

Prevalence of Noise Induced Hearing Loss in North Bihar: A Cross-Sectional Study

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Abstract

Background: Noise-induced hearing loss (NIHL) is one of the leading preventable causes of permanent hearing impairment worldwide. Long-term exposure to occupational and environmental noise damages the sensory hair cells of the inner ear, resulting in irreversible hearing loss. Industrialization, mechanization of agriculture, and increasing environmental noise have raised the risk of NIHL, particularly in rural and semi-urban populations. However, limited data are available from North Bihar regarding the prevalence of NIHL and its associated risk factors.

Aim and Objectives: The study aimed to determine the prevalence of noise-induced hearing loss among adults in North Bihar. The objectives were to estimate the prevalence of NIHL using pure tone audiometry, assess occupational noise exposure, evaluate the association between occupational noise exposure and NIHL, and identify demographic and clinical risk factors associated with hearing loss.

Methodology: A hospital-based cross-sectional observational study was conducted over 12 months in the Department of Otorhinolaryngology of a tertiary care hospital in North Bihar. A total of 100 adults aged 18 years and above were included in the analysis. Socio-demographic details, occupational history, noise exposure, use of hearing protection devices, smoking, alcohol consumption, hypertension, and ototoxic drug use were recorded using a structured questionnaire. All participants underwent ENT examination and pure tone audiometry. Data were analyzed using SPSS version 26.0, and associations were assessed using the Chi-square test, with $p < 0.05$ considered statistically significant.

Results: The prevalence of NIHL was 26%, with mild hearing loss being the most common type (46.2%). Bilateral hearing loss was observed in 61.5% of affected participants. Occupational noise exposure was reported by 45% of participants, and only 33.3% of exposed workers used hearing protection devices. A highly significant association was found between occupational noise exposure and NIHL ($p = 0.0002$). Smoking ($p = 0.018$), alcohol consumption ($p = 0.031$), history of ototoxic drug use ($p = 0.041$), and hypertension ($p = 0.027$) were also significantly associated with NIHL.

Conclusion: Noise-induced hearing loss is a common occupational health problem among adults in North Bihar. Occupational noise exposure is the major contributing factor, while smoking, alcohol use, hypertension, and ototoxic drug use further increase the risk. Strengthening workplace noise control measures, promoting regular hearing screening, encouraging consistent use of hearing protection devices, and improving public awareness are essential for preventing NIHL and reducing its long-term health burden.

Keywords: Noise-Induced Hearing Loss, Occupational Noise Exposure, Pure Tone Audiometry, Hearing Protection Devices, Risk Factors, Occupational Health, North Bihar.

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Introduction

Hearing is one of the most important senses for communication, education, social interaction, and overall quality of life. Hearing loss can significantly affect an individual's personal, social, and professional life. Among the different types of hearing impairment, noise-induced hearing loss (NIHL) is one of the most common preventable causes of permanent hearing loss across the world.

It develops due to prolonged or repeated exposure to loud sounds that damage the delicate hair cells present in the cochlea of the inner ear. Since these sensory hair cells do not regenerate, the hearing loss caused by excessive noise is usually permanent and irreversible. Noise-induced hearing loss is recognized as a major occupational health problem because millions of workers are regularly exposed

to hazardous noise levels in their workplaces. Industries such as manufacturing, mining, construction, transportation, agriculture, and heavy engineering often generate noise levels above the recommended safety limits. Continuous exposure to such environments without adequate hearing protection increases the risk of hearing damage. Apart from occupational settings, increasing exposure to environmental noise from road traffic, railways, airports, loudspeakers, and recreational activities has also contributed to the growing burden of NIHL.

According to the World Health Organization (WHO), more than 1.5 billion people worldwide live with some degree of hearing loss, and a substantial proportion of these cases are preventable.

Occupational and environmental noise remain among the leading avoidable causes of hearing impairment. Hearing loss not only affects communication but is also associated with reduced work productivity, social isolation, depression, cognitive decline, and poor quality of life.

India is experiencing rapid industrialization, urbanization, and mechanization of agriculture, resulting in increased exposure to occupational and environmental noise.

Many workers, especially those employed in factories, rice mills, brick kilns, transportation services, construction sites, and agricultural machinery operations, are exposed to high noise levels for prolonged periods. Unfortunately, the use of personal hearing protection devices and regular hearing screening remains inadequate in many workplaces, particularly in rural and semi-urban areas. As a result, many individuals develop hearing impairment without being aware of the early symptoms until the damage becomes permanent.

North Bihar is predominantly an agricultural region but has also witnessed considerable industrial development over the past few decades. The increasing use of heavy agricultural machinery, diesel-powered equipment, rice mills, small-scale industries, and growing traffic has increased the likelihood of chronic noise exposure among the local population.

Despite these changes, there is limited published information regarding the prevalence of noise-induced hearing loss in this region. Most available studies from India have been conducted in large metropolitan cities or industrial zones, leaving a significant gap in data from rural populations such as North Bihar.

Early detection of noise-induced hearing loss is essential because the condition is largely

preventable. Identification of individuals at risk allows timely implementation of preventive measures such as workplace noise control, periodic audiometric examinations, awareness programs, and the use of hearing protection devices. Understanding the prevalence of NIHL and its associated risk factors will help healthcare professionals, policymakers, and occupational health authorities develop effective strategies to reduce the burden of hearing impairment in the community. Therefore, the present study was conducted to determine the prevalence of noise-induced hearing loss among adults in North Bihar and to evaluate its association with occupational noise exposure and other important risk factors.

Aim and Objectives

Aim: To determine the prevalence of noise-induced hearing loss among adults in North Bihar.

Objectives

- To estimate the prevalence of noise-induced hearing loss using pure tone audiometry.
- To assess occupational noise exposure among study participants.
- To evaluate the association between occupational noise exposure and NIHL.
- To identify demographic and clinical risk factors associated with NIHL.

Methodology

This cross-sectional observational study was conducted over a period of 12 months in the Department of Otorhinolaryngology (ENT) of a tertiary care hospital in North Bihar.

The study included adult participants aged 18 years and above who attended the ENT outpatient department (OPD) and individuals screened during community health camps organized in the study area. A total of 400 participants were enrolled using a convenience sampling technique after obtaining written informed consent.

Information was collected using a pre-designed and structured questionnaire. The questionnaire included details regarding the participants' socio-demographic characteristics such as age, gender, place of residence, and occupation.

It also gathered information on occupational noise exposure, duration of exposure, use of hearing protection devices, smoking habits, alcohol consumption, history of hypertension, and use of ototoxic medications. Relevant medical and occupational histories were recorded through face-to-face interviews conducted by the investigators.

All participants underwent a detailed ENT examination to rule out other causes of hearing impairment. Hearing assessment was carried out using pure tone audiometry (PTA) in a sound-

treated room by a trained audiologist following standard audiological procedures.

Air conduction and bone conduction hearing thresholds were measured at frequencies ranging from 250 Hz to 8000 Hz.

Participants showing the characteristic audiometric pattern of high-frequency sensorineural hearing loss, consistent with prolonged noise exposure, were diagnosed as having noise-induced hearing loss (NIHL). The severity of hearing loss was classified according to standard hearing threshold levels.

The collected data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0.

Continuous variables were summarized as mean and standard deviation, while categorical variables were presented as frequencies and percentages. The association between noise exposure and hearing

loss, as well as other risk factors, was assessed using the Chi-square test.

A p-value of less than 0.05 was considered statistically significant.

Inclusion Criteria

- Adults aged ≥ 18 years.
- Residents of North Bihar.
- Individuals willing to provide written informed consent.
- Participants undergoing pure tone audiometry.

Exclusion Criteria

- Congenital hearing loss.
- Chronic suppurative otitis media.
- History of ear surgery.
- Conductive hearing loss.
- Acute ear infection.
- Patients unwilling to participate

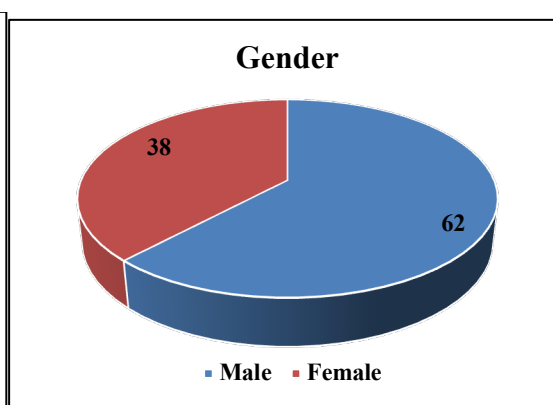
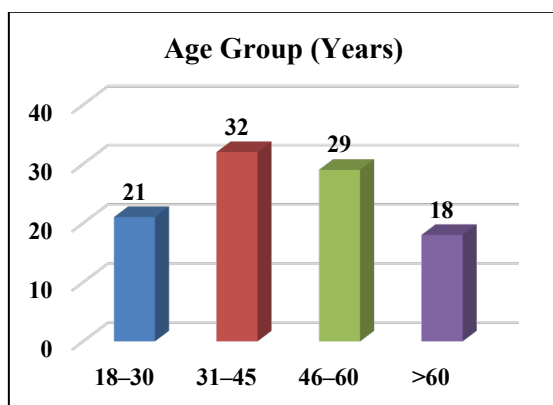
Result

Table 1: Socio-Demographic Distribution of Study Participants (N = 100)

Variable	Category	Number (n)	Percentage (%)
Age Group (Years)	18–30	21	21.0%
	31–45	32	32.0%
	46–60	29	29.0%
	>60	18	18.0%
Gender	Male	62	62.0%
	Female	38	38.0%
Residence	Rural	67	67.0%
	Urban	33	33.0%
Occupation	Agricultural	33	33.0%
	Industrial/Factory	25	25.0%
	Service	19	19.0%
	Business	11	11.0%
	Unemployed/Other	12	12.0%

The study included 100 participants, with the highest proportion belonging to the 31–45 years age group (32%), and followed by 46–60 years (29%). Males constituted the majority of the study population (62%), and most participants were from rural areas (67%). Regarding occupation,

agricultural workers formed the largest occupational group (33%), followed by industrial/factory workers (25%), indicating that the study population was predominantly rural and engaged in occupations with potential exposure to occupational noise.



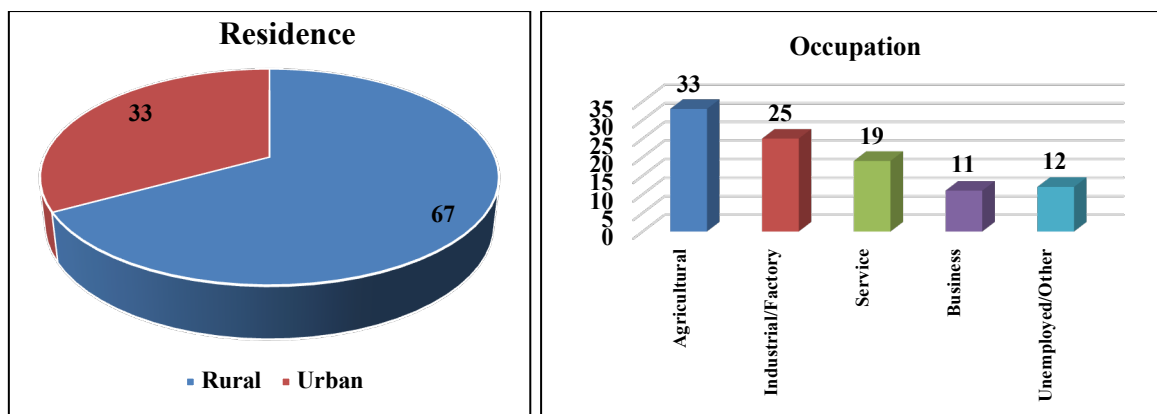


Figure 1:

Table 2: Prevalence of Noise-Induced Hearing Loss (NIHL) (N = 100)

Variable	Category	Number (n)	Percentage (%)
Presence of NIHL	Yes	26	26.0%
	No	74	74.0%
Degree of Hearing Loss*	Mild (26–40 dB)	12	46.2%
	Moderate (41–55 dB)	8	30.8%
	Moderately Severe (56–70 dB)	4	15.4%
	Severe (>70 dB)	2	7.6%
Laterality*	Unilateral	10	38.5%
	Bilateral	16	61.5%

This table shows that 26% of the study participants had audiometry-confirmed noise-induced hearing loss (NIHL), whereas the remaining 74% had no evidence of NIHL. Among the affected participants, mild hearing loss was the most frequently observed degree (46.2%), followed by

moderate (30.8%), moderately severe (15.4%), and severe hearing loss (7.6%). The findings also indicate that bilateral involvement (61.5%) was more common than unilateral involvement (38.5%), suggesting that noise exposure predominantly affected both ears.

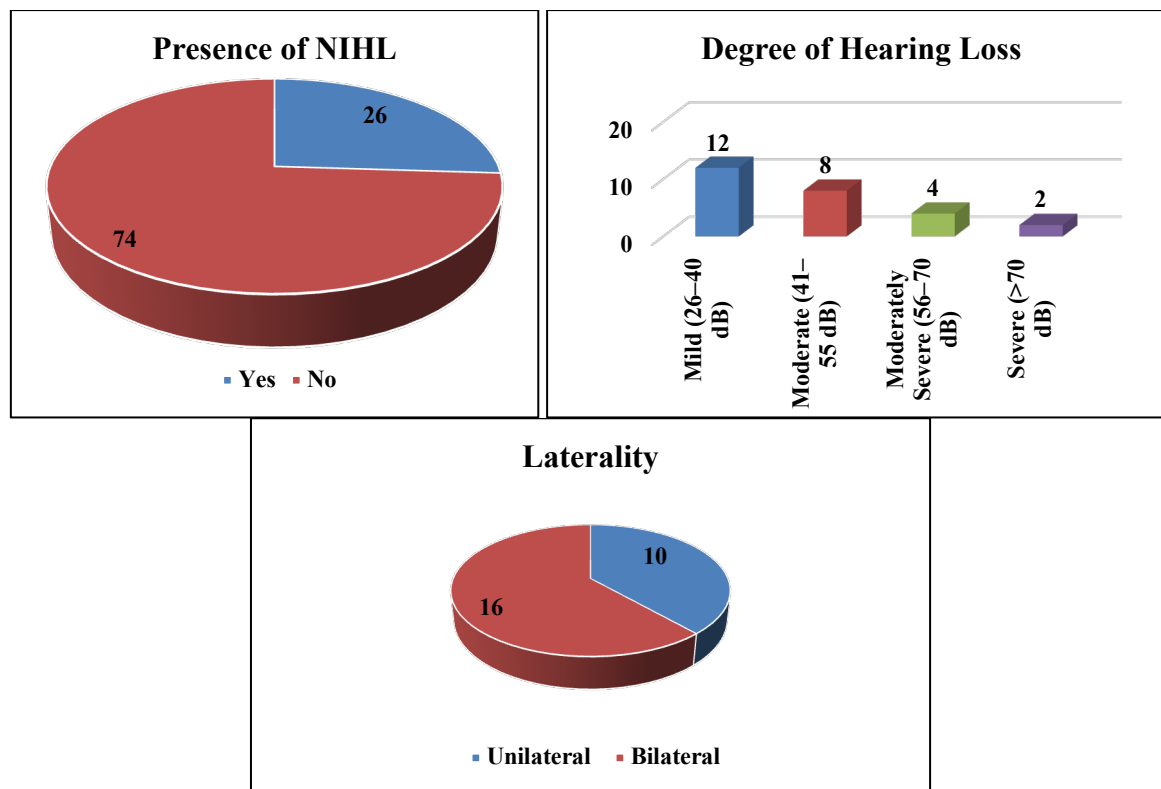


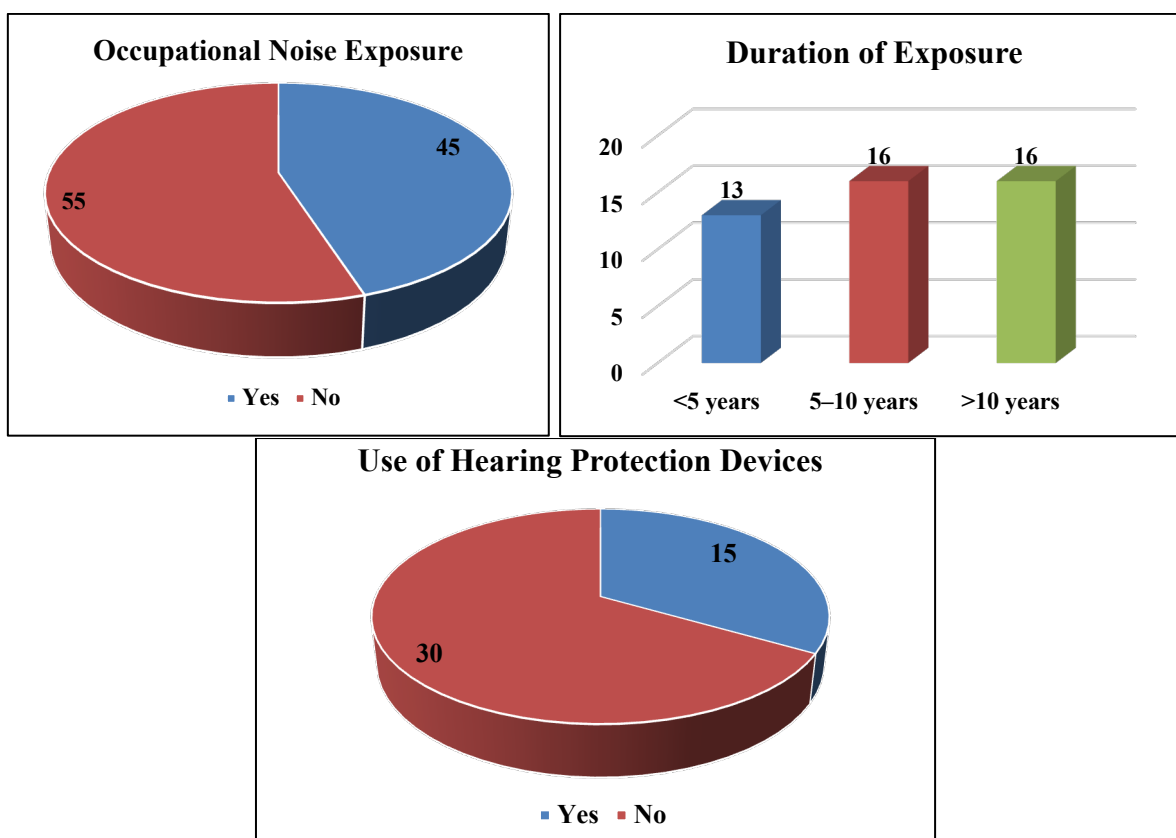
Figure 2:

Table 3: Distribution of Occupational Noise Exposure (N = 100)

Variable	Category	Number (n)	Percentage (%)
Occupational Noise Exposure	Yes	45	45.0%
	No	55	55.0%
Duration of Exposure*	<5 years	13	28.9%
	5–10 years	16	35.6%
	>10 years	16	35.6%
Use of Hearing Protection Devices*	Yes	15	33.3%
	No	30	66.7%

This table depicts the distribution of occupational noise exposure among the study participants. A total of 45% of participants reported occupational noise exposure, while 55% had no such exposure. Among the exposed individuals, 35.6% had been

exposed for 5–10 years and another 35.6% for more than 10 years, whereas only 33.3% reported using hearing protection devices, indicating that the majority (66.7%) were exposed to workplace noise without adequate hearing protection.

**Figure 3:****Table 4: Association between NIHL and Occupational Noise Exposure (N = 100)**

Noise Exposure	NIHL Present n (%)	NIHL Absent n (%)	Total	Chi-square	P value
Exposed	20 (44.4)	25 (55.6)	45	13.72	P = 0.0002 (Highly Significant)
Not Exposed	6 (10.9)	49 (89.1)	55		
Total	26	74	100		

This table demonstrates the association between occupational noise exposure and the presence of noise-induced hearing loss (NIHL).

Among participants exposed to occupational noise, 44.4% had NIHL compared to only 10.9% among

those without occupational noise exposure. The association was found to be highly statistically significant (Chi-square = 13.72, $p = 0.0002$), indicating that occupational noise exposure is significantly associated with an increased risk of developing NIHL.

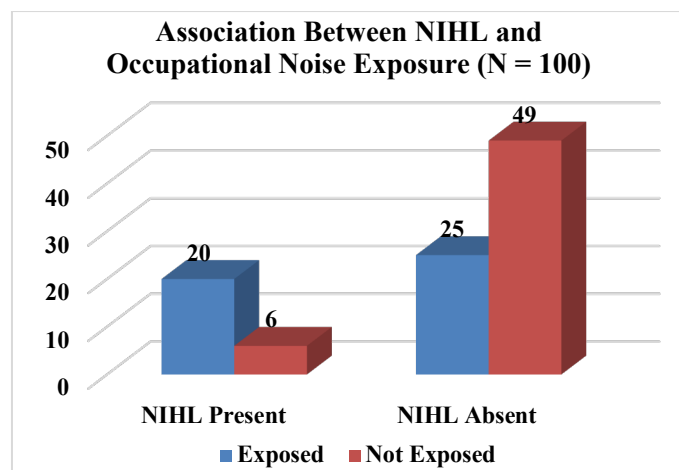


Figure 4:

Table 5: Associated Risk Factors for NIHL (N = 100)

Risk Factor	Category	Number (n)	Percentage (%)	P-value
Smoking	Yes	30	30.0%	0.018
	No	70	70.0%	
Alcohol Consumption	Yes	24	24.0%	0.031
	No	76	76.0%	
History of Ototoxic Drug Use	Yes	11	11.0%	0.041
	No	89	89.0%	
Hypertension	Yes	22	22.0%	0.027
	No	78	78.0%	

This table presents the distribution of selected risk factors associated with noise-induced hearing loss (NIHL) among the study participants. Smoking (30.0%), alcohol consumption (24.0%), hypertension (22.0%), and a history of ototoxic drug use (11.0%) were identified as significant risk factors. All these variables showed a statistically significant association with NIHL, with p-values less than 0.05, indicating that these factors may contribute to an increased risk of developing noise-induced hearing loss.

Discussion

The present study included 100 participants from different age groups and occupational backgrounds. The largest proportion of participants belonged to the 31–45 years age group (32%), followed by 46–60 years (29%). Males (62%) were more than females (38%), and most participants were from rural areas (67%). Agricultural workers formed the largest occupational group (33%), followed by industrial workers (25%). This distribution reflects the population commonly exposed to occupational and environmental noise in rural and semi-urban settings.

The overall prevalence of noise-induced hearing loss (NIHL) in the present study was 26%. Among affected individuals, mild hearing loss was the most common type (46.2%), followed by moderate hearing loss (30.8%). Bilateral hearing loss (61.5%) was more frequent than unilateral hearing

loss (38.5%), suggesting that prolonged exposure to loud noise usually affects both ears. These findings are similar to those reported by Basner et al. (2024), who stated that continuous occupational noise exposure commonly results in bilateral, gradually progressive hearing impairment. Likewise, World Health Organization (2024) reported that early stages of NIHL are usually mild but can worsen with prolonged exposure if preventive measures are not adopted.

In the present study, 45% of participants reported occupational noise exposure. Among them, more than one-third had been exposed for over five years, and only one-third (33.3%) regularly used hearing protection devices. The low use of hearing protection indicates poor awareness or limited availability of protective equipment in many workplaces. Similar observations were reported by Masterson et al. (2023), who found that inadequate use of hearing protection remains a major reason for occupational hearing loss among workers in noisy industries. A highly significant association was observed between occupational noise exposure and NIHL ($\chi^2 = 13.72$, $p = 0.0002$). Nearly 44.4% of noise-exposed participants had NIHL compared with only 10.9% among those not exposed. This finding strongly supports the role of occupational noise as an important risk factor for hearing loss. Comparable findings were reported by Ruhl et al. (2023), who demonstrated that workers exposed to high levels of workplace noise had a significantly

greater risk of developing hearing impairment than non-exposed workers. The present study also identified several additional risk factors associated with NIHL. Smoking, alcohol consumption, history of ototoxic drug use, and hypertension showed statistically significant associations with hearing loss. Smoking may reduce blood supply to the inner ear, while alcohol and certain ototoxic medications can damage cochlear structures. Hypertension may also impair cochlear circulation, increasing susceptibility to hearing damage. Similar associations have been reported by Yang et al. (2022), who found that smoking and hypertension increase the risk of hearing impairment, particularly when combined with occupational noise exposure.

Overall, the findings of this study indicate that occupational noise exposure remains the primary contributor to NIHL, while lifestyle and medical factors further increase the risk. Regular hearing screening, improved workplace safety measures, and consistent use of hearing protection devices are essential to reduce the burden of occupational hearing loss. Health education programs should also focus on modifying lifestyle-related risk factors and promoting early detection among high-risk workers.

Conclusion

The present study found that the prevalence of noise-induced hearing loss (NIHL) among the study participants was 26%, with mild hearing loss being the most common form. Occupational noise exposure showed a highly significant association with NIHL, indicating that prolonged exposure to workplace noise is a major risk factor for hearing impairment. In addition, smoking, alcohol consumption, history of ototoxic drug use, and hypertension were significantly associated with an increased risk of NIHL.

The low use of hearing protection devices among noise-exposed workers highlights the need for greater awareness and preventive measures. These findings emphasize the importance of regular hearing screening, strict implementation of workplace noise control measures, consistent use of personal hearing protection, and health education programs to reduce the burden of occupational noise-induced hearing loss and improve workers' hearing health.

Ethical Consideration: Ethical clearance was obtained from the Institutional Ethics Committee of

Sri Krishna Medical College and Hospital before commencement of the study. Informed consent was taken from all participants, and confidentiality of patient information was strictly maintained throughout the research.

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Conflict of Interest: The authors declare that there are no conflicts of interest in any form; personal, professional, or financial to the conduct and publishing of this study.

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