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A CROSS SECTIONAL STUDY OF AGE AND GENDER DIFFERENCES ON NOISE INDUCED HEARING LOSS (NIHL) AMONG SMALL SCALE WORKERS

Community Medicine

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ABSTRACT

Introduction: Noise induced hearing loss (NIHL) is the second most common form of acquired hearing loss after age-related hearing loss (presbyacusis). The most serious health effect caused by noise is NIHL resulting from irreversible damage to the delicate hearing mechanisms of the inner ear. The main aim of our study is to obtain the prevalence of predominant age group and gender affected with noise induced hearing loss among small scale industrial workers. Methods: A cross sectional study was conducted among 867 industrial workers from small scale industries in and around Kanchipuram town. Noise level in the work place was measured using mini sound level meter. Results: The average noise level measured in the industries is 90dB A. Results showed that the prevalence of NIHL among the workers in small scale industries was 32.1%. Thus 278 workers among the 867 workers had noise induced hearing loss with predominance of male gender and average age group is 45 years. Conclusions: We conclude that the prevalence of NIHL increase with increase of age and it was more among the age group 45 to 65 years. The prevalence of NIHL was more among males 227 (34.9%).The prevalence of NIHL was more among the workers who have studied up to primary school level. There is a serious shortage of accurate epidemiological information on prevalence and risk factors of NIHL, especially in developing countries.

KEYWORDS

Noise induced hearing loss (NIHL), Sensory neural hearing loss (SNHL), Small scale industries.

INTRODUCTION

Noise is the cause of more than one-third of the hearing impairments [6]. The most serious health effect caused by noise is NIHL resulting from irreversible damage to the delicate hearing mechanisms of the inner ear. NIHL typically involves the frequency range (pitch) of human voices, and thus interferes with spoken communications. Noise induced hearing loss refers to reduction in auditory acuity associated with noise exposure. This situation may be temporary and described as temporary threshold shift (TTS) although strict definition regarding duration is not available and may be from hours to days [2].

Occupational hearing loss includes acoustic traumatic injury and noise-induced hearing loss (NIHL), and can be defined as a partial or complete hearing loss in one or both ears as the result of one's employment. Exposure to excessive noise is the major avoidable cause of permanent hearing impairment worldwide. NIHL is an important public health priority because as populations live longer and industrialization spreads, NIHL will add substantially to the global burden of disability [1]. In many countries, excessive noise is the biggest compensable occupational hazard. Worldwide 16% of the disabling hearing loss in adults is attributed to occupational noise, ranging from 7 to 21% in the various sub region. The effects of the exposure to occupational noise are higher in the developing regions [3] .

A typical NIHL is of a sensory neural type involving injury to the inner ear. It is bilateral and symmetrical, usually affecting the higher frequencies (3k, 4k or 6k Hz) and then spreading to the lower frequencies (0.5k, 1k or 2k Hz). Impairment of hearing at high frequencies will initially cause a loss of clarity in perceived speech and then interfere with daily activities as hearing loss progresses [4]. Hearing loss-related symptoms, such as trouble in normal and telephone conversation, turning up the radio/television volume and tinnitus, usually occur in the early stages of NIHL [5]. The risk of hearing loss and injury to the ears increases with the sound intensity, the length of time an employee is exposed to noise and the individual susceptibility to NIHL. In India, occupational permissible exposure limit for 8 h time weighted average is 90 dBA [6].

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. In India, NIHL has been a compensable disease since 1948 under the Employees State Insurance Act (1948) and the Workmen's Compensation Act (1923). But still there is very little awareness regarding this fact. Nearly 3 billion dollars has been paid as compensation for NIHL in the USA in the last two decades. In India, it was only in 1996 that the first case got compensation, and about 250 workers are receiving compensation for NIHL [5,6]. There is a lack of epidemiological data on prevalence and risk factors of NIHL in India especially in Tamil Nadu.

MATERIALS AND METHODS:

It was a prospective study conducted in Meenakshi Medical college, department of community medicine, in and around rural area Kanchipuram. This study was conducted for one year from month of June 2013 to August 2014. There were approximately 1872 weaving centers, 38 saw mills, 76 printing press units and 62 lathe industries in and around Kanchipuram town. The number of workers in each unit varies from 1 – 15 in weaving centers, 2 – 8 in saw mills, 3-7 in printing press and 2 – 4 in lathe industries. Many of the centers were hesitant to give permission to our study for fear of legal issues and so on. Hence at the first level the centers which gave consent for participation in my study were enlisted. At the second level the name and contact numbers of workers were enumerated.

A total of 926 workers were listed among which 59 were drop outs. Among the drop outs 41 of them had experience of less than 1 year and rest of them (18) were not willing to participate in the study. Hence 867 subjects were studied. Among them 661 were from weaving industry, 102 from saw mills, 59 from printing press and 45 were from lathe industries. Clearance from the Institutional Ethical Committee was obtained. Permission to conduct the study was obtained from the owners of the corresponding small scale industrial units. Informed consent was obtained from each participant.

The data collection was done with the help of the postgraduates of the department of community medicine, of our institution. Before data collection orientation training was given to them to get familiarized with the interview schedule. The small scale industrial units were visited after getting permission from the owners, after explaining the purpose of the study and procedures to the participants, informed consent was obtained from each worker. After getting the consent the pretested interview schedule was administered to the study subjects by the investigators. Otoscopic examination was done in all workers to rule out other causes of hearing impairment like wax impaction, perforation of the tympanic membrane, retracted tympanic membrane etc by the qualified ENT person. After clinical examination the tuning fork tests were done by the qualified ENT person with 512 Hz tuning

fork. The tuning fork test included (i) RINNIE TEST, (ii) WEBER TEST and (iii) ABSOLUTE BONE CONDUCTION TEST. All the workers with reduced absolute bone conduction test were subjected to pure tone audiometry. Since the audiometric evaluation needs a silent environment the participants were taken to a hearing aid center situated in kanchipuram town for pure tone audiometry.

Pure tone audiometry was done with TRIVENI TAM – 25 instrument. The test was done 16 hours after cessation of noise exposure to eliminate effects of noise induced temporary threshold shift (TTS). The average of the hearing threshold levels at 500 Hz, 1000 Hz, 2000 Hz, and 3000 Hz were calculated in each ear and the level of hearing loss was assessed. Noise level in the work place was measured with METRAVI SL – 4010 mini sound level meter. Noise level was measured in various areas of the working place and average was taken.

Inclusion Criteria: Both males and females working in small scale industries for a period of one year.

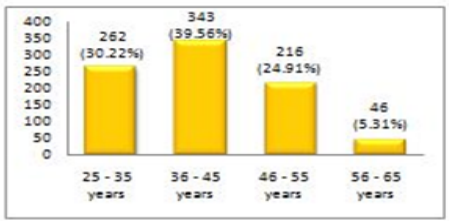
Exclusion Criteria: Workers with history of hearing loss before joining the work, workers not willing to participate in this study and workers with other causes of hearing loss .

Statistical Analysis was performed using SPSS software Statistical Package for Social Sciences (Version 21.0). Descriptive statistics was used to present the data. Chi- square analysis was used to compare the baseline demographic variables. P-value < 0.05 was considered statistically significant.

RESULTS :

A total of 867 population were included in our study as per the inclusion and exclusion criteria. The study was done based on their gender and age working in small scale industries. Out of 867 workers, majority of workers 661 were from weaving industries, 102 workers were from saw mills, 59 workers were from printing press and 45 workers were from lathe industries. In our study majority of the workers 343 (39.56%) belong to the age group 36 to 45 years, followed by the age group 25 to 35 years which include 262 (30.22%) workers (Figure 1). In our study there were no workers below the age of 25 years and above the age of 65 years.

Figure 1: Distribution of the industrial workers by Age



Among the 867 workers, 651(75.10%) were males and the remaining 216 (24.90%) workers were females. (Figure 2) Among the 867 workers majority of them 454 (52.37%) have studied up to secondary school (Table 1). The total number of workers who work for less than or up to 8 hours were 482 (55.59%) and 385 (44.41%) workers work for more than 8 hours a day (Figure 3). The working experience of 550 (63.44%) industrial workers was less than or equal to 10 years and 317 (36.56%) workers were working for more than 10 years (Figure 4).

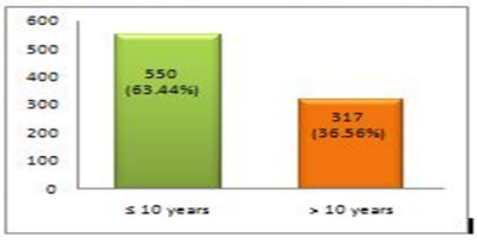
Figure 2 : Sex wise distribution of small scale industrial workers.

Table 1: Literacy status of industrial workers

Literacy status of workers	Frequency	Percentage%
Illiterate	100	11.53%
Primary school	225	25.95%
Secondary school	454	52.37%
College	88	10.15%
Total	867	100%

Figure 3 : Industrial workers and Hours of work in a day.

Figure 4 : Industrial workers and Years of work



Among the study samples 148 (17.07%) workers respond poorly to others verbal orders for more than 6 months (Figure 5). In the study only 7(0.81%) workers had awareness about the adverse effects of noise. (Table 2). Only 35 (4.04%) workers felt themselves that their performance in work was reduced day by day (Table 3). In this study majority of the workers 722(83.28%) were exposed to a noise level of ≥ 91 dB in the work place (table 4). Absolute bone conduction test was done with 512 Hz tuning fork in which 278 (32.1%) workers had sensory neural hearing loss (SNHL) (Figure 6).

Figure 5: Workers and Responsiveness to others verbal orders

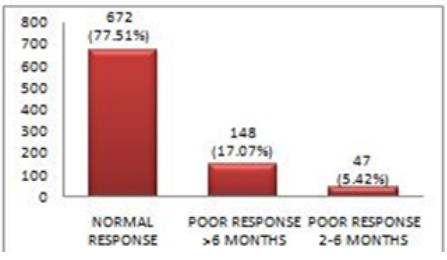


Table 2: Awareness about the adverse effects of noise

Awareness regarding noise	Number of workers	Percentage%
No	860	99.19%
Yes	7	0.81%
Total	867	100%

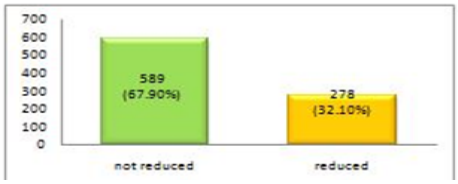
Table3 : Reduced performance in work.

Reduced performance	Number of workers	Percentage %
Yes	35	4.04%
Total	867	100%

Table 4 : Noise level in work place.

Noise level	Number of workers	Percentage %
91 dB and above	722	83.28%
Upto 90 dB	145	16.72%
Total	867	100%

Figure 6 : SNHL detected by Absolute bone conduction test.



The workers with SNHL (revealed by tuning fork test, ABC), subjected to pure tone audiometry confirmed the prevalence of noise induced hearing loss to be 278 (32.1%). As the age of the workers increase the prevalence of NIHL also increases and the prevalence among different age groups differ significantly (Table 5). The prevalence of noise induced hearing loss was more in males than in

females and the difference was statistically significant (Table 6).In this study NIHL did not show any significant association with the Literacy status of the workers (Table 7). In our study the prevalence of NIHL was more among workers with more than 10 years of work experience when compared to others which was statistically significant (Table 8).

Table 5 : Association of Age and NIHL.

Literacy status	NIHL ABSENT	NIHL PRESENT	Total
Illiterate	66(66.0%)	34(34.0%)	100(100%)
Primary school	139(61.8%)	86(38.2%)	225(100%)
Secondary school	318(70.0%)	136(30.0%)	454(100%)
College	66(75.0%)	22(25.0%)	88(100%)
Total	589(67.9%)	278(32.1%)	867(100%)
Chi square = 7.031 df =3 p value is 0.071			

Table 6: Sex distribution of NIHL

YEARS OF WORK	NIHL ABSENT	NIHL PRESENT	TOTAL
≤ 10 YEARS	456(82.9%)	94(17.1%)	550(100%)
> 10 YEARS	133(42.0%)	184(58.0%)	317(100%)
TOTAL	589(67.9%)	278(32.1%)	867(100%)
Chi-square = 154.831 df = 1 p value < 0.001.			

Table 7 : Literacy status and NIHL

Age in years	NIHL absent	NIHL present	TOTAL
25 – 35	206(78.6%)	56(21.4%)	262(100%)
36 – 45	251(73.2%)	92(26.8%)	343(100%)
46 – 55	116(53.7%)	100(46.3%)	216(100%)
56 – 65	16(34.8%)	30(65.2%)	46(100%)
TOTAL	589(67.9%)	278(32.1%)	867(100%)
Chi square = 61.367 df = 3 p value < 0.001.			

Table 8: Years of work and hearing loss.

Sex	NIHL ABSENT	NIHL PRESENT	Total
Male	424(65.1%)	227(34.9%)	651(100%)
Female	165(76.4%)	51(23.6%)	216(100%)
Total	589(67.9%)	278(32.1%)	867(100%)
Chi square = 9.437 df = 1 p value is 0.002			

In this study the commonest symptom given by the workers with NIHL was Ringing sensation 41 (14.7%) followed by head ache 28 (10.1%). Among the workers with NIHL 153 (55.0%) workers did not give history of any symptoms because they may not be aware of the symptoms or got used to it (Table 9). Poor responsiveness to others verbal order was significantly associated with prevalence of NIHL (Table 10).

Table 9 : Association of related symptoms and NIHL

Associated symptoms	NIHL PRESENT
Ringing sensation	41(14.7%)
Headache	28(10.1%)
Pain in the ears	25(9.0%)
Pain and head ache	10 (3.6%)
Giddiness and head ache	8(2.9%)
Giddiness	6(2.2%)
Pain and ringing sensation	5(1.8%)
Pain and giddiness	2(0.7%)
None	153(55.0%)
Total	278(100%)

Table 10 : Responsiveness to verbal orders and NIHL.

Responsiveness to verbal order	NIHL ABSENT	NIHL PRESENT	Total
Normal responsiveness	539(80.2%)	133(19.8%)	672(100%)
> 6 months poor responsiveness	23(15.5%)	125(84.5%)*	148(100%)
2 – 6 months poor responsiveness	27(57.4%)	20(42.6%)	47(100%)
Total	589(67.9%)	278(32.1%)	867(100%)
Chi square = 235.357 df = 2 p value < 0.001			

DISCUSSION

A typical noise induced hearing loss (NIHL) is of a sensory neural type involving injury to the inner ear. It is bilateral and symmetrical, usually affecting the higher frequencies (3k,4k or 6k Hz) and then spreading to the lower frequencies (0.5k,1k or 2kHz)*. NIHL is usually a high frequency sensorineural hearing loss (SNHL). Sensorineural hearing loss usually occurs when the nerves that transmit sound information from the ear do not function properly due to injury or disease. In our study all the workers were included after confirming that they were free of any other form of sensorineural hearing loss (SNHL). Hence based upon the audiogram findings the workers with SNHL were termed to have NIHLA study done by K. Deepalakshmi et al[16] among the workers of 22 -58 years of age in 3 Industries at Chennai revealed the prevalence of NIHL as 20.6%. The lower prevalence may be due to the lesser sample size (n = 96) in their study.

Noise-induced hearing loss is preventable. Persons who have to work at places where noise is above 85 dB should have pre-employment and then annual audiograms for early detection of hearing loss. Ear protectors (ear plugs or ear muffs) should be used where noise levels exceed 85 dB. They provide protection up to 35 dB . The most effective way to prevent NIHL is to protect the worker from hazardous noise at the workplace. Hearing protectors should be used when engineering controls and work practices are not feasible for reducing noise exposure to safe levels. A personal hearing protection device is a device designed to reduce the level of sound reaching the eardrum. Ear muffs, ear plugs and ear canal caps are the main types of hearing protectors[7]. To select hearing protectors, we should consider the following: The hearing protectors should be made in suitable materials according to the work place. For example, in industries with high temperature and noise the hearing protector should be made of heat resistant material. Instead of cotton ear plugs, ear plugs made of rubber can be used in industries with high humidity.

A variety of hearing protectors should be provided so that workers may select a hearing protector on the basis of comfort, ease of use and handling and impact on communication. Each worker should receive individual training in the selection, fitting, use, repair and replacement of hearing protectors. The most common excuses reported by workers for not wearing hearing protectors include discomfort, interference with hearing speech and warning signals and the belief of workers that there is no control over an inevitable process that causes hearing loss. Given adequate education and training, workers can realize the crucial importance of wearing hearing protectors.

The current study shows the prevalence of noise induced hearing loss among small scale industries as 32.1%. This result correlates with the studies conducted by M.M.Ruikar et al(8) in which hearing loss to be 33.7% almost similar to our study and J D Whittaker et al(9) in which hearing loss is 30.4% . In both these studies workers were exposed to >85 dB(A) whereas in our study workers were exposed to > 90 dB.

Morata et al (10) observed the prevalence of occupational NIHL to be 49% among 124 workers in Rotogravure printing workers in Brazil which was significantly associated with age. This higher prevalence might be due to the exposure of the workers to higher noise levels from 71 to 93 dB. Exposure to high noise levels for a longer duration results in increased prevalence of NIHL. In a study done by Raja and Ganguly 1983(11) the results showed that hearing impairment was progressive with age for all age groups and in our study the results showed significant association of age with prevalence of NIHL.

Presence of high noise level in the work place results in interference in speech and the affected person will give poor response to others verbal orders. In a study done by Bedi R et al[12] the results showed speech interference in 70% of workers. In our study 22.5% of workers had speech interference. Among the 278(100%) workers with NIHL, 125(45.0%) workers were poorly responding to others verbal orders for more than 6 months and 20(7.2%) workers were poorly responding for others verbal orders for a period of 2 to 6 months. A study done by Hafiz Danish Ashraf et al[13] also revealed that noise was a major factor which created interference in speech in 92.7% workers .

Noise induced hearing loss is always preventable. Awareness among the workers about the ill effects of high noise exposure plays a major role in prevention of noise induced hearing loss. In our study only 0.81% of the workers were aware regarding the effects of high noise exposure. Bedi R. et al[12] reported that 29% of the study populations knew the effects of exposure to high noise level.

In our study the incidence of NIHL is predominate between age groups of 45 to 55 years (46.3%)[Table 14]. This result correlates with studies conducted by Yusuf Haider et al[14] in a textile industry at Gaziapur .

In his study the incidence of NIHL was 20.59% in workers aged less than 35 years and 41.38% in workers aged above 35 years.

Based upon the study conducted by Shaikh et al 1996[15] in polyester fiber plant, the average noise exposure is 48 hours per week whereas in our study average noise exposure is similar to this study [Table 12]. Therefore our study shows increased hours of work was significantly associated with increased prevalence of noise induced hearing loss.

Table 11 : Hours of work in a day and NIHL.

HOURS OF WORK/day	NIHL ABSENT	NIHL PRESENT	TOTAL
≤ 8 HOURS	370(76.8%)	112(23.2%)	482(100%)
> 8 HOURS	219(56.9%)	166(43.1%)	385(100%)
TOTAL	589(67.9%)	278(32.1%)	867(100%)
Chi square = 38.834 df = 1 p value < 0.001			

CONCLUSION

In this study majority of the workers 343 (39.56%) belong to the age group 36 to 45 years. In the study population 651(75.10%) were males. Majority of the workers studied up to secondary school. Among the workers 482 (55.59%) workers work for ≤ 8 hours in a day, 769 (88.70%) workers work for ≤ 6 days per week and 550(63.44%) workers were working for ≤ 10 years. In the study the prevalence of NIHL increase with increase of age and it was more among the age group 45 to 65 years. The prevalence of NIHL was more among males 227 (34.9%).The prevalence of NIHL was more among the workers who have studied up to primary school level. There is a serious shortage of accurate epidemiological information on prevalence and risk factors of NIHL, especially in developing countries. Hence research needs to be undertaken on pathogenic mechanisms, technical measures for noise abatement, improving hearing protectors. National Programs for prevention of noise-induced hearing loss should be established and strengthened in our country. The national program should include health promotion and education, noise reduction, hearing conservation, effective legislation, enforcement, and training. The small scale industrial workers should be educated regarding the NIHL to minimize the prevalence.

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