

EFFECT OF AGEING ON HEARING IMPAIRMENT IN SPINNING MILL EMPLOYEES

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Abstract: The industrial revolution has modernised the companies with machines before kept only by man. In recent times, noise pollution is one of the most permeative problems in the occupational environment which affects workers in various professions. Based on demographic prognoses, it must be assumed that a greater number of older workers will be found in the future labor market. How to deal with their possible age-related impairments of sensory functions, like hearing impairment and work performance during extended working time, has not been addressed explicitly until now. The aim of this study was to detect the effect of ageing on hearing impairment in spinning mill workers. 53 workers in the age group of 15-40 years from a spinning mill were included in the study. Healthy individuals in the same age group who were not exposed to noisy workplaces were taken as controls. Pure tone audiometry was performed in both cases and controls in the sound proof audiometry room. The results observed was that there was a significant degree of hearing loss as age advances in spinning mill worker. The study implies the need of awareness about health hazards due to excessive noise levels. Hearing conservation programmes in industry must give attention to many factors which include identification of hazardous noise by sound pressure means, usage of protective devices, engineering improvements to reduce noise production and administrative measures to regulate the exposure of personnel.

INTRODUCTION

Hearing loss is the most frequent sensory impairment and, globally, the fourth largest source of disability in the population of all ages. It affects approximately 466 million people (6.1% of the world's population), and unless appropriate measures are taken, its incidence could rise up to 630 million by 2030 and to 900 million by 2050 (World Health Organization, 2017b, 2018). Hearing loss has a profound impact on the individuals and their social environments leading to a decrease in quality of life (World Health Organization, 2017b, 2018). It also impacts economy, affecting several sectors including occupational, educational and health care, with an estimated annual global cost over US\$ 750 billion (World Health Organization, 2017b, 2018). The industrial revolution has modernised the companies with machines before kept only by man. The technological development created bigger and noisier machines each time, which contributed substantially to aggravate the problem of noise. In recent times it is one of the most permeative problems in the occupational environment which affects workers in various professions. Throughout the world, occupational noise exposure is responsible for about 16% of hearing loss in adult population. Small scale industries like textile, sawmills, printing and mining etc. are responsible for excessive noise and exposure of workers to hazardous noise levels. In India there are large numbers of agro based small scale industries. The workers in these industries are exposed to higher noise levels prevailing at the workplace environment during duty hours. Such high levels of noise can affect hearing threshold. Also it is associated with disorders of gastrointestinal, nervous and cardiovascular system. It causes many psychological problems which ultimately leads to stress. Hypertension and stress are attributed to disorders of the nervous system. This study is conducted in Coimbatore, the city known as Manchester of Tamilnadu where many spinning mills are located. The workers are subjected to a risk of loud noise for prolonged duration. This could affect not only their hearing acuity but also may reduce social interaction, social responsibility, diminish helping behaviour and increase aggressive response. Noise exposure is one of the most common health risk factors. Millions of laborer workers worldwide are exposed to sound pressure levels capable of producing hearing loss¹. This occupational exposure to loud noise can damage the hair cells of the organ of Corti, causing progressive and irreversible hearing loss, a condition known as noise-induced hearing loss (NIHL)². Based on demographic prognoses, it must be assumed that a greater number of older workers will be found in the future labor market. How to deal with their possible age-related impairments of sensory functions, like hearing impairment and work performance during extended working time, has not been addressed explicitly until now.

NIHL is a permanent change in the hearing threshold caused by acoustic trauma; it is chronic and characterized as sensorineural, usually bilateral and symmetrical, mild at low frequencies and severe at high frequencies, with typical audiometric configuration (slot-shaped V) in the 6000, 4000, and/or 3000-Hz frequency range, which progresses slowly at other frequencies and reaches its maximum level at higher frequencies within the first 10–15 years of stable exposure to high sound pressure levels^{1,2}. The progression of hearing loss ceases when the exposure to the noise stops, but the damage caused is

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irreversible. Tinnitus has also been recognized as a high-pitched auditory effect of NIHL. Both age-related hearing loss (ARHL) and noise-induced hearing loss (NIHL) may share pathophysiological mechanisms in that they are associated with excess free radical formation and cochlear blood flow reduction, leading to cochlear damage. Therefore, it is possible that short, but repeated exposures to relatively loud noise during extended time periods, like in leisure (i.e., musical devices and concerts) or occupational noise exposures, may add to cochlear aging mechanisms, having an impact on the onset and/or progression of ARHL.

The intended result of this study is to detect the noise levels in the cotton spinning industry and to identify the effect of ageing on hearing impairment among workers. The outcome of the present study will raise the level of awareness among industrialists and workers on health risks of their workplace environment as age advances and this will help to express clearly and exactly the strategies which will protect the workers from the hazardous sound prevailing in the industries³.

AIMS AND OBJECTIVES

1. To perform puretone audiometry in spinning mill workers of 15-40 years
2. To detect the noise levels in cotton spinning industry.
3. To detect the effect of ageing on hearing impairment in spinning mill employees.

MATERIAL and METHODS

This is a combined cross sectional and case control study. This study was performed in the Department of Otorhinolaryngology, Coimbatore Medical College Hospital, Coimbatore after obtaining ethical clearance. A total of 53 cases were included in the study of which 15 were males and 38 were females. They were of 15-40 years age group. They were randomly selected workers from a spinning mill located in Coimbatore. The industry employed around 150 employees. They work for 8-12 hours per day for 6 days in a week with 3 - 5 years of occupational noise exposure. Fifty three healthy individuals in the age group of 15-40 years of both sexes who were not exposed to noisy workplaces were included in the study. It included students, office workers, housewives etc. Their noise exposure level was within permissible limit.

Materials used for the study

Proforma - to record the details of cases and controls and to record the clinical findings.

Pure tone audiometer.

Exclusion criteria (for both cases and controls)

Diabetes, Hypertension, H/O Ototoxic drugs, middle ear diseases like CSOM, Otosclerosis and Head injury.

Methodology

The study was carried out after explaining the procedures in detail and getting informed consent from the subjects. Ethical clearance was obtained from the Institutional Ethical Committee before the start of the study. The experimental protocol involved

1. Recording of detailed history including their age, number of years of exposure to noise, number of days of work per week, number of hours of work per day and the department in which they work in the spinning mill.
2. Clinical examination of the ear was performed by Otorhinolaryngologist. It included examination for the presence of cerumen in ear, structural assessment, mobility of tympanic membrane, abnormality of external auditory canal, otorrhoea, bleeding or foreign body.

3. Rinne's test was done in all subjects to compare air conduction with bone conduction of each ear separately. It is done by placing the base of the vibrating tuning fork over the mastoid process and the subject is asked to raise the hand when he stops hearing the sound. Then the vibrating tuning fork is held in front of the ear.
4. Weber's test was done in all subjects to study bone conduction. A vibrating tuning fork is placed in the middle of the forehead and subject is asked to indicate in which ear the sound is heard better or heard equally in both the ears or in the center of the forehead. This is expressed as lateralization of sound to a particular ear or not.
5. Pure tone audiometry was performed in both cases and controls in the sound proof audiometry room at the Department of Otorhinolaryngology, Coimbatore Medical College Hospital. The subjects were clearly instructed to respond even to faint sounds by raising their arms when the test tone is heard. Since this is a subjective test it was started after getting the full co-operation of the subject.

Hearing examination included pure tone bone and air conduction audiometry. Audiometry testing was performed in a sound proof room as per the recommendations of American Speech Language Hearing Association using MAICO MA 52 Clinical diagnostic audiometer.

Air conduction was tested with using supra aural earphones Telephonics TDH 39p in the better ear first at 1000 Hz for a duration between 1 and 3 seconds. The reason for starting at 1000 Hz is probably that 1000 Hz has the greatest test - retest reliability. To make sure that the subject is familiar with the procedure the tone is presented at 30 dB hearing level for subjects with normal hearing or around 30 dB more than the estimated threshold for a subject with a hearing disability, but never more than 80dB hearing level. If the tone is inaudible it is increased in 5 dB steps until a response occurs. After the initial positive response, the tone is reduced in 10 dB till there is no further response.

The tone is reduced by 10 dB and increased by 5 dB till the subject responds at the same level on two out of three or four (i.e 50% or more) responses on the ascent. This is the hearing threshold level. The lowest level at which responses occur in at least half of a series of ascending trials with a minimum of two responses required at that level is defined as the threshold.

Then the next frequency is tested in a similar manner by starting at a clearly audible level and a using a 10 dB down, 5 dB up sequence until the threshold criterion is satisfied. The various frequencies were tested in the following order: 1000, 2000, 4000, 8000, 250, 500 Hz. The second ear was tested and hearing threshold was obtained for both ears by this conventional Hughson-Westlak technique and expressed in decibel hearing level units (dB HL).

Bone conduction is tested by placing a bone vibrator B-71 over the mastoid prominence of the affected ear with the required area of the vibrate in contact with the skull. It is placed as near as possible behind the pinna without touching it and without resting on hair and held firmly in place by means of a headband. The same 5 up and 10 down sequence was used for each of the testing frequency. The subject was asked to raise his hands when he hears the sound in either ear or at the center. The other ear was tested in a similar manner.

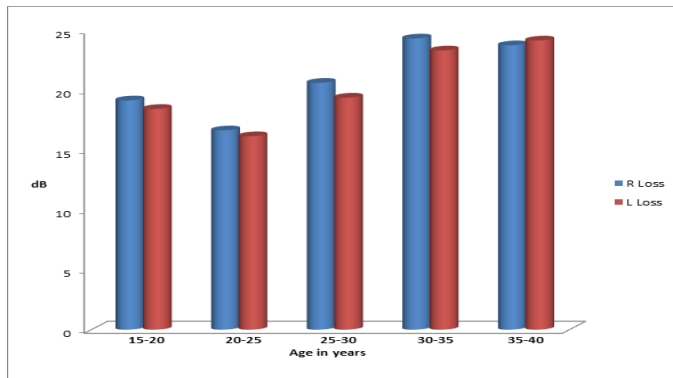
The hearing threshold levels obtained for each frequency was plotted graphically on an audiogram.

RESULTS

The present study was done in the Department of Otorhinolaryngology, Coimbatore medical college hospital, Coimbatore. Fifty three industrial workers (15 males and 38 females) of 15-40 years were recruited for the study. They were randomly

Table 1: Aging and hearing loss due to industrial noise pollution

Age (Years)		15 – 20	20 – 25	25 – 30	30 – 35	35 – 40	F	p
No. of Persons		26	10	8	5	4		
R Loss	Mean	19.13	16.63	20.6	24.3	23.73	3.84	0.0087*
	SD	3.59	3.34	5.02	5.48	4.39		
L Loss	Mean	18.42	16.14	19.36	23.3	24.13	3.35	0.0169*
	SD	3.97	3.26	6.78	4.24	3.96		



selected from various departments in the spinning mill.
Figure 1: Aging and Hearing loss due to industrial noise pollution

DISCUSSION

The study of pure tone audiometry in 53 industrial workers in the age group of 18-40 years was done to assess the effect of ageing on hearing impairment in spinning mill employees and compare it with non exposed individuals

The workers participating in the study spend around eight to twelve hours in a day for 6 days in a week in the spinning mill without using any personal protective equipment. They are exposed to noise levels between 85-97 dB. The previous studies showed as age advances there is more hearing impairment in workers exposed to noise pollution. This may be due to changes in micromechanical structures within the cochlea. It causes depolymerisation of actin filaments, swelling of stria vascularis, afferent nerve endings and supporting cells. It is evidenced that both apoptosis and necrosis play a role in noise induced hearing loss. Acoustic overstimulation could lead to excessive release of glutamate. There is reduction in cochlear blood flow associated with acoustic stimulation. Specifically there are indications that stimulation with sound of moderate intensity increases cochlear blood flow and with sound of high intensity decreases cochlear blood flow. There is also some evidence that noise induced hearing loss and cochlear hypoxia precede changes in cochlear blood flow. The study shows significant increase in degree of hearing loss ($p < 0.05$) as age advances in industrial workers. Kennedy GD et al⁴ also noticed the loss became more severe with increasing age. In a study among mining workers in Ghana, Amedogu GK et al⁵ observed that severity of noise induced hearing increased as age advances.

Ageing is associated with a down regulation of metabolism. This leads to increased sensitivity to stress agents and a decreased repair of tissues following stress. In the auditory system this could lead to increased sensitivity to noise induced hearing loss with age⁶. A lifetime of exposure to noise is likely to have negative effects on the hearing, but the interaction between noise-induced hearing loss (NIHL) and age-related hearing loss is difficult to determine. The most commonly accepted assumption is a simple accumulating effects of noise and ageing on the hearing. However, both additive effect as well as a supraadditive effect can cause hearing impairment

In the Framingham study, a combined effect of noise and aging has been described⁷. According to this more recent study, the aging process in a noise-damaged cochlea is different from that in a cochlea not exposed to excessive noise. They found that elderly men with noise notches in their audiograms had a reduced progression of hearing loss over time at 3 kHz, 4 kHz, and 6 kHz, and an accelerated rate of hearing loss in frequency areas adjacent to noise-damaged frequencies, especially at 2 kHz. In men without typical noise-notches, this pattern was reversed. This finding could not be reproduced by Lee et al^{8,9}. who studied 97 men aged 60-81 years at entry. In their study, the rates of threshold change for subjects with a positive noise history were not significantly different from those with a negative history of noise exposure.

The study implies the need of awareness about health hazards due to excessive noise levels. Hearing conservation programmes in

industry must give attention to many factors which include identification of hazardous noise by sound pressure means, usage of protective devices, engineering improvements to reduce noise production and administrative measures to regulate the exposure of personnel. Potential harmful effects of noise exposure to workers may also be decreased by reducing the number of working hours per day.

There is no known treatment for established deafness of noise damage, though treatment with plasma expanders has been advocated for acoustic trauma.

CONCLUSION

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Conflict of interest

The authors declare that there are no conflict of interests.

Financial disclosure

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