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Noise Induced Hearing Loss among an Occupational Group of Textile Workers in Karachi, Pakistan

Afshan Shahid[1,*] **[Associate Professor]**, **Tanzil Jamali**[2] **[Assistant Professor]**, and **Muhammad Masood Kadir**[3] **[Professor]**

[1]Department of Community Health Sciences, Services Institute of Medical Sciences (SIMS), Lahore, Pakistan

[2]Department of Community Medicine, CMH Institute of Medical Sciences, Bahawalpur, Pakistan

[3]Department of Community Health Sciences, Aga Khan University, Karachi, Pakistan

Abstract

A cross sectional survey was conducted among textile workers of six textile factories of different industrial areas of Karachi to determine the frequency of hearing loss. A total of 264 workers were assessed for frequency of hearing loss with audiometric and otoscopic examination conducted by audiologist.

About 79% workers had hearing impairment on audiometric assessment having hearing loss ≥25 dB. Of these, 19% of the workers had conductive deafness while 71% had mixed hearing loss. Otoscopic examination revealed that 38% had wax, 41.8 % had ear discharge and 1.6 % had perforation. The multiple logistic regression model shows sound level more than 25 dB aOR: 1.15; 95%CI: 1.10, 1.30 and ear discharge aOR: 2.23; 95%CI: 1.27, 3.92, was found as a strong risk factor of hearing loss ($p<0.05$). Hearing impairment affects a large proportion of the workers in Pakistan. There is a need for screening of workers exposed to occupational noise. Efforts should be made by the health care system to prevent the problem from an early stage and require effective management of ear-related diseases.

Keywords

Occupational noise; Noise induced hearing loss; Textile workers

Introduction

Noise exposure causes many auditory and non-auditory health effects. Exposure to excessive noise is the major avoidable cause of permanent hearing impairment worldwide [1,2].

[*]*Corresponding author: Shahid A, et al., Department of Community Health Sciences,* Services Institute of Medical Sciences (SIMS), Lahore, Pakistan, Tel: 9203005257060, dr.afshanshahid@yahoo.com.

Competing financial interests

The authors declare that they have no conflict of interests

Workers of textile industries are exposed to high level of noise. The functions and processes in textile industry can be broadly classified into four categories: spinning, weaving, wet processing and fabrication [1–4]. Noise is produced in all the processes but the highest noise is reported in the weaving section of the textile factory where the weaving of the fabric from the thread takes place[3,4]. The non-auditory effects due to noise include annoyance, inability to communicate, headaches, lack of concentration, hypertension, disturbance of psychosocial well-being, and psychiatric disorders reported by various studies [1,3].

Globally, 16% of the disabling hearing loss around 4 million workers is attributed to occupational noise, ranging from 7 to 21% in different regions [1]. The estimated cost of noise to developed countries ranges from 0.2 to 2% of the gross domestic products (GDP), where it is the cause of more than one-third of the hearing impairments. The effects of the exposure to occupational noise are higher in the developing regions than the developed countries [2]. In Canada, occupational hearing loss continues to be among ten leading occupational diseases and is reported to be 7–21% amongst the textile workers [5]. In one of the study, Lagos reported hearing loss in 79.8% workers and highest reported (84%) among workers of weaving section [6]. One of the study from India reported that noise level in weaving sections of textile industry was 91dB leading to hearing loss in 93% of the textile workers [7]. Studies conducted among textile workers of Jordan [8], reported hearing loss in 30 – 53% of workers of weaving section. A study conducted amongst textile workers of Karachi showed that noise was a major factor which created hearing loss in 22% of workers [3].

The Occupational Safety and Health Administration (OSHA) standards and environmental protection agencies regulations have been implemented in high income countries which is 85 dB for 8 hours of work [4]. However, in many low and middle income countries, excessive noise is the biggest compensable occupational hazard [9–11].

Pakistan is the fourth-largest producer of cotton in the world and it contributes 5% to the global spinning capacity. Therefore, the textile industry plays a significant role in the national economy and also provides[12,13]. In Karachi approximately, 794 registered textile units with approximately 40,500 workers working in the city. However, the burden of disease among textile workers is unknown which is necessary for making policies and regulations, so that preventable noise induced hearing loss can be addressed [14]. Few studies have been conducted in Karachi to assess the frequency of hearing loss in textile worker [3,15]. Most of these studies were questionnaire based and non-specific tests like Rinnes and Weber were used to diagnose hearing impairment. There wer no objective assessment was done to estimate the problem and the evaluation of associated symptoms and factors was not been done so far. Therefore the aim of this study was to measure the noise levels in 8 hour shift through sound level meter in the weaving sections; type of hearing loss and the associated symptoms and factors due to noise induced hearing loss among textile workers of Karachi.

Methods

Study design and Setting

It was a cross-sectional survey conducted for the period of three months from July 2014 till September 2014. This study was conducted in the largest mega city and industrial hub of Pakistan; Karachi which contributes around 30% of Pakistan's manufacturing sector is a metropolis, located in the southern region of Pakistan, and the capital of Sindh province is a commercial hub and accounts for more than to 50% of national economic income [16]. According to the Labor Force Survey 2015, approximately 14.31 million people work in Sindh. Karachi is the center of the textile industry in Pakistan, where an estimated 4500 industrial units operate in the formal sector [16,17].

Sampling technique

We have applied all the factories through Towel Manufacturing Association (TMA) Group and after receiving approval from six factories from five main industrial areas in Karachi (located in Korangi/Landhi Industrial Area, North Karachi Industrial Area, Sindh Industrial Trading Estate (SITE) and Super Highway) we started data collection. All the textile factories were selected through permission from their owners. The convenient sampling was done to recruit participants in the textile mills as it was difficult to perform probability sampling in such conditions. The list of all the workers was provided through the administrator and those workers, who were fulfilling the inclusion criteria, were selected in the study.

Inclusion & exclusion criteria

We included adult workers aged above 19 years, working for at least 1 year in the weaving department, working for minimum 8 hours per shift. Workers from the morning and afternoon shifts were included in the sample due to time constrain. However, we excluded the administrative staff from the study. We further excluded workers having a visible deformity, self-reported pain or discomfort in an ear by the help of physical examination by a trained physician and the medical record and history provided by the textile mills.

Sample Size calculation

The sample size was calculated by using the WHO sample size calculator. With the 95% confidence interval, anticipated population proportion of 22% [3], absolute precision of 0.05, the sample was found to be 264. For determining the associated factors, the sample size was calculated by using odds ratio of 3.6 for sound levels, age OR: 1.8 and hearing loss OR: 1.14 [18–20] using 95% confidence interval and 80% power and the case to control ratio of 1:1, the sample size was calculated to be 162. Therefore the final sample size for the study was 264.

Operational definitions

The WHO definition of hearing impairment, was used with the threshold of ≥26dB [21].

Conductive deafness defined, if the bone conduction threshold was below or equal to 25 dB and an air-bone conduction gap was 15 dB or greater. Air-bone conduction gap is the space

between two lines drawn for air-conduction and bone-conduction on the audiogram. If the bone conduction threshold was greater than 25 dB and the air-bone conduction was 15 dB or greater, the hearing impairment was classified as mixed loss [22]. If no air-bone gap was seen on the audiogram, the loss was described as the sensorineural.

Data collection

The data were collected by using self reported structured questionnaire, regarding socieo-demographic information including age, ethnicity, education status, marital status, monthly income in (PKR), working hours and job duration

Noise Level measurement

The noise levels were measured in the factories at the working places by noise level meter (TES-1358, TES Electronic Company, Taiwan). The noise meter report 1 sec to 24 hours continuous sound level in a range of 30–130 dBA. It also records the time weighted average (TWA) noise level. The average of three days reading was taken to report the noise exposure of the workers.

Ear and Audiometric evaluation

Ear examination through an otoscope was also done by a trained audiologist. The research audiologist conducted the audiometric evaluation for all the study participants in accordance with the WHO Ear and Hearing Disorders Survey Protocol [23]. A portable diagnostic audiometer was used (Model AD-12; Interacoustics Co, Denmark) with TDH-39 supra-aural earphones. The audiometer was calibrated prior to the study to ensure reliability of the results. The participant was seated with his/her back to the instrument and the audiologist. First the right ear was tested after ensuring that the headphones were fit snugly over the participant’s ears. Each time the participant heard a sound, to respond by raising a hand. Sound at the start of the test was presented at 60 DBHL at 1 KHz. If there was no response at this threshold, it was increased by 10 dBs until there was a response from the participant. The hearing threshold was established at this frequency by decreasing the threshold by 10 dB and then increasing it in 5 dB steps until the threshold was confirmed by the participant on 3 successive occasions.

Statistical Analysis

Data was analyzed using software of Statistical Package of Social Sciences (SPSS version 21). Descriptive statistics of the sociodemographic variables were computed as mean, standard deviation or frequency percentages. Univariate and multivariate logistic regression was performed for various symptoms of hearing loss and other associated factors including; job duration, ear discomfort, ear discharge tinnitus and sound levels. These factors were adjusted for age, marital status, ethnicity, monthly income (PKR) and smoking status. The $p<0.05$ taken as significance level.

Ethical considerations

Approval was taken from the ethics review committee of Aga Khan University, Karachi. Written informed consent was taken from all participants.

Results

The response rate of the study was 91%. We approached in total 290 participants in which n=264 were finally agreed to be in the study. The mean age of the workers was 30 years (± 10.58). Most of the study participants, 63.1% categorized under the age group of 18–34 years, followed by 23.5% in the age group of 35–44 years and 13.3% in the age group of more than 45 years. Almost around 15 to 20 percent of the sample collected from each selected 6 mills in the study with; 9.5% were taken from mill 1, 17.8% mill 2, 16.3% mill 3, 15.5%, 19.3% mill 4 and 5 each and 21.6% mill 6. Majority of the workers 57.8% were educated with 28.4% were primary and 33.4% were having secondary and above education. Illiterate were 38.3% who were unable to read and write, with the majority of workers 70.5% earning less than 20,000 rupees per month and 29.5% earning more than 20,000 rupees per month. The mean duration of work was 5.6±5.8 years, with the 66.3% of the workers duration of work had been working in the textile mills for 1–5 years (Table 1).

The frequency of hearing impairment on audiometry among selected textile mills was found 79%. Furthermore, by otoscopic examination 75.6% workers had hearing impairment in both ears (Table 2).

Audio logical examination (including an otoscopy and audiometry) shows 38% of the workers had difficulty in hearing. During the otoscopic examination, 17% of the workers had normal ears, 38.5% had wax in ears, 41.8% had ear discharge, 1.6% were found to have ear perforation and 1.1% with tinnitus (Figure 1).

A nearly symmetrical hearing loss was observed in both the ears, 21% were having normal hearing in right ear, and 22% on the left ear. In right ear 15.4% had conductive loss, 1.1% had sensorineural loss and 62% had mixed loss. Similarly in the left ear, 14% had conductive loss, 0.7% had sensorineural loss and 63.2% had mixed loss (Table 3).

The univarite and multivariate logistic regression modeling was done to describe the associated factors of hearing loss among textile workers. The multivariate model shows the sound level more than 25 dB in a textile unit is a strong risk factor of hearing loss (aOR: 1.15; 95%CI: 1.10, 1.30). Further, Ear discharge was also found significant with (aOR: 2.2; 95%CI: 1.2, 3.9). The model was adjusted for workers age, marital status, ethnicity, education level, monthly income (PKR) and smoking status ($p<0.05$) (Table 4).

Discussion

Hearing loss is a ‘silent’ disorder that mostly affects the extreme age groups, the very young and old as demonstrated by prevalence studies from around the world [1,24,25]. In Pakistan, only two studies have focused on NIHL in textile workers of Karachi with limited screening and diagnostic methodology [3,15]. However, our study was the first of its own kind in Pakistan to have evaluate hearing problems in occupational settings by using an audiometric screening test in six textile factories to estimate the burden of hearing loss among these workers. Furthermore, this study also highlighted the important associated factors and ear symptoms, leading to hearing loss among textile workers.

The findings of our study are comparable with the findings of other studies globally. A study conducted in Nigeria reported disabling hearing loss in 17% of the workers from weaving section with 58% attributable fraction for hearing loss among workers [26]. Other studies from India, Nigeria and Saudi Arabia reported the range of prevalence of 38–49.3% by audiometry for textile workers using threshold values of ≥ 26Db [4,26,27]. The audiometer used in this study was validated against the “Gold Standard” at the ENT clinic at the Aga Khan University Hospital and a difference of 10 dB was recorded which may have led to the high estimates of prevalence and severity. The reason of this difference could be the ambient noise as well as instrument difference. It is also possible that the inability to use sound-attenuated booth for audiometric testing could have led to overestimation of the prevalence and severity of impairment of the study participants. On the otherhand, a study conducted in Karachi reported hearing loss in 17% workers by Rinnes test and 16% by Webers test, which are contrary to findings of our study, this difference in frequency of hearing loss can be explained by the use of non-standardized questionnaire and tests to assess the hearing loss [3].

The noise level in our sampled factories was very high with mean 97±2 dB and a range of 97–99 dB. Similar noise levels have been reported in a study conducted in a polyester fiber plant of Karachi. Another textile firm of Karachi reported a sound level ranging between 91–109 dB, showing that the workers are overexposed to noise by about 60 to 84 percent [28]. A study conducted in Saudi Arabia reported hearing loss in 30% of workers from a textile mill as compared to 8% hearing loss in the control group. Hearing loss increased with increasing noise level reaching up to 73% with a noise exposure of 97dB [27].

Literature have been reported that ear infection can cause 5dB to 20 dB of hearing loss depending on the extent of occlusion [29,30]. In our findings, ear-related conditions caused hearing impairment in one-third of the study participants, which is similar to that reported in other regional study conducted in Oman [11,31,32]. Our finding was based on an evidence of infection as seen on an otoscopy as well as presence of wax in ear examination. However, it was not feasible to reassess the participants with wax in ear after the removal of wax under the logistics of this study. Therefore, some hearing loss that could be attributed to presence of wax alone may have been misclassify under the combined category labeled as ear-related conditions [33]. Presence of wax and ear infections may have contributed to this high degree of severity and requires interpretation with caution.

The workers in our study sample was working for 12 hour duration, either in the day or night shift. In order to meet an 8 hours 85 dBA limit the average sound level over a 12 hour shift must be 83 dBA to allow for the extra 4 hours or exposure. Hearing loss accumulates over a period of years; their actual exposure according to the equal energy theory would actually be 2 dB lower if their exposure met the 83 dBA means an exposure of 81 dB for these long working hours. The high frequency of hearing loss in these workers is well attributed to be the product of duration of work and exposure to noise.

Education status and number of working hours per day showed no association with the hearing impairment. First, majority of the workers were uneducated or having informal education, while the remaining that had some education; it is unlikely that it would have

greatly influenced their health behaviors. Moreover, the number of working hours in this study was more or less the same with very little variation. No association was seen in hearing impairment and job duration in our study, which are contrary to the findings with other literature [31,34].Longitudinal occupation-based studies using 24 hour ambulatory sound-level monitoring could ascertain the noise exposure in a better manner [30–34].

The strength of our study included; first study of its kind to study the hearing loss among an occupational group of textile workers from different textile factories in Karachi. We used a gold standard tool was used to assess the hearing status of the workers. Otoscopic examination was carried out for all the interviewed workers to assess the aural status. Very few studies in the past have been conducted in this domain reporting the hearing loss and noise exposure in the factories. This study highlighted the important symptoms and associated factors by using a regression model with adjusted sociodemographic factors. The sample was powered for various associated factors.This study provides a useful information about the level of hearing loss, which if not catered; can lead to a handicap to the young workers contributing to the economy of Pakistan.

The non-probability sampling was done to estimate the prevalence of hearing loss. Due to limited textile mills were approved to participate in the study, variety of the sample was unable to collect. Secondly, there is a standard clinical protocol requires audiometric testing be performed in the sound-proof chamber. However, due to limited finances and logistical difficulties, we were unable to provide a mobile sound-proof chamber for audiometry. We were unable to obtain the sound level as we did not have a sound-meter for the study because of insufficient budget.

There is a dire need for screening of workers exposed to occupational noise at regular interval. Furthermore, health education sessions for the awareness of preventive and protective care within the industry should also be the part of workers schedule on a monthly basis. Efforts should be made by the health care system at preventing the problem from an early stage and policy changes to protect people from high levels of occupational and environmental noise.

Conclusion

Hearing impairment affects a large proportion of the workers in Pakistan. The findings of this study highlighted the magnitude of the problem, the necessity of the application of preventive measures and the need for more studies in this field. The findings of this study established that textile workers in the weaving department of textile industries were at high risk of developing hearing loss and other associated infirmities due to excessive occupational exposure to noise. The evidence generated by this study needs to be further strengthened by conducting a more objective research on a large scale.

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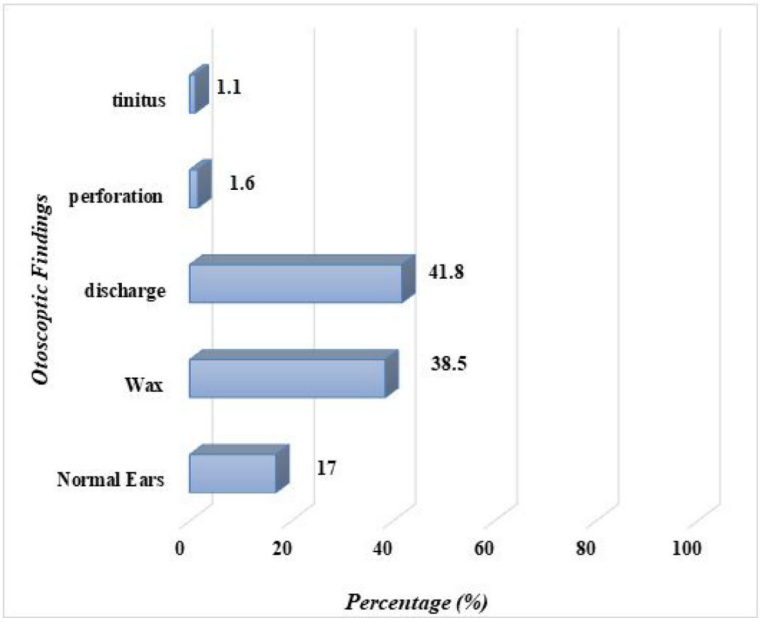

Figure 1:
Percentage distribution of otoscopic findings in textile workers of Karachi (n=264).

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Table 1:

Frequency distribution of socio demographic and occupational characteristics among textile workers in Karachi, Pakistan (n=264).

Characteristics	Frequency (n)	Percentage (%)
Age		
18–34 years	167	63.1
35–44 years	62	23.5
>45 years	35	13.3
Mill ID		
Mill 1	25	9.5
Mill 2	47	17.8
Mill 3	43	16.3
Mill 4	41	15.5
Mill 5	51	19.3
Mill 6	57	21.6
Educational Status		
Uneducated1	114	43.2
Educated	150	56.8
Marital Status		
Unmarried	89	33.7
Married	175	66.3
Ethnicity		
Urdu	66	25
Sindhi	25	9.5
Pushto	54	20.5
Punjabi	54	20.5
Others2	66	25
Duration of work (in years)		
1–5 years	175	66.3
>5–10 years	51	19.3
Above 10 years	38	14.4

Characteristics	Frequency (n)	Percentage (%)
Monthly Income in PKR		
≤20,000	201	76.1
>20,000	63	23.9

Included informal education and uneducated.

Included Saraiki,Gujrati, Hindko and Gilgiti

Table 2:

Frequency distribution of hearing symptoms and impairment among textile workers in Karachi, Pakistan (n=264).

Variable	Frequency (n)	Percentage (%)
Self-reported hearing loss		
Yes	100	38
No	164	62
Audiometrya		
≤25 dB	55	21
≥25 dB	209	79
Otoscopic examination		
No hearing loss	55	21
Impairment in one ear	9	3.4
Impairment in both ear	200	75.6

A WHO classification <25 no hearing loss and >25 hearing loss in both ears.

Table 3:

Frequency distribution of type of hearing impairment in both ears among textile workers in Karachi (n=264).

Types of hearing impairment	Right Ear n(%)	Left Ear n(%)
No deafness	55 (21)	58 (22)
Conductive	40 (15)	37 (14)
Sensorineural	3 (1.11)	2 (0.7)
Mixed	166 (62)	167 (63.2)

Table 4:

Multiple logistic regression for various risk factors of hearing loss among occupational group of textile workers.

Characteristics	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Job duration	0.73 (0.37–1.44)	1.63 (0.80–3.30)
Ear discomfort	1.46 (0.72–2.94)	1.66 (0.79–3.45)
Ear discharge	1.89 (1.11–3.23)	2.23 (1.27–3.92) *
Tinnitus	1.43 (0.35–5.84)	1.70 (0.41–7.01)
Sound level (dB)	1.10 (1.04–1.28)	1.15 (1.10–1.30) *
Ear ringing	1.07 (0.56–2.41)	1.16 (0.54–2.47)

* p<0.05, Adjusted for age, marital status, ethnicity, monthly income, smoking status; Hearing loss on the basis of >25dB in one or two ear.