

Extra Auditory Effect of Noise – A Study on Textile Workers of Surat City

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ABSTRACT

Aims: To find out extra auditory effect of noise like headache, vertigo, tinnitus and difficulty in hearing on textile workers of Surat city who were exposed to high level of sound at their workplace and to find out their relationship with duration of exposure to noise. It was also tried to determine any relationship between degree of hearing loss and extra auditory effect of sound.

Materials and methods: 50 male Hindu workers of different textile mills of Surat City were examined by audiometry to determine degree of hearing loss and interviewed for subjective feeling of headache, vertigo or tinnitus. Age group of workers was between 20-50 years. Controls were taken from different parts Surat city. All were male and Hindu by religion, between 20-5- years of age without any of exposure to any kind of noise.

Results: Among 50 workers exposed to high level of sound, 30% workers had complained about tinnitus whereas among controls only 2% had complained about it. When tinnitus was correlated with duration of exposure, it was seen that with duration of exposure to noise >20 years (n=20) 55% workers were suffering from tinnitus, with duration of exposure 10-20 years (n=15) 20% were suffering from tinnitus and with duration <10 years (n=15) 6.66% had complained about it. As far as difficulty in hearing was concerned, among study group 14% had complained of hearing difficulty whereas the figure was 4% among controls. When relationship between degree of hearing loss and subjective feeling of hearing difficulty was calculated, it was found that 7 out of 9 i.e. 77.77% workers suffering from moderate degree of hearing loss had complained about hearing difficulties. No one with normal hearing or mild degree hearing loss had any problem with hearing. 2% workers exposed to noise had complained about headache whereas the no. was 4% among unexposed group. As far as vertigo was concerned, 4% workers among study group were suffering from it whereas it was 2% among control group. No one among study as well as control group had complained about any difficulty in speech. Prevalence of tinnitus was significantly high among exposed group which increases with increase in duration of exposure. Prevalence of difficulty in hearing between study and control group was statistically not significant, but relationship between degree of hearing loss and difficulty in hearing was highly significant. No significant relationship between noise and headache, vertigo or difficulty in speech can be established.

Conclusion: From this study it can be concluded that noise has significant effect on tinnitus and difficulty of hearing is related with degree of hearing loss.

KEY WORDS: Audiometry; Tinnitus; Vertigo

INTRODUCTION

A healthy and productive worker is critical to sustainable social and economic development. The oldest occupation of human beings in 4000 BC was hunting. Men used to hunt with hand tools. The industrial revolution of 18th century had brought in new problems of society like creations of slums, overcrowding, social problems, industrial and communicable diseases etc. With the industrialization came louder machines and perhaps noise become most common occupational and industrial hazard.

After presbycusis noise induced hearing loss is the second most common cause of sensory neural hearing loss. As many as 30 million Americans are affected by potentially harmful sound levels in their workplace and worldwide the numbers are from 500-600 million.^[1] Apart from its effect on hearing threshold, noise has many extra auditory effects also like hypertension, headache, tinnitus, vertigo, difficulty in hearing or speech etc. It is now regarded as the obligation of the employer to keep noise down to acceptable harmless level by using modern machines or by keeping the old machine update.

There are many industries where the risk of development of noise induced harmful effect is very high e.g. diesel engine room, electric furnace arc, petroleum industry, newspaper press etc. A noise level of 90 dB(A), 8 hours a day for 5 days per week is the maximum safe limit as recommended by Ministry of Labour, Govt. Of India- Model rules under Factories Act.^[2] Textile industry is one of such industry where the risk of development of noise induced hazards is very high as the average sound level is about 106 dB. High level of noise in workplace is very hazardous as it is sustained on a regular basis for many hours each day over many years.

Noise has mainly three types of effect on health-

1. Acute acoustic trauma – It is mainly due to intense noise damaging middle and/or inner ear. In one study on 52 cases of acute acoustic trauma, the most common symptoms were hearing loss (95%) and tinnitus (70%).^[3] A

survey of world war II casualties indicated that aural injuries accounted for 5.8% patients treated at a US military hospitals in Paris.^[4] In an event in 1980 in Belfast, Northern Ireland, about one year after an explosive blast in a restaurant, 30% of those present there were suffered from high frequency hearing loss.^[5]

2. Chronic hearing loss- Exposure to chronic noise primarily damages organ of corti. The hair cells, cochlear vessels, stria vascularis can also be damaged.^[6]
3. Extra auditory effect- An important extra auditory effect of noise is on blood pressure. The proposed cause of hypertension is stress response. Stress due to noise causes release of adrenocortical hormones which eventually leads to high blood pressure. In a study in 1990 on about 200 workers in a quiet plant in comparison to other in a noisy plant showed no difference between mean systolic or diastolic blood pressure. But another study on 245 retired metal assembly workers showed a significant relationship between hypertension and noise induced hearing loss.^[7,8] Study by Bell S et al in 1984 on 500 textile workers showed that approximately a third had hypertension. Pillsbury claimed a significant relationship between hypertension, noise, hyperlipoproteinuria and hearing loss.^[9] In some research the effect of noise on various hormonal responses like increased level of urinary catecholamine and 17 hydroxy corticoids was described.^[10] Some study showed that exposure to noise had increased teratogenic effect on laboratory rats,^[11] but in another study 1200 women were evaluated and the result shows no relation between noise exposure and teratogenic effect on pregnancy.^[12]

In a study by Lalnde NM on 131 offspring of Quebec women, threefold increase in the risk of high frequency hearing loss in the children was observed who were exposed to noise in utero in the range of 85-95dB.^[13]

In one study 60% workers rated high level of unwanted noise as highly annoying. Impact of annoying noise may serve as a warning that it is adversely affecting the health. So it reduces the processing capacity and increases the cost of performing a task. The efficacy on multiplication task decreases in the presence of background noise. It increases fatigue symptom and post work irritability and after work was over relaxing become very much difficult.^[14,15]

ONIT (Occupational Noise Induced Tinnitus)

Tinnitus is the sensation of sound not brought by simultaneously externally applied mechanoacoustic or electric signals. This definition excludes vascular sounds and bruits.^[16] Johnston reported tinnitus as a common complaint. It was present in 40% workers, but it was slight and never causes loss of sleep.^[17] In contrast to this Goldner AI in a study on shipyard workers in USA reported that tinnitus was more disturbing than deafness and in some it required change in job.^[18] In a study on 160 patients with acoustic trauma 30% had tinnitus and in one third it was sole symptom.^[19] Some reported tinnitus in 94 patients who also had noise induced hearing loss.^[20]

ONIV (Occupational Noise Induced Vertigo)

Vertigo is a hallucination of movement. It should be regarded as symptom of a vestibular system lesion, whether peripheral or central and should not be restricted to a sensation of rotation, but should also include linear motion as in tending to stagger in one side.^[16] In 1831, Fosbroke wrote 'The black smith deafness is a consequence of their employment; it creeps on them gradually, the deafness increases with a ringing noise in the ear, slight vertigo and pain into the cranial bones, periodical or otherwise and often violent.'^[17] In the MRC/NPL survey hearing and noise in industry, 2 out of 581 subjects were reported to have vertigo which is much lower prevalence than general population.^[21] In another study done on 29 maintenance engineers of Royal Dutch Airlines, 10 subjects complained of occasional spells of dizziness and sensation of being off balance.^[22] Chadwick shows

unsteadiness and dizziness in 30 out of 160 patients.

MATERIALS AND METHODS

A sample size of 50 male textile workers of Surat city who were exposed to high level of noise was taken. For control 50 people of different places of Surat city were taken who were not exposed to any kind of such high noise in their life. Age group of both study and control group were between 20-50 years. After exclusion criteria, data were collected by interviews, physical and local examinations and by audiometry. Study was conducted with the help of pre tested structured questionnaire which includes a detail and relevant history, duration of exposure, any difficulty in hearing or speech. All of them were especially enquired about headache, tinnitus and vertigo.

All audiometric tests were carried out in a quiet room outside the factory before the workers entered their work shift. Testing frequency was between 250- 8000 Hz. The model used was 'ELCON MILLI'.

Audiometry

Measurement of hearing using electro acoustic devices, in contrast to the non-electro acoustic devices (human voice, tuning fork) is termed audiometry. It is an electronic device in which an earphone is connected to an electronic oscillator capable of emitting pure tones ranging from low frequency to high frequency. The instrument is so calibrated that the zero intensity of sound at each frequency is the loudness that can barely be heard by the normal person. Each tone can be separately amplified to a maximum of 100 or 110 dB.

Then the hearing threshold is determined at each frequency. Hearing threshold is the minimum sound that a subject may hear for a given tone or frequency. The International Standards Organization has defined hearing threshold as "*the lowest sound pressure level at which under specified conditions, a person gives a predetermined percentage of correct response on*

repeated trials,” for our clinical use this ‘predetermined percentage’ was 50% of the number times the tone is introduced into the ear. That is, the sound at threshold should be so faint that if the sound is presented to the test ear 6 times, the subject will hear it only thrice and miss it for the other three times. The method used for audiometry was that recommended by ASHA i.e. American Speech And Hearing Association. In this the test is started with 1000 Hz and the threshold is obtained for various frequencies in the order 1000-2000-4000-8000 and then 250 & 500 Hz.

After determining hearing threshold, workers were classified into 6 groups according to WHO classification. Then it was tried to find out any relationship between degree of hearing loss and hearing difficulty as well as tinnitus. As the difficulty in hearing is mainly related with speech frequency, i.e. average hearing threshold level at 500 Hz, 1000 Hz and 2000 Hz and most severely affected frequency is 4000 Hz. So degree of hearing loss was determined at speech frequency as well as at 4000 Hz frequency.

WHO classification of hearing loss

Hearing loss in dB	Degree of hearing loss
0-25	No hearing loss
26-40	Mild
41-55	Moderate
56-70	Moderately Severe
71-91	Severe
Above 91	Total

RESULTS

Tinnitus

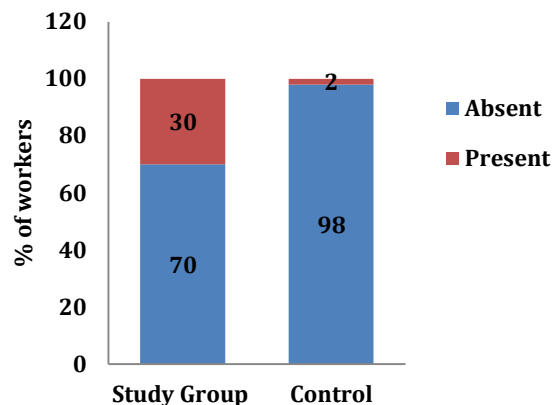
In this study hypertension was in exclusion criteria. So no relationship between noise and blood pressure can be established. Most important association was found between noise and tinnitus. Among study group 30% workers had complained about tinnitus whereas it was only 2% among controls. It was highly significant as $p < 0.01$. (Table 1, Figure 1)

Table-1: Comparison of prevalence of tinnitus among study group and control

Tinnitus	Study group (n=50)	Control group (n=50)
Present	15 (30%)	1 (2%)
Absent	35 (70%)	49(98%)

$p < 0.01$

Figure-1: Prevalence of tinnitus among study and control group

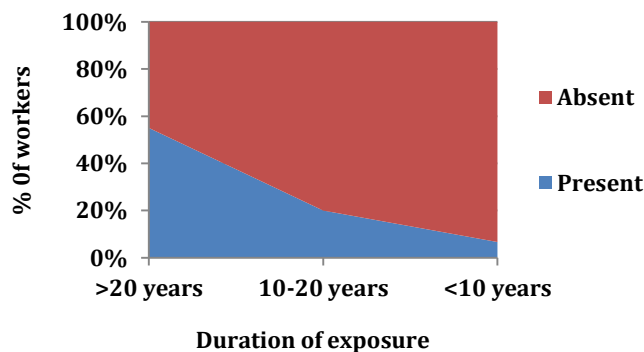


After this the effect of duration of exposure on tinnitus was studied. For this workers were divided into three groups- >20 years of exposure (n=20), 10-20 years of exposure (n=15), <10 years of exposure (n=15). With duration of exposure >20 years, 55% workers had complained about tinnitus whereas with duration of exposure 10-20 years it was 20% and with duration of exposure < 10 years it was only6.66%. it is statistically highly significant as $p < 0.01$. (Table 2, Figure 2)

Table-2: Effect of duration of exposure on tinnitus

Duration of exposure	Tinnitus	
	Present	Absent
>20 years (n=20)	11 (55%)	9 (45%)
10-20 years (n=15)	3 (20%)	12 (80%)
<10 years (n=15)	1 (6.66%)	14 (93.34%)

Figure-2: Effect of duration of exposure on prevalence of tinnitus

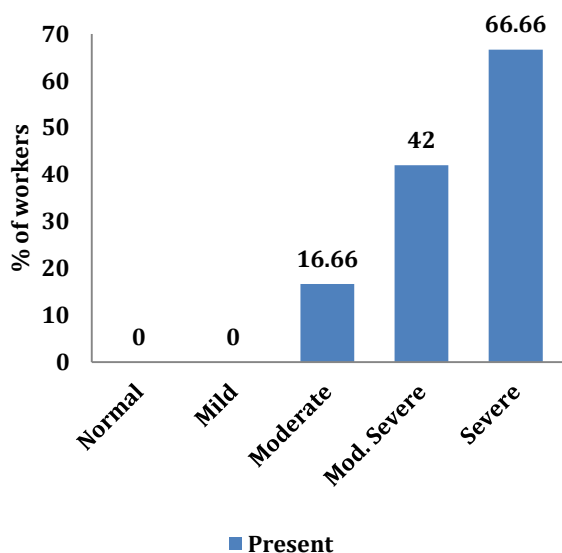


Then it was tried to find out whether there is any relationship between degree of hearing loss and tinnitus is present or not. 30% workers were suffering from tinnitus. Among them no one had normal hearing or mild degree of hearing loss. Among 18 workers having moderate degree of hearing loss, 3workers i.e. 16.66% had tinnitus. 19 workers were suffering from moderately severe degree of hearing loss. Among them 8 (42%) had complained about tinnitus. 4 out of 6 i.e. 66.66% workers with severe degree of hearing loss were suffering from tinnitus. (Table 3, Figure 3)

Table-3: Relationship between degree of H. loss and tinnitus

Degree of hearing loss	% of workers having tinnitus
No hearing loss	0
Mild	0
Moderate	16.66
Moderately Severe	42
Severe	66.66

Figure-3: Prevalence of tinnitus among study and control group



Difficulty in Hearing

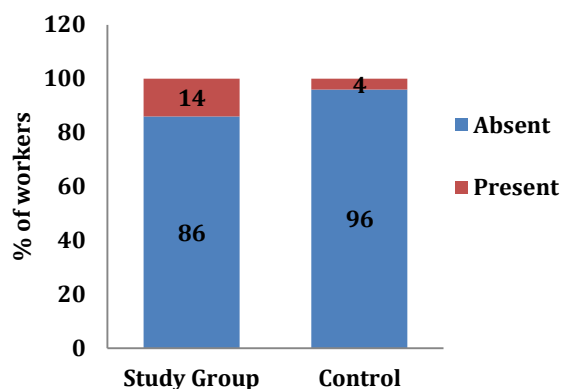
As far as subjective feeling of difficulty in hearing is concerned, it was present in 14% of workers whereas 4% people among control group had difficulty in hearing. It was statistically not significant as $p > 0.05$. but when we look for the difficulty in hearing with regards to degree of hearing loss, it can be seen that 7 out of 9 workers i.e. 77.77% workers with moderate

degree of hearing loss had complained about it. No one with mild degree of hearing loss had any difficulty in hearing. (Table 4, Figure 4)

Table-4: Relationship between degree of Hearing loss and tinnitus

	Difficulty in hearing		
	Present	Absent	Total
Study group	7 (14%)	43 (86%)	50
Control	2 (4%)	48 (96%)	50

Figure-4: Prevalence of tinnitus among study and control group



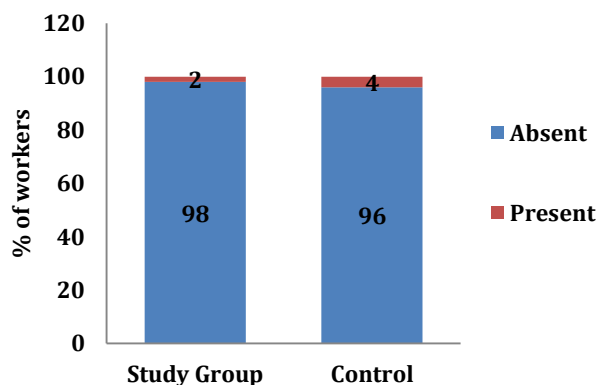
Headache

In this study 2% workers have complained about headache whereas among controls it was 4%. Statistically this difference was not significant as $p > 0.05$. (Table 5, Figure 5)

Table-5: Distribution of people according to presence of headache

	Headache		
	Present	Absent	Total
Study group	1 (14%)	49 (98%)	50
Control	2 (4%)	48 (96%)	50

Figure-5: Distribution of workers according to presence of headache



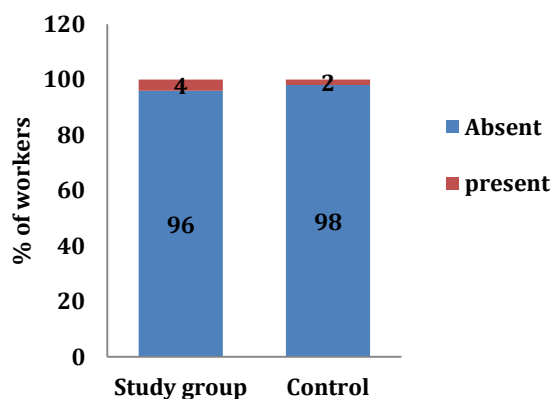
Vertigo

Again no statistically significant relationship between noise and vertigo can be established in this study. 4% workers in the study group were suffering from vertigo and the number was 2% among controls. (Table 6, Figure 6)

Table-6: Distribution of people according to presence of vertigo

	Vertigo		
	Present	Absent	Total
Study group	2 (4%)	48 (96%)	50
Control	1 (14%)	49 (98%)	50

Figure-6: Distribution of workers according to presence of vertigo



Difficulty in Speech

In this study neither any workers from study group nor any subject from control group had complained about it.

DISCUSSION

Noise has deleterious effect on hearing as well as on other system of the body. In this study among extra auditory effects of noise, the positive relationship between noise and tinnitus is found. Prevalence of tinnitus is significantly high among workers exposed to noise. Prevalence of tinnitus is also increasing with increase in duration of exposure to noise. It is maximum with duration >20 years and minimum with duration <10 years of exposure to noise. Again the prevalence is increasing with increase in degree of hearing loss. It is highest among the workers suffering from severe degree of hearing loss. Prevalence is higher among workers having moderately severe

degree of hearing loss than the workers having moderate degree of hearing loss. No one with mild hearing loss or with normal hearing had complained about tinnitus.

Prevalence of difficulty in hearing was statistically not high among workers exposed to noise, but it was confined to those workers only who were suffering from moderate degree of hearing loss.

No significant relationship between noise and headache, vertigo or difficulty in speech can be found in this study.

CONCLUSION

From this study it can be concluded that the prevalence of tinnitus is very high among textile workers of Surat city who were exposed to very high level of sound at their workplace. The prevalence is increasing with increase in duration of exposure as well as with increase in severity of hearing loss.

It certainly shows that the condition is critical which demands some modification at their workplace to keep the sound level at lower level.

LIMITATION

In spite of taking all the precautions during data collection, there were certain limitations faced by the investigators. For data collection they have to rely on truthfulness and memory of the workers among whom the literacy rate was very low.

Sample size was small, so some observed data could not show any statistical difference.

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