Personal Noise Exposure and Associated Health Effects among Trade Workers on Melbourne Residential Construction Sites

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Abstract: ***Occupational noise remains a persistent hazard in residential construction. In my view, quantifying task-specific exposure is essential for targeted controls. This analysis-study compared 8-hour time-weighted noise levels and self-reported health outcomes among carpenters, masons, and concrete workers across five Melbourne sites (n = 30 measurements per task; 25 survey respondents). Dosimeters and sound-level meters captured personal and area readings, while questionnaires explored tinnitus, fatigue, and stress. It is evident that masons and carpenters routinely exceeded the occupational exposure limit (OEL) of 85 dB(A), with tile-grinding peaking at 109 dB(A). This suggests that hearing-protection compliance (reported at only 40 %) lags behind risk. Adopting quieter equipment, reinforcing PPE programmes, and integrating task-rotation could meaningfully reduce noise-induced harm.***

Keywords: Occupational Noise, Construction Workers, Hearing Loss, Residential Buildings, Australia

1. Introduction

Occupational noise exposure is a significant concern in the construction sector, where workers frequently encounter excessive noise from tools and machinery. When sound reaches the outer ear, it causes the eardrum to vibrate. These vibrations are transmitted to the inner ear through small bones, where delicate nerve cells transform them into signals that are sent to the brain. Prolonged noise exposure can impact these nerve cells, leading to hearing loss, stress, and other health issues, exceeding the Australian standard of 85 decibels over an eight-hour workday (OHS Regulations, 2017).

1.1 Research Problem Statement

Construction workers are exposed to high-noise equipment—including grinders, drills, excavators, compactors, mixers, screw guns, and cutters—during task performance such as drilling, cutting, hammering, grinding, screwing, cement pouring, mixing, material shifting, scaffolding, structuring, masonry (tiling), it has resulted high incidence rate of hearing loss (Chong *et al.*, 2022). In 2023, SafeWork, Australia, reported a 15% increase in the incident rate in the construction and mining industry. This has led to investigating the noise exposure level among construction workers to explore noise prevention strategies (SafeWork, Australia, 2023).

1.2 Scope

This comparative study examined the personal occupational noise exposure among a cohort of carpenters, masons, and concrete workers and assessed their health effects as well as noise levels variations during the aforementioned tasks' performance at residential construction sites in Australia (Lewkowski *et al.*, 2018). It has evaluated 8-hour time-weighted average (TWA) noise levels and area noise, and compared results with the Australian Occupational Exposure Limit (OEL) of 85 dB. This has assessed the exposed workers' experience of noise-induced hearing loss (NIHL), fatigue, stress, and distraction, and monitored the effectiveness of noise controls (Damaraju Lakshmi Lavanya, T. Usha Madhuri, 2023).

1.3 Research Rationale

In the year 2022, WorkSafe reported hearing loss cases due to high noise exposure among construction workers, such as carpenters **7%**, painters **6%**, concrete workers **9%**, electricians **9%** and roofers **1%** respectively (WorkSafe, 2022). In 2023, SafeWork reported a **15%** increase in the incident rate of workers in the mining and construction industry. Over the past four years, more than **10,000 workers** in NSW have suffered noise-related injuries, with **over 90%** experiencing permanent disabilities (SafeWork, 2023). The most affected workers' compensation claims include carpenters, concrete workers, and machine operators who frequently operate in noise levels exceeding the **85-decibel** workplace permissible limit. SafeWork has introduced new hearing test requirements from January 1, 2024, aimed at improving early detection and prevention of NHIL. This has led to noise investigations to explore noise prevention strategies (SafeWork, 2023).

1.4 Research Aim

The specific objective of the study is to quantify and compare individual noise exposure levels and related tasks at residential building construction to develop control interventions. This is a novel study as this type of comparative research has not been conducted among construction workers in Melbourne. Additionally, measured results have been analysed using IHSTAT and SPSS (Lewkowski *et al.*, 2018) to find the outcomes. The analysis outcome to be used to evaluate the effectiveness of the current controls at construction sites. This aims to generate noise exposure data among carpenters, masons and concrete workers in residential buildings while performing the aforementioned construction tasks to differentiate, because noise varies depending on equipment type and duration. While regulations exist, studies rarely assess the actual effectiveness of noise controls like engineering, PPE, and administrative controls. This has helped in the development of effective control strategies to improve the health and well-being of construction workers (T. Usha Madhuri, 2023).

2. Literature Review

In Australia, the residential construction sector plays a crucial role in driving economic growth. In recent years, the demand for residential building construction has been driven by population growth, urbanisation, and government incentives for homebuyers. There is a growing emphasis on sustainable, environmentally friendly, and safe building practices to comply with health, safety, and environmental standards. The construction industry faces some challenges, such as labour shortage, cost and regulatory compliance, such as noise effluence and its impact on workforces. Therefore, the industry needs to focus on ensuring the well-being of workers (Yang, Wei, and Zhang, 2023). Noise generated by various equipment operations e.g. jackhammers, mixers, concrete breakers, screw gun, excavators, drills, hammers, grinder, generator engines and cutter during tasks performance is a common occupational hazard in construction (Li *et al.*, 2016). The high noise exposure impacts the construction workers' hearing ability, and on-site communications in relation to specific job tasks, duration, and equipment. This can also lead to stress, lower productivity, and accidents. To protect workers' health, improvements in site layout, noise reduction techniques, and equipment optimisation have been recommended as effective solutions. The EPA and WorkSafe regulate construction noise according to a legal exposure limit is 85 dB(A) over 8 hours with a peak limit of 140 dB(C) (EPA Act 2017; EPA Regulations 2021). Guidelines emphasise a hierarchy of noise control: source reduction, engineering, administrative, and PPE. Local and International Standards are used to manage workplace noise exposure (AS/NZS 1269.1:2005; ISO 9612:2025). Workers are at risk if they have a daily 8-h equivalent continuous A-weighted exposure level (LAeq,8h) larger than or equivalent to 85 dB (WorkSafe, 2019).

3. Materials and Methods

This study is based on a critical review of relevant literature and measurement of noise exposure in real-time, monitoring the equipment and tasks at construction sites (Lewkowski *et al.*, 2018; Chong *et al.*, 2022).

3.1 Research Design Strategy

This is a comparative cross-sectional study of personal noise exposure among a cohort of workers during the aforementioned tasks performance at residential construction sites, where data is collected among similar exposure group at the same time over different days at five construction sites, and compared based on specific variables (e.g., age, experience, health, tasks, equipment, certain conditions) (Chong *et al.*, 2022). The subjective data from 25 individuals through structured questionnaire surveys was collected about their demographics, noise perception and related health effects. The combination of quantitative and qualitative data has ensured a comprehensive understanding of the research problem and enhanced the validity of the findings.

3.2 Data Collection Methodology

In this research, personal noise exposure and area noise level data have been collected using dosimeters and sound level meters, respectively, at five construction sites, ensuring 8-hour shifts over 10 days to capture possible variations in exposure level. The qualitative data collected from workers have helped to inquire about workers' attitudes, beliefs, and behavioural intentions associated with hearing loss prevention (Stephenson *et al.*, 2011).

The combination of quantitative and qualitative data has provided a complete understanding of noise exposure and its impact on workers' health, facilitating the identification of specific risks and targeted interventions (Patten and Michelle, 2018). The personal noise exposure level is measured using calibrated dosimeters with serial numbers ESJ090169, ESK100152, ESK100150, ESQ110041, respectively and area noise levels measured using calibrated sound level meter BLY110005, all having valid calibration performed by Air Met Scientific Pty Ltd using a reference level of 114 dB. The devices recorded a response of 114.2 dB during calibration, resulting in a deviation of +0.2 dB, which falls within the acceptable calibration range (±1.0 dB), indicating the instrument is functioning accurately (AS/NZS 1269.1:2005).

Noise measurements have been taken at selected sites for a 10-sample population of carpenters, masons, concrete workers and supervisors during their routine tasks performance to capture the variability over a specified period (Patten and Michelle, 2018). In this study, noise assessment has been conducted using three different approaches, including shift-based, task-based and job-based noise (Mir *et al.*, 2022). The construction companies have been approached by calling after getting details from the official website of the companies.

3.3 Data Analysis

This study utilised the SPSS tool to analyse descriptive statistics from the collected questionnaire survey responses. This has also used the IHSTAT tool to analyse 30 area noise measurements collected during each task performance and evaluated mean, median, minimum, maximum, standard deviation, log normal and geometric mean to get the trends and patterns (Akbar-Khanzadeh *et al.*, 2013). Moreover, a comparison of TWA noise exposure value over eight hours among a cohort of workers is completed.

4. Results and Discussion

Findings of comparative analysis among carpenters, masons and concrete workers and the designated tasks at construction sites have been discussed in detail.

4.1 Demographics and Noise Perception

The subjective demographics and noise perception assessment of the survey questionnaire responses of workers have been shown through frequency distribution tables using SPSS (Akbar-Khanzadeh *et al.*, 2013). The survey consisted of 25 responses, including carpenters (40%), masons (30%), and concrete workers (30%).

Table 4.1: Construction Workers Demographics and Noise Perception

Age Range (Years)			Noise Effect on Site Communication		
	Frequency (n=25)	Percentage		Frequency (n=25)	Percentage
< 25	2	8.0	Always	2	8.0
25-29	12	48.0	Often	6	24.0
30-34	7	28.0	Sometimes	10	40.0
35-39	3	12	Rarely	3	12.0
45-49	1	4.0	Never	4	16.0
Work Experience (Years)			**Noise Effects Headache, Fatigue, or Ringing in the ear**		
1-5	18	72.0	Yes	11	44.0
6-10	6	24.0	No	14	56.0
16-20	1	4.0			
Primary Tasks at Site			**High Noise Health Effects Symptoms**		
Carpentry	11	44.0	Tinnitus	4.0	4.0
Cutting	2	8.0	Hearing Loss	4.0	8.0
Tiling	5	20.0	Headache	12.0	20.0
Material Shifting	6	24.0	Fatigue	12.0	32.0
Scaffolding	1	4.0	Stress	12.0	44.0
Daily Working Hours without Break			Difficulty Concentration	44.0	88.0
3-4	4	16.0	None of the above	12.0	100.0
5-6	12	48.0			
7-8	7	28.0			
9-10	2	8.0			
Weekly Working Hours			**Hearing Protection Usage Frequency**		
15-29	5	20.0	Always	1	4.0
30-34	13	52.0	Often	2	8.0
35-49	7	28.0	Sometimes	3	12.0
Noise Level Rating by Construction Workers			Rarely	4	16.0
Slightly Noisy	11	44.0	Never	15	60.0
Moderately	7	28.0			
Very Noisy	7	28.0			
Noise Experience at Construction Site			**Hearing Protection Effectiveness**		
Distracting	18	72.0	Very Effective	1	4.0
Annoying	5	20.0	Effective	7	28.0
Unsafe	2	8.0	Neutral	11	44.0
			Ineffective	6	24.0

Table 4.1. reveals that most construction workers are mid-career professionals aged 25-34, with a relatively young workforce where 72% have 1-5 years of experience. 92% have been with their employer for less than five years or are business owners. Carpentry is the most common task (44%), followed by material shifting (24%) and tiling (20%). Many workers (48%) work 5-6 hours without breaks, with 28% working 7-8 hours daily, increasing noise exposure risks. Additionally, 52% work 30-34 hours per week, while 28% exceed 35 hours, potentially worsening health concerns related to prolonged noise exposure (Budak, Çoban and Erbek, 2021; Chong *et al.*, 2022). It highlights significant noise exposure among construction workers, with 56% experiencing moderate to severe noise levels, impacting focus, communication, and well-being. Approximately 40% of individuals report experiencing health issues such as headaches, fatigue, and stress, which can lead to increased risk of miscommunication and decreased productivity, and a negative impact on team collaboration (Chong *et al.*, 2022). While only 4% suffer from tinnitus or hearing loss. Despite these concerns, 60% of workers never use hearing protection, and 76% use it inconsistently, increasing susceptibility to hearing damage. 44% of workers are undecided about its effectiveness, indicating that they either have doubts about its reliability or do not perceive a significant improvement. 44% of workers are "neutral" about effectiveness, presenting they either lack confidence in protective gear or don't feel a noticeable difference and 24% find it ineffective, which may be attributed to misuse, improper equipment, or excessive noise levels surpassing the protective capabilities suggesting a need for better awareness, training, and improved protective gear to mitigate occupational noise hazards (Stephenson *et al.*, 2011).

4.2 Personal Occupational Noise Exposure TWA 8h

In this study, 8-hour Time-Weighted Average (TWA) personal occupational noise exposure is measured using a calibrated dosimeter attached to workers' shoulders, ensuring accurate recordings. Data is collected from carpenters during wood structuring (cutting, grinding, screwing and hammering), masons (tiler) during tile cutting, grinding, fixing and glue mixing, concrete workers during floor levelling using compactor and excavator, and supervisors during stay at construction site (Mir *et al.*, 2023). For workers with shorter shifts (4-6 hours), the TWA 8h is calculated using a standard formula to ensure accuracy (Damaraju Lakshmi Lavanya, T. Usha Madhuri, 2023).

LAeq,8h = LAeq,Te + 10 log [Te/To],

Where Te, is the effective duration of the working day, To, is the reference duration is 8 hours.

Table 4.2: Personal Noise Exposure TWA 8h (dB)

	Personal Noise Exposure TWA 8h (dB)					
	Carpenter	Mason (Tiler)	Excavator Operator	Compactor Operator	Supervisor	Glue Mixer Operator
1	82.5	86.9	83.9	82.69	79.26	75.5
2	83.8	85.9	82.5	83.4	76.76	76.0
3	90.9	85.4	83.5	80.2	79.30	69.0
4	81.0	83.8	84.6	79.8	82.50	77.4
5	85.2	84.6	85.6	81.6	78.40	74.8
6	79.9	85.5	86.1	80.5	78.59	
7	85.4	84.9	82.8	83.6	77.00	
8	87.7	86.9	84.4	82.7	78.60	
9	82.2	87.3	86.5	83.5		
10	84.5	87.9	79.5	84.6		
Average	84.3	85.9	83.9	82.3	78.8	74.5

Table 4.2. represents TWA 8h noise exposure varies across construction roles, with masons (85.9 dB) and excavator operators (83.9 dB) experiencing the highest levels, while supervisors (78.8 dB) and glue mixer operators (74.5 dB) have lower exposure. Some carpenters recorded noise levels above 85 dB, exceeding the recommended threshold. At 85 dB(A) or higher, hearing protection is advised to prevent temporary or permanent hearing damage (Damaraju Lakshmi Lavanya, T. Usha Madhuri, 2023).

4.3 Task-Based Noise Levels Measurements

IHSTAT is an essential tool, enabling occupational hygienists to assess exposure levels to track the trends and patterns. The IHSTAT Analysis is used to evaluate the noise exposure among various construction tasks by comparing and checking compliance with OELs (Lewkowski *et al.*, 2024). All tasks have been analysed by adding 30 noise recordings (Mir *et al.*, 2023). These values have been taken across 10 sites for SEG using a calibrated sound level meter, positioned at ear height, approximately 1 meter away from the operator and compiled for analysis.

Table 4.3: Descriptive Statistics of Task-Based Noise Levels Measurements

	Noise Levels Measurements (dB)										
Tasks (N=30)	Max	Min	Range	%> OEL	Mean	Median	Std. dev	Mean LN	Std. dev LN	GM	Geo. std. dev
Cement Pouring	69.2	62.1	7.1	0.0	65.8	65.8	1.8	4.2	0.03	65.8	1.0
Wood Shifting	**90.7**	70.8	19.9	43.3	83.0	**84.7**	5.7	4.4	0.1	82.8	1.1
Wood Cutting & Grinding	**86.7**	79.0	7.7	36.7	**84.6**	**84.9**	1.67	4.44	0.02	84.5	1.02
Wood Hammering	**100.2**	68.1	32.1	70.0	**87.3**	**86.7**	7.1	4.5	0.1	87.0	1.1
Wood Drilling	**98.2**	67.9	30.3	60.0	**85.8**	**87.6**	8.2	4.4	0.1	85.4	1.1
Wood Screwing	**101.2**	75.3	25.9	46.7	**85.8**	**85.0**	7.6	4.4	0.1	85.5	1.1
Floor levelling (excavator)	**85.6**	80.2	5.4	10.0	83.3	**83.9**	1.5	4.4	0.0	83.3	1.0
Floor Levelling (Compactor)	**96.8**	82.8	14	93.3	**91.0**	**90.2**	3.8	4.5	0.0	90.9	1.0
Scaffolding Erection, Dismantling	**101.5**	84.3	17.2	96.7	**93.0**	**93.8**	4.8	4.5	0.1	92.8	1.1
Tile Cutting	**105.1**	68.0	37.1	70.0	**88.6**	**90.0**	10.4	4.5	0.1	88.0	1.1
Tile Grinding	**109.4**	**96.4**	13	100.0	**101.8**	**101.5**	3.1	4.6	0.0	101.6	1.0
Glue Mixing	**96.4**	**88.4**	8	100.0	**92.6**	**92.5**	2.3	4.5	0.0	92.5	1.0

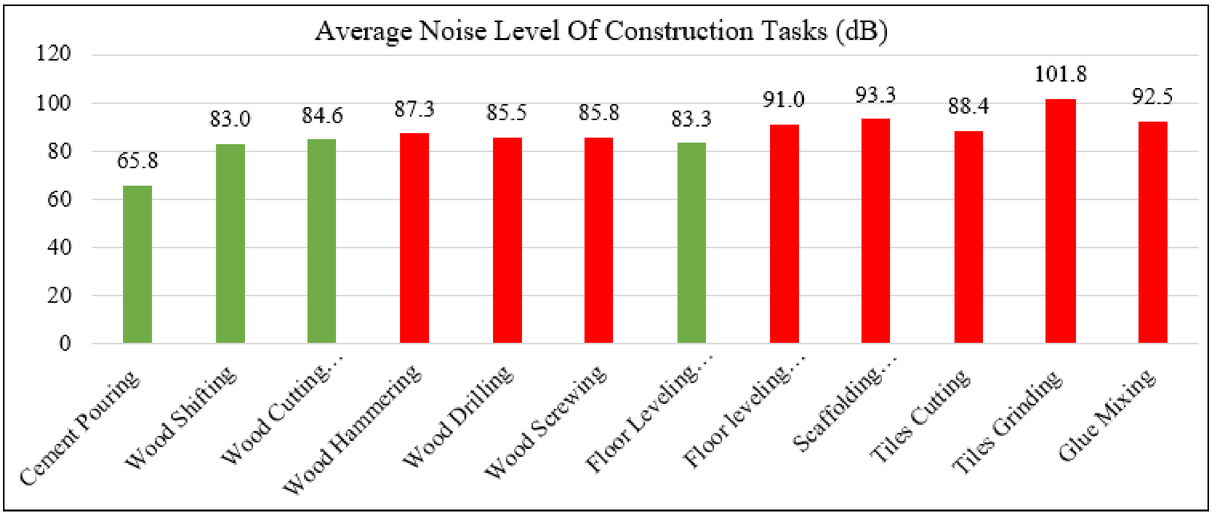

Figure 4.1: Average Noise Level of Construction Tasks

Table 4.3. Represent the area noise level recorded for each task at the construction site and provide valuable information on the risks associated with the trades (Mir *et al.*, 2023).

4.4 Implications of Occupational Health and Safety

The tile-grinding, scaffolding, and glue mixing generated the highest mean levels—101.8 dB, 93 dB, and 92.6 dB, respectively—all exceeding the 85 dB(A) limit, posing a severe health hazard demanding immediate intervention. The mean and median values for wood cutting & grinding (84.6 vs 84.9) are very close, suggesting the data is symmetrically distributed – noise exposure stays constant around the average. The wood hammering and tile cutting exceed both noise values by 70%, demonstrating significant overexposure. The cement pouring stands out with a 0% OEL exceedance rate, presenting a safe environment. The tile cutting has the greatest range (37.1 dB) and the highest standard deviation (10.4), indicating significant variability in noise exposure, possibly due to inconsistent task approaches and the cutting machine used. On the other hand, tasks like cement pouring (SD = 1.8) and excavator floor levelling (SD = 1.5) tend to be pretty steady and controlled. Since noise data usually follows a log-normal pattern, using geometric means gives a better idea of the average noise levels. For instance, Tile grinding has a geometric mean of 101.6 dB, showing high exposure. Meanwhile, cement pouring (65.8) and wood shifting (82.8) show lower geometric means, indicating more moderate noise levels, and are relatively safe. In most cases, Geometric SD ≈ 1.1 shows moderate variability in noise exposure. Overall, tasks with consistent exposure over 85 dB, like wood hammering, drilling, screwing, tile grinding, glue mixing, scaffolding, and compactor use, presenting occupational health risks; Fig 4.1 (Lewkowski *et al.*, 2024).
Some other environmental parameters measured during noise monitoring are temperature, relative humidity and wind speed. Temperature ranges from 15.0 ºC to 30 ºC during different times of the day, in the morning and afternoon, respectively. Relative humidity (RH) varies between 18% to 72% in the morning and afternoon. Wind Speed ranges from 0.1 m/s to 2.5 m/s. These factors may contribute to the noise assessment (Todoroski, A., 2015).

4.5 Research Limitations

This study has some limitations: small sample size, due to the short time duration to collect data values and unwillingness of companies to participate in the study. There could be inconsistencies in noise levels due to background music sounds at the site. The health assessment mostly relied on self-reported symptoms like fatigue and stress, which can be subjective and might miss long-term effects. Despite challenges, the study provides useful information about noise exposure and shows the need for better measures.

5. Conclusions and Recommendations

This study investigates personal noise exposure and related health risks among carpenters, masons, and concrete workers at residential construction sites. Using on-site measurements and surveys, the research identifies tasks like grinding and hammering as major sources of noise exceeding the 85 dB(A) OEL. Masons (tilers) experienced the highest exposure due to grinder use. IHSTAT analysis revealed task-specific risks, showing gaps in current noise control practices. The study highlights insufficient use and effectiveness of hearing protection, with 60% of workers not wearing protective equipment and 68% dissatisfied with the efficiency, or using incorrect protection. It recommends improved noise mitigation strategies (AS 2436:2010), as the adoption of quieter equipment, for instance replacement of diesel engine excavators with electric ones, strengthening the practice of wearing protective equipment, enhanced companies' commitment to PPE provision through awareness campaign and future research with larger samples to cover the variability in circumstances and octave band analysis to recommend an accurate protective device. This study focuses on residential construction sites in Melbourne. Its findings may apply to similar urban construction settings in Australia because the work conditions, trade roles, and occupational health and safety rules are similar across the country. However, the results may not be as valid for large commercial or infrastructure projects or countries with very different climates, regulations, or construction practices. Future studies that involve multiple sites or different states can improve the broader applicability of these findings.

Ethical Considerations

This project is approved by RMIT University's Ethics Committee with support from construction site owners. Participants were informed about the study purpose, procedure and personal noise monitoring and a consent form was signed with the right to withdraw at any time. All the collected information is kept confidential.

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