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### Prevalence of Noise Induced Hearing Loss (NIHL) among Sawmill Workers in West Bengal, India

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#### KEYWORDS

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Noise level meter,  
Audiometry.

#### A B S T R A C T

Noise induced hearing loss (NIHL) is caused by sustained and repeated exposure to excessive sound levels. Exposure to noise (>85 dB A) causes temporary or permanent hearing loss. The major industries release excessive noise and exposing workers to hazardous levels of noise are textile, printing, mining and sawmill is one of them. Aims of the present study are to assess the noise level in the sawmill sectors and to assess the prevalence of hearing loss among the sawmill workers. The present study was done among 84 male sawmill workers in West Bengal. The exclusion criteria were the subjects with any injury/ infection in ear, taking medicine, early hearing loss, etc. The modified Noise Questionnaire was administered. Then sound level was measured and pure tones Audiometry for air conduction (AC) for the both ears were conducted by using audiometer. The average sound level of the sawmill sector in the study area was above the acceptable value, i.e. 92.1-116.3 dB (A). Among the study population for 33.33 % of them have hearing defect only in left ear, and for about 38.89 % they had a hearing defect only in right ear and for 16.66% of them they had a combined hearing defect. These values are significantly greater than the referent personnel. The workers working in sawmill are exposed a highly noisy environment and they are having highly threat of NIHL.

#### Introduction

Noise-induced hearing loss (NIHL) continues to be one of the most prevalent occupational conditions and occurs across a wide spectrum of industries. The world Health organization (WHO) estimates that 250 million people have a hearing loss and two third of these people lived in developing

countries (Vaishali *et al.*, 2011). Occupational noise-induced hearing loss or noise-induced hearing loss (NIHL) in the industry contributes about 16% of hearing loss among adults globally, ranging from 7% to 21%.1 NIHL is also regarded as a serious problem and one of the most

recorded occupational disorders in Europe and in the rest of the world and amounts to between 7 and 21 % of the hearing loss (Nelson *et al.*, 2005).

Noise-induced hearing loss (NIHL) is caused by sustained, repeated exposure to excessive sound levels. The main location of impairment is the outer hair cells of the cochlea and the damage is irreversible. Very high levels of noise exposure can lead to acute mechanical damage to inner and outer hair cells, but this form of damage is rare (SCENIHR, 2008; Bamiou and Lutman, 2007).

Exposure to noise (>85 dBA) causes temporary or permanent hearing loss. It has been proved that workplace noise of 90 dBA or above reduces working efficiency and increases the liability to make mistakes and thus resulting in decrease in productivity through increment in loss of man-hours (Ebemiro and Abumere, 1999). The following categories are widely applied because they correspond to regulatory limits in developed (usually 85dB (A) and many developing (usually 90dB (A) countries for 8-hourday: Minimum noise exposure: <85dB (A), moderately high noise exposure: 85–90 dB (A), High noise exposure: >90 dB (A) (Marisol *et al.*, 2004). Noise exposure can create permanent threshold shifts (PTS); temporary threshold shifts (TTS), permanent or temporary tinnitus and other physical side effects such as high blood pressure. These types of hearing damage are often referred to as noise induced hearing loss (NIHL) (Anne, 2003).

Hearing loss due to noise exposure in the workplace is a significant health problem. Sawmill machines generates high intensity noise during operation that vary from 80dB (A) up to 120dB (A) (Vaishali *et al.*, 2011).

In India, occupational permissible exposure limit for 8h time weighted average is 90 dB (A) (Suter, 1998). 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 (NIOSH). Large number of people are engaged in the sawmill industry for their daily life hood.

**Aims:** To assess the noise level in the unorganized sawmill sectors and to assess the prevalence of hearing loss among the sawmill workers.

## **Methods**

**Study population:** A total of eighty two male persons were randomly selected from different districts of West Bengal for the present study. They are classified in to two sub-groups, those who are directly exposed to the noise i.e. Exposed group (N= 54) and rest are referent group (N= 28); basically they are university stuff, mill owner and businessman. Subjects were excluded from this study those were suffering previous history of any chronic illness, injury or infection in the ears, early hearing loss, etc. The subjects were earlier informed about the study. The study was carried out from mid of March, 2015 to end of June, 2015 and throughout the working period.

## **Measurement of physical parameters**

Height of each subject was measured by using standard Martin anthropometric rods and weight was measured by digital weighing machine and during both measurement subjects were asked to stand erect on the machine and the reading was noted. From the above readings body mass

index (BMI) of individual subjects was calculated (Weisell, 1998).

$$\text{BMI} = \frac{\text{Weight(Kg)}}{\text{Height (m}^2\text{)}}$$

### **Questionnaire Study**

After noticing the actual activity of the workers and gathering information about their life style a Modified Noise Questionnaire was developed administered. The questionnaire consists of objective type questions with multiple choice responses. The questions were grouped into the following major sections dealing with: General information about the saw mill workers, Work organization and work behaviours and detailed question on noise induced hearing loss.

### **Measurement of Noise**

The noise levels were measured in-situ on the different workshop tools (machine) at a distance of 3 metres from the sources, using a precision digital sound level meter (Lutron, SL-4010) set on the A-weighting scale and slow response. Measurements were taken when the machines were put on (machine noise) and when wood were sawed (operational noise) and then the nature of the wood sawed was noted. All the measuring procedures were followed of OSHA's guideline. Three readings were taken at each spot when the machine was in operation and the average value was recorded.

### **Audiometry Test**

Workers who had worked a minimum of 3 years in the saw mill, working for a period of 8-10 hours daily and 6-7 days a week. A pure tone Audiometry for air conduction (AC) and for the left ear and the right ear was conducted to diagnose the workers' hearing impairment by using a portable

audiometer (the ELKON, edg Giga 3, Diagnostic Speech Audiometer with AC & AC/DC option), the threshold values of all the subjects at different sound frequencies in the range of 250–8000 Hz. Instructions and information about the task were given earlier to the subjects. As soon as the subject heard a sound (tone), indication was given to raise the finger or something. The laps duration and interval between tones were varied by 1-3 seconds.

### **Statistical Analysis**

Chi-square test was done for analysis of the hearing disturbances among the sawmill workers in West Bengal. Parameters of hearing disability was analysed by students two tail t-test.

### **Results and Discussion**

Figure -1 is showing about the noise sources in sawmill and it have been found that there are several noise sources from where noise are emitting into the environment.

Figure-2: Showing the noise level in deferent conditions in the saw mills, i.e. during single machine operation, double machine operation, during moulding and environmental noise. In the saw mills, sound level varies at different level, which is presented in the chart-1 and the value varies from 92.1 to 120.4 dB (A).

In all saw mills, there are two types of machine present, i.e. horizontal chain saw machine and table chain saw machine. When one machine is cutting soft woods and hard woods, the average noise level is 96.80 dB (A) and 103.2 dB (A), respectively. But when both machines are in operation condition for soft and hard woods, the average noise levels is 101.5 dB (A) and 116.3 dB (A), respectively. When saw is

moulding the noise level is 92.1 dB in average.

The environmental average noise level of the saw mills is 74.4 dB (A).

Figure-3: Represents the perceive noise level by the workers in a working day from the workstation. They start their job generally at morning (9am) and take a lap for about one hour and again they join their task and finish off at about 6 pm. In a working day, every worker spends 8-10 hours in the saw mill. Most of the time they spend above the 90 dB (A) noise level during their working hours.

Table-1: Showing the comparison of physical parameters of reference and exposed groups of workers. Out of 82 male subjects, 54 persons are exposed and rest 28 persons formed reference group.

Figure-4: Shows the disturbed feelings of workers and reference personnel due to noise during work. From the questionnaire analysis, it has been observed that the only 11.11 % of workers feel low disturbed whereas 78.57 % of reference personnel feel low disturb, 29.63 % of workers and 21.43 % of reference for mild disturb, 51.85 % of workers and no reference for sever disturb and 7.4 % workers & no reference feel extremely sever disturb during their work.

Hearing symptoms are analysed from the questionnaire's outcome it is shown in the table-2. All the hearing symptoms like feeling disturbed during work, talking to co-workers in normal conversation during work, temporary hearing decreased after work and ringing/ roaring/ buzzing in the ear are highly significantly higher in sawmill workers compared to reference people.

Table-3: Comparison of noise induced hearing loss between the reference and exposed groups of workers. The table shows that the occurrences of NIHL among sawmill workers are significantly more than the reference personnel.

From the present study, it is clear that the all activities in sawmill are performed by the workers manually. In unorganised sawmills the workers perform multitask means every workers have to work all kinds of task in sawmill. That's why they have to move and perform deferent working areas in the saw mill. As a result they consume deferent level of noise throughout the working day. Noise level in the saw mill industry exceeds all the recommendation limits for 8 hrs. of OSHA, NOSH and ILO during the almost total working period. It is noted that the maximum permissible noise level in work place for 8 hours shift is 90 dB (A), as recommended by the Government of India, Ministry of Labour, Model Rules under Factories Act, 1948 (corrected up to 31-031987), Occupational Safety and Health Administration (OSHA) and International Organization of Standardization (ISO). Considering the high magnitude of deafness among the employees in this study, it is high time that all employees working in high decibel sound environment (higher than the permissible level of 90 dBA) are given the highest priority regarding the promotion, prevention and containment of their hearing impairment. If this aspect of industrial health is overlooked, ignored or neglected then it is certain that a large number of people who have given the best of their life in the advancement of their organization will turn deaf long before even senility overcomes them. It was observed that the noise level in the repair workshop and production unit far exceeded the permissible noise level and employees were working

more than the permitted daily exposure hours.

The noise level during cutting depend also some factors like timber: species, width, thickness, and length, moisture content; tooling: width of cut, cutter sharpness, cutter projections, speed, balance; machine setting: timber control and timber support; and air velocity/ system design.

As the workers exposed that high level of noise for above 8 hours per day, they are might be in risk of NIHL. Exposure to high occupational noise which results in health risks is commonly encountered in a variety of industrial processes. Its effects depend not only on the intensity, but also on exposure time, frequency and the type of noise (Ahmed *et al.*, 2001).

High-level noise exposures present special challenges to the auditory system. The mammalian ear has evolved so that it can detect sounds with displacements in the sub-

angstrom range while, at its upper limits, it can faithfully encode sounds 106 units above threshold, or over a dynamic range of 120 dB (A) SPL. However, with repeated exposure to sounds in the ear's upper range (above 85 dB (A) SPL), the auditory periphery, or cochlea, progressively deteriorates (Mills *et. al.*, 1979). The damage caused by noise is pervasive and affects virtually all of the cellular subsystems of the inner ear (sensory cells, nerve endings, vascular supply). Sounds such as gunfire and certain industrial impacts—peak levels greater than 125 dB (A) are especially hazardous to the cochlea because they cause direct mechanical damage (Henderson and Hamernik, 1986). In short, the ear was not designed for exposures to the high-level noises found in contemporary environments.

Major number of sawmill workers are feeling sever disturb where reference personnel are nil yet both are near about same age and working experience.

**Table.1** Comparison of physical parameters between two groups.

Physical parameters	Reference (N=28)	Exposure (N=54)	T test	P- value
<b>Age (Yr.)</b>	42.86 ± 6.94 (55 - 30)	42.13 ± 7.28 (55 - 25)	0.437	0.663
<b>Height (cm)</b>	162.09 ± 4.34 (171 - 154)	161.5 ± 4.85 (172.5 - 150.4)	0.532	0.596
<b>Weight (Kg)</b>	66.64 ± 6.09 (81 - 57)	57.23 ± 8.91 (82 - 40)	5.007	0.0001*
<b>BMI (Kg/m2)</b>	25.37 ± 2.26 (32.5 - 21.7)	21.82 ± 2.94 (31.16 – 16.73)	5.585	0.0001*
<b>Experience (Yr.)</b>	14.79 ± 6.37 (28 - 3)	15.65 ± 5.53 (30 - 3)	1.370	0.174

\*Indicates the Significant, P < 0.05, Data are presented as mean, ± SD and their range within the bracket.

**Table.2** Represents the comparison of hearing symptoms between the two groups.

Hearing Symptoms	Reference	Exposure	Chi-square	p- value
<b>Feeling disturbed during work</b>	1	38	30.365	0.0001**
<b>Talking to co-workers in normal conversation during work</b>	0	46	50.925	0.0001**
<b>Temporary hearing decreased after work</b>	1	31	20.254	0.0001**
<b>Ringing/ Roaring/ Buzzing in the ear</b>	2	16	4.209	0.04*

Data presented (n) as the positive outcome of each hearing symptom. \* = Significant and \*\* = highly significant.

**Table.3** Comparison of NIHL of the reference and Exposed personnel.

NIHL	Reference	Exposure	Chi-square	P-value
<b>Left Ear</b>	2	18	5.512	0.01**
<b>Right Ear</b>	1	21	9.986	0.001**
<b>Combined</b>	0	9	1.115	0.05*

Data presented (n) as the positive outcome of each hearing symptom. \* = Significant and \*\* = highly significant.

**Fig.1** Different Noise sources in the sawmill sectors.



Fig.2 Noise level in different conditions in sawmill.

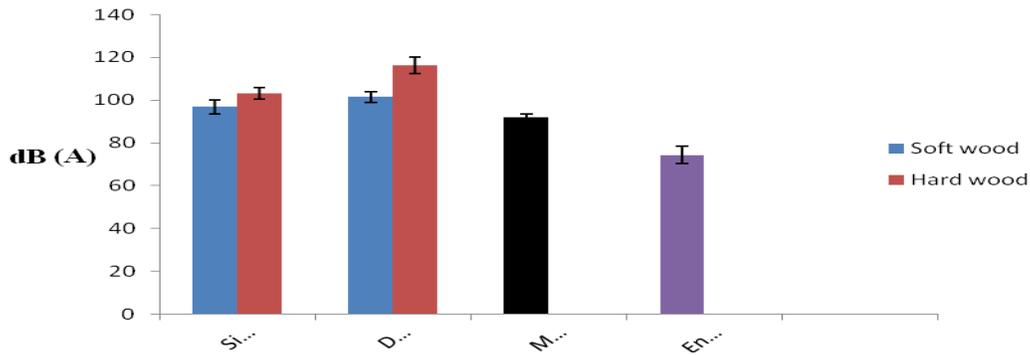


Fig.3 Dose consumed by worker in working day.

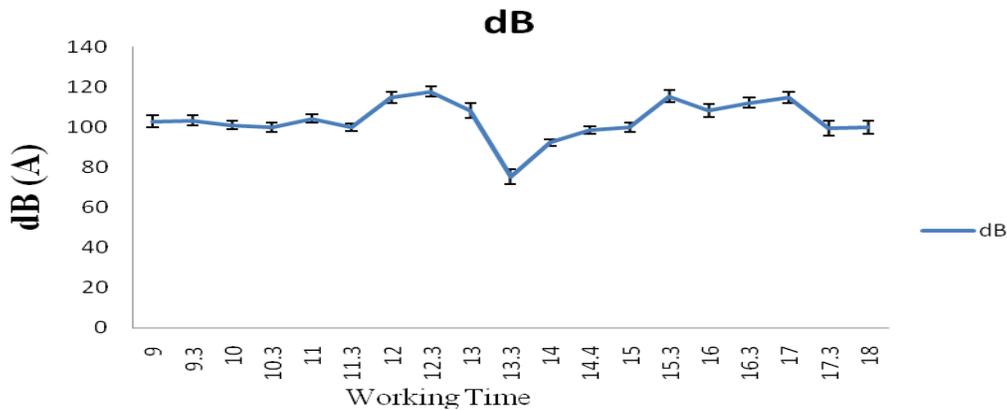
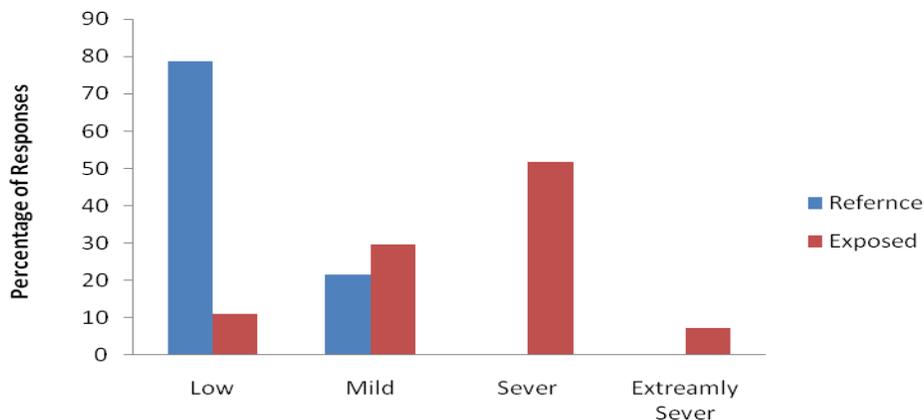


Fig.4 Disturb feeling due to noise during work.



That indicates the high intensity noise may causes their disturb feeling during work. Beside this, the result of all others hearing symptoms from table-2 also are evidence of noise may cause hearing disturbances in the sawmill workers.

The present study deals with the evaluation of exposure of noise to the hearing impairment as detected by audiometry. The person who positioned on the right site to the noise source (saw machine), are getting impaired in their left ear and viseversa.

Although the combined effect of NIHL of the workers is not significantly differ but this value is also greater than that of combined effect of NIHL of the reference persons.

### **Conclusion**

From the present study it can be concluded that sound level in the saw mills exceed the all national and international recommendation limits (85/ 90 dB (A) for 8 hrs. per day). All workers are working in this high level of sound for full working period and that could affect their normal hearing capability. Questionnaire study indicates that the workers are not feeling well and their hearing symptoms are significantly more adverse compared to reference personnel due to noise during the work. Beside these workers hearing impairment becomes worse, especially in the left and right ears. So, all the saw mill workers are in the high risk of NIHL.

### **Recommendations**

Based on the results of this study, the following recommendations are made:

- There should be regular medical examinations of workers in all work stations. The regular check-ups should include comprehensive evaluation, in order to detect cases of any hearing loss.
- Personal protective devices should be used to provide appropriate medical education of both workers in industries in order to prevent this kind of occupational disease.
- More effort should be put into hearing conservation programme activities in order to achieve a greater positive impact on workers awareness. And

reduce the risk of occupational noise induced hearing loss.

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