Main Article

Assessment of Hearing Loss and Its Correlates among Industrial Workers of Kanpur

https://doi.org/10.47210/bjohns.2026.v34i1.272

Chitranshi Gupta,[1] Amrita Srivastava,[1] Nishant Saurabh Saxena,[1] Surendra Kumar Kanaujia,[1] Harendra Kumar Gautam,[1] Bhavishya Kumar Patel,[1] Shiroman Singh,[1] Mritunjay Gupta[2]

ABSTRACT

Introduction

Prolonged noise exposure poses a substantial risk to public health, resulting in noise induced hearing loss. This purpose of this study to assess the magnitude of occupational noise induced hearing loss and to study its correlation with various contributing factors.

Materials and Methods

A prospective longitudinal study was conducted on 426 industrial workers, aged 18-55 years, predominantly men (mean age 39.83 ± 0.76 yrs), exposed to noise levels of 85 dB or higher. Hearing assessments were conducted by Pure Tone Audiometry at time of presentation and followed up at 3, 6 and 12 months.

Results

Hearing loss affected 39.7% (169/426) of workers, mainly aged 30–50 yrs, with mild bilateral sensorineural impairment. A statistically significant association was found with noise exposure duration, intensity, and daily working hours. However, one-year follow-up showed no correlation, indicating that long-term exposure is key to hearing loss development.

Conclusion

The study highlights the need for regular hearing assessments, mandatory use of protection devices, and stronger conservation measures, as prolonged noise exposure, long work hours, and high sound levels significantly increase hearing loss risk.

Keywords

Noise; Noise Induced Hearing Loss; Pure Tone Audiometry; Sensorineural Hearing Loss

Occupational noise induced hearing loss (ONIHL) is decreased auditory acuity as a result of multifactorial damage to auditory structures following exposure to occupational noise, environmental or recreational source of loud sound. It can result from exposure to either a single extremely loud sound or repeated exposure to loud sound over time.

The World Health Organisation (WHO)[1] reports that 15% of workers globally are exposed to noise levels exceeding 90 decibels (dB). National Institute for Occupational Safety and Health (NIOSH) notes that 14% of workers in developed countries face similar exposure. To mitigate this risk, the recommended guidelines suggest limiting occupational noise exposure to 85dB or less, averaged over an 8-hour period with a 3dB exchange rate.[2]

Noise induced hearing loss (NIHL)is a Bilateral Sensorineural hearing loss, symmetrically affecting high frequencies at 4kHz with/without dip later involving 3 kHz and 6 kHz with hearing recovery at 8 kHz. It can also involve lower frequencies 0.5, 1, 2 kHz.[3] Men are disproportionately affected compared to women, which is attributed to differences in occupational categories and variations in lifetime work history.

1 - Department of ENT, GSVM Medical College Kanpur, Uttar Pradesh

2 - Department of Electrical Engineering Indian Institute of Technology, Roorkee

Corresponding author:
Dr Chitranshi Gupta
email: chitranshigupta0987@gmail.com

High-intensity sound exposure can lead to reduced blood flow in the cochlea, resulting in cochlear hypoxia.[4] This stress triggers an excessive release of glutamate, disrupting normal cellular function.[5] The outer hair cells, being more susceptible to damage than inner hair cells, can undergo apoptosis or necrosis due to the harmful effects of reactive oxygen species (ROS) contributes to hearing loss.

Patient presents with features of aural fullness, tinnitus, dizziness, earache,lack of concentration, sleep disturbances, depression, inability to hear high pitched sound with difficulty to percept speech in noisy environment, high blood pressure, increased heart rate, obstructs ability to hear warning signals, react to environmental sounds and coordinate with coworkers; thereby posing threats to workers safety.

Diagnosis can be made by Tympanometry, Speech in noise testing, Distortion Product Otoaccoustic Emission (DPOAE), Auditory Brainstem Response (ABR).

The clinical management involves the use of hearing protection devices and in severe cases, cochlear implants. Temporary threshold shift (TTS) monitoring enables timely pharmacological intervention such as intratympanic steroids like dexamethasone for acute noise induced TTS, although their long-term effectiveness is uncertain. Notably, this treatment is not recommended for chronic occupational noise exposure.[6] Certain antioxidants, including beta-carotene, vitamins B, C, E, zinc and magnesium have been found to reduce vasoconstriction, hearing loss and cochlear cell damage.[7] Hyperbaric oxygen therapy is also being explored to alleviate cochlear hypoxia.[8] However, the adoption of Hearing Protective Device can be challenging, particularly in military settings where they may compromise auditory situational awareness, including sound detection and localization and speech perception.[9]

Kanpur was known as Manchester of India and is key industrial belt of Uttar Pradesh which caters employment to approx.1 lakh population of Kanpur in various industries. This government tertiary care centre provides health services to numerous people belonging to and around Kanpur. Through this study, focusing on prevalence of NIHL and identifying associated factors and its correlation can help bridge gaps in knowledge and practice, ultimately contributing to development of targeted intervention and improved workplace safety standards with reduction in Years lived with Disability (YLD). Ultimately, eliminating ONIHL poses a significant, long-term challenge that necessitates a multifaceted approach at the individual, organizational policy and population level.

Materials and Methods

The study is prospective longitudinal study involving a total of 426 workers aged 18-55 yrs underwent screening during a field visit and outpatient department evaluation at the ENT department of tertiary care centre, Kanpur. After obtaining ethical clearance and proper written informed consent, participants who met inclusion and exclusion criteria were included in the study. The workers with history of ear discharge, conductive hearing loss with and without otitis media (otitis externa, ossicular disruption, upper respiratory tract infection, trauma, ear wax) or diagnosed with presbycusis and other causes of Sensorineural hearing loss were excluded from the study.

Complete detailed history, ENT examination and systemic examination of workers was done. All the workers were subjected to otoscopic examination which was followed by Pure Tone Audiometry (PTA) and were followed up with serial audiometric evaluation at 3, 6 and 12 months. Intensity of noise in industries was measured by Sound meter app. The results were evaluated and hearing loss was classified according to WHO classification of degree of hearing impairment. Data obtained was recorded and sent for statistical analysis.

0	-	None	≥ 25 dB
1	-	Slight	26–40 dB
2	-	Moderate	41–60 dB
3	-	Severe	61–80 dB
4	-	Profound	≥ 81 dB

Results

Table I : Demography and Prevalence of NIHL

GENDER DISTRIBUTION	NO. OF WORKERS	PERCENTAGE
Male	161	95.27%
Female	8	4.73%
Male to female ratio	20:1	
AGE DISTRIBUTION	**NO. OF WORKERS**	**PERCENTAGE**
18 to 20 Yr	6	1%
21 to 30 Yr	47	11%
31 to 40 Yr	151	36%
41 to 50 Yr	179	42%
51-55Yr	43	10%
Mean age in yrs	39.83 ± 0.76 yrs	
REGIONAL DISTRIBUTION	**NO. OF WORKERS**	**PERCENTAGE**
Rural	311	73%
Urban	115	27%
No. of workers screened	426	
No. of workers with HL	169	
Prevalence	39.67%	

Table II : Correlation Analysis : Age Group, Working Hours, Noise Exposure Duration

	NO. OF WORKERS	WORKERS WITH HL	WORKERS WITHOUT HL	PERCENTAGE POSITIVE
(I) Age Groups				
18 to 20 Yr	6	0	6	0%
21 to 30 Yr	47	7	40	14.89%
31 to 40 Yr	151	44	107	29.13%
41 to 50 Yr	179	75	104	41.89%
51-55Yr	43	33	10	76.74%
(ii) Working Hours Per Day				
8-10 Hours	92	12	80	13.04%
10-12 Hours	273	111	162	40.65%
>12 Hours	61	46	15	75.41%
(iii) Duration of noise exposure				
Less than 5 Yr	92	17	75	18.48%
5 to 10 Yr	122	39	83	31.97%
10 to 15 Yr	92	41	51	44.57%
15 to 20 Yr	101	53	48	52.48%
More than 20 Yr	19	15	4	78.94%

P value for working hours per day and duration of noise exposure
(ii) $X^2 = 88.7$ Degree of freedom =4 pvalue =<0.0001 (highly significant)
(iii) $X^2 = 57.02$ Degree of freedom =4 p value =< 0.001 (highly significant)

Table III : Hearing Profile in Workers on Basis of Intensity of Sound

INTENSITY OF NOISE	NO. OF WORKERS EXPOSED	WORKERS WITH HL	PERCENTAGE POSITIVE
85-90 dB	74	10	13.51%
90-100 dB	100	20	20.00%
100-110 dB	146	57	39.04%
110-120 dB	106	82	77.36%

$X^2 = 40.78$ Degree of freedom =3 pvalue =<0.001(highly significant)

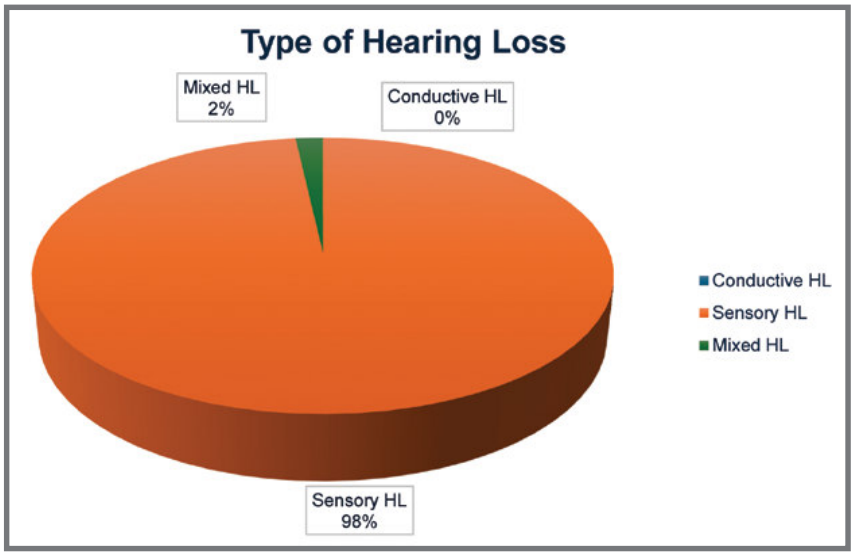

Fig. 1. Types of hearing loss

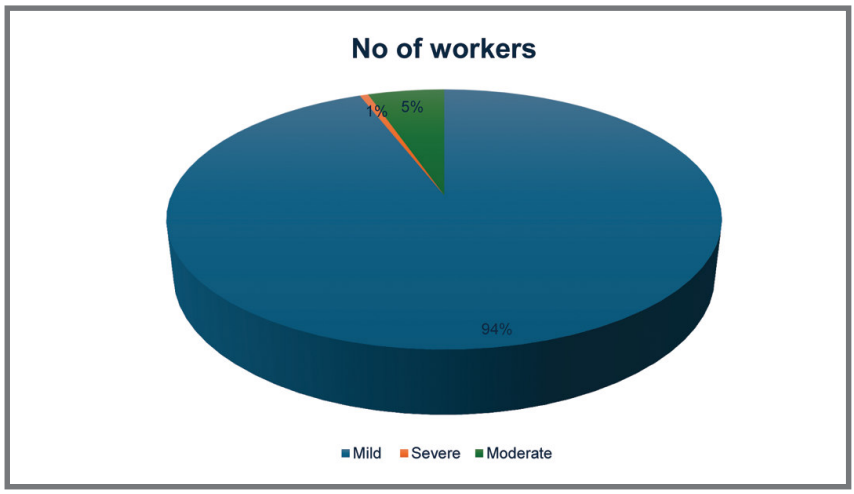

Fig. 2. Degree of hearing loss

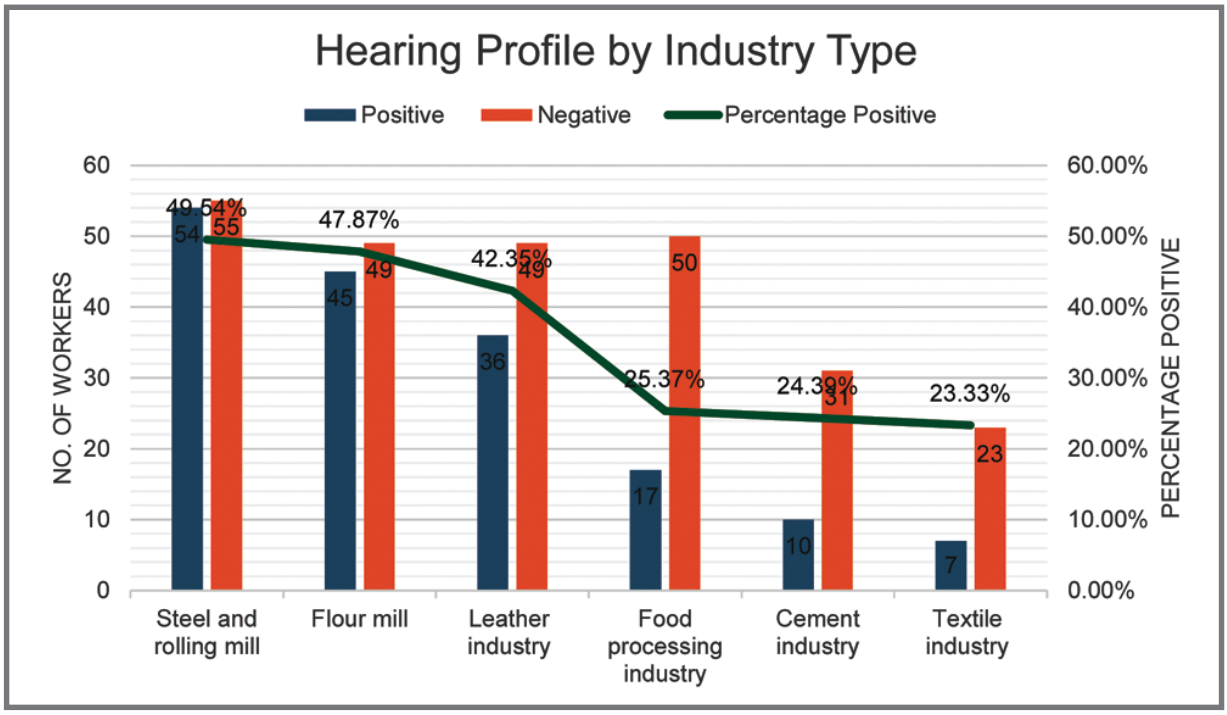

Fig. 3. Hearing profile by industry type

Table IV: Incidence of Hearing Loss on Follow up for One Year

DURATION OF STUDY	NO. OF WORKERS WITH POSITIVE AUDIOMETRIC VALUE
At time of presentation	165
3 Months	165
6 Months	166
12 Months	169

$X^2 = 3.97$ Degree of freedom = 3
pvalue =<0.26 (non significant)

426 industrial workers were screened to assess the prevalence and characteristics of noise-induced hearing loss (NIHL). Out of these, 169 workers (39.67%) were found to have hearing loss with a male predominance affecting 161 males (95.26%) compared to 8 females resulting in a male-to-female ratio of 24:1. The maximum workers reside in rural areas (73%) as compared to rural areas (27%). The majority of affected workers were aged between 41 to 50 years (42%), followed by those aged 31 to 40 years (36%) (Table I).

Hearing loss was most prevalent in workers over 50 years old (99%), followed by those aged 41–50 years (59.21%) and 31–40 years (13.24%) attributing to fact that long duration of exposure is synergistic with hearing loss. Workers working for 10 hours daily showed significantly higher hearing loss ($p < 0.0001$). Those with over 20 years showed the highest prevalence (99%), followed by those with 15–20 years of exposure (71%), confirming a strong correlation ($p < 0.001$) between duration of exposure and NIHL (Table II).

Additionally, most workers were exposed to noise levels between 90–110 dB, but hearing loss peaked (77%) among those exposed to higher intensities of 110–120 dB, again showing a significant association ($p < 0.001$). (Table III).

Audiometric assessments revealed that 98% had sensorineural hearing loss, with the condition being

predominantly mild (94.10%) followed by moderate hearing loss (5.30%) (Figure 1, Figure 2). Industry wise, the highest number of workers were from the steel sector 109 workers (25%) where nearly half (49.54%) experienced hearing loss (Figure 3).

A one-year follow-up recorded only four new cases of hearing loss, which was not statistically significant (p = 0.26), suggesting that longer-term observation is needed to capture the effects of noise induced hearing loss, which often develops after several years of exposure (Table IV).

Discussion

Our study revealed a substantial prevalence of hearing loss, affecting 39.6% of the workers (95% CI, error margin: 5%). The finding of present study is in support of studies done by Agarwal et al. (2015)[10] (46%) and is closest to the rate reported by Oliveria (2014) (36.07%).[11] In contrast to our study Ologe et al. (2006) [12] reported higher prevalence of 57%.

The current study found that ONIHL predominantly affects individuals in their 4th and 5th decades of life. This aligns with Pathak's[13] findings, which reported a high percentage of NIHL in the 40-45 years age groups. ONIHL affects older and middle-aged workers highlighting the fact that older workers are particularly vulnerable, as the cumulative effects of noise exposure over time contribute to this trend as per Sulkowski et al., study.[14] Contrary to present study Amedofu et al. (2017) [15] observed that most individuals with ONIHL fell within the 20-39 years age range.

The current study states that male to female ratio 20:1 highlighting male dominance. The result is synchronous with study conducted by Wang et al. (2021);[16] stating that noise induced hearing loss was significantly higher in males (34.4%). However, male preponderance can be attributed to fact that they are often employed in industries which has higher noise exposure, such as construction, manufacturing, and transportation, which may contribute to the higher incidence of ONIHL among them.

In our study majority workers experienced mild hearing loss (94.10%) followed by moderate hearing loss (5.30%). Oliveria et al. (2014)[11] study favoured this observation which stated that 111 out of 116 subjects (95.68%) were mild hearing loss followed by 4 out of 116 subjects experienced moderate hearing loss (3.44%). Contrary to this Singh et al [17] reported that majority had moderate hearing loss.

This study found that workers with over 10 years of work experience were more likely to develop hearing loss. This suggests that the longer the exposure to noise, the greater the risk of NIHL. This finding is supported by Bhattacharya et al. [18] The possible reason could be chronic noise exposure can cause permanent hearing loss by directly damaging hair cells in the cochlea, generating toxic free radicals, and leading to cell death. Aging can exacerbate this effect, as the cochlea's self regeneration ability is impaired, hair cell loss irreversible.[19]

Our study found that 166 out of 169 workers suffered from sensorineural hearing loss (SNHL), consistent with previous research. Ranga et al. (2014) Bukuru et al. (2019).[20,21] noted that chronic noise exposure affects the bilateral cochlea, leading to high-frequency SNHL with a 4 kHz notch. In this study, factors such as age, working experience, and working area noise level were positively associated with hearing loss.

Conclusion

The risk of hearing impairment among workers is significantly influenced by factors such as prolonged noise exposure, extended working hours, and high sound intensity. Regular auditory evaluations should be a mandatory component of workplace. Furthermore, strict enforcement of hearing protection device usage is crucial to ensure early detection and intervention for potential hearing issues, ultimately safeguarding the auditory health of workers.

References

1. Toppila E, Koskinen, H, Pyykkö, I (2011) Hearing loss among classical-orchestra musicians. Noise and Health 13(50):45-50
2. Sriwattanatamma P, Breysse P (2000) Comparison of NIOSH

noise criteria and OSHA hearing conservation criteria. Am J Ind Med. (4), 334-338

3. Lie A, Engdahl B, Hoffman HJ, Li CM et al. (2017) Occupational noise exposure, hearing loss, and notched audiograms in the HUNT Nord-Trøndelag hearing loss study, 1996-1998. Laryngoscope. 127(6):1442-1450
4. Puel JL, Ruel J, Gervais d'Aldin C, Pujol R (1998) Excitotoxicity and repair of cochlear synapses after noise-trauma induced hearing loss. Neuroreport. 9(9):2109-2114
5. Furness DN. (2015) Molecular basis of hair cell loss. Cell Tissue Res. (1):387-399
6. Zhou Y, Zheng G, Zheng H, Zhou Ret al. (2013) Primary observation of early transtympanic steroid injection in patients with delayed treatment of noise- induced hearing loss. Audiol Neurotol. 18:89–94
7. Choi YH, Miller JM, Tucker KL, Hu H et al. (2014) Antioxidant vitamins and magnesium and the risk of hearing loss in the US general population. Am J Clin Nutr.99:148–155
8. Suzuki H, Hashida K, Nguyen KH, Hohchi N et al. (2012) Efficacy of intratympanic steroid administration on idiopathic sudden sensorineural hearing loss in comparison with hyperbaric oxygen therapy. Laryngoscope.122:1154–1157
9. Smalt CJ, Calamia PT, Dumas AP, Perricone JP et al. (2020) The effect of hearing-protection devices on auditory situational awareness and listening effort. Ear Hear. 41:82–94
10. Agarwal G, Nagpure PS, Gadge SV (2015) Noise Induced Hearing Loss in Steel Factory Workers. Int J Occup Saf Health .4:34-43
11. Oliveira A, Cacodcar J, Motghare DD (2014) Morbidity among iron ore mine workers in Goa. Indian J Public Health. 58:57–60
12. Ologe FE, Akande TM, Olajide TG (2006) Occupational noise exposure and sensorineural hearing loss among workers of a steel rolling mill. Eur Arch Otorhinolaryngol.263:618–621
13. Solanki JD, Mehta HB, Shah CJ, Gokhale PA (2013) Occupational noise-induced hearing loss: Is planning appropriate type of shift work for the workers the most practical potential preventive measure? Indian J Otol.19:155–156
14. Sulkowski WJ, Szymczak W, Kowalska S, Sward-Matyja M (2004) Epidemiology of occupational noise-induced hearing loss (ONIHL) in Poland. Otolaryngol Pol.58(1):233-236
15. Amedofu GK (2002) Hearing impairment among workers in a surface gold mining company in Ghana. Afr J Health Sci. 9:91–97
16. Wang Q, Wang X, Yang L et al. (2021) Sex differences in noise-induced hearing loss: a cross-sectional study in China. Biol Sex Differ.12(1):24
17. Singh LP, Bhardwaj A, Deepak KK (2013) Occupational noise-induced hearing loss in Indian steel industry workers: an exploratory study. Hum Fact. 55:411–424
18. Bhattacharya SK, Saiyed HN, Roy A, Chatterjee SK (1981) Hearing acuity in weavers of a textile mill. Indian J Med Res.74:779–785
19. Ravikumar A, Mohanty S, Senthil K, Raghunandan S (2004) Evoked otoacoustic emissions to detect early noise-induced hearing loss. Indian J Otol.10:7–16
20. Ranga RK, Yadav SPS, Yadav A, Ranga SB et al. (2014) Prevalence of occupational noise-induced hearing loss in industrial workers. Indian J Otol. 20:115–118
21. Bukuru J, Byiringiro F, Mukara BK, Twagirumukiza E et al. (2019) Prevalence of occupational noise-induced hearing loss among wood and metal workers of Gakiriro, Kigali city, Rwanda. Public Health Bull.1:20–25.