Section: ENT

Original Research Article

HEARING LOSS AMONG CONSTRUCTION WORKERS ATTENDING ENT OPD IN A TERTIARY CARE HOSPITAL IN CHENNAI- A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Hearing loss is a major occupational hazard among construction workers due to chronic exposure to hazardous noise. Assessing its prevalence and associated factors is crucial for prevention and management. **Objectives:** To find the prevalence of hearing loss and its associated factors among construction workers attending the ENT outpatient department of a tertiary care hospital in Chennai. **Materials and Methods:** A cross-sectional study was conducted from December 2022 to November 2023 among 211 construction workers aged 20–50 years. Sociodemographic characteristics and comorbid condition details were collected using a questionnaire. Hearing assessment was done with pure tone audiometry, and degree of hearing loss was classified according to American Speech- Language-Hearing Association (ASHA) guidelines. Audiometric notches and high-frequency slopes were also assessed. Data were summarized using descriptive statistics and Chi-square test was applied to find the associated factors. **Result:** Hearing loss was identified in 75.4% of participants, including slight or minimal loss in 64% and mild loss in 11.4%. Audiometric notch was observed in 35.5%, while high-frequency slope was detected in 5.2%. Age was significantly associated with hearing loss ($p<0.001$), audiometric notch ($p=0.014$), and high-frequency slope ($p=0.047$). Comorbid condition was associated with hearing loss ($p<0.001$) and high-frequency slope ($p=0.011$). Longer daily working hours (>8 hours) showed significant association with hearing impairment ($p=0.006$). Work experience was significantly related to audiometric notch ($p<0.001$) and high frequency slope (0.039). Educational level and type of construction work showed no significant associations with hearing loss, 4kHz notch or high frequency slope. **Conclusion:** Hearing impairment is highly prevalent among construction workers, with age, comorbidities, prolonged work hours, and longer work experience identified as key risk factors. Routine screening, health education, and enforcement of protective measures are essential to reduce occupational hearing loss.

INTRODUCTION

Hearing loss is a prevalent occupational health concern, particularly among workers exposed to high levels of noise, such as those in the construction industry. Globally, hearing loss affects approximately 18% of the population, with occupational noise exposure recognized as a major modifiable risk factor for both temporary and permanent auditory impairment.[1,2]

Chronic exposure to hazardous noise can lead to noise-induced hearing loss (NIHL), which is often bilateral, irreversible, and progressive, especially when protective measures are inadequate.[1,2]Noise levels are considered hazardous when they reach 85 decibels or higher. A NIOSH study examining hearing loss across industries found that construction workers have higher levels of hearing loss than workers in most industries.[3] The highest prevalence of noise exposure is observed among construction workers engaged in non-residential

building projects, highway and bridge construction, and heavy civil engineering. The widespread use of power tools, mobile machinery, and other high-noise equipment at construction sites creates multiple sources of hazardous exposure, underscoring the need for consistent use of hearing protection devices. Much of the equipment commonly operated by construction workers generates noise levels exceeding the permissible limit of 85 dBA. Understanding the prevalence and associated risk factors among high-risk groups is essential for developing effective prevention and management strategies.

Hence this study was conducted to find the prevalence of hearing loss and its associated factors among construction workers attending ENT OPD in a tertiary care hospital in Chennai and plan appropriate managing strategies based on the findings of the study.

MATERIALS AND METHODS

The study was conducted in the ENT outpatient department of tertiary care medical college in Chennai, from December 2022 to November 2023. A cross-sectional design was adopted, and the study population comprised construction workers attending the ENT OPD. Institutional ethical clearance was obtained [ref no: Dr.MGR-ERI/SLMCH/2022/005]. Construction workers aged 20–50 years who consented to participate in the study were included, while those with previously diagnosed hearing loss, previous ear surgery, acute otitis media, chronic otitis media, otosclerosis and Meniere's disease were excluded. The sample size was calculated based on a previously reported prevalence of 21.4%,[4] hearing loss among construction workers. Using the formula $4pq/d^2$, with p = 39.6%, q = 60.4%, and d= an absolute precision of 7%, the minimum sample size was estimated to be 195. Participants who met the inclusion criteria were recruited consecutively. Total number of participants recruited for the present study was 211. Written informed consent was obtained from all participants. Data was collected using a questionnaire to obtain sociodemographic details such as age, education status, type of construction worker based on the nature of work, hours of work per day and work experience. Information regarding the history of comorbid conditions was also obtained. After history taking, a comprehensive systemic and ENT examination was performed. Ear evaluation began with inspection under a bull's eye lamp, followed by otoscopic assessment, with otoendoscopy reserved for selected cases. Subsequent examination of the nose and throat was carried out. All participants then underwent pure tone audiometry in a sound proof environment using a calibrated digital audiometer (Labat, India) for assessment of hearing status. Hearing thresholds were recorded for each ear at frequencies ranging from 250 Hz to 8 kHz, and audiometric notches as well as high-frequency slopes were also assessed.

Degree of hearing loss was classified based on American Speech-Language-Hearing Association (ASHA),[5] as follows

- Normal: <16 dbHL (decibel hearing level)
- Slight / Minimal hearing loss: 16 – 25 dBHL
- Mild hearing loss: 26 – 40 dBHL
- Moderate hearing loss: 41 – 55 dBHL
- Moderately Severe hearing loss: 56 – 70 dBHL
- Severe hearing loss: 71 – 90 dBHL
- Profound hearing loss: >90 dBHL

A 4 kHz notch is a distinct dip in the audiogram at 4 kHz, often associated with noise-induced hearing loss (NIHL). It is considered pathognomonic for NIHL. The notch is typically defined as a threshold at 4 kHz that is at least 10 dB worse than adjacent frequencies (e.g., 2 or 8 kHz).[6,7]

A high frequency slope (HFS) refers to a pattern where hearing thresholds increase (worsen) with increasing frequency, especially above 2 kHz.[8] High-frequency slope is common in both noise-induced and age-related hearing loss.[6]

Data was entered in codes in excel and analysis was performed with SPSS statistics software version 21.0. Data were summarized using descriptive statistics, with categorical variables expressed as frequencies and percentages. Associations between risk factors and hearing loss were analyzed using the Chi-square test. A p value < 0.05 was considered statistically significant.

RESULTS

A total of 211 participants were included in the study. The majority belonged to the 20–30 years (44.1%) and >30–40 years (42.2%) age groups, while 13.7% were above 40 years. All the study participants were males.With respect to education, 27.5% had studied up to primary school, 35.1% up to middle school, and 37.4% had completed high school or higher. Regarding type of construction workers based on their nature of work, 44.1% were heavy machinery equipment operators, followed by drivers (27.0%), welders (15.6%), lift operators / signal men (8.1%), and breaker operators (5.2%). Most participants (92.4%) had no comorbidities, whereas 7.6% reported at least one chronic condition, such as diabetes, hypertension or cardiovascular disease. The majority (95.7%) worked for ≤8 hours per day, whereas 4.3% reported working more than 8 hours. In terms of work experience, 35.5% had 1–5 years, 33.6% had >5–10 years, and 30.8% had more than 10 years of exposure [Table -1].

With respect to hearing outcomes, 52 (24.6%) participants had normal hearing. Slight or minimal hearing loss was observed in 135 participants (64%), with 124 (58.7%) having bilateral involvement and 11 (5.2%) having unilateral

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involvement. Mild hearing loss was identified in 24 participants (11.4%), with 17 (8.1%) presenting bilateral and 7 (3.3%) unilateral hearing loss [Figure - 1]. An audiometric notch was present in 75 (35.5%) participants with bilateral presentation noted among 38(18%) and unilateral among 37(17.5%). The notch was absent among 136 (64.5%) [Figure - 2]. High frequency slope was reported among 11(5.2%) with bilateral involvement found among 4(1.8%) and unilateral among 7 (3.3%). However no such change was seen among 200 (94.8%) [Figure - 3].

Age group showed a highly significant association with hearing status ($p<0.001$), with the prevalence of mild hearing loss rising markedly among those above 40 years. Educational level and type of construction work did not demonstrate significant associations with hearing loss ($p>0.05$). The presence of comorbidities was significantly associated with greater hearing impairment ($p<0.001$). Similarly, working for more than 8 hours per day was significantly associated with hearing loss ($p=0.006$). Years of work experience showed a progressive increase in hearing impairment with longer duration, though the association was not statistically significant ($p=0.168$) [Table -2].

Age was significantly associated with audiometric 4kHznotch ($p=0.014$), with higher prevalence among those over 30 years. Years of work experience demonstrated a highly significant association ($p<0.001$), with prevalence rising from 17.3% in those with <5 years to 52.3% in those with >10 years. In contrast, education, type of construction work, comorbidity, and working hours per day were not significantly related to notch presence [Table -3].

High frequency slope and age showed a significant association ($p=0.047$), with prevalence increasing from 2.2% among 20–30 years to 13.8% in those above 40 years. Comorbidities were also significantly associated with HFS (18.8% vs. 4.1%; $p=0.011$). Years of work experience showed a significant association with high-frequency slope, with prevalence rising from 1.3% among workers with <5 years of experience to 4.2% in those with 5–10 years, and 10.8% in those with >10 years ($p=0.039$)[Table-4].

Table 1: Socio demographic characteristics and comorbid status of study participants [n=211]

Study variable	No of Participants (n)	Percentage
Age In Years		
20 To 30	93	44.1
>30 To 40	89	42.2
>40 To 50	29	13.7
Education		
Primary School	58	27.5
Middle School	74	35.1
High SchoolAnd Above	79	37.4
Type of Construction Workers		
Welders	33	15.6
Heavy Machinery Equipment Operators	93	44.1
Breaker Operators	11	5.2
Drivers	57	27
Lift Operators /Signalmen	17	8.1
Comorbid condition		
No	195	92.4
Yes	16	7.6
Hours of Work / Day		
≤ 8	202	95.7
>8	9	4.3
Years of Work Experience		
1 To 5	75	35.5
>5 To 10	71	33.6
>10	65	30.8

Table 2: Association between sociodemographic characteristics, comorbid status and hearing loss [n=211]

Study Variable	Normal Hearing n(%)	Minimal Hearing Lossn(%)	Mild Hearing Loss n(%)	Total n(%)	Chi Square Value	P Value
Age In Years						
20 To 30	24(25.8%)	66(71.0%)	3(3.2%)	93(100%)	39.68	<0.001**
>30 To 40	25(28.1%)	56(62.9%)	8(9.0%)	89(100%)		
>40 To 50	3(10.3%)	13(44.8%)	13(44.8%)	29(100%)		
Education						
Primary School	12(20.7%)	41(70.7%)	5(8.6%)	58(100%)	2.29	0.682
Middle School	21(28.4%)	43(58.1%)	10(13.5%)	74(100%)		
High School And above	19(24.1%)	51(64.6%)	9(11.4%)	79(100%)		
Type Of Construction Worker						
Welders	6(18.2%)	25(75.8%)	2(6.1%)	33(100%)	9.66	0.29

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Heavy Machinery equipment Operators	31(33.3%)	50(53.8%)	12(12.9%)	93(100%)		
Breaker Operators	1(9.1%)	9(81.8%)	1(9.1%)	11(100%)		
Drivers	11(19.3%)	39(68.4%)	7(12.3%)	57(100%)		
Lift Operators / Signalmen	3(17.6%)	12(70.6%)	2(11.8%)	17(100%)		
Comorbid Status						
No	50(25.6%)	128(65.6%)	17(8.7%)	195(100%)	18.09	<0.001**
Yes	2(12.5%)	7(43.8%)	7(43.8%)	16(100%)		
Hours of Work /Day						
≤ 8	51(25.2%)	131(64.9%)	20(9.9%)	202(100%)	10.29	0.006**
>8	1(11.1%)	4(44.4%)	4(44.4%)	9(100%)		
Years of Work						
< 5	23(30.7%)	48(64.0%)	4(5.3%)	75(100%)	6.44	0.168
> 5To 10	14(19.7%)	48(67.6%)	9(12.7%)	71(100%)		
> 10	15(23.1%)	39(60.0%)	11(16.9%)	65(100%)		

*$p<0.05$ – significant , **$p\leq 0.01$ – highly significant

Table 3:Association between sociodemographic characteristics, comorbid status and audiometric 4kHz notch [n=211]

Study Variable	4 kHz Notch Absent n(%)	4 kHz Notch Present n(%)	Total n(%)	Chi Square Value	P Value
Age In Years					
20 To 30	70(75.3%)	23(24.7%)	93(100%)	8.609	.014*
>30 To 40	49(55.1%)	40(44.9%)	89(100%)		
>40 To 50	17(58.6%)	12(41.4%)	29(100%)		
Education					
Primary School	39(67.2%)	19(32.8%)	58(100%)	.690	0.708
Middle School	45(60.8%)	29(39.2%)	74(100%)		
High SchoolAnd Above	52(65.8%)	27(34.2%)	79(100%)		
Type of Construction Workers					
Welders	21(63.6%)	12(36.4%)	33(100%)	3.383	0.496
Heavy Machinery Equipment Operators	58(62.4%)	35(37.6%)	93(100%)		
Breaker Operators	5(45.5%)	6(54.5%)	11(100%)		
Drivers	39(68.4%)	18(31.6%)	57(100%)		
Lift Operators /Signalmen	13(76.5%)	4(23.5%)	17(100%)		
Comorbid condition					
No	125(64.1%)	70(35.9%)	195(100%)	0.139	0.709
Yes	11(68.8%)	5(31.3%)	16(100%)		
Hours of Work / Day					
≤8	129(63.9%)	73(36.1%)	202(100%)	0.728	0.393
>8	7(77.8%)	2(22.2%)	9(100%)		
Years of Work Experience					
1 To 5	62(82.7%)	13(17.3%)	75(100%)	19.29	<0.001**
>5 To 10	43(60.6%)	28(39.4%)	71(100%)		
>10	31(47.7%)	34(52.3%)	65(100%)		

*$p<0.05$ – significant , **$p\leq 0.01$ – highly significant

Table 4: Association between sociodemographic characteristics, comorbid status and high frequency slope [n=211]

Study Variable	High Frequency Slope Absent n(%)	High FrequencySlope Present n(%)	Total n(%)	Chi Square Value	P Value
Age In Years					
20 To 30	91(97.8%)	2(2.2%)	93(100%)	6.11	0.047*
>30 To 40	84(94.4%)	5(5.6%)	89(100%)		
>40 To 50	25(86.2%)	4(13.8%)	29(100%)		
Education					
Primary School	52(89.7%)	6(10.3%)	58(100%)	4.35	0.113
Middle School	72(97.3%)	2(2.7%)	74(100%)		
High School and above	76(96.2%)	3(3.8%)	79(100%)		
Type f Construction Workers					
Welders	31(93.9%)	2(6.1%)	33(100%)	3.52	0.475
Heavy Machinery Equipment Operators	90(96.8%)	3(3.2%)	93(100%)		
Breaker Operators	10(90.9%)	1(9.1%)	11(100%)		
Drivers	52(91.2%)	5(8.8%)	57(100%)		
Lift Operators /Signalmen	17(100%)	0(0.0%)	17(100%)		
Comorbid condition					
No	187(95.9%)	8(4.1%)	195(100%)	6.42	0.011*

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Yes	13(81.3%)	3(18.8%)	16(100%)		
Hours of Work / Day					
≤8	191(94.6%)	11(5.4%)	202(100%)	0.517	0.472
>8	9(100.0%)	0(0.0%)	9(100%)		
Years of Work Experience					
1 To 5	74(98.7%)	1(1.3%)	75(100%)	6.486	0.039*
>5 To 10	68(95.8%)	3(4.2%)	71(100%)		
>10	58(89.2%)	7(10.8%)	65(100%)		

*$p<0.05$ – significant

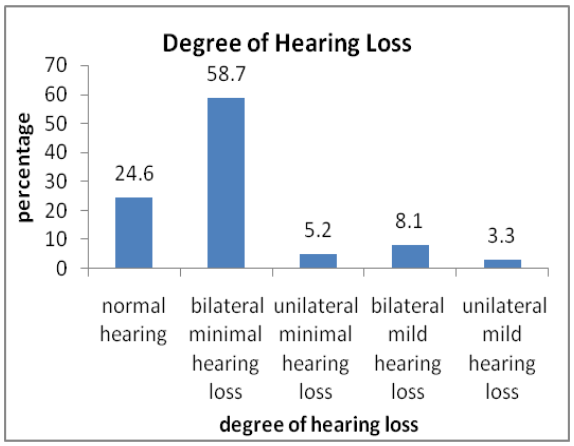

Figure 1: Prevalence of Hearing Loss [n=211]

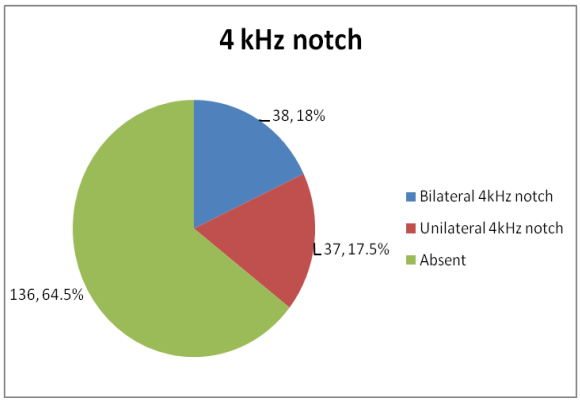

Figure 2: Prevalence of audiometric 4 kHz Notch [n=211]

DISCUSSION

The present findings reveal a high prevalence of hearing loss among construction workers, with only 24.6% exhibiting normal hearing, and the majority experiencing slight (64%) or mild (11.4%) hearing loss, predominantly bilateral. The presence of audiometric notches (35.5%) and high-frequency slope (5.2%) further underscores the impact of occupational noise exposure. Prevalence of hearing loss among construction workers ranges from 11% to over 58%, depending on the population and assessment methods .[9-14] In large-scale studies, about 23% of U.S. construction workers had hearing loss, with certain sub-sectors (e.g., heavy machinery

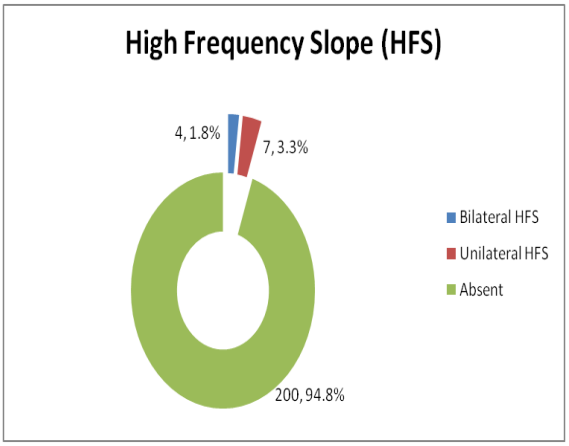

Figure 3: Prevalence of High Frequency Slope [n=211]

operators ,site preparation) showing even higher rates.[9] Indian studies report prevalence rates from 11% to 24.6%, with mild hearing loss being most common and bilateral sensorineural loss frequently observed.[11,12] Audiometric notches (indicative of noise-induced hearing loss) and high-frequency hearing loss are common, especially with longer work duration.[11,13-15] Age emerged as a significant determinant, with both overall hearing loss and specific patterns (audiometric notch, high-frequency slope) increasing markedly in older age groups. This aligns with extensive epidemiological evidence identifying age as a primary risk factor for adult-onset hearing loss, with risk rising exponentially with advancing age due to cumulative cochlear degeneration and increased vulnerability to environmental insults.[16-19] Age-related hearing loss is often characterized by high-frequency involvement and bilateral presentation, consistent with the observed patterns.[16,18] Comorbid conditions, such as cardiovascular disease, diabetes, and hypertension, were significantly associated with greater hearing impairment and high-frequency slope. Large cohort and meta-analytic studies confirm that these health conditions contribute to microvascular and metabolic changes in the cochlea, exacerbating susceptibility to both noise-induced and age-related hearing loss.[16 -17,20- 22]

The presence of multiple chronic diseases nearly doubles the odds of hearing loss.[19,21]While years of work experience showed a non-significant trend toward increased hearing loss, occupational noise exposure remains a well-established risk factor, accounting for up to 16% of global disabling hearing.[16-17,23] Extended work hours (>8 hours/day) were significantly associated with hearing loss,

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supporting the role of cumulative noise dose. However, educational level and specific job roles did not show significant associations, consistent with some population-based studies.[16,19,23]

The audiometric notch, a classic marker of noise-induced hearing loss, was significantly associated with both age and duration of exposure, reflecting the cumulative effect of occupational noise.[16-17,23]

High-frequency slope, though less prevalent, was also linked to age , comorbidities and longer work experience highlighting the multifactorial etiology of hearing impairment in this population.[16-18,20,24]

CONCLUSION

The present study highlights a considerable burden of hearing impairment among construction workers, with the majority exhibiting slight or mild hearing loss, predominantly of bilateral type. Audiometric notches and high-frequency slopes, characteristic markers of noise-induced hearing loss, were observed in 35.5% and 5.2% of participants, respectively. Age, comorbidities and extended working hours emerged as significant determinants of hearing impairment. Work experience was significantly associated with audiometric notch ($p<0.001$) and high frequency slope (0.039). Educational level and type of construction work, showed no significant associations with hearing loss, 4kHz notch or high frequency slope.These findings underscore the need for periodic audiological screening, early preventive interventions, and strict enforcement of occupational safety measures to mitigate the long-term auditory health risks among construction workers.

Limitations

The cross-sectional design limits causal inference, and the inclusion of only male participants reduces generalizability to women. The absence of direct noise exposure measurements and reliance on self-reported occupational history may introduce recall bias. Additionally, potential confounders such as recreational noise exposure and ototoxic drug use were not evaluated.

Recommendations

Future research should adopt longitudinal designs with direct measurement of workplace noise exposure to strengthen causal evidence. Inclusion of both genders and larger, multicentric samples would improve representativeness. Policy measures should mandate regular audiometric surveillance, enforce permissible noise exposure limits, and strengthen hearing conservation programs in the construction sector. Awareness campaigns on the use of personal protective equipment and integration of occupational health services into routine worker welfare programs are critical for sustainable prevention.

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