ORIGINAL ARTICLE

Occupational Hearing Loss: A Health Hazard in Textile Workers

Md. Daulatuzzaman[1], Md. Ashfaquzzaman Sikder[2], SM Khorshed Alam Mojumder[3], Niamatullah Khan[4], Md. Omar Aziz[5]

Abstract:

Hearing loss due to chronic exposure to noise, the Noise Induced Hearing Loss (NIHL) has been associated with industries for many years and NIHL has become an alarming situation for the authorities all over the world. The size of the problem in Bangladesh is not known. Textile industry is one of the most noise producing industries. So, this study was undertaken in one of the textile industries at Narshindi to find out the prevalence, type and severity of NIHL among the workers. The working population of this study industry was 2100 out of which 100 were randomly selected for the study. Out of 100 subjects, 26 (26%) were found to have NIHL. The industry had six departments where study was carried out. The noise intensity levels of each department were measured. Highest intensity of noise was in generator department and lowest in administration department, 97 dB to 10 dB and 45 dB to 50 dB respectively. Average duration of exposure to noise of each subject at various departments in a working day was between 11.33 and 12.17 hours. No NIHL was found in administration department. The highest percentage (53.33%) of NIHL was found in generator department. Dyeing department having highest duration of employment of 9.58 years had NIHL in 43.75%. Factors that were found to be important for developing NIHL were intensity or loudness of noise to which the person was exposed and the cumulative duration of exposure. More than fourth of the employees had NIHL who worked at a noise intensity level 82 dB to 102 dB in contrast to none who worked at 45 dB to 50 dB.

Introduction:

Occupational hearing loss is the dominant cause of preventable sensorineural hearing loss in adults. Noise is the most ubiquitous industrial pollutant. All noise exposure is important. The ear does not distinguish between social, military or industrial noise; they are additive[1]. The effect of noise or any acoustic trauma is of considerable industrial or public health importance. Repeated exposure to high levels of noise is a major cause of deafness, particularly in certain industrial occupations and in places of public or private entertainment where there is over amplification of sound[2]. Noise induced hearing loss is a process of permanent metabolic cochlear damage caused by chronic exposure to loud sound between 90 dB and 140 dB[3].

1. Associate Professor, Department of ENT, Holy Family Red Crescent Medical College , Dhaka.
2. Associate Professor, Department of ENT, Holy Family Red Crescent Medical College, Dhaka.
3. Professor and Head, Department of ENT, Holy Family Red Crescent Medical College, Dhaka.
4. Assistant Registrar, Department of ENT, Holy Family Red Crescent Medical College, Dhaka.
5. Associate Professor, Department of ENT, National Medical College, Dhaka.

Habitual exposure to noise above 85 dB would cause a gradual hearing loss in a significant number of individuals, and louder noises would accelerate this damage. The United States Department of Occupational Safety and Health Administration (OSHA) developed the hearing conservation amendment in 1983 that limited occupational exposure to noise. The noise exposure standard is estimated for unprotected ears; the allowed exposure time decreases by one half for each 5 dB increase in the average noise level. The recommended permissible noise levels and duration of noise exposure is limited to eight hours per day at 90 dB[4].

Noise induced hearing loss (NIHL) has been associated with industry for many years. The results reported from many industrialized countries[5] are alarming to authorities all over the world including Bangladesh. The management of cases of NIHL is proved to be hopeless [6-7]. Most of the western countries have their own regulation and rules for the protection of the workers in noise producing factories[8].

The current regulation will protect 85% of the individuals exposed to recommended noise levels. The remaining 15% could be attributable to individual susceptibility to noise[9], the effect of melanin concentration in the cochlea[10] and aging[11]. Bangladesh is a developing country and the industrial sectors in Bangladesh are growing gradually. Among the workers in the industries, most of the populations in both genders, either skilled or unskilled, are involved in textile and related industries. Workers in certain industries are concerned about developing NIHL as compared with other lower noise levels industries or with the general population. As per environment conservation rules, 1997 the permissible amount of sound has been recommended for industrial zone in Bangladesh is 70 dB for both day and night[12].

The size of the problem of noise induced hearing loss in Bangladesh is not known. Considering the above facts, this study was undertaken to find out the prevalence, type and severity of noise induced hearing loss among the workers of a textile industry.

Materials and method:

This prospective cross-sectional study was carried out in a private textile industry at Narshindi. The main objective of this study was to find out the prevalence of noise induced hearing loss among textile industry workers. This study was carried out between July 2006 to November 2006 by random sampling among 2100 workers. The sample size was 100. Data were collected through interviews, physical examination, audiometry and environmental noise survey. Various tests were carried out within the factory departments and on the workers.

Environmental noise survey was carried out by a trained technician from Hicare Hearing Centre in every work station using a sound level meter (Quest sound level meter, Oconomowoc W. WISCONSIN. Model no: 2400).

Auroscopic examination of the subjects' ears was done by using an otoscope. The condition of the external ear was assessed for the presence of wax in the external meatus and also assessed for the scarring or perforation of the tympanic membrane.

A tuning fork with a frequency of 512 Hz was used to assess bone and air conduction by the Rinne, Weber and Absolute Bone Conduction methods.

A pure tone clinical audiometer (KAMPLEX Audiometer, Model no: AC 30; Calibrated by P.C. Werth Limited on October 2004) with a frequency range of 250 Hz to 8000 Hz and sound intensity levels of between -10 dB to 120 dB was used to test each ear of the subjects separately. The hearing threshold of sound per frequency was tested and manually recorded on an audiogram. PTA of only twenty workers was done at the factory clinic which is situated at sixth floor of the factory, separated from the production departments. Environmental sound intensity level measured at factory clinic was 37 dB to 39 dB. All others workers were brought to Dhaka at Hicare Hearing Centre for audiological assessment.

Subjects were considered impaired when their hearing threshold level exceeded 25 db[13-14]. The background noise level in the factory clinic was between 37 dB to 39 dB.

Results:

The industry had six departments. After measurement of the noise intensity level, the highest intensity level was found in Generator department. and lowest in administration department as 97 dB to 102 dB and 45 dB -50 dB respectively. Average exposure to noise of each subject at various departments in a working day was between 11.33 to 12.17 hours. No NIHL was found in administration department and the highest percentage (26%) of NIHL was found in generator department.

Factors that were found to be important for developing NIHL were intensity or loudness of noise to which person was exposed and the cumulative duration of exposure.

Table- I : Sex distribution of the subjects

Sex	Number of participants	Percentage
Male	91	91
Female	09	09
Total	100	100

The table demonstrates that most of the participants (91%) were male.

Table- II : Distribution of workers in various departments

Department	Number	Percentage
Administration	19	19
Knitting	17	17
Dyeing	17	17
Finishing	14	14
Sewing	18	18
Generator	15	15
Total	100	100

The participants were distributed in various departments as above.

Table-III : Departmental noise intensity levels

Departments	Noise intensity level ranges (dB)
Administration	45-50
Knitting	88-93
Dyeing	93-98
Finishing	85-90
Sewing	82-90
Generator	97-102

Noise intensity levels in various departments were as above.

Table- IV: Duration of daily overtime exposure to noise

Department	Who worked overtime (%)	Mean overtime Hours/month	Mean overtime Hours/day
Administration	68.42	100	4.17
Knitting	100	80	3.33
Dyeing	100	80	3.33
Finishing	100	80	3.33
Sewing	83.33	100	4.17
Generator	100	80	3.33

The average overtime worked in a month by subjects in every section was calculated.

Table-V: Departmental distribution of average daily exposure to noise

Department	Who worked overtime (in %)	Mean overtime Hours/ month	Mean hours of exposure/ day
Administration	68.42	100	12.17
Knitting	100	80	11.33
Dyeing	100	80	11.33
Finishing	100	80	11.33
Sewing	83.33	100	12.17
Generator	100	80	11.33

The table shows the average duration of exposure of each subject in the various departments in a working day.

The hearing status of the subject in the study was assessed by their audiometry curves. A dip in the curve of the audiometer at 4000 Hz to a level of greater then 25 dB was taken as a positive indication for noise positive for noise induced hearing loss[15-16].

Table- VI: Departmental prevalence of NIHL in relation to mean annual exposure

Department	Mean annual exposure (weeks)	NIHL (%)
Administration	48	Nil
Knitting	48	31.25
Dyeing	48	43.75
Finishing	48	21.43
Sewing	48	17.65
Generator	48	53.33

Table- VI1: Relationship of department wise prevalence of NIHL with noise intensity levels

Department	Noise intensity level ranges (dB)	NIHL (%)
Administration	45-50	Nil
Knitting	88-93	31.25
Dyeing	93-98	43.75
Finishing	85-90	21.43
Sewing	82-90	17.65
Generator	97-102	53.33

The highest percentage of NIHL (53.33%) was found in generator department and its noise intensity level was also highest (97 dB to 102 dB)

Table- VIII: Departmental prevalence of NIHL in relation to mean duration of employment

Department	Average duration of employment (years)	NIHL (%)
Administration	7.24	Nil
Knitting	4.88	31.25
Dyeing	9.58	43.75
Fishing	5.14	21.43
Sewing	5.13	17.65
Generator	5.11	53.33

Dyeing section had the highest duration of mean employment (9.58 years) and prevalence of NHIL was 43.75%.

Table- IX: Relationship of duration of employment with amount of hearing loss in NIHL cases (n=26)

Duration of employment (years)	Number (%)	Mean hearing loss dB HL
0-2	Nil	NIL
2-5	05 (18.52)	27
6-10	08 (30.77)	42
11-15	08 (36.33)	47
>15	05 (41.67)	55

Table X: Relation of NIHL with sound intensity level

Noise level	Number of workers	NIHL	No NIHL
45-50 dB	19	Nil	19 (100%)
82-102 dB	81	26 (26%)	55 (66.67%)

Twenty six percent of the workers with sound intensity more than 82 dB had NIHL.

Discussion:

This study was carried out at a textile industry in Narshindi to explore the problem of hearing loss among the workers. In the present study, noise levels at different departments ranged from 45 dB to 102 dB. Generator and Dying departments had the highest noise levels of 97 dB to 102 dB and 93 dB to 98 dB respectively. Administration unit had the lowest sound levels of 45 dB to 50 dB. One study carried out in Eldoret, Kenya[17] also found similar sound intensity level in a textile industry (ranged from 33 dB to 101 dB). Weaving and spinning had the highest noise intensity levels (99 dB to 101 dB and 91 dB to 97 dB respectively) whereas Administration unit had the lowest sound levels (33 dB to 40 dB).

In other similar studies done by Juyaratnam[18] and Belechew[19] both those sections also constituted the noisiest department with noise intensity levels of 92 dB to103.8 dB and 91 dB to 92.4 dB, 90 dB to 94 dB and 99 dB to 101 dB respectively which is similar to many industrialized countries in Europe and United States[20] as well as some African countries including Zimbabwe[21] and Kenya[17,31].

The noise level of 97 dB to 102 dB in generator department in this study was comparable to 99.5 dB measured in weaving section in textile mills in Asma[22], 102.5 dB in Hong Kong[23], 101.3 dB in Thailand[30], 100 dB in Egypt [25,30] and 99 dB to 102 dB in a jute weaving mills in UK[26].

In this study 19% of the study population were exposed to noise intensity levels of 45 dB to 50 dB and 81% were exposed to 82 dB to 102 dB (Table-II, III). More than one fourth of the subjects working at noise intensity levels of 82 dB to 102 dB had a hearing threshold shift characteristic of noise induced hearing loss. This figure was also portrayed almost to near in surveys done in other countries like Kenya[24], Tanzania[18], Euthopia[19] and Jordan[27] where cases of noise induced hearing loss were reported in 32.25%, 26.40%, 32% and 30% respectively.

From the study it was found that 53.33% of the workers in generator department and 43.75% in dying department had a hearing threshold shift towards noise induced hearing loss (Tables-VI, VII). The mean daily exposure time was 11.33 hours and mean daily overtime was 3.33 hours both in generator and sewing department but in sewing section only 17.65% workers had hearing loss whereas 53.33% worker in generator department suffered from NIHL.

In contrast, administrative department had none of their workers with a hearing threshold shift towards noise induced hearing loss. Mean daily exposure of 8.00 hours and a mean daily overtime of 4.17 hours are high but alone could not predispose to hearing loss because of low sound intensity levels between 45 dB to 50 dB in the areas where they work. Exposure up to 78 dB is totally safe[1].

Olero et al reported that hearing threshold for subjects increased with both age and duration of employment[28]. Gunter Rosler reported that the duration of employment was the most decisive cause for pronounced hearing loss increase. In this study, dying department had highest duration of employment (9.58 years) compared to knitting (4.88 years) with prevalence of NIHL of 43.75% and 31.25% respectively. Table-X shows a good correlation between duration of employment and hearing loss. This explains the relationship between long duration of employment and noise induced hearing loss.

This study demonstrated that noise was a serious occupational health hazard in the textile factory. The major risk factors for noise induced hearing loss were the duration of employment and the intensity of noise exposure.

From this study it may be concluded that NIHL is quite prevalent among the workers in textile industries in Bangladesh. It can also be concluded that frequency of NIHL is more among the workers in the department with high intensity noise levels. NIHL is also found to have a direct relationship with the duration of noise exposure and employment time.

Based on the study findings, implementation of hearing conservation programmes through development and enforcement of regulations to identify and monitor occupational risk groups, restriction of import of equipment which emits dangerous level of noise, are recommended. In addition, it is highly recommended that the adaptation of the following principles by factories or any such establishments where noise exposure is hazardous to their employees:

1. Baseline audiogram and periodic screening of the workers;
2. Personal hearing protection by using protective device;
3. Engineering control by maintenance of machines, and equipment, isolation of machines, substitution of machines, sound absorption and damping support;
4. Administrative control by rotating jobs, transferring employees and scheduling machine operating times;
5. Encouraging education of workers to increase their awareness of the hazards of noise exposure;
6. Continuous analysis and assessment of noise exposure; and
7. Continuous analysis of the effectiveness of hearing conservation programme.

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