A exposed to high noise compared to control group B which could be attributed to occupational high noise exposure >85db.

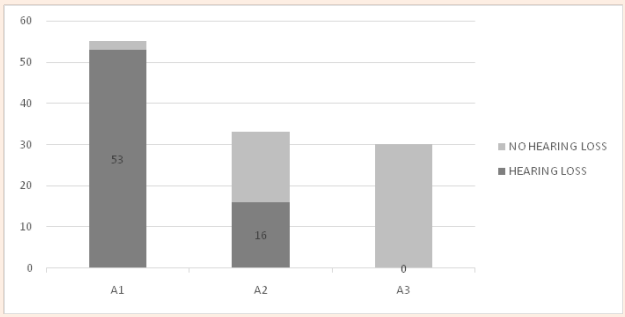

Figure 2: Hearing loss attributed to high noise exposure was found increasing with duration of exposure, after an average exposure of >15 years, almost each exposed person was having some degree of ONIHL. An increase in prevalence of SNHL among workers exposed to high noise with increase in duration (years) of noise exposure can be made out from chart clearly. Duration of exposure divided into three subgroups of durations 5-9 years (A1), 10-14 years (A2), and ≥15 years (A3).

Discussion

Noise induced hearing loss develops gradually at the higher frequencies (3000Hz-6000Hz) due to chronic exposure to

excessive sound levels [13] at an average Sound Pressure Level (SPL) of 85db (A) or higher for an eight-hour period [14]. Noise of 90dB (A) SPL, 8 hours a day for 5 days per week is the maximum safe limit as recommended by Ministry of Labor, Govt. of India-Model Rules under Factories Act [15]. Classically NIHL appears as steep isolated audiometric dip, the Acoustic notch at about 4kHz [16]. The effects of the exposure to occupational noise are higher in developing countries [17]. NIHL can be either temporary or permanent. Noise-induced temporary threshold shift (NITTS) is a temporary loss of hearing acuity experienced after a relatively short exposure to excessive noise. Pre-exposure hearing is recovered fairly rapidly after cessation of the noise. Noise-induced permanent threshold shift (NIPTS) is an irreversible sensory loss of hearing that is caused by prolonged noise exposure [13]. Hearing loss due to prolonged excessive noise exposure is generally associated with destruction of the hair cells of the inner ear. The severity of hearing loss is correlated with both the location and the extent of damage in the organ of Corti.

Workers exposed to high noise levels are susceptible to occupational hazard termed as occupational noise induced hearing loss (ONIHL). This leads to varying degree of hearing impairment which holds true as per observational outcomes of this study. There is a statistically significant hearing loss observed in group A exposed to high noise levels ≥85dB as compared to control group. Worldwide, 16% of the disabling hearing loss in adults is attributed to occupational noise, ranging from 7 to 21% in the various sub regions. The effects of the exposure to occupational noise are higher in the developing regions [18,19]. In the present study it was found that most of the workers in group A were exposed to more than normal permissible limits for noise i.e. 85dB A, for 8 hours daily exposure set by the NOISH (1998), WHO [14,17] and 90dB for 8 hours daily in India [20]. This was the first NIHL study in manufacturing industry of this region. This study was conducted on workers working in heavy engineering industry, which included machines shop and press divisions. The sound levels ranged from 78 to 112dB A. It was observed that hearing impairment was progressive with age and duration of exposure in the exposed group which was in accordance with findings of a study in heavy engineering industry [21].

Only few reports from India give statistical data regarding the incidence and etiology of hearing impairment. These are generally on a state or district rather than national basis. However, an Indian Council of Medical Research (ICMR) report in 1983 found the proportion of hearing impairment to be 10.7% [22]. In an observational cross sectional Indian study on occupational deafness of workers in a heavy engineering industry in West Bengal a prevalence of deafness was approximately 35% among those exposed to high noise as compared to only 6.9% in those workers not exposed to high noise [23]. In a study from Bangladesh the prevalence of ONIHL in a textile industry was found to be 33.46% among textile workers [24]. In India traffic branch personnel screened for NIHL showed high prevalence of 81.2% [25]. In a Brazilian cross sectional study involving different mills with noise exposure >85dB, out of 192 hearing threshold evaluations after an occupational anamnesis, concerning NIHL, 49% of the audiometry results presented hearing deterioration [26]. In another Cross sectional cohort study of 85 cement factory workers to evaluate the effect of noise exposure on the prevalence of occupational hearing loss 55% per cent of the study population presented some degree of hearing loss due to noise exposure [27]. In the present study, it was observed that an overall prevalence of 41.5% hearing loss exists in the exposed study group (A) which was bilateral in almost all. Out of which 77.5% had mild while 22.5% had moderate hearing loss as compared to only 2.5% overall prevalence in unexposed group (B) all of which had mild hearing loss and the difference between two groups was statistically significant. There exists a rotation policy for workers who had appreciable hearing loss. Secondly we had limited our range of study to 30-50 years age group which leaves out workers working for prolonged years in noisy area which probably explains why we could not found any case with moderately severe, severe or profound hearing loss. However, it further demands an observational study with larger study sample to bring out correct prevalence and incidence figures.

In a Thai study involving textile workers, the results of Audiometric tests revealed significantly higher NIHL among worker's working with longer years of exposure in high noise sections as compared to control group that included only office workers [28]. In the present study, comparing audiometry results with duration of exposure, revealed a hearing loss of 3.7% among workers exposed for duration of 5- 9years, 51.6% for duration of 10-14years and 100% for duration of ≥15years as compared to control group. In the present study 118, only male workers in age group 30 to 50 years working in high noise areas with ≥85dB noise levels were examined & about 41.5% of exposed sample had an abnormal audiogram predominantly due to occupational NIHL however incipient NIHL couldn't be ruled out. Hearing loss usually started at higher frequencies 4kHz and 6kHz and mostly involved both ears. This was found in accordance with a Brazilian study on marble factory workers with a prevalence of 48%. Lower frequencies showed better thresholds than higher frequencies; however both showed worsening with increased duration of exposure probably owing to cumulative damaging effects of noise on Organ of Corti in accordance with a study by Pourbakht et al. [29].

The hearing loss observed in present study fulfilled Dobie's criteria [30]. NIHL develops slowly after many years of exposure. Susceptibility varies quite widely, but 10 years or more of exposure is generally required for significant hearing loss to occur. In the present study an increase in pure tone averages progressively with duration of exposure that was found to be around 26.88dB for 5-9 years exposure group, 30.63dB for 10-14 years exposure group and 36.55dB for ≥15 years exposure group which was in accordance with Dobie's criteria [30]. However as speech frequencies are affected least the deficit remains unnoticed which has been proved time and again by multiple studies in India and outside like previous studies done in India on Tractor driving farmers [31], heavy engineering industry workers [28].

Some of the other highlights of our study showed that workers working in high noise area do know about harmful effect of noise on them but do not know that this effect was permanent and preventable. Another striking issue was they thought that using

HPD off and on will preserve their hearing. Most of them knew how to correctly use HPD but remove them during conversation. These all things suggest that awareness and education of workers is equally important for the success of hearing conservation programme [32].

Conclusion

ONIHL is widely prevalent in noisy work environment which is directly proportionate to the duration of exposure. A definite hearing conservation plan with use of hearing protection devices and annually repeated audiometry to look for threshold shift should be made mandatory for prevention and early detection of ONIHL. Frequent awareness session should be done for workers to make them aware of the fact that ONIHL is permanent but preventable.

Compliance with Ethical Standards

1. Research involving Human Participants and/or Animals: This case report does not involve any animal or human research.
2. Informed consent: No data pertaining to revealing the identity of patient is included in report hence informed consent is not required.

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