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ASSOCIATION BETWEEN NOISE INDUCED HEARING LOSS AND AGE IN INDUSTRY WORKERS

Physiology

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ABSTRACT

Introduction :
Long term exposure to noise at work causes hearing loss. Counter measures have reduced noise levels in many industries, but noise still remains a common occupational hazard, and noise induced hearing loss is one of the major occupational diseases worldwide. The interaction between noise and age might be additive or they may not interact at all while according to some researchers it is difficult to distinguish the effect of noise and ageing. With this background the present study was undertaken to find out association between noise induced hearing loss and age in industry workers.

Methodology:
The sound level meter was calibrated before each use. The measurements, in dBA units, on the LCD display were noted.Air conduction and bone conduction for each ear were. The diagnosis of noise induced hearing loss was based on full evaluation of history, physical examination and audiometry. An employee was considered as having hearing impairment if his average of the hearing thresholds for frequencies 500Hz, 1000Hz, 2000 Hz and 4000 Hz, exceeded 25 dB. Analysis was done using Chi square test and T test.

Results :
The difference in the mean values of age between exposed group and unexposed group was statistically insignificant Most of the workers in the present study were observed to be more than 40 years of age. Maximum number of workers with noise induced hearing loss was above 50 years of age. The association between noise induced hearing loss and age was statistically significant in exposed group The association between noise induced hearing loss and age in unexposed group was statistically insignificant [P>0.05].

Conclusion :
The age effect did not substantially alter the results and we conclude that the occurrence of auditory damage was considered to be mainly due to the occupational noise rather than ageing.

KEYWORDS

Introduction :
Long term exposure to noise at work causes hearing loss. Counter measures have reduced noise levels in many industries, but noise still remains a common occupational hazard, and noise induced hearing loss is one of the major occupational diseases worldwide.

Noise is a wrong sound in a wrong place at a wrong time. [1] Noise is any undesired sound and, by extension, noise is any unwanted disturbance within a useful frequency band. [2] The term "Noise pollution" has been coined to signify the vast cacophony of sounds that are being produced in the modern life, leading to health hazards. [1] Noise induced hearing loss (NIHL) is a permanent sensorineural hearing impairment resulting from prolonged exposure to high levels of noise.[3]

Worldwide, 16% of the disabling hearing loss in adults is attributed to occupational noise, ranging from 7 to 21 % in the various sub regions.[4]

52-60% of all industrial workers get exposed to noise level of 85 dB or more for 8 hours a day.[5]

As industrialization spreads, NIHL will add substantially to the global burden of disability.[6,7]

The 1976 amendment of the factories act includes noise induced hearing loss, among the list of notifiable diseases.[8]

Many people experience some decrease in hearing ability with age. [9] Hearing sensitivity declines with age, starting at an early age, but it is not certain how much of the decline should be attributed to ageing and how much to noise to which a person is exposed to during lifetime.[6]

The interaction between noise and age might be additive or they may not interact at all [2] while according to some researchers it is difficult to distinguish the effect of noise and ageing.[10]

With this background the present study was undertaken to find out association between noise induced hearing loss and age in industry workers

Material and Methods:
Industries around an urban city were surveyed. Heavy engineering industry associated with high intensity noise production was chosen for the present study. The study was conducted from March 2008 to March 2009.The study protocol was approved by the local ethics committee. All the industrial workers were thoroughly interviewed by using a standard proforma.

Workers with no pre-employment history of hearing loss were included in the present study. Workers having history of any disease, local or systemic, that can affect hearing, presence of any otological disease that affects hearing, history of high blood pressure, history of treatment with ototoxic drugs, past history of ear trauma or head trauma, evidence of respiratory infection including common cold, positive family history of hearing loss, history of smoking, history of noise exposure in previous jobs were excluded from the study.

Some workers were excluded from the study on the basis of history. Remaining workers were then subjected to clinical examination at the E.N.T. department, of a city general hospital, to rule out any otological disease that can cause hearing loss. 110 male workers belonging to the age group of 22 to 54 years were thus selected for the present study and a written consent regarding participation in the study was taken from them.

The present study was of cross sectional type. The workers working in manufacturing section, assembly section and paint shop section were

exposed continuously to excessive noisy working during their working hours. Workers concerned with clerical job in office were not exposed to high intensity of noise. Hence the workers were classified into

Group	High intensity noise exposure	Section
Exposed	Present	Manufacturing
		Assembly
		Paint shop
Unexposed	Absent	Office

Of the 110 male workers selected for the present study, 70 workers belonged to the exposed group and 40 workers belonged to the unexposed group.

The ambient noise levels were measured in different sections of the industry on a weekly holiday and on a working day on a dBA scale by 'Digital sound level meter'. The ambient noise levels were recorded in manufacturing section, assembly section, paint shop section and office section, first with no machine working and then with all machines working at four different times of the day namely: 9 am, 12 noon, 3 pm and 6 pm. The mean of these determinations was calculated. The aim of the time determinations was to ascertain if there were peak periods for noise levels in these places.

Digital sound level meter- AGRONIC 8928 was used. It has a measuring range from 40 dB to 130 dB and measures minimum, maximum and real time values of sound levels. Its dimensions are 30 mm [H] x 72 mm [W] x 182 mm [D] and weighs 150 g. It has got LCD type of display with 12.5mm height.

The sound level meter was calibrated before each use. It was held away from the operator's body to prevent sound reflection. Care was taken to avoid blocking of the sound waves by removing the objects in between sound source and the sound level meter. While taking the reading workers position relative to the sound source was considered. The measurements, in dBA units, on the LCD display were noted.

Manufacturing section, assembly section and paint shop section together comprised the exposed group. It was observed that all the machines in these sections were working almost throughout the day. The factory works continuously round the clock in three shifts of eight hours each. Posting of a worker in a particular section was of permanent nature. The shifts of workers were changed in rotation at the interval of one month. Hearing protective devices like ear muffs were provided to the workers in the exposed group.

Office section comprised the unexposed group. Office section was 100 meters away from the study group and it was not surrounded by any other plant concerned with noise production. The workers working in office section were having a working schedule from 9 am to 5 pm.
The workers in the exposed and unexposed groups were subjected to pure tone audiometry.

An audiometer is an electronic instrument capable of producing pure tone sounds of different frequencies at variable intensities. Audiometry is a graphic recording of hearing quantitatively and qualitatively. [11] Air conduction and bone conduction for each ear were noted in both the groups.

Audiometric tests were carried out in a sound proof room in the E.N.T. department of a city general hospital with a diagnostic audiometer [Model: eda 3 N 3 mille, Elkon co. ltd.].

The normal test sound was pure tone pulses at standardized frequencies in the range of 125-8000 Hz and the normal presentation mode was monoaurally by means of a standardized type of earphone. Ascending method [modified Hughson-Westlake method] was used for recording.

After familiarization by presenting a clearly audible test tone, it was based on repeated ascents from inaudible to just audible stimuli in steps of 5 dB. As soon as the listener responded, the level was decreased by 10 dB and a new ascent was started. The first test frequency was 1000 Hz followed by the higher frequencies in rising order and finally the lower frequencies in falling order. Air conduction and bone conduction for both the ears were noted.[12]

The diagnosis of noise induced hearing loss was based on full evaluation of history, physical examination and audiometry.[2]

A worker was diagnosed as a case of noise induced hearing loss on the basis of a clear and prolonged history of exposure to excessive noise, no evidence of any other otological pathology and an audiogram showing a significant high tone hearing loss with classical notching at 4-6 kHz, with some recovery at 8 kHz.[13,14]

However, in exposed group workers with more duration of service, the notch broadened and the neighbouring frequencies were progressively affected and NIHL was also detected at lower frequencies.

An employee was considered as having hearing impairment if his average of the hearing thresholds for frequencies 500Hz, 1000Hz, 2000 Hz and 4000 Hz, exceeded 25 dB. [6,7]

The collected data was entered into SPSS (Statistical package for social science) database for analysis. Analysis was done by SPSS software version 10 by using Chi square test and T test. Significance level was set at $P<0.05$ and considered as significant.

Results :

Table 1: Comparison of age of workers in exposed group and unexposed group.

Parameter	Exposed	Unexposed	t Value	P Value
	Mean ± SD (n=70)	Mean ± SD (n=40)		
Age (Years)	43.16 ± 9.68	40.38 ± 11.19	1.32	>0.05

Table 1 shows comparison of age in exposed group and unexposed group. The difference in the mean values of age between exposed group and unexposed group was statistically insignificant [$P<0.05$]. That means the exposed and unexposed groups were comparable age wise.

Table 2: Age wise distribution of workers in exposed group and unexposed group

Age (Years)	Exposed group (%)	Unexposed group (%)	Total workers (%)
21 – 30	9 (8.18)	9 (8.18)	18 (16.36)
31 – 40	15 (13.64)	10 (9.09)	25 (22.73)
41 – 50	21 (19.09)	9 (8.18)	30 (27.27)
> 50	25 (22.73)	12 (10.91)	37 (33.64)
Total	70 (63.64)	40 (36.36)	110 (100)

Table 2 shows age wise distribution of workers in both exposed and unexposed groups. Most of the workers in the present study were observed to be more than 40 years of age.

Table 3: Age wise distribution of workers with noise induced hearing loss in exposed group.

Age (Years)	Noise Induced Hearing Loss		Total
	Present	Absent	
21 – 30	1	7	8
31– 40	4	11	15
41 – 50	7	15	22
> 50	15	10	25
Total	27	43	70

$x^2 = 8.46, P<0.05$

Table 3 shows that as the age advanced the number of workers with noise induced hearing loss in the exposed group also increased. Maximum number of workers with noise induced hearing loss was above 50 years of age. The association between noise induced hearing loss and age was statistically significant in exposed group [$P<0.05$].

Table 4: Age wise distribution of workers with noise induced hearing loss in unexposed group.

Age (Years)	Noise induced hearing loss		Total
	Present	Absent	
21 – 30	0	9	9
31 – 40	0	10	10
41 – 50	1	8	9
> 50	0	12	12
Total	1	39	40

$x^2 = 3.53, P>0.05$

Table 4 shows that only 1 worker from the unexposed group in the age group of 41 to 50 had noise induced hearing loss. The association

between noise induced hearing loss and age in unexposed group was statistically insignificant [P>0.05].

Discussion :

The present study found that the association between noise induced hearing loss and age in exposed group was statistically significant while in the unexposed group it was statistically insignificant.

Chen et al., Hasan et al. and many workers in their reports used a limit of 55 years of age for an onset of a detectable age-induced hearing loss. [15] All the subjects participating in the present study were younger than 55 years of age.

Furthermore, none of the workers in the present study, either from the exposed group or unexposed group, had audiogram suggestive of age-related hearing loss.

Therefore, it would be reasonable to state that although there was an increase in the number of workers with noise induced hearing loss with age in the exposed group, the age effect did not substantially alter the results. The occurrence of auditory damage could be considered to be mainly due to the occupational noise. Our observations are in agreement with Plakke et al., Tunay M.[15, 16]

Hinchcliffe R found that the greatest effect of noise on hearing was in age group 50-60 years which is similar to the finding in the present study.[17]

Olero UG et al., Muttamara S reported that hearing loss for the exposed subjects increased with age which also agrees with the findings in the present study. [18, 19]

Hearing ability declines with age, starting in infancy, but it is not certain how much of the decline is due to ageing and how much due to excessive noise.[6]

According to American Academy of Audiology, normal hearing continues at least up to age 60, if ears are not exposed to high Noise levels.[20]

According to Kup W, Miller et al. the older ear is more susceptible to noise induced hearing loss. [21, 22]

Studies in humans by MacRae JH, Novotny, Welleschik and Raber suggested that at worst, the interaction between noise and age is additive and, at best, they do not interact. [2]

According Pelmear PL, Williams RG and some other workers the effects of age and noise are presumed to be additive. [6, 23, 24, 25,26]
According to Mills et al. the additive model overestimates the interaction between noise and ageing.[27]

Donald Hendersan et al. reported that age can only account for minor amount of variability across the subjects in their susceptibility to NIHL. [25]

According to Rosler G, it is not possible to distinguish the effect of noise and ageing on hearing and the ad hoc assumption of their additivity is no longer valid. [10]

NIOSH states that although many people experience some decrease in hearing sensitivity with age, some do not. It is not possible to know who will and who will not have an age-related hearing loss. Thus, applying age corrections to a person's hearing thresholds for calculation of significant threshold shift will overestimate the expected hearing loss for some and underestimate it for others, because the median hearing loss attributable to presbycusis for a given age group will not be generalized to that experienced by an individual in that age group. Application of age correction on individual audiograms is not scientifically valid.[9]

According to Schneider et al person's pre-exposure hearing appears to be more important than his age.[28]

In the present study, although the association between noise induced hearing loss and age was found to be statistically significant in the exposed group, no interaction of age and noise induced hearing loss could be established. The age effect did not substantially alter the results and we conclude that the occurrence of auditory damage was considered to be mainly due to the occupational noise rather than ageing.

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