

Awareness and usage of personal protective equipment among construction workers and their hearing assessment by pure tone audiometry; A cross-sectional study in South India

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ABSTRACT

Context: Occupational hazards at the building construction workplace are enormous. Good compliance to the use of personal protective equipment (PPE) alongside other safety measures is critical in reducing the hazards. Occupational hearing loss is one such occupational hazard among construction workers. **Aims:** This study was conducted for determining the awareness of the benefits of PPE and its usage among construction workers along with hearing assessment. **Settings and Design:** A cross-sectional study was conducted among construction workers in a building project in Mangaluru city in Dakshina Kannada district in South India. **Methods and Material:** After obtaining informed written consent, 110 construction workers were recruited by simple random sampling method. Basic information, awareness, and use of PPE were collected using a semistructured questionnaire through personal interviews. Hearing assessment was done by pure tone audiometry. **Statistical Analysis Used:** Data collected was analyzed. Chi-square test and Fischer's exact probability test were used to test the association between variables. **Results:** Majority (85.5%) of the construction workers are working for duration of 15 years or less. Difficulty in hearing was reported by 9.6% of them. Awareness regarding benefits of using personal protective devices like helmets, masks, and earplugs/muffs were 58.2%, 56.4%, and 14.5%, respectively. The utilization of at least one PPE among them was 58.1%. The presence of sensory neural hearing loss (SNHL) in both/either ears was detected among 14.5% of the workers. There was a statistically significant association of SNHL among workers and their duration of construction work. **Conclusion:** The current study highlights that awareness and usage of PPE was low and a proportion of them had a hearing impairment. Occupational health and safety training along with a periodic examination of construction workers need to be focused so as to detect and manage occupational health hazards early.

Keywords: Audiometry, construction workers, personal protective equipment

Introduction

In the current era of globalization, construction has appeared as a fast-growing industry. It is also one of the stable growing

industries across the world and construction laborers form 7.5% of the world labor force.^[1,2] This industry employs a large number of people on its workforce.^[3] In India, after agriculture, it is the largest economic activity. This labor-intensive industry consists majority, about 44%, of all urban unorganized workers.^[2,3] It is a complex sector where injuries at the workplace are enormous.^[4] Workers in the construction sectors are more exposed to the effects of physical, psychological, biological, and chemical risk factors.^[5] In developing countries as compared to industrialized

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countries, the impact of occupational health and safety hazards faced by construction workers is 10 to 20 times higher.^[6] In developing countries like India, these workers are mostly migrants from remote villages or less educated and not vigilant with regards to different preventive measures.^[7]

Personal protective equipment (PPE) is an equipment used to eliminate or minimize a specific occupational injury by a worker.^[8,9] Its utilization is a universal requirement and it protects the workers from injuries in their workplace.^[4,10] In the building construction sector, good compliance to the use of PPE like gloves, hardhats, overalls, safety boots, earplugs, face shields, and safety harnesses with other safety measures is important and critical in reducing the incidences of injuries and deaths.^[11]

Among the various occupational hazards, high levels of occupational noise remains a problem.^[12] Worldwide 16% of the disabling hearing loss in adults (ranging from 7% to 21% in the various subregions) is attributed to occupational noise.^[13] Occupational hearing loss includes acoustic traumatic injury and noise-induced hearing loss (NIHL). It can be defined as a partial or complete hearing loss in one or both ears as a result of one's employment. The noise exposure of construction workers varies greatly with the activities performed and the equipment used on the worksite.^[14] Long-term exposure to daily noise levels above the lower action level of 80 dB (A) may eventually cause NIHL. It may have a great impact on a worker's quality of life.^[15]

There are limited studies on the awareness of occupational safety measures and assessment of hearing loss among construction workers. In this context, this study was conducted with the objectives of determining the awareness of the benefits of PPE and its usage among construction workers along with hearing assessment by pure tone audiometry. Primary care physicians being the first contact physicians may encounter occupational health aspects in their day-to-day practice. The findings of this study will be significant to primary care physicians, construction stakeholders, contractors, and construction workers in highlighting the gap that exists between PPE's awareness, its usage, and the importance of auditory assessment of workers for early detection of hearing problems and focus on overall health and safety in the construction sector.

Methods

A cross-sectional study was conducted from October 2018 to March 2019 among construction workers, working on building project in Mangaluru city in Dakshina Kannada district of Karnataka, South India. The ethical clearance for the study was obtained from the Institutional Ethical Committee to conduct the study. Considering that 50% of the construction workers may be aware of the benefits of personal protective devices used in occupational safety, with absolute precision of 10% and a confidence interval of 95%, the calculated sample size was 100. Adding a 10% nonresponse rate, the final sample size came to 110. One of the construction sites in the city was selected by

purposive sampling. A total of 122 construction workers were employed. Among them, 110 construction workers were selected by a simple random sampling method. The purpose and nature of the study were explained to each construction worker and written informed consent was obtained. Basic information, awareness, and use of various personal protective measures and history of ear-related complaints were collected on a semistructured questionnaire through personal interviews.

Pure tone audiometry was used to assess the hearing on both ears at the Department of Otorhinolaryngology of the Teaching Hospital. The subjects were clearly instructed to respond even to faint sounds by raising their arms when the test tone was heard. Since this is a subjective test, it was started after getting the full cooperation of the subject and it included pure tone bone and air conduction audiometry. Testing was performed in a soundproof room as per the recommendations of American Speech Language Hearing Association using MAICO MA 52 Clinical diagnostic audiometer.^[16] The various frequencies were tested in the following order: 1000, 2000, 4000, 8000, 250, and 500 Hz. Both the ears were tested and hearing threshold was obtained for both ears by this conventional Hughson–Westlak technique.

Data collected was compiled, entered into a database and then was analyzed using SPSS (Statistical Package for Social Sciences trail version 16). Results were expressed as frequencies and proportions for categorical variables. Chi-square test was used to test the association between variables such as age group and duration of work with the presence of SNHL in both/either ear. Fischer's exact probability test was considered if more than 20% of the cells had an expected count of less than 5. The statistical significance level was fixed at $P < 0.05$.

Results

Among the construction workers, the majority (47.3%) were between 18 and 30 years. There was no one employed below 18 years. Only, 1.8% were above 60 years. Most of them (85.5%) were employed for less than 15 years in construction work and further among them, 68% were employed for less than 5 years. Migrant workers formed about 65.5% of the workers. With regard to habits among them, 32.7% and 55.5% consumed alcohol and used tobacco in any form, respectively [Table 1]. On asking about the difficulty in hearing, 9.6% reported to be having symptoms of hearing loss.

When enquiring about the benefits of personal protective devices, only 58.2% were aware of the benefits of using helmets. Benefits of using masks were known to only 56.4% of them. Awareness regarding the benefits of using earplugs/muffs was least, which was 14.5%. Usage of personal protective devices like helmets, masks, and earplugs/muffs were 54.5%, 45.5%, and 1.8%, respectively. The utilization of at least one PPE among building construction workers was 58.1% [Figure 1].

Construction workers' pure tone audiometry findings suggest that 54.5% and 60% had normal hearing in right and left ear, respectively. Among the workers, 40% had minimal to severe conductive hearing loss in the right ear and 27.2% had minimal to moderate conductive hearing loss in the left ear. On assessing for sensory neural hearing loss (SNHL), 5.4% had minimal to moderate SNHL in the right ear and 12.7% had minimal to severe SNHL in the left ear [Table 2]. Presence of SNHL in both/either ears was detected among 14.5% of the workers.

SNHL was higher (22.2%) among those aged above 40 years as compared to those aged 40 years or less (10.8%); however, this association was not statistically significant ($P = 0.098$). The proportion of SNHL was higher among those who were working in construction for more than 15 years (50%) as compared to those who were working for 15 years or less (8.5%). This association was statistically significant ($P < 0.001$) [Table 3]. There was no association of hearing loss with alcohol intake, tobacco use, and type of worker.

Discussion

Occupational hazards are a major challenge and are common among building construction workers.^[5,17] All workers in the construction industry should be trained on the importance and proper use of PPE to get them protected from potential occupational hazards.^[18,19]

The present study showed that awareness of the benefits of PPE like helmets, masks, and earplugs/muffs among construction workers were 58.2%, 56.4%, and 14.5%, respectively. A study by Jasani *et al.*^[20] in Gujarat, India, showed that only 26% of the workers had knowledge of prevention of work-related hazards by the use of PPE.

Further, our study showed that utilization of at least one PPE among 58.1% of building construction workers and usages of

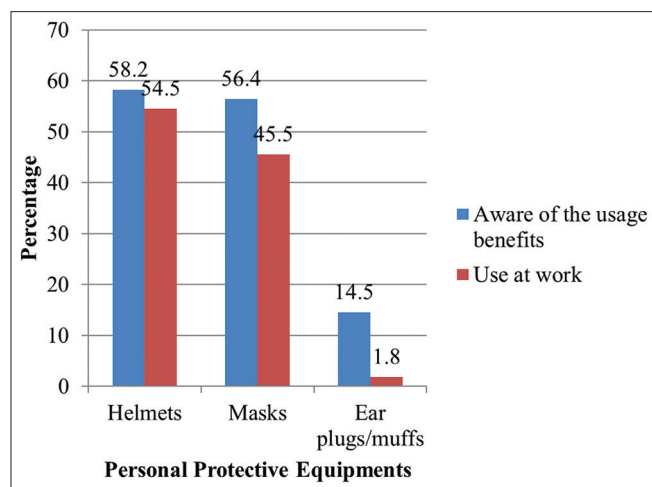


Figure 1: Bar diagram showing awareness of benefits of personal protective devices and their usage among construction workers ($n = 110$)

the personal protective devices like helmets, masks and earplugs/muffs were 54.5%, 45.5%, and 1.8%, respectively. A study by Jasani *et al.*^[20] revealed that 25% of the workers were using one or other forms of PPE. PPE used by them were mainly hand gloves (59%) followed by boots (28%), masks (13%), helmets (7%), eyeglasses (5%), and earplugs (2%). The use of earplugs was least, similar to the finding of this study. Another study by Ashish *et al.*^[21] in Gujarat found only 12% PPE utilization. These few studies done in India showed that awareness and utilization of PPE among construction workers was low.

Table 1: Basic information and personal habits of construction workers ($n=110$)

Variable	Categories	Number	Percentage
Age Category (In years)	<30	52	47.3
	31-40	22	20.0
	41-50	30	27.3
	51-60	4	3.6
	61-70	2	1.8
Duration of Occupation (In years)	0-15	94	85.5
	16-30	16	14.6
Type of Worker	Migrant worker	72	65.5
	Nonmigrant worker	38	34.5
Alcohol Consumption	Yes	36	32.7
	No	74	67.3
Tobacco use in any form	Yes	60	54.5
	No	50	45.5

*There were no workers employed for duration of 11 to 15 years

Table 2: Pure tone audiometry findings among the construction workers ($n=110$)

Classification of hearing defect	Right ear (%)	Left ear (%)
Normal	60 (54.5)	66 (60.0)
Minimal conductive hearing loss	12 (10.9)	14 (12.7)
Mild conductive hearing loss	16 (14.5)	13 (11.8)
Moderate conductive hearing loss	6 (5.5)	3 (2.7)
Moderate to severe conductive hearing loss	10 (9.1)	-
Minimal sensory neural hearing loss	2 (1.8)	4 (3.6)
Mild sensory neural hearing loss	2 (1.8)	-
Moderate sensory neural hearing loss	2 (1.8)	2 (1.8)
Moderate to severe sensory neural hearing loss	-	8 (7.3)

Table 3: Association of age and duration of exposure with the presence of sensory-neural hearing loss in both/either ears among the workers ($n=110$)

Variable categories	Sensory-neural hearing loss		P
	Yes (%)	No (%)	
Age of the worker (years)	≤40	66 (89.2)	0.098*
	>40	28 (77.8)	
Duration of exposure (years)	≤15	86 (91.5)	<0.001#
	>15	8 (50)	
		8 (50)	

P-value analyzed by *Chi-square test and #Fisher's exact test

The utilization of PPE in this study is in line with a study conducted in Kampala, Uganda (50.4%)^[22] but lower than studies conducted in Hawassa, Ethiopia (82.4%)^[23] and higher than studies done in Cairo, Egypt (31.4%)^[24] and Addis Ababa, Ethiopia (38%)^[25]. These differences in results may be attributed to methodological differences, study populations, and study areas.

Construction workers are constantly exposed to high sound pressure levels due to noise emitted by motor graders, wheel loaders, track tractors, and other machines. Workers are also exposed to solvents and paints, as well as to certain types of vibration that can damage the auditory system.^[26] In this study, SNHL in both/either ears was detected among 14.5% of the workers. Similarly studies by Kerns *et al.*^[27] in United Nations, Santos *et al.*^[28] in Brazil, and House *et al.*^[29] in Canada showed that 14%, 14.4%, and 18.3% of construction workers had hearing losses, respectively. This suggests that audiometric screening seems to be warranted for construction workers during preplacement and periodic examinations.

The current study also revealed that a statistically significant association of SNHL among workers with their duration of construction work. Higher hearing loss among those, who were working in construction for more than 15 years, was observed. The rate of hearing loss was higher among workers who reported longer years of working in the construction industry as reported by Hong.^[14] Similarly, Dement *et al.*^[30] showed that age and duration of construction work increased the risk of hearing loss. Some studies have shown that in relation to age, older workers reported a higher prevalence of hearing handicaps.^[28,31,32] This fact is understandable because older individuals tend to be exposed to occupational risk factors for hearing loss for longer periods.^[28] However, in the present study, the association of age was not significant. Moreover, the majority of the workers were below forty years of age in this study.

The present study was based on inferences in one of the construction sites; hence, the generalizability of results is low. Further studies are required with multiple sites taken from different places. Even then, the general pattern of construction workers may still remain the same. The study being a cross-sectional study could assess only the hearing impairment. A longitudinal study is needed to assess the work pattern associated with the occurrence of NIHL.

Conclusion

The occupational health and safety of construction workers is a subject that needs more focus, especially in the Indian context. The current study highlights that awareness and usage of PPE among construction workers is low. This mandates occupational health and safety training to construction workers to raise their awareness of occupational hazards and their prevention. Workplace supervision and safety supervision by owners and contractors also need emphasis. The study also revealed that hearing impairment was present, which was associated with

duration of work in construction-related activities. Primary care physicians being the first contact may need to screen for occupational hazards and advise preventive measures in their routine practice. Further, preplacement and periodic examination for unorganized sector workers like construction workers needs to be focused like other industries so as to detect and manage occupational health hazards early.

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Declaration of consent of participants

The authors certify that they have obtained all appropriate participant consent forms. In the form, the participants have given their consent for their images and other clinical information to be reported in the journal. The participants understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Key Messages

With literature review suggesting limited studies among construction workers wellness, this study highlights the gap that exists between PPE benefit awareness, its usage, and the importance of auditory assessment of workers for early detection of hearing problems and focus on the need of occupational health and safety training along with periodic examination in the construction sector. Primary care physicians being the first contact physicians need to focus on occupational health aspects in their day-to-day practice.

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Conflicts of interest

There are no conflicts of interest.

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