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COMPARATIVE ASSESSMENT OF OCCUPATIONAL NOISE IMPACT ON HEARING THRESH HOLD LEVEL IN MINING AND NON MINING WORKERS USING PURE TONE AUDIOMETRY (PTA) AT A TERTIARY CARE HOSPITAL, UDAIPUR (RAJASTHAN)

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ABSTRACT

Introduction: Noise induced hearing loss (NIHL) is a significant health concern, particularly in industries with prolonged exposure to high noise level. Long term exposure to excessive noise can lead to a gradual and irreversible shift in hearing threshold, impacting workers` quality of life and productivity. The present study aims to conduct a comparative assessment of hearing threshold levels in mining and non mining workers using PTA. The objective includes assessing the impact of work duration and noise exposure levels hearing threshold shifts. **Material and Methods:** The present study was conducted in the Department of Physiology in collaboration with Department of otorhinology, Pacific Institute of Medical Sciences Umarda, Udaipur. This is an observational analytical study which is conducted to assessment and compares the impact of occupational noise on hearing threshold level in rural and urban population. Study population includes mining workers of Udaipur and well-matched normal individual between the ages of 18 to 50 years. The subjects were classified in 2 groups, study group (N = 200 workers of mining factory, who are continuously associated with this profession since one year), control group (N=200 normal individuals, who are never exposed to any kind of occupational noise). **Results:** In present study, evaluated 400 participants, with 200 individuals each in the miner (case) and non-miner (control) groups on the basis of inclusion and exclusion criteria. This study observed that, analysis of hearing threshold in control group mild hearing loss (26–40 dB HL) was the most prevalent, affecting 98 participants in the right ear and 116 participants in the left ear. Moderate hearing loss (41–55 dB HL) was reported in 57 participants for the right ear and 32 participants for the left ear. No cases of severe or profound hearing loss were recorded in either ear. The differences between ears were statistically significant ($p = 0.01$). **Conclusion:** The comparative assessment of hearing threshold levels between mining and non mining workers underscores significant impact of occupational noise exposure on auditory health. Mining workers experience greater hearing threshold shift, particularly at higher frequencies, with severity increasing with years of exposure. These finding highlight the urgent need for improved occupational safety measures, regular audiometric screenings and stricter enforcement of hearing conservation programs to protect workers from irreversible hearing loss.

KEYWORDS: Noise Induced Hearing Loss (NIHL), Pure Tone Audiometry (PTA), Mining workers, Hearing Threshold levels.

INTRODUCTION

Noise induced hearing loss (NIHL) is a significant health concern, particularly in industries with prolonged exposure to high noise level. Mining is one such profession where workers are frequently exposed to hazardous noise levels generated by drilling, blasting heavy machinery and transport operations. Long term exposure to excessive noise can lead to a gradual and irreversible shift in hearing threshold, impacting workers` quality of life and productivity.

After presbycusis, noise-induced hearing loss (NIHL) is the second most prevalent kind of acquired hearing loss. It is an irreversible but preventable condition. It is described as a progressive loss of hearing acuity brought on by ongoing exposure to high sound pressure levels, which damages the inner and outer hair cells of the organ of corti.[1, 2]

Noise-induced hearing loss (NIHL) is a sensorineural form of hearing loss that normally affects both ears and

can be brought on by prolonged and continuous exposure to loud noise levels (higher than 85 dB). While NIHL is initially a transient condition, prolonged exposure to loud noise might result in a permanent shift in hearing threshold level.[3] Hearing loss is the most common sensory loss accounting for 250 million population of world out of which 16% is attributed to the occupational exposure to loud noise, ranging from 7% to 21% in different parts of the world.[4, 5]

Consequences of hearing impairment include inability to interpret speech sounds, often producing a reduced ability to communicate, delay in language acquisition, economic and educational disadvantage, social isolation and stigmatization.[6]

However, a number of companies have loud environments often above the 90 dBA limit, putting their workers at danger of hearing loss. One such industry is the textile sector, which employs up to 40 million people directly and frequently has ambient noise levels above this limit, particularly in jute and woollen mills. Moreover, workers in a number of developing-world-centred industries, such as woodworking, marble, ceramics, etc., are frequently subjected to hazardous noise.[7]

Several studies have highlighted the prevalence of NIHL among industrial workers, but limited research has compared hearing threshold levels of mining workers with non mining workers. Understanding these differences is crucial for implementing effective occupational health policies, noise control measures and early intervention strategies. The present study aims to conduct a comparative assessment of hearing threshold levels in mining and non mining workers using PTA. The objective includes assessing the impact of work duration and noise exposure levels hearing threshold shifts.

MATERIAL AND METHODS

The present study was conducted in the Department of Physiology in collaboration with Department of otorhinology, Pacific Institute of Medical Sciences Umarda, Udaipur. This is an observational analytical study which is conducted to assessment and compares the impact of occupational noise on hearing threshold level in rural and urban population. Before starting the study, ethical approval was obtained from the Institutional Ethics Committee. Informed and written consent was taken from all the subjects before enrolment into the study.

The study included a total of 400 clinically diagnosed cases of ONIHL attending Department of Otorhinology OPD of PIMS Hospital Udaipur (Rajasthan). Study population includes mining workers of Udaipur and well-matched normal individual between the ages of 18 to 50 years. The subjects were classified in 2 groups, study group (N = 200 workers of mining factory, who are continuously associated with this profession since one year), control group (N=200 normal individuals, who are never exposed to any kind of occupational noise). Inclusion criteria of study groups are the mining workers between the age of 18 to 50 years and willing to give consent, who are exclusively exposed to continuous noise and individual having exposure for at least last one year. Control groups are normal individuals of Udaipur between the ages of 18 to 50 years who are never exposed to any kind of occupational noise were included in this study. Exclusion criteria of study groups are subjects who are not willing to give consent, who have worked in other noisy occupations before, previous history of ototoxic drugs, family history of deafness, History of any other ear diseases, past history of Diabetes Mellitus, patient who were having history of streptomycin usage. Control groups are subjects who are not willing to give consent, who have worked in other noisy occupations before, previous history of ototoxic drugs; family history of deafness, History of any other ear diseases, past history of Diabetes Mellitus was excluded from the study.

METHODS OF COLLECTION OF DATA

Details of the study protocol will be explained to the subjects. Informed consent will be obtained. Detailed history will be taken. A questionnaire form has been designed for the purpose of the history will be filled which will be included name; age; sex; and family history. General physical examination will be done. Pure tone audiometry will be performed.

Audiometric characteristics of NIHL

Pure tone audiometry is an art for ascertaining the hearing acuity (hearing threshold level) of a subject for pure tone sounds of various frequencies, the intensity of which can be adjusted in 5 dB steps. The result, when plotted graphically, is called a pure tone audiogram. The instrument used for this is an electronic device called pure tone audiometer. It consists of audio- oscillator which generates pure tone sounds of various frequencies usually at regular steps of 125, 250, 500, 1000, 1500, 2000, 3000, 4000, 6000, and 8000 Hertz (Hz). For right ear red color and for left ear blue color pencils are used. For air conduction, continuous line and for bone conduction, interrupted (broken) line is used for recording. Pure tone audiometry test assesses only auditory sensitivity of pure tone sounds not even that of speech. None of the other faculties of supra-threshold hearing is evaluated by the pure tone audiometry test.

RESULTS

In present study, evaluated 400 participants, with 200 individuals each in the miner (case) and non-miner (control) groups on the basis of inclusion and exclusion criteria. (Shown in Table 1) The age distribution of participants revealed that the highest proportion of cases belonged to the 41–50 years age group (41.00%), whereas the control group showed a majority in the 31–40 years age group (33.00%). (Shown in Table 2) This

study observed that, analysis of hearing threshold in control group mild hearing loss (26–40 dB HL) was the most prevalent, affecting 98 participants in the right ear and 116 participants in the left ear. Moderate hearing loss (41–55 dB HL) was reported in 57 participants for the right ear and 32 participants for the left ear. No cases of severe or profound hearing loss were recorded in either ear. The differences between ears were statistically significant (p = 0.01), indicating a greater impact on the left ear in this population. (Shown in Table 3) Among miners (Case group), moderate hearing loss (41–55dBHL) was the most frequent, affecting 95 participants in the right ear and 78 participants in the left ear. Mild hearing loss (26– 40 dB HL) was reported in 47 participants for the right ear and 74 participants for the left ear. Additionally, moderate-severe hearing loss (56–70 dB HL) was observed in 36 participants for the right ear and 34 participants for the left ear. Severe hearing loss (71– 90 dB HL) was recorded in 15 participants for the right ear and 12 participants for the left ear, while profound hearing loss (>91 dB HL) was noted in 6 participants for the right ear but none for the left ear. These results were statistically significant (p=0.01), highlighting the varying level so hearing impairment among miners. (Shown in Table 4) The use of hearing protection devices (HPDs) was more common in the case group, with 41.50% (83participants) reporting usage compared to 21.50% (43participants) in the control group. This difference was highly significant (p<0.001), indicating greater awareness or necessity of HPDs among miners. (Shown in Table 5)

Table 1: Occupation Wise Distribution (N = 400)

OCCUPATION	NO. OF CASES	PERCENTAGE
Miner	200	50.00%
Non Miner	200	50.00%

Table 2: According To Age Wise Distributionof Patients.

	CONTROL		CASE	
Age Group(yrs)	No. of cases	Percentage	No. of cases	Percentage
<21	2	1.00%	1	0.50%
21-30	54	27.00%	13	6.50%
31-40	66	33.00%	50	25.00%
41-50	52	26.00%	82	41.00%
51-60	23	11.50%	54	27.00%
61-70	3	1.50%	0	0%
Total	200	100.00%	200	100.00%

Table 3: Pure Tone Audiometry (Pta) (Db Hl) Non-Miner Group (N= 200).

PTA	RIGHT EAR	LEFT EAR
<15 None	0	0
16-25 dB Slight	41	44
26-40 dB Mild	98	116
41-55 dB Moderate	57	32
56-70 dB Moderate Severe	4	8
71-90 dB Severe	0	0
>91 dB Profound	0	0

P =0.01 (S)

Table 4: Pure Tone Audiometry (Pta) (Db Hl) Miner Group (N=200)

PTA	RIGHT EAR	LEFT EAR
<15 dBNone	0	0
16-25 dB Slight	1	2
26-40 dB Mild	47	74
41-55 dB Moderate	95	78
56-70 dB Moderate Severe	36	34
71-90 dB Severe	15	12
>91 dB Profound	6	0

Table 5: Use Of Hearing Protection Devices (Hpds).

USE OF HPDS	CASE GROUP	CONTROL GROUP
Yes	83 (41.50%)	43 (21.50%)
No	117 (58.50%)	157 (78.50%)
Total	200	200

P=<0.001 (HS)

DISCUSSION

This study was aimed to assess the effect of noise pollution on hearing threshold level in mining factory workers. Further, hearing threshold level in mining factory workers (study group) and normal individuals who never exposed to prolonged and continuous period of occupational noise pollution (control group) were compared.

The finding of this study highlight significant difference in hearing threshold levels between mining and non mining workers, reinforcing the impact of occupational noise exposure on auditory health.

In our study, Out of 400 patients NIHL studied patients; both in rural and urban group the age range observed was between 18 – 50 years. Majority of the patients were age group 41 - 50 years in miner and non-miner group. Specifically the control group demonstrated mean age of 37.40+- 10.12 whereas the case group showed a higher mean Age of 44.02+- 8.62. Similar findings were observed in study conducted by Ertem M et al; (1998).[8] Contrarily, Kim MG (2011) et al; assessing the incidence of hearing loss attributed to the age of 65 years or above.[9]

Our study revealed a high prevalence of ONIHL among workers; with the severity of hearing loss correlating with older age; reflecting a cumulative effect of long term noise exposure. The noise exposure was found to be highly significant ($p = 0.001$) in the case group compared to the control group. This finding underscores the critical relationship between occupational noise exposure and the development of hearing loss.

In Present study, demonstrate that prevalence of hearing threshold level is significantly higher in study groups as compare to control groups. In the present study hearing threshold in right and left ear for Air conduction among study and control group was studied. In case group there was higher hearing threshold at 250hz, 500hz, 1000hz, 2000hz, 3000hz, 4000hz, 6000hz, 8000hz in both right and left ear as compare to control group. Result shows significant difference across case and control group in right and left ear for air conduction ($p<0.001$). In this study, it is noted that hearing loss occurred in all frequencies. However, more common at higher frequencies as compare to lower frequencies. Maximum hearing loss occurred between 3000 Hz to 8000Hz in both ear. Similar finding was seen in a study conducted by Huang FJ et al. their results showed that mining workers in the study group apparently had the higher hearing loss in both the low and high frequencies.[10]

In a study conducted by Z Musiba et al, the prevalence of NIHL was 47%, with 12% with poor hearing and 35% with mild hearing impairment. Z Mushiba et al found that occupational exposure to hazardous A-weighted equivalent noise level (> 85 dB) was associated with higher hearing thresholds at all frequencies (highest at 4 kHz followed by 6 kHz), particularly in younger workers below the age of 40 years. Nearly 71% of noise-exposed workers had hearing impairment, and 47% had NIHL compared with unexposed workers.[11] Chadambuka. A et al also found that 36.7% workers had NIHL.[12]

In the present study the use of hearing protection devices (HPDs) was more common in the case group; with 41.50 % compared to 21.50 % in the control group. Similarly; Svensson et al conducted a study in Sweden found that 85 % of workers understood that hearing protection devices (HPDs) could prevent hearing damage; yet only a fraction of these workers consistently used them when exposed to loud noise levels. This discrepancy suggests that while awareness of the importance of hearing protection is high; barriers to regular and correct usage such as discomfort; inconvenience; lack of enforcement continue to impede the optimal effectiveness of HPDs.[13]

Addressing these issues requires not only improving the design and comfort of HPDs but also implementing stronger safety training; workplace monitoring and enforcement of protective regulations to ensure that workers consistently utilize hearing protection as intended.

Mining workers exhibited a higher prevalence of noise induced hearing loss (NIHL) with a noticeable threshold shift particularly at high frequencies (3 kHZ, 4kHZ and 6kHZ). This aligns with previous studies indicating that prolonged exposure to high intensity noise leads to early damage in these frequency ranges often referred to as the noise notch. In contrast non mining workers, who generally experience lower occupational noise exposure, shows better preserved hearing threshold across all frequencies.

CONCLUSION

The comparative assessment of hearing threshold levels between mining and non mining workers underscores significant impact of occupational noise exposure on auditory health. Mining workers experience greater hearing threshold shift, particularly at higher frequencies, with severity increasing with years of exposure. To completely assess the impact of noise concerns in India and to reduce variability, more and repeated measurements should be done for future studies. These finding highlight the urgent need for improved occupational safety measures, regular audiometric screenings and stricter enforcement of hearing conservation programs to protect workers from irreversible hearing loss. Workers should participate in regular awareness training to help them understand that ONIHL is a permanent condition that may be prevented.

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