EVALUATION OF EXCESSIVE NOISE EXPOSURE AMONG CONSTRUCTION WORKERS IN SOUTH QUAY SQUARE (SQS), SUNWAY CITY, KUALA LUMPUR

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A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Bachelor of Science (Hons) Environmental, Occupational Safety & Health

Faculty of Engineering and Green Technology
Universiti Tunku Abdul Rahman

May 2024

DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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ACKNOWLEDGEMENTS

I would like to thank everyone who had contributed to the successful completion of this project. I would like to express my gratitude to my research supervisor, Dr Nurhanim Binti Abdul Aziz for her invaluable advice, guidance, and her enormous patience throughout the development of the research.

In addition, I would also like to express my gratitude to my co-supervisor, Dr Putri Anis Syahira Binti Mohamad Jamil, my loving parent, and friends who had helped and given me encouragement along my research.

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ABSTRACT

The construction industry in Malaysia have been making a substantial contribution to the economic development in the current era. However, researchers have found that the involvement of on-site mechanization and the excessive noise produced from the utilization of machineries and power tools in construction sites are a main contributor to the development of hearing loss symptoms among construction workers in the construction industry. The noise level generated from the machinery and power tools on site was reported to have exceeded the daily noise exposure level of 85 dB(A) which specified in the Occupational Safety and Health (Noise Exposure) Regulations 2019. Therefore, the continually exposure to noise level exceeding 85 dB(A) can resulted in hearing diseases such as hearing impairment, hearing disorders, Noise-Induced Hearing Loss (NIHL), presbycusis, and tinnitus. A total of 4 similar exposed groups (SEGs) was selected from construction site in Sunway City, Kuala Lumpur: SEG 1 hacking activities, SEG 2 formwork dismantling, SEG 3 falsework dismantling, and SEG 4 aluminium formwork installation. A point monitoring was carried out in all SEGs to determine the noise exposure levels and compared them with the noise levels written in Noise Risk Assessment (NRA) report. Subsequently, a validated and adopted questionnaire "Self-Evaluation of Hearing Status' was distributed to the construction workers in all SEGs. The questionnaire focused on socio-demographic, lifestyle, and occupational factors to determine the prevalence of hearing loss among 50 respondents. The results were then transferred to Statistical Package of the Social Science (SPSS) version 21 to conduct a chi-square test on determining the significant risk factors that contributing to the development of hearing loss symptoms among construction workers using chi-square test.

Furthermore, the comparison of noise levels obtained from point monitoring showed less variations to the noise levels written in the NRA report. The noise exposure levels obtained from point monitoring based on selected SEGs were between 86.7 and 97.8 dB(A), while the noise exposure levels stated in the NRA report were between 89.0 and 96.7 dB(A), which in both cases showed that the daily noise exposure level of 85 dB(A) was exceeded. Meanwhile, the results showed that 20% of them have severe hearing loss symptoms, 48% of them have hearing loss symptoms from acute to mild, and 32% of them have no hearing loss symptoms. Additionally, socio-demographic, lifestyle, and occupational factors were found significantly contributed to the development of hearing loss symptoms such as age ($p=0.012$), level of education ($p=0.05$) and smoking habits ($p=0.014$), Hearing Protective Devices (HPDs) ($p=0.044$), duration of employment ($p=0.002$), working days ($p=0.004$), and working hours ($p=0.026$). To sum up, the predicting factors that were found to be associated with hearing loss symptoms among construction workers were age, level of education, smoking habits, wearing HPDs while working, duration of employment, working days, and working hours. Recognizing the hearing loss symptoms at an early age is crucial, especially for those who have prolonged exposure to excessive noise in construction sites. Therefore, this study helps in identifying the risk factors which could lead to hearing loss symptoms among construction workers and providing suitable control measures as recommendations to be considered in managing construction noise, hence preventing the likelihood of occupational noise-related hearing loss cases within a rapidly industrializing country like Malaysia.

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LIST OF SYMBOLS / ABBREVIATIONS

AOR	Adjusted Odds Ratio
CI	Confidence Interval
dB	decibel
DOSH	Department of Occupational Safety and Health
FMA	Factories and Machinery Act
GDP	Gross Domestic Product
HPD	Hearing Protection Device
ICOP	Industry Code of Practice
MFMER	Mayo Foundation for Medical Education and Research
MOH	Ministry of Health Malaysia
NIHL	Noise-Induced Hearing Loss
NRA	Noise Risk Assessment
NRR	Noise Reduction Rate
OSH	Occupational Safety and Health
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
SEG	Similar Expose Group
SLM	Sound Level Meter
SPSS	Statistical Package of the Social Sciences
SQS	South Quay Square
TWA	Time-weight average
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background

The construction industry in Malaysia brings an exceptional impact towards economic development and expansion in recent years as it has prime importance in becoming a major cornerstone that signifies the quality-of-life enhancement for the society in Malaysia. Besides that, the construction sector plays a vital role in generating significant revenue as contributions to the national gross domestic product (GDP), simultaneously influencing the forward and backward linkages with other sectors to achieve sustainable development in Malaysia (Alaloul. et al., 2021). The most recent theoretical development has revealed that the value of construction work in Malaysia has escalated by approximately RM 10 billion from 2012 to 2018. The highest value was recorded in 2019 with approximately RM 146.37 billion (Alaloul, et al., 2021).

However, a challenging problem that arises in this domain is the excessive noise generated by construction activities. Noise is commonly known as any unjustifiable disturbance within the frequency band that unreasonably interfere the comfort of any person. Construction noise is typically composed of complex combinations of noise sources when several tasks are carried out simultaneously (Lee, Kim and Hong, 2019). Thus, this could result in a high variability of noise exposure among the construction workers. In spite of that, the complex combination of noise sources and the day-to-day variations in occupation and shift lengths are the decisive factors that resulted the difficulties in determining the excessive noise exposure

levels among construction workers, making the noise control plan an indispensable task (Siti Nadia, et al., 2017). The Department of Occupational Safety and Health (DOSH) Malaysia stated that the recommended daily exposure limit for occupational noise exposure is 85 dB(A), as an 8-hr time-weight average (8-hr TWA). However, any daily noise exposure level exceeding 82 dB(A) are considered as hazardous noise levels.

The construction workers usually exposed themselves to potentially hazardous noise levels generated from the construction activities. Generally, the excessive noise in construction is emitted from the various sources of equipment and machinery used during the construction development process including bored pile machines, backhoes, excavators, lifting cranes, bar-bender machines, concrete mixers, and hydraulic jackhammers. Various acoustic characteristics of occupational noise such as steady noise, fluctuating noise, intermittent noise, impulsive noise, and isolated bursts of sound energy were introduced in construction sites (Lee, Kim and Hong, 2019). The construction activities were reported to generate range of excessive noise levels from 80 to 120 dBA depending on the type of activities conducted and different equipment and machineries used (Lee, Kim, and Hong, 2019). Then, the continuous excessive noise exposure could bring deleterious effects to the health of construction workers, including hearing impairment, hypertension, permanent deafness, attention disruption, and noise-induced hearing loss (NIHL) (Nur Muizzah, et al., 2018). This phenomenon has been widely observed in the United States, as hundreds of millions of dollars have been spent for NIHL disease claims and 16-50% of them are construction workers (Nur Muizzah, et al., 2018).

The workers' behaviour, and absence of commitment toward the mitigation of excessive noise control in the construction industry have led to a significant surge in cases of occupational noise-related hearing disorders. Several studies have highlighted that prolonged occupational noise exposure is an underestimated threat in the construction industry, also the most persistent physical hazard that could lead to several critical effects unnoticed instantaneously such as tinnitus, presbycusis, acute acoustic trauma, temporary hearing loss, tinnitus, hearing impairment, and Noise-Induced Hearing Loss (NIHL) among construction workers. According to The Star, there was a marked elevation in occupational noise-related hearing disorders of 5,699

cases reported to the Department of Safety and Health Malaysia (DOSH) in 2019 (The Star, 2022). Furthermore, DOSH has concluded that exposure to excessive noise at work accounted for 91% of the reported occupational diseases in 2019 (DOSH, n.d.). Therefore, the Occupational Safety and Health (Noise Exposure) Regulations 2019 was introduced to replace the Factory and Machinery (FMA) (Noise Exposure) Regulations 1989 for setting a benchmark to guide and assist contractors in implementing Noise Exposure Control Plans in their construction projects (DOSH, n.d.). Besides that, The World Health Organization (WHO) estimated approximately 466 million people around the world were living with hearing impairment and 16% of them are caused by occupational exposure to noise (WHO, 2018).

1.2 Problem Statements

Previously in Malaysia, 91% of reported occupational disease reported in 2019 were associated to the exposure of excessive noise at work (Fairuz et al., 2023). The exposure of excessive noise at work was recorded as the highest which consists of 8,997 cases out of 9,860 cases. Apart from that, the Department of Statistics had highlighted that occupational noise-related hearing disorder was recorded as the highest which is 3,648 cases out of 5,289 cases reported in Occupational Disease and Poisoning Statistics 2021 (Department of Statistic Malaysia, 2022). In addition, WHO assumed that the people living with hearing disability will soar to at least 630 million people by the year 2030, and over 900 million people by 2050 along with the rise and ageing of global population (WHO, 2018).

The construction workers in Malaysia exposed themselves to excessive noise in the construction site which resulting in high risk of developing hearing loss symptoms. The involvement of on-site mechanization in construction sites is a common practice nowadays due to technological advancement which contributes to accelerating the construction process. For instances, heavy machinery and power tools are generally involved in the construction activities and processes such as rock excavation, demolition works, bored piling, earthwork, and blasting operations

(Gannoruwa and Ruwanpura, 2007). However, the onsite mechanization of heavy machinery and power tools are the primary contributor of excessive noise in construction sites as Saleh et al., (2017) has concluded that the noise level generated by power tools ranged from 87 dB(A) to 115 dB(A), whereas the noise emitted from heavy machinery ranged from 80 dB(A) to 120 dB(A). Hence, the noise ranged generated from most of the power tools and heavy machinery on site have exceeded the daily noise exposure level of 85 dB(A) which is listed in the Occupational Safety and Health (Noise Exposure) Regulations 2019.

In addition, continuous exposure of excessive noise in construction site could bring deleterious effects on individual's hearing ability including permanent tinnitus and hearing loss among construction workers. Noise induced hearing loss (NIHL) is a major negative concomitant after prolonged exposure to excessive noise in construction site (Koushiki et al., 2004). Based on the previous research by Siti Nadia et al. (2017) had revealed that excessive noise exposure affects the work performance of construction workers by creating significant physiological reactions such as depression, stress, and sleep disturbances that may interfere the worker's concentration and cause difficulties in workplace communication and speech comprehension. Hence, excessive noise had become one of the casual factors which contributed to the increasing of number of errors and risks of accidents among construction workers during performing their daily tasks.

In consequence, this study focuses on identifying the hearing status and the contributing factors which are associated with the development of hearing loss symptoms among construction workers because hearing loss among construction workers had become a critical matter that need to be addressed as to prevent long-term hearing damage such as tinnitus, Noise Induced Hearing Loss, presbycusis, and age-related hearing loss.

1.3 Significant of Study

Through the comprehensive exploration of this study on excessive noise exposure among construction workers, the ones who are significantly exposed to the excessive noise emitted from heavy machinery and power tools will be identified. The findings will also notify the employer in acknowledging the noise exposure level of different sources of heavy machinery and power tools based on similar expose group in the construction site. Besides that, this study also aims to provide recommendations on appropriate control measures to reduce noise exposure among construction workers in the construction site. Any noise level that are exceeding 85 dB(A) in construction site should be assessed and controlled by implementing appropriate control measures to reduce the noise level.

Moreover, the results of this study are able to elucidate the current hearing ability among the construction workers and the chances of them to develop hearing loss symptoms based on socio-demographic characteristics, lifestyle, and occupational factors. Consequently, this study will also spread the awareness on the negative impacts resulting from excessive noise exposure among construction workers because the workers may have not received sufficient information regarding to the deleterious effects bringing from excessive noise exposure in construction sites. Therefore, the importance of wearing hearing protection devices while working will be addressed to ensure the construction workers have instil the risk perception and risk behaviour toward excessive noise in the construction site precisely.

1.4 Study Objectives

1.4.1 General Objectives

The primary focus of this study is to investigate the excessive noise exposure and the prevalence of hearing loss symptoms among construction workers in the construction site.

1.4.2 Specific Objectives

1. To access the trends of sociodemographic, lifestyle, and occupational factors among construction workers in the construction site.
2. To determine the prevalence of hearing loss symptoms among construction workers in the construction site.
3. To evaluate the noise exposure level experienced by the construction workers.
4. To identify the predicting factors (sociodemographic, lifestyle, occupational factors) affecting the hearing loss symptoms among construction workers.

1.4.3 Alternative Hypothesis

1. The noise exposure level experienced by the construction workers is exceeded the permissible exposure limit according to Noise Regulation 2019 DOSH.
2. There is a high prevalence of hearing loss symptoms among construction workers in the construction site.
3. There is an association between the contributing factors (sociodemographic, lifestyle, occupational factors) toward hearing loss symptoms among construction workers in the construction site.

1.5 Conceptual Framework

The conceptual framework underlying this study is illustrated in Figure 1.3. The construction of this framework is fundamentally based on the existing research about hearing loss symptoms and the related risk factors among construction workers in the construction site.

The variables highlighted in blue are the centre of attention for this study. The risk factors that contribute to hearing loss symptoms are classified into non-occupational factors and occupational factors. The non-occupational factors are

known to be the demographic factors including age, level of education, cardiovascular disease, diabetes, smoking habits, and non-occupational activities. These are the non-occupational risk factors that will contribute to hearing loss symptoms. Next, occupational factors are referring to any circumstances that arise at the workplace such as safety climate, type of work, noise intensity, exposure duration to noise, and additional shift work which can force the occurrence of hearing loss symptoms among construction workers.

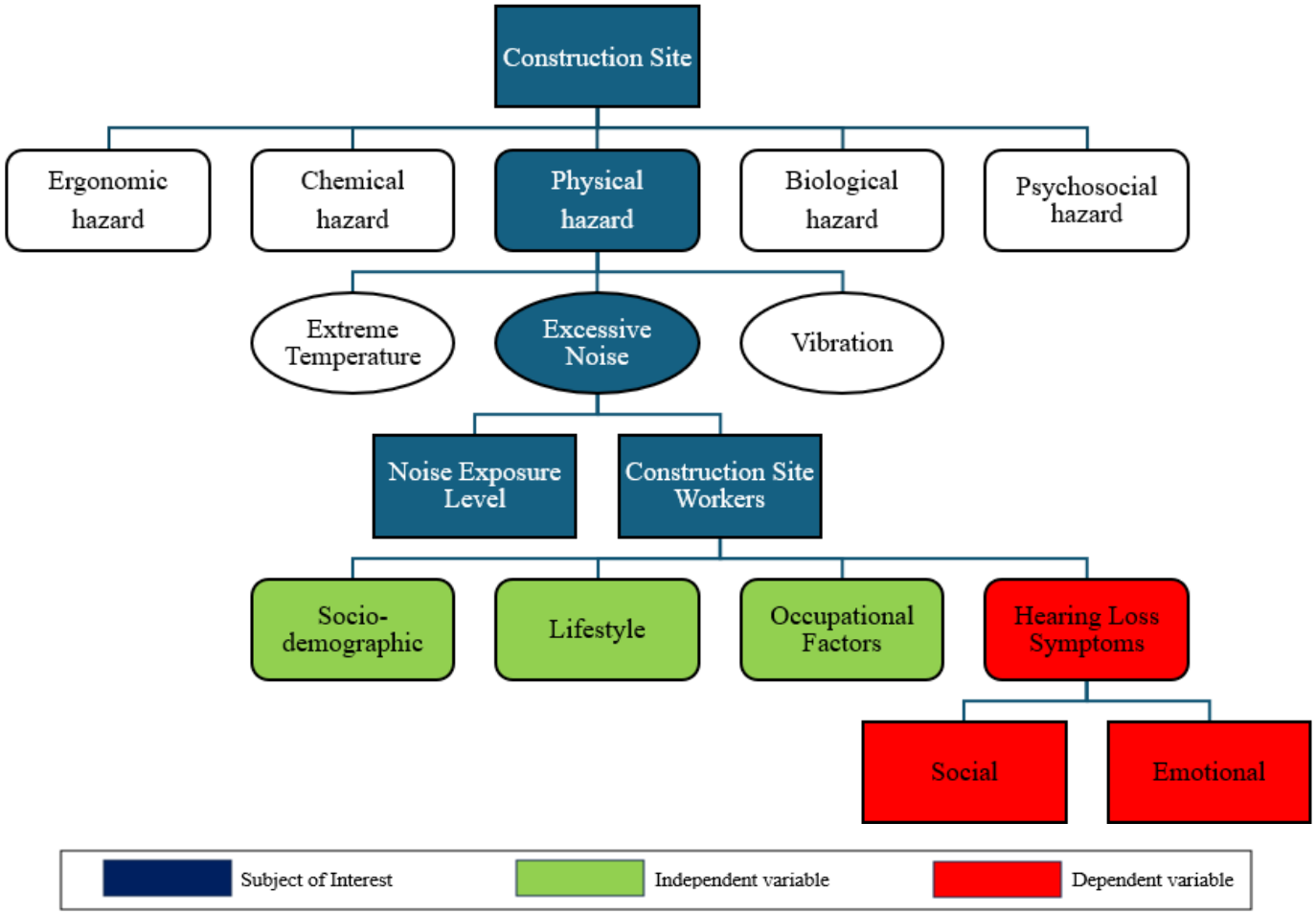

Figure 1.1: A conceptual framework of the relationship between hearing loss symptoms and the associated risk factors.

CHAPTER 2

LITERATURE REVIEW

2.1 Construction Project

2.1.1 Construction Phase

In recent years, the expanding population of cities has forced the rapid execution and significant increase of construction projects in Malaysia. The construction industry in Malaysia is now more modernized and advanced which has the capability to deliver heavy construction infrastructure and skyscraper projects with the adaption of technological advancement and mechanized techniques (Khan, Liew and Ghazali, 2014). Thus, it encompasses varieties of projects including high rise commercial, industrial buildings, highways, expressways, tunnels and bridges, educational institutions, recreational buildings, monorail and mass rapid transit rail, and power plants (Khan, Liew and Ghazali, 2014). Besides that, Khan, Liew and Ghazali has listed some of the major projects accomplished by the Malaysian construction industry such as Penang Bridge (1985), Petronas Twin Towers (1992-1998), Kuala Lumpur International Airport (1993-1998), North South Expressway (1994), Stormwater Management and Road Tunnels (2003-2007), Commonwealth Games Village and other numerous projects. However, constructing a major project is often a lengthy and complex process because they are known to be riddled inherently with the adverse effects of change. Therefore, construction projects are generally executed based on a predictable sequence of events which is commonly classified into five different stages.

Pre-design phase or planning is known as the first phase in constructing a project where the project's location, concept, scope, and design are discussed among the stakeholders. The detailed description of the project is introduced in this stage including the schematic design of project's development, the usage of materials, contingencies of risks, environmental reviews, and land acquisition. Then, the second phase of a construction project is acknowledged as pre-construction or the design stage. Comprehensive plans for the project's design gets to be finalized and drawn up by the architect and his team. Then, submitting necessary building permits and documentation to the local, state, and federal authorities for the entitlement of project execution.

Apart from that, the construction project is tendered to the contractors based on their capabilities at this stage. Moreover, procurement as the third phase is meant for the preparation of purchasing building materials, equipment, and services. The complexity of the procurement phase basically depending on the project size, availability of resources and the commencement date. The construction and monitoring phase is acknowledged as the following phase which refers to the execution of actual construction project. The execution of construction involves dissimilar work activities such as laying foundations, erecting structures, installing utilities, and internal and external finishes.

Ultimately, the post-construction phase also known as the closeout stage is the final step in the construction process where the site is cleaned up and is ready to be handed over to the owner.

Figure 2.1: The 5 Phases of a Construction Project (BigRentz, 2023).

2.1.2 Construction Work

Construction works are typically classified into five different stages including demolition, foundation, earthwork, concreting, and finishing (Lee, Kim, and Hong, 2019). Construction work is often a lengthy and complex process which are widely seen as unpredictable in terms of delivery on time, hence all the work activities involved must be delivered in a sequence of work. First and foremost, demolition can be defined as the destruction of buildings or other structures prior to new projects or

civil structures. Next, foundation in construction refers to the lowest part of the civil structure which provides an overall lateral stability for the structure by transferring the loads to a deeper depth of soil underneath the ground surface uniformly (The Construction Encyclopedia, n.d.). Moreover, earthwork is a process which consist of excavation, transportation, placement, and compaction of soils and gravels during construction. Consequently, concreting work is known as another major activity in building construction because it applies to a variety of tasks, including the building of columns, beams, slabs, and reinforced concrete structures (The Construction Encyclopedia, n.d.). Last but not least, finishing activities including glazing, flooring, painting, and plastering is the final step in building construction by putting the finishing touches on the building structure.

2.1.3 Heavy Machinery and Power Tools

The recent expansion of infrastructure and industrialization has forced the application of onsite mechanization in construction to meet shorter timelines and complexities of designs (Waris, et al., 2014). Onsite mechanization in construction is characterized as the usage of heavy machinery and power tools to carry out complex construction activities. The utilization of the construction heavy machinery and power tools have increased the construction efficiency and decreased the dependency on intensive labour. Mechanized practices also help in accelerating the construction activities; hence it aids in reducing the completion time and cost for a construction project (Waris, et al., 2015). Due to the adoption of onsite mechanization, manual methods are getting disused due to expensive and shortage of skilled labour, especially in industrialized countries (Waris, et al., 2015). However, the excessive noise emitted from the heavy machinery and power tools is still recognized as the most challenging problem nowadays because they have contributed the most to the majority of noise in construction sites. A study conducted by Saleh et al., (2016) showed that heavy machinery generated a range of noise from 80 dB(A) to 120 dB(A), whereas the power tools used for construction activities generated a range of noise from 87 dB(A) to 115 dB(A). Therefore, Table 1 presents the average and maximum noise level generated by the 10 noisiest power tools on construction sites (Sekisov et al., 2023).

Table 2.1: Nosiest power tools in construction site (Sekisov et al., 2023).

Power tools	**Average noise level (dB)**	**Maximum noise level (dB)**
Welding, cutting equipment	94.9	122.8
Miscellaneous hand tools	95.4	118.3
Saws	97.2	114.0
Screw guns, drills	97.7	123.7
Rotary hammers	97.8	113.5
Chop Saws	98.4	117.7
Impact wrenches	98.4	131.1
Stationary power tool	101.8	119.8
Powder driven tool	103.0	112.8
Electric jackhammers	103.0	119.2

2.2 Occupational Noise Exposure

Excessive noise exposure is categorized as one of the most common occupational risks in construction site because a previous study conducted by Feder et al., (2017), had revealed that the construction industry generates the highest occupational noise exposures and hearing loss risks among other industries. This is mainly due to the increasing onsite mechanization of work processes which have resulted in the growing prevalence of construction noise exposure in construction sites. For instance, construction activities and processes including rock excavation, demolition works, bore piling, and blasting operations are part of the leading noise generators (Gannoruwa and Ruwanpura, 2007). Besides that, construction power tools such as cement mixers, generator, jack hammer, pile driver, circular saw are some of the equipment which contribute to excessive noise exposure in construction sites.

2.2.1 Construction Noise Sources

The noise generated may direct towards the construction workers through the path from the sources (Gannoruwa and Ruwanpura, 2007). However, the construction site is known as an open location, thus the excessive noise generated from the sources may vary in different locations, and the output may differ significantly in time. Therefore, the path by which noise reaches a listener from a source, is highly uncertain (Gannoruwa and Ruwanpura, 2007). Figure 2.2 shows the transmission of noise from a source to a reception point, which refers to a similar expose group of construction workers.

Figure 2.2: The transmission of noise from source to a reception point (Gannoruwa and Ruwanpura, 2007).

2.2.2 Regulations and Guidelines for Noise Exposure

The construction industry in Malaysia is rigorously regulated by Occupational Safety and Health (Noise Exposure) Regulations 2019. The significant components enacted within the OSH (Noise Exposure) Regulations 2019 including the permissible exposure limit, exposure monitoring, compliances procedures, hearing protection devices, audiometric testing program, education and training for employees, mandatory signage, and record keeping for noise related documentation. According to OSH (Noise Exposure) Regulations 2019, the daily noise exposure level for a worker must not exceeding a level of 85dB(A) to reduce the risk of getting hearing loss symptoms. Next, it was highlighted in OSH (Noise Exposure) Regulations 2019, that the employers shall implement such measures to reduce the excessive noise if any workers who are found exposed themselves to a noise level exceeding the Noise Exposure Limit (NEL).

According to section 3(1) of OSH (Noise Exposure) Regulations 2019, employers are responsible to identify the sources of excessive noise if there is any alterations made to the machinery, equipment, process, work, or operation at the workplace. In consequence, the noise risk assessment (NRA) shall be conducted when the excessive noise at the workplace is identified. The NRA shall only be conducted by a noise risk assessor, who is registered with the Department of Occupational Safety and Health (DOSH). Then, the completed NRA report which contain the noise mapping data and personal noise exposure level shall be submitted to DOSH for compliance verification and documentation purposes.

Besides that, the Industry Code of Practice (ICOP) for Management of Occupational Noise Exposure and Hearing Conservation 2019 is publicize as a significant guidance to comply with the provisions of Occupational Safety and Health (Noise Exposure) Regulations 2019.

2.3 Types of Hearing Loss

Hearing loss is commonly categorized into three main levels, including conductive hearing loss, sensory hearing loss, and cortical deafness (Safenviro, 2017). Conductive hearing loss relates to the defects to either outer or middle part of the ear which amplify the sound wave in air to the inner ear. However, the conduction of the sound has limited to 50 to 55 decibels, thus people who developed conductive hearing loss may still be able to hear louder sounds.

Next, sensory hearing loss refers to the loss of sensitivity from the sensory or hair cells known as stereocilia in the cochlea. Stereocilia is a spiraling organ within the cochlea which is responsible for converting vibrations from sound waves into neural signals (Yetman, 2020). The loss of hearing caused by sensory hearing loss depend substantially on the degree of damage of the spiraling organ.

Third, cortical deafness, also called central hearing loss is known as a neurological condition which the primary auditory cortex in the inner ear is defective and unable to convert the electrical nerve impulses to sounds (Safenviro, 2017).

2.4 Hearing Loss Symptoms

The development of hearing loss symptoms generally depending on the types of hearing loss. General symptoms of hearing loss are recognized such as experiencing ringing in one or both ears, communication difficulties, often asking others to repeat themselves, muffling of speech, difficulty in hearing people through the phone, turning up high volume of the television or handphones, and struggling discriminating speech consonant sounds (Mayo Foundation for Medical Education and Research (MFMER), n.d.).

Tinnitus is commonly described as a ringing sound in one or both ears and may differ in pitch from soft to loud and from low to high pitched. It can also be defined as the perception of varieties of sounds such as humming, roaring, clicking, hissing, and buzzing in the ears with the absence of external noise sources (MFMER, n.d.). Besides that, the chain of circumstances that are leading to tinnitus has been reported to be associated with loud noise exposure, hearing loss, head or neck injuries, ear infection, and high doses of medications (National Institute on Deafness and Other Communication Disorders, 2023). A previous study conducted by Hong et al., (2016) has highlighted that 40% of firefighters and operating engineers were reported to have developed tinnitus and 34% of firefighters and 59% of operating engineers have showed hearing loss at noise-sensitive frequencies of 4kHz and 6kHz. Therefore, the study found that workers with hearing loss demonstrated significantly higher rates of tinnitus.

Furthermore, individuals who developed hearing loss symptoms are often notice struggling with speech comprehension. Speech comprehension is a process of recognizing the spoken language signal from an auditory background and transforming it into information. Speech is normally delivered at 6-12 dB louder than

the auditory background to be clearly heard and understood (Themann and Masterson, 2019). However, excessive noise level could interfere with speech comprehension by affecting the worker's concentration in work, working efficiency, and stress reactions (Lee, Kim, and Hong, 2019). Based on a previous study conducted by Hong, (2005), he had concluded that 38% of the operating engineers who exposed themselves to heavy construction equipment have diagnosed with a phantom sound of ringing and buzzing in their ear whereas, 62% of the rest were having communication difficulties under loud auditory environment.

2.5 Factors Associated with Hearing Loss Symptoms

2.5.1 Non-occupational Factors

Non-occupational factors that are outlined to have been associated with hearing loss symptoms are age, level of education, cardiovascular disease, diabetes, smoking habits, and non-occupational activities or hobbies (Mazlan et al., 2018). In general, age is said to have been related to hearing loss due to the deterioration of the inner hair cell as the workers grow older. The inner hair cell which is located within the cochlea acts as a function to transmit auditory signal to the central nervous system. Therefore, the deterioration of inner hair cells will result in the development of hearing loss among older workers.

The level of education among the construction workers also indicates a significant relationship in evaluating their awareness towards the negative impacts of noise exposure to their health (Koushki, et al, 2004). A study by Koushki, et al (2004) found that construction workers with college degrees and higher education levels were accompanied with higher awareness level towards the adverse impacts of occupational noise exposure. Conversely, the uneducated labourers in the construction industry were the group of people who did not perceive noise as an issue. They were also known as the most frequent among those who did not think that noise is a health threat and will not affect their productivity at work after prolonged exposure.

Additionally, cardiovascular disease is also found associated with cochlea damage (Mazlan et al., 2018). High levels of cholesterol and triglycerides within our body will likely disrupt the blood flow and result in cardiovascular disease. Consequently, the disruption of blood circulation will reduce the amount of oxygen supply to the inner hair cells which are important for hearing. Hence, the inner hair cells will be damaged, and the individual will likely to suffer from permanent hearing loss (San Diego ENT, 2023).

Furthermore, study have proofed that diabetic factor show a higher prevalence of hearing loss compared to those without diabetes as the escalating of glucose or insulin pathology can have a direct effect toward the inner hair cells in the cochlea by decreasing the amount of blood flow, oxygen exchange, and ion transport (Bonet et al., 2021). Besides that, Bonet et al., (2021) had highlighted that individuals with diabetes have twice the incidence of hearing loss compared to those without diabetes and those with prediabetes have a 30% higher rate of hearing loss in his previous research study.

In addition, workers with frequent smoking habits are found having higher risk in developing permanent hearing loss compared to non-smokers (Mazlan et al., 2018). Agrawal et al., (2009) concluded that prevalence of individuals with heavy smoking history with more than 20 packs yearly to develop hearing loss is 16%. As a result, cigarette smoke contains hazardous ingredients such as carbon monoxide and nicotine which will result in temporary threshold shift after prolonged exposure by reducing the oxygen blood levels that is to deliver to the cochlea (Victory, 2022). Besides that, lower oxygen blood levels will likely contribute to hearing loss by interfering with the neurotransmitters within the auditory nerve in the cochlea. Other non-occupational factor which are associated with hearing loss including the usage of power tools at home, attending loud recreational activities such as bar, restaurant, concerts, and theatre, and listening to loud music were outlined in the study by Neitzel et al., 2004.

2.5.2 Occupational Factors

Occupational factors can be defined as the association of health risk factors with individuals' occupation which include the characteristics of their working environment. Occupational factors including safety climate of an organization, type of work, noise intensity, exposure duration to noise, and additional shift work, are found contributing to the development of hearing loss symptoms. First and foremost, safety climate is referring to an organized safety culture practices within an organization. Good safety climate on occupational noise is known as an objective factor that allow the construction workers to become more aware of the excessive noise exposure in construction sites. According to Arezes and Miguel (2005), the worker's awareness towards health risk of occupational noise exposure is much related to the internal management on occupational noise of an organization. Therefore, safety climate brings a consequential impact on the perception of excessive noise exposure among construction workers (Chong et al., 2021).

Apart from safety climate, the combined effects of additional shift work and exposure duration to noise was found significantly associated with the developing of hearing loss symptoms. Gopinath et al., (2021) completed a cross-sectional and longitudinal study regarding the association of past workplace noise exposure with the development of hearing loss symptoms among older adults. Consequently, the result revealed that the exposure to occupational noise for more than 10 years will develop mild and moderate-to-severe hearing loss. In short, occupational noise exposure are justified to likely increase the risk of hearing loss symptoms among older adults who had exposed themselves to excessive noise for more than 10 years.

Additionally, the type of work in construction site shows a significant relationship with noise intensity in order to develop hearing loss symptoms among construction workers. The utilization of different heavy machineries and power tools that are involved in varieties of construction work including demolition, foundation, earthwork, concreting, and finishing have contributed to the majority of noise in construction site. In general, heavy machinery generates a range of noise from 80 dB(A) to 120 dB(A) and power tools that are used in construction site are justified to have generate a range of noise from 87 dB(A) to 115 dB(A) (Saleh et al., 2016).

Table 2.2: Noise level data of construction equipment at the reference distance of 15m (Hong et al., 2015).

Type of equipment	Noise level (dBA)		
	Minimum	**Most likely**	**Maximum**
Backhoe	74.5	82.5	86.5
Breaker (small)	62.6	64.3	65.9
Breaker (large)	78.0	89.6	106.0
Bulldozer	70.5	80.0	96.0
Compactor	82.0	86.0	96.0
Compressor	73.1	79.0	83.5
Concrete mixer	62.5	67.0	85.0
Concrete pump	73.5	78.0	82.0
Concrete vibrator	68.3	72.2	76.0
Crane	70.1	81.5	100.0
Drilling machine	85.0	87.9	100.0
Dump truck	70.5	74.9	88.0
Excavator	67.5	74.5	87.0
Generator	64.5	69.9	78.0
Grader	72.7	79.3	85.0
Loader	75.6	79.5	88.0
Pile driver (hydraulic)	84.0	91.0	93.0
Pile driver (impact)	82.5	89.1	101.0
Rock drill	80.9	87.0	98.0
Scraper	88.0	92.0	96.0

2.6 Summary of Literature Review

The overall literature review emphasized heavily on the risk factors that was found resulting in hearing loss symptoms among construction workers in construction sites. Both non-occupational factors and occupational factors are the key points to be highlighted in determining the prevalence of hearing loss symptoms. Besides, heavy machinery and power tools are the majority of excessive noise in construction sites (Saleh et al., 2017). Hence, the employers are required to perform their general duties to ensure the safety, health, and welfare at work for the construction workers as stated in section 15 of Occupational Safety and Health Act 1994. Indications on the usage of personal protective hearing devices among construction workers are the fundamental in Noise Exposure Control Plan and should be implemented to minimize the worker's excessive noise exposure in construction site (Ferández et al., 2009).

Lastly, it was noted that no study has been conducted to investigate the prevalence of hearing loss symptoms among construction workers in the construction site of South Quay Square, Sunway City, Kuala Lumpur. Therefore, it is crucial to conduct a study on the risk factors that contribute to the development of hearing loss symptoms among construction workers. The findings acquired from this study will deliver a comprehensive knowledge to both occupational health officers and construction workers for implementing a much better Noise Exposure Control Plan in construction site.

CHAPTER 3

METHODOLOGY

3.1 Study Design

A cross-sectional study was carried out to investigate the excessive noise exposure and the prevalence of hearing loss symptoms among construction workers in the construction site.

3.2 Study Location

The study is carried out at a construction site that is located in South Quay Square, Sunway City, Kuala Lumpur (3.065040, 101.605475). It is a proposed construction of mixed development project which consists of:

- Tower A: 37 - storey Hotel Suite
- Tower B: 34 – storey Hotel Suite with sky deck
- Tower C: 37 – storey Hotel Suite

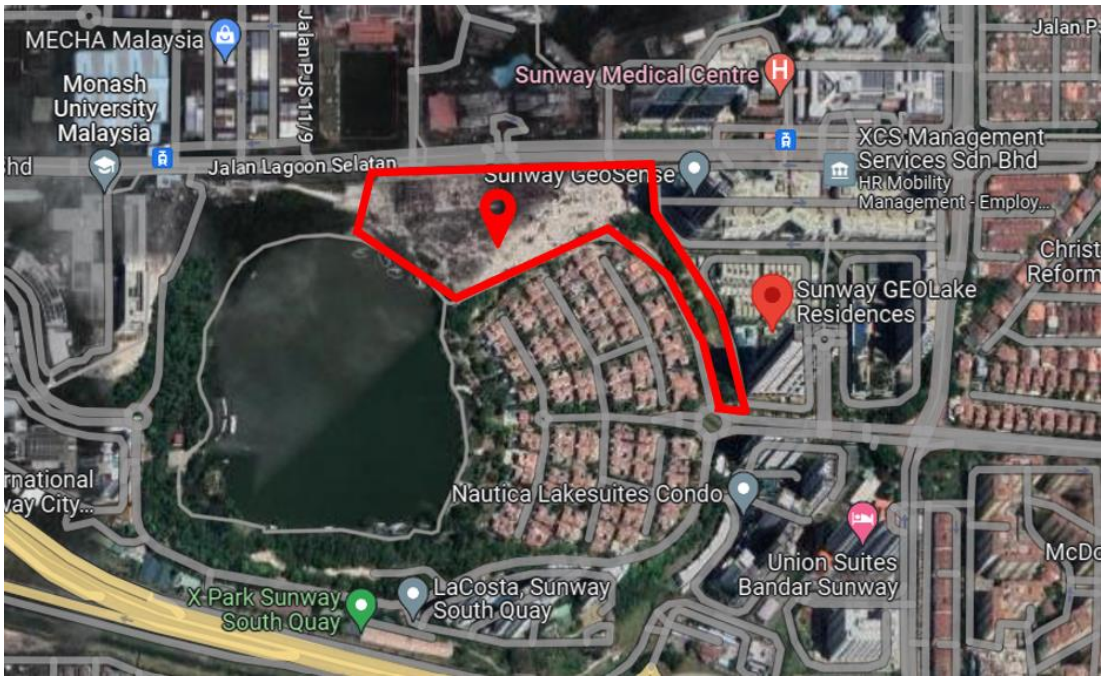

Figure 3.1: Location of South Quay Square (SQS), Sunway City in Google Maps.

Figure 3.2: The entrance gate of South Quay Square (SQS), Sunway City.

3.3 Study Population

The study population for this research was the workers in construction site which fulfil the following **inclusion criteria** and **exclusion criteria**.

Table 3.1: Inclusion and Exclusion Criteria for Study Population.

Inclusion criteria	Exclusion criteria
• Workers working with any heavy machinery and power tools.	• Workers with a history of hearing loss.

3.4 Sampling Method

This study is a purposive sampling which the noise exposure levels were determined in a manner that would accurately identify employees exposed to or likely to be exposed to excessive noise. Every employee who may be exposed to excessive noise must be included in the noise risk assessment activities. This can be achieved by grouping employees who have similar noise exposure (e.g., perform the same tasks, have similar job functions, or work in the same area), into similar exposure groups (SEG). The respondents which fulfil the criteria will be chosen as participants of the study. The self-administered survey questionnaire will be emailed to the person-in-charge (PIC) of South Quay Square (SQS), project of Sunway City after obtaining ethical approval.

3.5 Research Equipment and Instrument

3.5.1 Noise Exposure Level

The worker's daily noise exposure level was obtained from the Initial Noise Risk Assessment (NRA) Report, similarly, based on 4 different SEG, including hacking, formwork dismantling (plywood), falsework dismantling, and aluminium formwork installation as the organization had just hosted GLOTEQ RESOURCES SDN. BHD. to conduct NRA on 26th June 2023. The NRA report was received on 10th July 2023 which is near to my data collection date which falls on 25th October 2023. Besides that, the research equipment that is used in this study is the sound level meter (SLM) 'Optimus -Model CR:171B'. The equipment was inspected on-site for functionality and the monitoring device was checked and calibrated before hand-over. The SLM was placed near to the noise sources and point sampling was conducted to determine the noise level that generated from the usage of power tools based on 4 different SEG.

3.5.2 Questionnaire Distribution

Validated questionnaire is adopted from Self-Evaluation of Hearing Status (Nilai Sendiri Status Pendengaran) prepared by the Ministry of Health Malaysia (Kementerian Kesihatan Malaysia) (Farhana, 2014). The questionnaire consists of 54 items: 8 items for socio-demographic data, 16 items for occupational information, 5 items for personal lifestyle, and 25 items for hearing loss symptoms.

Section A (socio-demographic data) consists of contact information, age, races, marriage status, height, weight, and education level of the respondents.

Section B includes questions relating to the respondents' occupational information such as duration of employment, occupational noise exposure, working duration per shift, overtime, current job position, previous job experience, personal protective behaviour toward excessive noise in construction site.

Section C includes questions associating with personal lifestyle and habit including smoking status, ingestion of drugs, insomnia, and exercising.

Section D comprises of questions regarding hearing loss symptoms that may be experienced by the respondents based on social and emotional factors. For example, suffering from listening and understanding their peers, restricting themselves from visiting neighbours, family, and friends, avoiding crowded places, gatherings, and events, to have fewer conversations with family and friends, reducing their phone usage, and seldom watching movies and theatre in the cinema.

All questions in Section A, B, and C are categorial under 'Yes or No', while Section D, 'Yes, Sometimes, and No' (**Appendix A**). The total scoring was rated through a score out of 48 for social, and a score out of 52 for emotional. Then, the calculated score from social and emotional sections was summed up and rated into healthy, moderate, and unhealthy as in Table 3.2.

Table 3.2: The Score Rating for Hearing Status.

Score Rating	Healthy Status	Justification
0% to 16%	Healthy	No hearing loss symptoms
18% to 42%	Moderate	Hearing loss symptoms from acute to mild
43% and above	Unhealthy	Severe hearing loss symptoms

3.6 Data Collection Procedures

Figure 3.3 shows the data collection procedures for this study. First of all, an application was applied for this study at the selected construction site, SQS, Sunway City. Then, the survey questionnaire had went through for ethical approval by UTAR for research purposes. Next, the noise exposure level was obtained based on SEG with the current construction phase and work activities they had in SQS, Sunway

City. Also, the questionnaires were distributed to the respondents in obtaining their socio-demographic characteristics, lifestyle, occupational factors, and hearing status to determine the significance risk factors that are associated with the development of hearing loss symptoms among construction workers. Lastly, the interpretation of data and findings acquired were assessed using SPSS Software to determine the predicting factors that contribute the most to the development of hearing loss symptoms among construction workers.

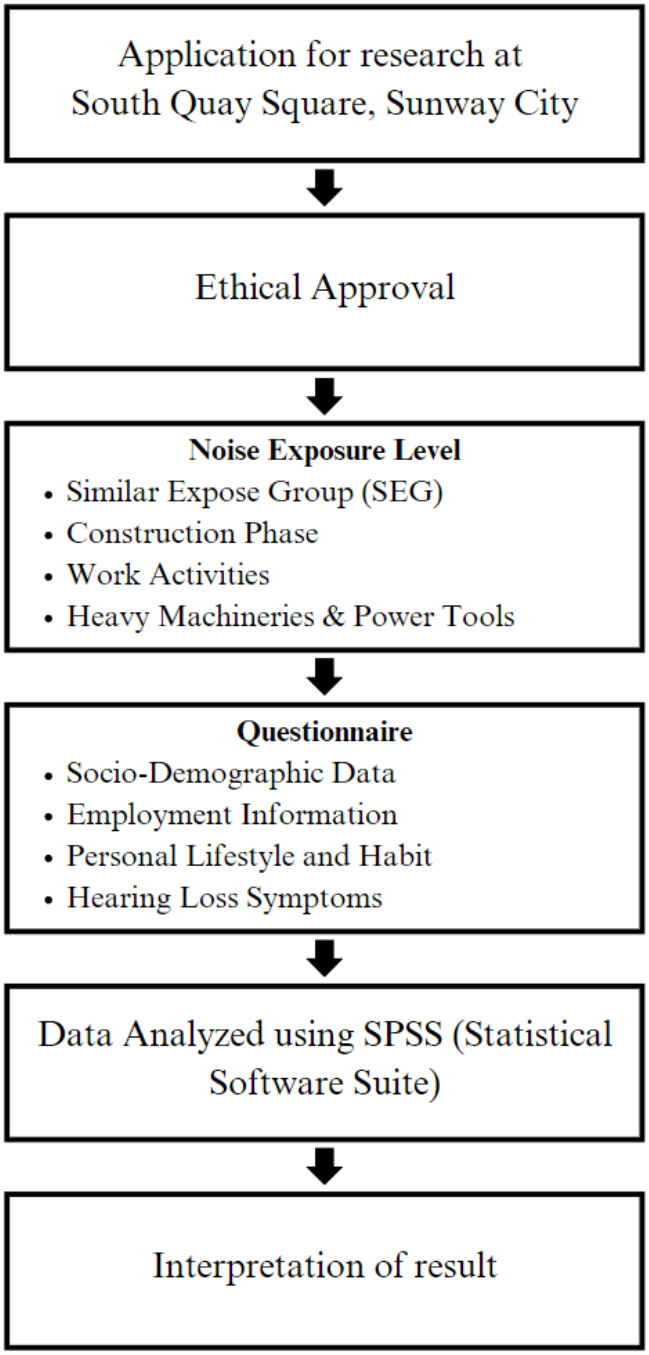

Figure 3.3: Flowchart of Research Procedure.

3.7 Data Analysis

3.7.1 Types of Data Analysis

As shown in Table 3.3, the application of descriptive analysis on all study variables by the usage of frequencies and percentage on categorical variables, whereas mean and standard deviation on numerical variables. Normality test is conducted for this set of data and chi-square test was used if the set of data is not normally distributed.

Table 3.3: Data analysis methods and tests for relative objectives of study.

No.	Objectives	Tests
1	To evaluate the noise exposure level experienced by the construction workers.	Descriptive Statistics
2	To determine the prevalence of hearing loss symptoms among construction workers in the construction site.	Descriptive Statistics
3	To analyse the contributing factors of sociodemographic, lifestyle, and occupational factors toward hearing loss symptoms among construction workers in the construction site excluding gender, cardiovascular disease, and diabetes.	Chi-Square Test

3.7.2 Statistical Software: Statistical Package of the Social Sciences (SPSS)

The collected data from questionnaire distributed to the workers in construction site will be transferred to a Microsoft Excel spreadsheet and consequently export to the Statistical Package of the Social Sciences (SPSS). The raw data acquired are statistically analysed to determine the relationship between dependent and independent variables.

3.7.3 Study Ethics

Ethical approval is applied to UTAR's Scientific and Ethical Review Committee in order to request ethical permission for this research after questionnaire has been created (**Appendix B**).

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Non-occupational Factors of Respondents

4.1.1 Socio-demographic and Lifestyle of Respondents

Personal information on age, level of education, cardiovascular disease, diabetes, smoking habits, sleep disorders, sleep disturbances, and non-occupational activities were obtained from a total of 50 responses from the chosen construction site. As shown in Table 4.1, 8% of the respondents were between the ages of 20 to 29, followed by 54% respondents were between the ages of 30 to 39, while 36% respondents were between the ages of 40 to 49, and only 2% of my respondent is between the ages of 50 to 59. Therefore, majority of the respondents are between the ages of 30 to 39 and the there was only 1 respondent that is between the ages of 50 to 59.

Next, 20% of respondents in this study had not attended any formal education, whereas 56% of the respondents had attended the education in primary level, followed by 20% of them had gone through education in secondary level. There were 4% of them had completed their Diploma or certificate according to their profession as construction workers. Thus, we can conclude that majority of the workers had completed their education in primary level, whereas there are least number of workers who had completed their Diploma or certificate in accordance with their profession as construction workers.

As shown in Table 4.2, none of the respondents reported having diabetes or cardiovascular disease. Other than that, 82% of the respondents were smokers and 18% of them were non-smokers. There were 98% of the respondents did not have encountered sleep disturbances while only 2% of the respondents were reported to have sleep disturbances. In addition, 92% of the workers did not have sleep disorders and only 8% of them were reported to have sleep disorders. Last but not least, 60% of the respondents seldom to have any outdoor or physical activities after their work while the other 40% of them have regularly engaged in outdoor or physical activities after their work.

Table 4.1: Distribution of Socio-demographic of Construction Workers (n=50).

Socio-demographic		**Frequency (%)**
Age	20 - 29 years old	8
	30 - 39 years old	54
	40 - 49 years old	36
	50 - 59 years old	2
Level of Education	No formal education	20
	Primary level of education	56
	Secondary level of education	20
	Certificate/Diploma/Degree	4

Table 4.2: Distribution of the Lifestyle of Construction Workers (n=50).

Lifestyle		**Frequency (%)**
Cardiovascular disease	No	100
	Yes	0
Diabetes	No	100
	Yes	0
Smoking habits	Non-smoker	18
	Smoker	82
Sleep disorders	No	92
	Yes	8

Sleep disturbances	No	98
	Yes	2
Non-occupational activities	No	60
	Yes	40

4.1.2 Occupational Factors of Respondents

Occupational factors that can influence the development of hearing loss symptoms include safety climate, type of work, exposure duration to noise, and additional shift work. As shown in Table 4.3, 58% of the respondents were not wearing any hearing protection devices and the remaining 41% respondents were utilizing the hearing protection devices during performing their daily work activities. Besides, 62% of the respondents have attended noise-related training whereas 38% of the respondents have not been through any noise-related training upon joining the current project in SQS, Sunway City. Moreover, Table 4.3 also shows that 32% of the respondents were working for aluminium formwork installation, followed by 30% of them who were working for falsework dismantling activities. Also, 28% of the respondents were involved in formwork dismantling activities, and only 10% of the remaining respondents were working for hacking activities.

Based on all the respondents in this study, there were 12% respondents have worked between the range of 1 to 5 years, followed by 54% of the respondents who have worked between the range of 6 to 10 years, whereby 26% of them worked between the range of 11 to 15 years, and only 8% of respondents who worked between the range of 16 to 20 years. Therefore, we can summarize that most of the respondents in this study have worked for 6 to 10 years whilst only the least number of respondents have worked for 16 to 20 years.

Furthermore, 80% of respondents were reported to have worked every day, indicating ≥ 7 days in a week while the remainder 20% of respondents were reported to have worked ≤ 6 days in a week. Then of all workers, 52% of the respondents are working ≤ 10 hours a day and 48% of the respondents are working ≥ 12 hours a day.

Last but foremost, all the respondents were reported to have worked overtime (OT) more than 5 times in a month.

Table 4.3: Distribution of Occupational Factors of Construction Workers (n=50).

Work Characteristics		**Frequency (%)**
Wearing Hearing Protection Devices while working	No	58
	Yes	42
Attended Noise Related Training	No	38
	Yes	62
Type of work	Hacking Activities	10
	Formwork Dismantling	28
	Falsework Dismantling	30
	Aluminium Formwork Installation	32
Duration of Employment	1 - 5 years	12
	6 - 10 years	54
	11 - 15 years	26
	16 - 20 years	8
Working days in a week	≤ 6 days	20
	≥ 7 days	80
Working hours in a day	≤ 10 hours	52
	≥ 12 hours	48
Working Overtime (OT)	No	0
	Yes	100
Frequency of working OT in a month	0 times a month	0
	1 - 3 times a month	0
	3 - 5 times a month	0
	More than 5 times a month	100

4.2 Prevalence of Hearing Loss Symptoms based on SEG

The respondents in this study are categorised from 4 different SEG which comprised of hacking activities, formwork dismantling, falsework dismantling, and aluminium formwork installation. The prevalence of hearing loss symptoms among the respondents in these SEG was tested using a validated survey questionnaire 'Self-Evaluation of Hearing Status', adopted from MOH. The survey questionnaire consists of social and emotional related questions which are corresponding to the prevalence of hearing loss symptoms. Therefore, the results are shown in 4.2.1 and 4.2.2 respectively.

4.2.1 Social Responses associated with Hearing Loss Symptoms

Figure 4.1 shows that 26% of the workers agreed that hearing loss symptoms had caused them to reduce their phone usage in their daily lives. 18% of the workers were having difficulties in listening to and understanding their colleagues, which can easily lead to misunderstandings or frustrations for both parties. Next, 16% of the respondents encountered trouble when attending crowded gatherings or events in the presence of hearing loss symptoms. Then the results also showed that approximately 10% among the workers revealed to have hearing loss symptoms which has caused them to have struggle while watching movies and theatre, have fewer conversations with their family members, less likely to listen to television or radio broadcasts, and have encountered difficulties in listening to television and radio. Also, the remaining 8% of the respondents have concurred that their hearing problems have restricted them to engage in fewer entertainment activities including window shopping, crowded places, and visiting their friends, family, and neighbours. Last but not least, a minority comprising 6% of the workers have agreed on their hearing problems have caused difficulties for them while eating in a restaurant with their family and friends.

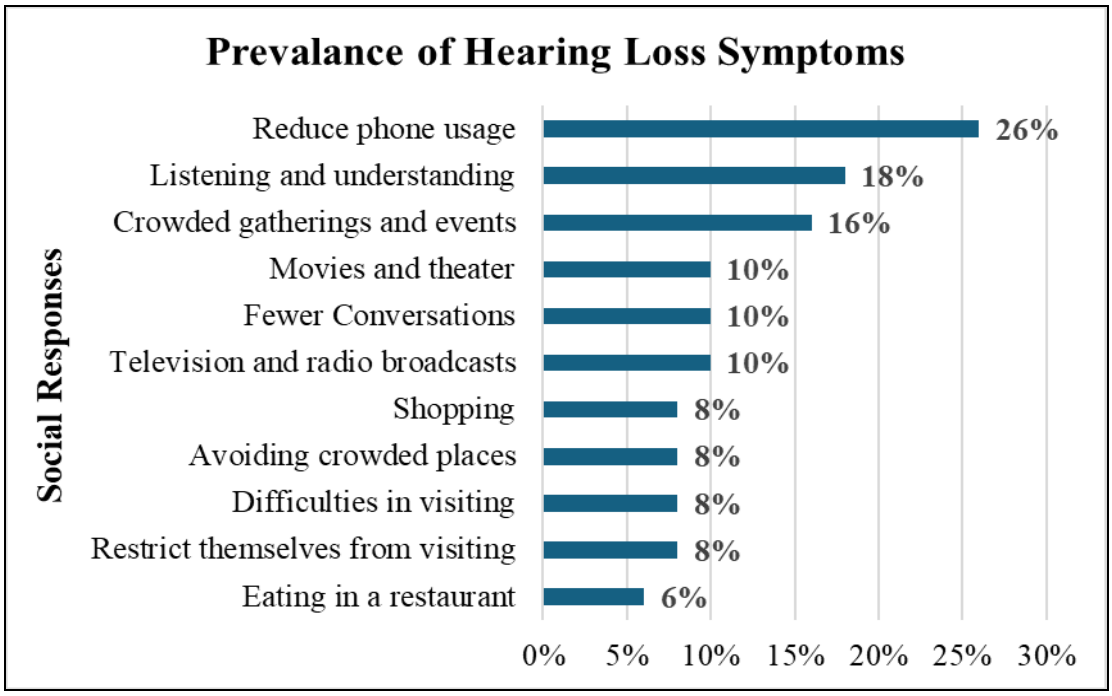

Figure 4.1: Social Responses associated with Hearing Loss Symptoms (n=50).

4.2.2 Emotional Responses associated with Hearing Loss Symptoms

Referring to figure 4.2, 30% of the respondents think that their hearing problems have caused them to feel embarrassed during meeting with new people and when participating into a group of people. Besides that, hearing loss symptoms have also resulted in 24% of the workers feeling uncomfortable when talking with their friends. Furthermore, hearing loss symptoms have caused 16% of the workers to feel incapacitated and disappointed all the time. Also, hearing loss symptoms have caused 14% of the workers to argue with their family members and experience emotional stress. Moreover, 12% of them agreed that hearing loss symptoms have led to difficulties limiting their personal and social life. Then, 10% of the respondents agreed that hearing problems have led them to become easily angered and want to be alone instead of joining the crowd most of the time. Meanwhile, they also felt that hearing problems have caused them to feel disappointed while having conversations with their colleagues or family members. Lastly, 4% of the respondents said that hearing loss symptoms have made them feel nervous.

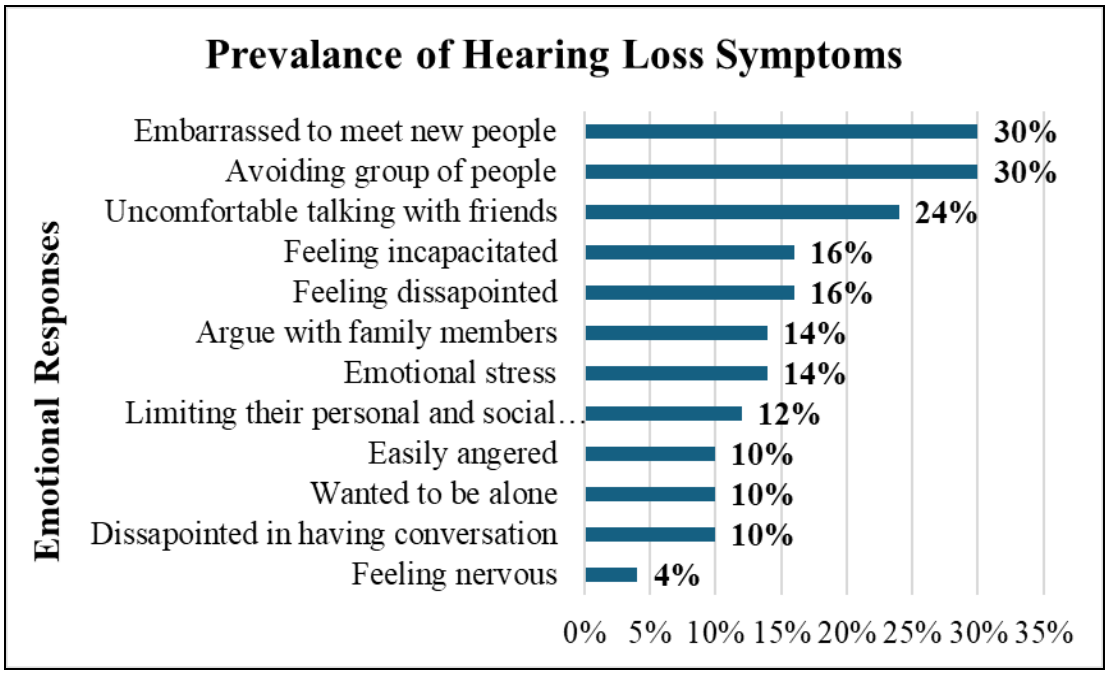

Figure 4.2: Emotional Responses associated with Hearing Loss Symptoms (n=50).

4.3 Total Score of Prevalence of Hearing Loss Symptoms among Construction Workers

Hearing loss can profoundly affect an individual's social and emotional well-being by impeding communication and interpersonal interactions. According to Ciorba et al. (2012), hearing loss symptoms have been identified as a contributing factor to diminished communication, social interactions, and emotional connections. Besides that, hearing loss symptoms are explicitly cited as a cause of communication issues, dissatisfaction in family relationships, source of loneliness and social isolation, and reduced engagement in social activities. Therefore, a validated questionnaire, 'Self-Evaluation of Hearing Status' which was adopted from the Ministry of Health Malaysia is distributed to the respondents to determine the prevalence of hearing loss symptoms based on their social interactions and emotional connections. The results are depicted in Figure 4.3 in which 32% of the respondents are healthy with no hearing loss symptoms, whereas 48% of the respondents are rated moderate with hearing loss symptoms from acute to mild. Lastly, the remaining 20% of them are evaluated as unhealthy with severe hearing loss symptoms.

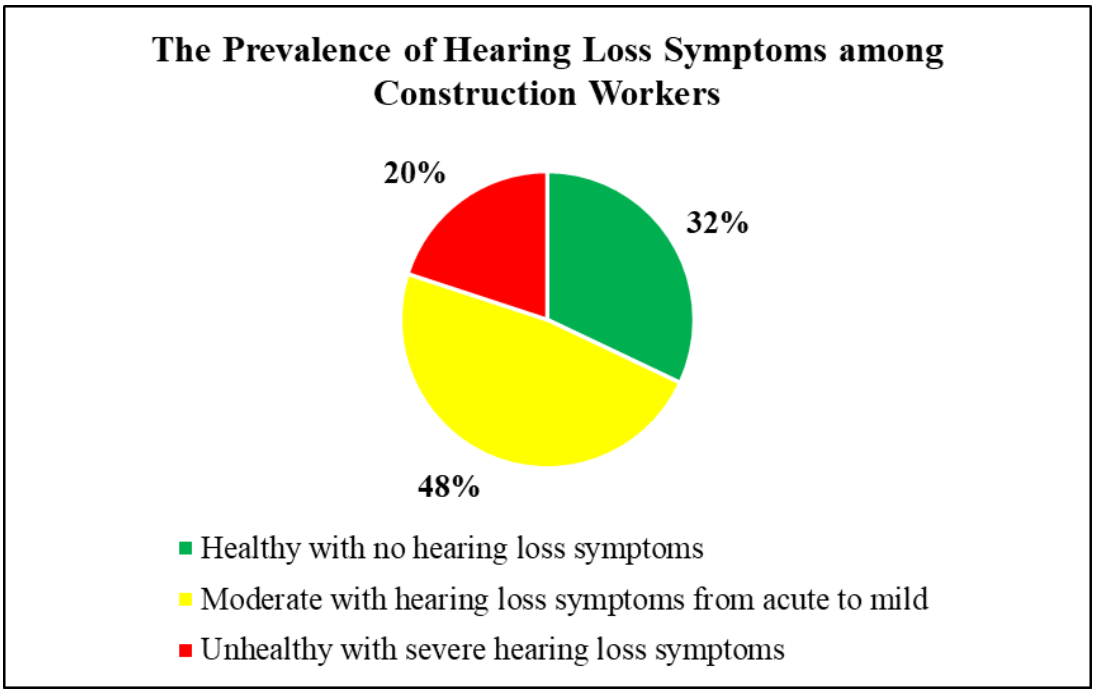

Figure 4.3: Total score of prevalence of hearing loss symptoms among construction workers based on social and emotional factors (n=50).

4.4 Noise Exposure Level

There were 4 different SEG selected for this study which comprised of SEG 1: Hacking, SEG 2: Formwork dismantling, SEG 3: Falsework dismantling, and SEG 4: Aluminium formwork installation. The measurement of noise exposure level for the selected SEG is adopted from the Initial Noise Risk Assessment (NRA) report of Sunway Construction Sdn. Bhd. (Sunway South Quay). However, point monitoring of noise exposure levels was also conducted toward the selected SEG to do comparisons to the measurement written in the NRA report and the permissible exposure limit regulated by the Occupational Safety and Health (Noise Exposure) Regulations 2019.

Table 4.4 shows the results of spot noise level measurement from the NRA report and the results of point monitoring. According to the spot measurement results, all of the selected SEG were generating noise levels of more than 85 dB(A) which have caused the exceeding of daily noise exposure level of 85 dB(A). The SEG which engaged in falsework dismantling activities was documented to have experienced a noise exposure level of 96.7 dB(A), which was the highest level of noise exposure in comparison to other SEG.

Furthermore, Table 4.5 shows the maximum and peak sound pressure levels experienced by construction workers who work within the selected SEG. The maximum sound pressure level of all SEG was reported exceeding the limit of 115 dB(A). However, the peak sound pressure level for SEG 2: Formwork Dismantling, and SEG 4: Aluminium Formwork Installation was found to have exceeded the limit of 140 dB(C) whilst SEG 1: Hacking, and SEG 3: Falsework Dismantling did not exceed the limit of 140 dB(C).

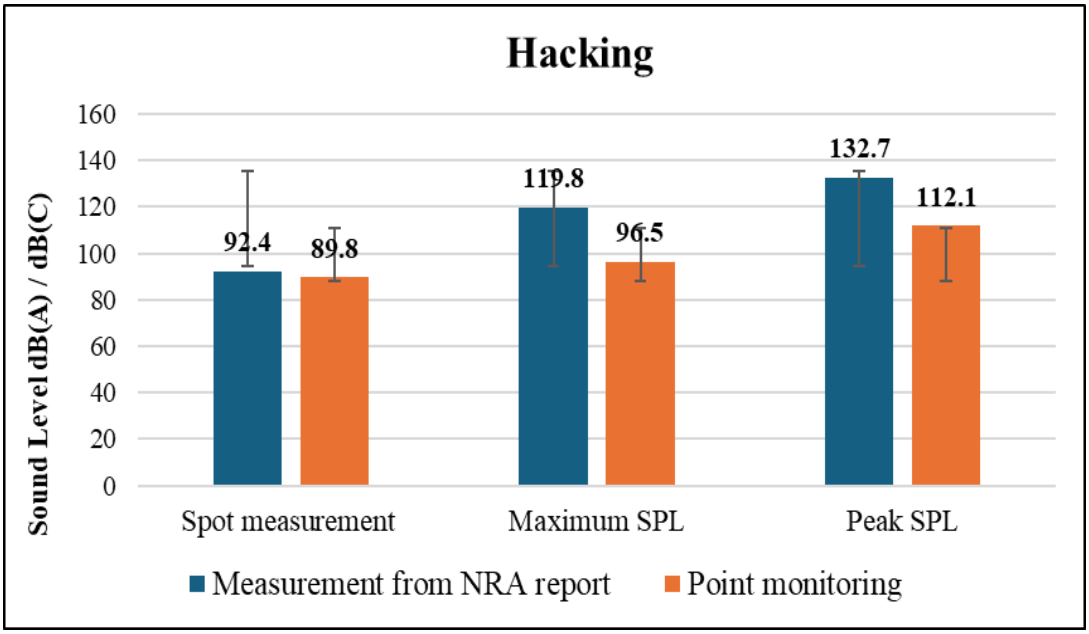

Figure 4.4: Comparison the measurement of sound level between NRA report and point monitoring for SEG 1: Hacking.

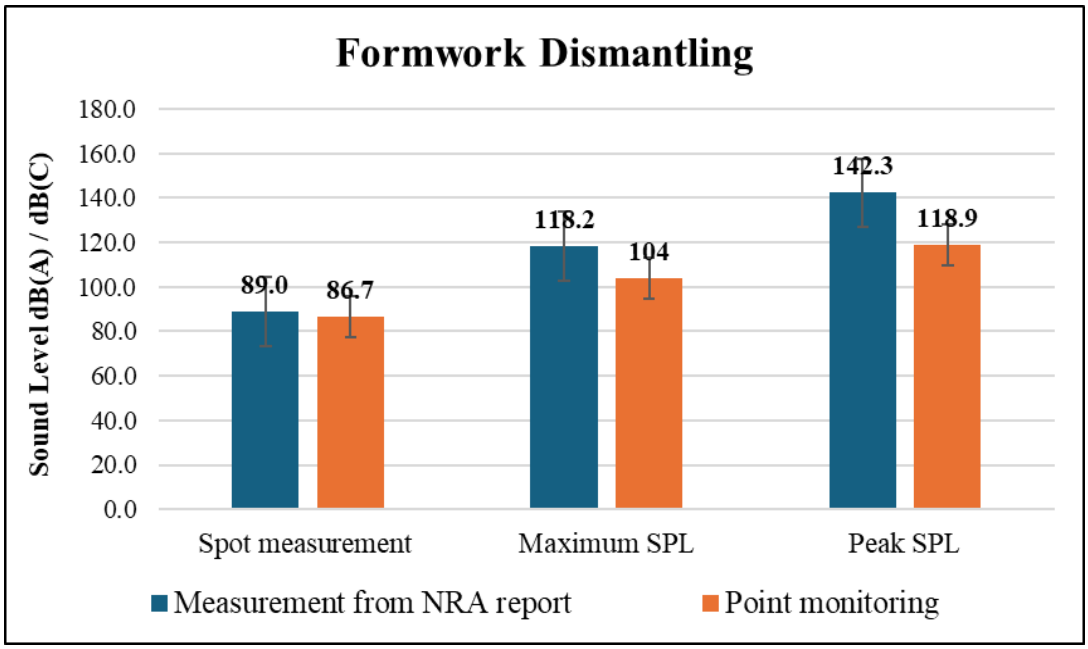

Figure 4.5: Comparison the measurement of sound level between NRA report and point monitoring for SEG 2: Formwork Dismantling.

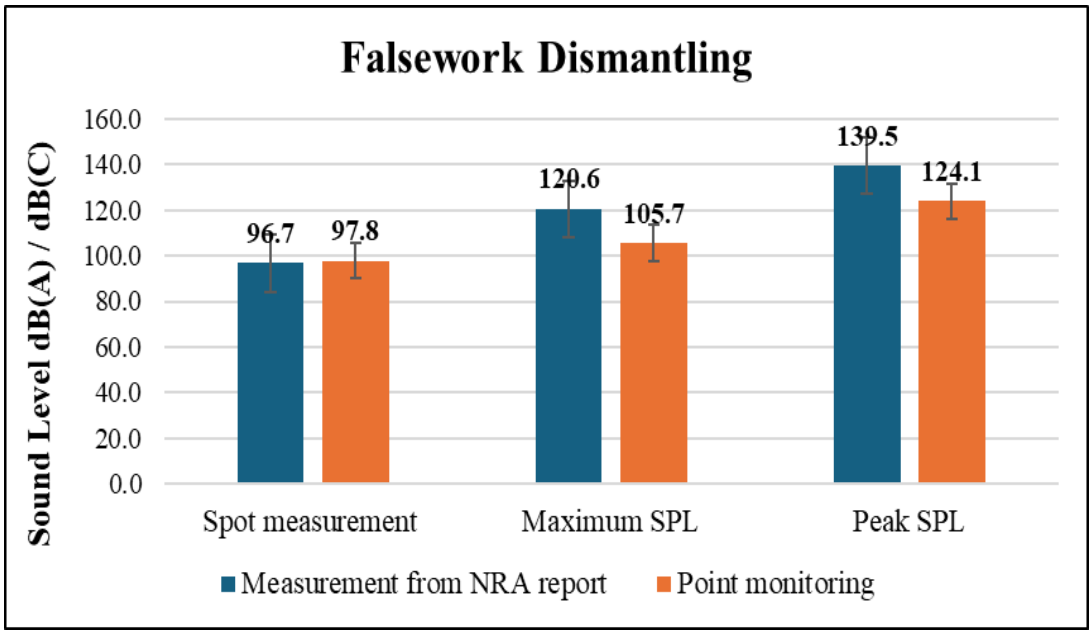

Figure 4.6: Comparison the measurement of sound level between NRA report and point monitoring for SEG 3: Falsework Dismantling.

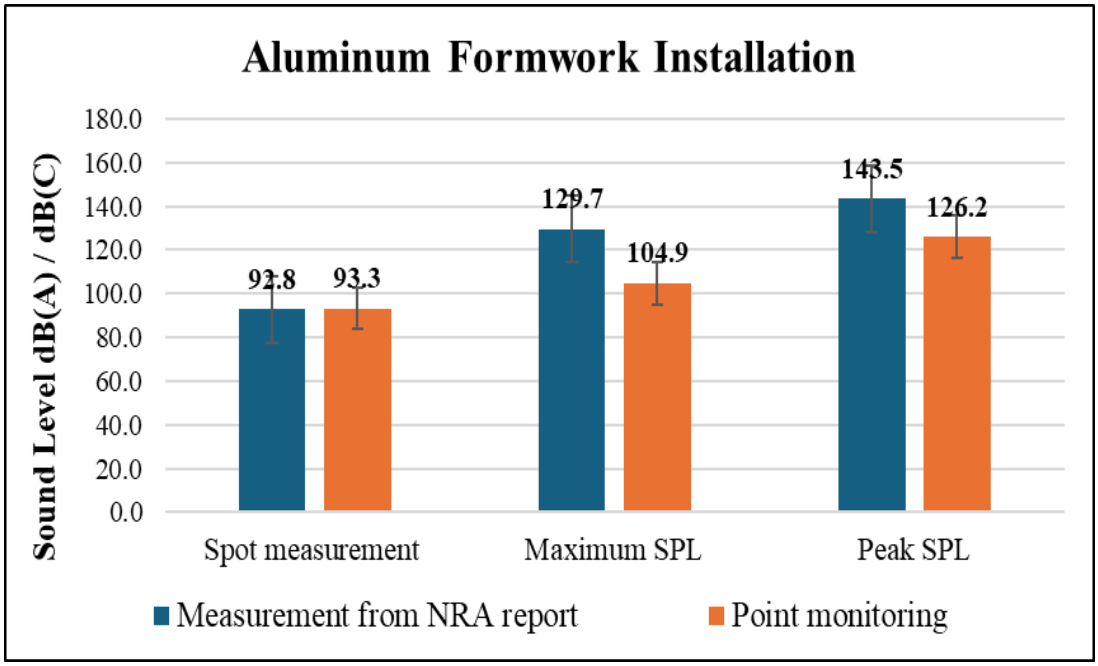

Figure 4.7: Comparison the measurement of sound level between NRA report and point monitoring for SEG 4: Aluminium Formwork Installation.

Table 4.4: Spot Noise Level Measurement Results and Point Monitoring (n=50).

Working Area	**Number of Employees**	**Source of Noise**	**Noise Level dB(A) Measurement from (NRA report)**	**Noise Level dB(A) Point Monitoring Result**
SEG 1: Hacking	5	**Hacking Activities** Jackhammer	92.4	89.8
SEG 2: Formwork Dismantling	14	**Formwork (Dismantle)** Formwork Knocking Noise	89.0	86.7
SEG 3: Falsework Dismantling	15	**Falsework (Dismantle)** Falsework Knocking Noise	96.7	97.8
SEG 4: Aluminium Formwork Installation	16	**Aluminium Formwork Installation** Aluminium Formwork Knocking Noise	92.8	93.3

*Noise Level in 'Red' indicates Noise Level exceeding 85 dB(A) based on OSH (Noise Regulations) 2019.

Table 4.5: Maximum and Peak Sound Pressure Level (n=50).

Working Area	Number of Employees	Source of Noise	Maximum Sound Pressure Level dB(A)	Peak Sound Pressure Level dB(C)
SEG 1: Hacking	5	**Hacking Activities** Jackhammer	119.8	132.7
SEG 2: Formwork Dismantling	14	**Formwork (Dismantle)** Formwork Knocking Noise	118.2	142.3
SEG 3: Falsework Dismantling	15	**Falsework (Dismantle)** Falsework Knocking Noise	120.6	139.5
SEG 4: Aluminium Formwork Installation	16	**Aluminium Formwork Installation** Aluminium Formwork Knocking Noise	129.7	143.5

*Noise Level in 'Red' indicates Noise Level exceeding 115dB(A) for maximum sound level and 140 dB(C) for peak sound level based on OSH (Noise Regulations) 2019.

4.5 Association of Risk Factors in Developing Hearing Loss Symptoms

4.5.1 Association between Socio-demographic with Hearing Loss Symptoms among construction workers

With the usage of chi-square analysis, the association of sociodemographic characteristics with hearing loss symptoms is tested and resulted in both age ($p=0.012$) and level of education ($p=0.05$) are significant to the prevalence of hearing loss symptoms among construction workers. The result was in line with the research conducted by Lawrence et al. (2019) about the relationship between hearing loss symptoms and human aging. The research shows that 13% of adults who were 40-49 years of age have started to develop hearing loss symptoms whilst 45% of elder adults who aged 60-69 years are living with hearing loss. This can be explained by human ageing has caused the loss of inner and outer hair cells at the basilar membrane, which results in the degradation of high frequency hearing and causes hearing loss.

In addition, research by Chen et al. (2020) revealed that individuals who falls under the age groups from 30-44 and 45-59 years are at high risk of developing hearing loss when exposed to occupational noise. Another research by Asghari et al. (2017) also showed that there was a significant relationship between age and hearing impairment ($p<0.001$) as the prevalence of hearing impairment rose significantly with age. Older adults are the vulnerable group of people who are likely to present with mild hearing loss which gradually develop throughout the years. This is due to human ageing modified the cochlea (inner ear) and result in diminished electrical signals being transmitted to the brain for interpretation, which frequently causes individual to feel like they can hear but not understand other people (Carrie and Esther, 2020).

As shown in Table 4.6, level of education among construction workers has a minimal influence contributing indirectly to hearing loss symptoms ($p=0.05$). There were limited sources that shows the association between level of education and hearing loss symptoms. However, previous study by Koushki et al. (2004) highlighted that the perceptions of construction workers on the impact of excessive

noise exposure were significantly correlated with their educational level. For instances, individuals who possessed higher education levels were tended to be more conscious on the harmful effects of construction noise whereas, labour workers with no or low education levels did not conceive construction noise as a potential hazard to their health. Therefore, an assumption was made that level of education has a significant contribution to the awareness level of construction workers toward the harmful effects of excessive noise exposure and the utilization of personal Hearing Protective Devices (HPD) during exposing to construction noise. Hence, leading to the development of hearing loss symptoms. Also, according to the study conducted by Sehsah et al. (2020), individuals who utilize the usage of personal protective equipment (PPE) are typically older and possess a managerial position with higher educational level. Hence, the usage of HPD will effectively reduce the risk of developing hearing loss symptoms from occupational noise.

Table 4.6: Association between Socio-demographic with Hearing Loss Symptoms among construction workers (n=50).

Variables (Socio-demographic)		**Hearing Loss Symptoms**			**X^2 (df)**	**P-value**
		Healthy	**Un-healthy**	**Total**		
		n (%)	**n (%)**	**n (%)**		
Age					10.938 (3)	0.012*
	20-29	4 (8)	0 (0)	4 (8)		
	30-39	9 (18)	18 (36)	27 (54)		
	40-49	3 (6)	15 (30)	18 (36)		
	50-59	0 (0)	1 (2)	1 (2)		
Level of education					7.819 (3)	0.050*
	No education	5 (10)	5 (10)	10 (20)		
	Primary level	11 (22)	17 (34)	28 (56)		
	Secondary level	0 (0)	10 (20)	10 (20)		
	Certificate/ Diploma/ Degree	0 (0)	2 (4)	2 (4)		

*p-value is significant at $p \leq 0.05$

4.5.2 Association between Lifestyle with Hearing Loss Symptoms among construction workers

As for Table 4.7, it represents the association between lifestyle with Hearing Loss Symptoms faced by the construction workers. In summary, smoking habits is the only lifestyle factor that is significantly associated with developing hearing loss symptoms, with a p-value of 0.014. A previous study from Themann and Masterson (2019) discussed that smoking tends to act interactively with noise exposure to exacerbate the severity and likelihood of hearing loss symptoms, which is also in lined with the ototoxic effects of carbon monoxide. Besides that, this phenomenon is also observed in individuals who are noise-exposed non-smokers nonetheless exposed to second-hand smoke.

Similarly, Hu et al. (2019) had stated that compelling evidence was obtained from their study that smoking is an independent risk factor leading to hearing loss. This is probably due to the impact caused by direct ototoxicity of nicotine to the auditory system hence increasing the levels of carboxyhaemoglobin and restricting blood supply to the cochlea (Hu et al, 2019). The discussion in the study also emphasizes the relationship of smoke intensity and the risk of hearing loss, with a p-value of less than 0.001. The result showed that the risk of developing hearing loss increased significantly with an increased number of cigarettes smoked daily. Also, Hu et al. (2019) had found out that the risk of hearing loss tends to diminish after 5 years of smoking cessation.

As for non-occupational factors such as frequent exposure to loud music through headphones or attending events with noisy atmosphere, showed not significant to the prevalence of hearing loss symptoms (p=0.322). The results are supported by a study summarized by Thorne et al. (2011) argued that the possibility of development of damage to hearing from listening to music are dependent on the extensivity of dosage of music, the volume and length of exposure. Therefore, development of damage to hearing may occurs only if the extensivity and volume of music and the length of exposure are high and long enough to have caused any adverse effects on hearing. Moreover, Lie et al. (2016) concluded that recreational noise sources are unlikely to contribute to hearing loss that is sufficiently to provide

discernible evidence on a group level. Conversely, hearing loss may occur in an individual level based on non-occupational factors if the noise exposure time and level are given sufficiently. However, previous study conducted by Lie et al. (2016) were saying there was a widely spread perception about hearing damage are not only limited to occupational factors but also leisure noise from hunting and shooting, music players, recreational activities, household appliances and noisy tools such as power drills and gardening equipment. Another study by Themann and Masterson (2019) also revealed that the noise level from our routine and leisurely engagements such as usage of power tools, listening to personal music player, commuting the train or subway, attending music concerts or loud music events could likely exceed safe levels and could be a potential risk for hearing loss.

Next, as shown in Table 4.7, sleep disorders and sleep disturbances were analysed not significant to hearing loss symptoms with the p-value of 0.754 and 0.141 respectively, which could be due to 92% and 98% of the workers have not encounter problems with sleep disorder and sleep disturbance. Nevertheless, in another study by Long and Tang (2023), a multivariable linear regression models was used to determine the significant association between sleep duration and hearing threshold shifts of 2777 participants. As a result, it shows that the rate of hearing loss for the participants in normal sleep group, short sleep group, and long sleep group were 16.97%, 19.02%, and 12.39%, respectively. Therefore, in comparison with all sleep groups, the participants in the short sleep group had the highest prevalence of hearing loss. Similarly, Feng et al. (2020) also found that sleep disturbance is one of the most significant effects (mean= 4.05, SD=0.675) resulted from noise exposure in construction site as the sleeping duration will be interrupt hence decrease. As a consequence, the affected individual will feel fatigue, have poor performance at work, and decrease of immune system.

Table 4.7: Association between Lifestyle with Hearing Loss Symptoms among construction workers (n=50).

Variables (Lifestyle)		**Hearing Loss Symptoms**			**X^2 (df)**	**P-value**
		Healthy	**Un-healthy**	**Total**		
		n (%)	**n (%)**	**n (%)**		
Smoking Habits					6.062 (1)	0.014*
	No	6 (12)	3 (6)	9 (18)		
	Yes	10 (20)	31 (62)	41 (82)		
Sleep Disorder						
	No	15 (30)	31 (62)	46 (92)	0.098 (1)	0.754
	Yes	1 (2)	3 (6)	4 (8)		
Sleep Disturbance						
	No	15 (30)	34 (68)	49 (98)	2.168 (1)	0.141
	Yes	1 (2)	0 (0)	1 (2)		
Non-Occupational Activities						
	No	8 (16)	22 (44)	30 (60)	0.980 (1)	0.322
	Yes	8 (16)	12 (24)	20 (40)		

*p-value is significant at $p \leq 0.05$

4.5.3 Association between Occupational Factors with Hearing Loss Symptoms among construction workers

Referring to Table 4.8, it showed that wearing hearing protection devices (HPD) while working had slightly significant, (p=0.004) to the development of hearing loss symptoms among construction workers. The use of a hearing protection device is mainly to enclose the ears, thereby attenuating the intensity of noise before reaching the ear drum. This result is supported by a study conducted by Pessina and Guerretti (2000) that the performance and effective noise attenuation of three different types of HPDs such as earmuffs, ear plugs, and ear canal caps are ranged 25 to 33 Noise Reduction Rate (NRR) (average 26.6); 25 to 34 NRR (average 27.8); and 16 to 26 NRR (average 19.4) respectively. In addition, direct measurements of HPD attenuation levels are also measured in a study conducted by Neitzel and Seixas (2007). They categorized a total of seven different earplug models into three categories which is Howard Leight model, Moldex models, and other models. Then, the results showed the NRR of 29 dB, 31 dB, and 27.3 dB respectively, which effectively attenuate the noise level.

Meanwhile, the result of the chi-square test also showed there are no significant association between noise related training and the development of hearing loss symptoms (p>0.05). The result was in lined with a study conducted by Tinoco et al. (2019), because the noise related training itself does not pose a direct effect on the development of hearing loss symptoms. However, the training factor has obtained a p-value of 0.033, to exerts a moderate indirect impacts on influencing the ‘Risk Perception’ and Risk Behavior’ of the workers (Tinoco et al. 2019). Therefore, providing noise-related training on subjects related to construction noise hazards, health effects of noise exposure, hearing loss, and proper usage of HPDs are essential to rectify the ‘Risk Perception’ and ‘Risk Behavior’ of construction workers during exposure to excessive noise, also to achieve a greater usage rate of HPDs among construction workers. Additionally, a bivariate analysis of safety training associated with the usage of PPE among construction workers was analysed in a study conducted by Sehsah et al. (2020). The results showed that previous safety training had doubled the likelihood of PPE usage among the workers and contributing to the reduction of incidence rate of hearing loss.

Furthermore, the type of work listed in Table 4.8 showed a p-value of 0.102 which indicates a no significant to the development of hearing loss symptoms. The result acquire might be due to the nature of work that exhibits an indirect association with the development of hearing loss symptoms. The development of hearing loss symptoms resulted from the nature of work can be associated with the utilization of machinery and power tools for construction activities. Therefore, jackhammer and claw hammer are the two main construction tools that is used by the respondents to carry out hacking activities (SEG 1), formwork dismantling (SEG 2), falsework dismantling (SEG 3), and aluminium formwork installation (SEG 4). In this study, the noise measurement taken for the activities carried out using jackhammer and claw hammer was recorded within a range of noise levels between 86.7 dB(A) and 97.8 dB(A), which had exceeded the daily noise exposure limit of 85 dB(A). Pertinently, Seixas et al. (2005) highlighted that exposing to an average noise exposure levels of ≤ 90 dB(A) for the first three years of work is sufficient to cause minor yet diagnosable effects on hearing. Another study by Majette et al. (2017) revealed that jackhammer was found to be the loudest source of noise among construction power tools which was recorded with the highest noise measurement of 130 dB(A) which can easily develop hearing loss if prolonged exposure. Therefore, the SEG 1 workers who worked with hacking activities have a higher tendency to develop hearing loss in the future as the result shows that they are frequently exposing to high noise level which have exceeded the daily noise exposure limit of 85 dB(A) and working overtime 5 times a month leading to a longer exposure duration to high noise level.

Moreover, the results in Table 4.8 also showed an association that is highly significant between the duration of employment, working days, and working hours on hearing loss symptoms, obtaining a p-value of 0.002, 0.004, and 0.026 respectively. This result is supported by a study prepared by Mamat and Naim, (2020) stating that the likelihood of developing hearing impairment among workers is strongly related to the duration of employment in relation to the worker's age and duration of noise exposure as secondary factors. Likewise, a study done by Sripaiboonkij et al. (2021) also discovered workers who worked in a noisy environment for more than 8 hours a day or have a duration of employment for more than 14 years showed a significant risk leading to hearing loss. This might result

from the irreversible hair cell damage that caused by the prolonged exposure to noise at work throughout the years (Sripaiboonkij et al, 2021). Again, a study from Gopinath et al. (2021) also showed a correlation between the rising prevalence of hearing loss and the longer duration of occupational noise exposure among the participants over the 10 years follow up. In current study, 20 out of 27 respondents who have worked for 6 - 10 years are categorized under unhealthy hearing status whereby, 11 out of 13 respondents who have worked for 11 – 15 years are with unhealthy hearing status, and 3 out of 4 respondents who have worked for 16 – 20 years exhibit unhealthy hearing status. Thus, the result can justify the association of increasing prevalence of hearing loss with the duration of employment among construction workers.

To summarize, the predicting factors for hearing loss symptoms from this research are age, level of education, smoking habits, wearing HPDs while working, duration of employment, working days, and working hours. However, Figure 4.8 shows the highest contributing factors toward hearing loss symptoms are smoking habits and working days, followed by wearing HPDs while working, working hours, duration of employment, age, and level of education. Therefore, in order to lessen the likelihood of hearing loss symptoms among construction workers, the organization shall first consider reducing their working days thus contributing to a shorter duration of noise exposure in construction site.

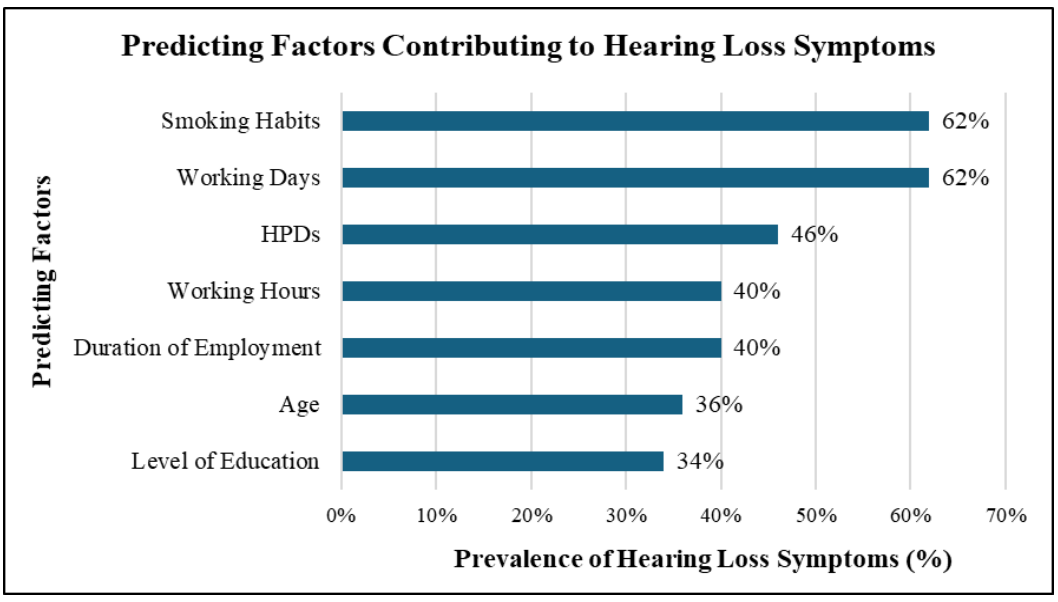

Figure 4.8: The Predicting Factors that contribute to Hearing Loss Symptoms.

Table 4.8: Association between Occupational Factors with Hearing Loss Symptoms among construction workers (n=50).

Variables (Occupational Factors)		**Hearing Loss Symptoms**			**X^2 (df)**	**P-value**
		Healthy	**Un-healthy**	**Total**		
		n (%)	**n (%)**	**n (%)**		
Wearing Hearing Protective Devices while working					4.059 (1)	0.044*
	No	6 (12)	23 (46)	29 (58)		
	Yes	10 (20)	11 (22)	21 (42)		
Attended Noise Related Training					0.002 (1)	0.960
	No	6 (12)	13 (26)	19 (38)		
	Yes	10 (20)	21 (42)	31 (62)		
Type of Work					6.213 (3)	0.102
	Hacking Activities	4 (8)	1 (2)	5 (10)		
	Formwork Dismantling	3 (6)	11 (22)	14 (28)		
	Falsework Dismantling	4 (8)	11 (22)	15 (30)		
	Aluminium Formwork Installation	5 (10)	11 (22)	16 (32)		

*P-value is significant at $p \leq 0.05$

Variables (Occupational Factors)		Hearing Loss Symptoms			X^2 (df)	P-value
		Healthy	Un-healthy	Total		
		n (%)	n (%)	n (%)		
Duration of Employment					14.947 (3)	0.002**
	1 - 5 years	6 (12)	0 (0)	6 (12)		
	6 - 10 years	7 (14)	20 (40)	27 (54)		
	11 - 15 years	2 (4)	11 (22)	13 (26)		
	16 - 20 years	1 (2)	3 (6)	4 (8)		
Working days in a week					8.295 (1)	0.004**
	≤ 6 days	7 (14)	3 (6)	10 (20)		
	≥ 7 days	9 (18)	31 (62)	40 (80)		
Working hours in a day					4.987 (1)	0.026*
	≤ 10 hours	12 (24)	14 (28)	26 (52)		
	≥ 12 hours	4 (8)	20 (40)	24 (48)		

*P-value is significant at $p \leq 0.05$

**P-value is highly significant at $p < 0.01$

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Early intervention and management of hearing loss symptoms is crucial to inhibit the development of hearing-related diseases such as age-related hearing loss, Noise-Induced Hearing Loss (NIHL), tinnitus, and sudden deafness. Therefore, recognizing the hearing loss symptoms at an early stage is important and to minimize the chances before it gets worse. The symptoms of hearing loss may vary from having difficulties in understanding conversations, trouble to listening in noisy environment, feeling disappointed when conversating with others, avoiding crowded events and gatherings, wanted to be alone all the time, reducing the usage of mobile phones, and having trouble in listening to radio and television. This can be the consequence of cumulative exposure to high noise level in the construction site as the findings for point measurement have obtained a range of noise levels between 86.7 dB(A) to 97.8 dB(A), which had exceeded the daily noise exposure level of 85 dB(A). Overall, the management and employers shall take initiatives to promoting the health of construction workers by addressing the physical hazard of noise in the construction site and to execute any actions to reduce the prevalence of hearing loss symptoms. Also, to ensure the risk perception and risk behaviour regarding occupational noise are regularly revitalized among their employees. Based on a comprehensive research for the literature review, interpretation of data analysis and the discussion on results attained, the aim and objectives of this study have been achieved. Hence, the conclusion generated from the study's findings and results are synopsized as follows:

i. According to sociodemographic trends, 54% of the respondents were aged between 30 and 39 years old, while 56% had only completed primary level of education. In terms of trends of lifestyle, none of the respondents had cardiovascular disease or diabetes, but the majority were smokers. Also, 92% and 98% have not experienced sleep disorders and disturbances. As far as non-occupational factors are concerned, 60% of the respondents were not involved in outdoor activities. Meanwhile, 58% of respondents did not wear HPDs while working and 62% had attended noise-related training. And 54% of them have 6 to 10 years of working experience. Workers who work seven days a week make up 80%, but almost half of them work less than 10 hours daily (52%). However, all workers have worked overtime more than five times a month.

ii. There was a prevalence of hearing loss symptoms among construction workers in the construction site. 48% of the workers have developed hearing loss symptoms from acute to mild while 32% of the workers have no hearing loss symptoms, and 20% of the remaining workers have experienced severe hearing loss symptoms.

iii. The findings acquired from NRA report showed that the noise exposure levels of all SEG were between 89.0 and 96.7 dB(A) whereas the findings from point monitoring of all SEG had demonstrated that the noise exposure levels were between 86.7 and 97.8 dB(A).

iv. Age, level of education, smoking habits, HPDs, duration of employment, working days, and working hours are the predicting factors which are significantly associated with hearing loss symptoms found among the construction workers in the construction site.

In summary, the findings from this study indicates that the occupational noise exposure emitted from the usage of power tools significantly contributes to the development of hearing loss symptoms among the construction workers in the construction sites. However, the findings obtained from this study are not comprehensive to make a conclusive judgement on the association between hearing loss symptoms and related risk factors among construction workers as the number of respondents or the working conditions or environment could be dissimilar under any circumstances.

5.2 Strength and Limitation of Study

5.2.1 Strength of Study

The strength of this study concentrated primarily on determining the predicting factors that leading to the prevalence of hearing loss symptoms among construction workers in the construction site. Besides that, point monitoring of all SEG was also conducted in this study to do comparison with the noise levels written in the NRA report and the study presented the range of noise levels obtained from the NRA report and point monitoring were indicating considerable fluctuation of noise levels.

Moreover, the questionnaire used for this study was adopted from the Ministry of Health (MOH), Malaysia which is a highly reliable medical source that enhance the accuracy of the results on the prevalence of hearing loss symptoms among construction workers. Last but not least, this study had obtained a high response rate of 100% to strengthen the study's validity and credibility, at the same time eliminating the non-response bias.

5.2.2 Limitation of Study

The objective of this study is to heighten the perception of risk and behavior regarding occupational noise among construction workers in the construction site. However, numerous limitations have been identified throughout the study that could potentially influenced the accuracy and robustness of the results. Therefore, the limitations of this study are outlined as follows:

i. The authenticity of the results may be limited by the small sample sizes which has constrained the statistical power and does not precisely reflect to the larger sample sizes.
ii. Although the questionnaire is printed out in Bahasa Malaysia to ease the understanding from the foreign workers. However, some of the wordings may cause confusion to their understanding due to knowledge barrier. Therefore, the respondents may embellish or downplay their symptoms and affect the precision of the final findings.

iii. The answering to the questionnaire pertaining to ‘Self-Evaluation of Hearing Status’ is fully dependence on self-reporting hearing loss symptoms which may introduce bias and could not be used as a clinical proof for the results of hearing status.

iv. This study only focuses on one construction site and the selected SEG, which the results could not aid in reflecting to other construction sites with dissimilar project phases and work tasks.

v. The questionnaire were given limited time to be filled up by the respondents during their resting hours to avoid interruption of work progress. Hence, the results may be vary from the reality as they prioritized their resting hours instead of properly answering the questionnaire.

5.3 Recommendation

5.3.1 Recommendation For Future Studies

In accordance with the recognized constraints in this study, a number of recommendations are to be provided to improve the insight of future research concerning about hearing loss symptoms, hence it is concluded as follows:

i. Future research should include noise mapping data and environmental noise factors to obtain a much more verifiable data on the noise exposure level among construction workers in the construction site.

ii. Future research should perform a face-to-face interview with the respondents instead of relying on the questionnaires to ensure the respondents comprehend the questions completely, hence improving the quality and accuracy of the data.

iii. Access additional data from worker’s audiometric testing results, PPE usage, control measures implemented and noise-related training records to aid in improving the reliability of findings acquired other than depending on the questionnaires only.

iv. Future research can have a larger sample size or to collect data from a few construction sites with the same project phases and SEG in order to do comparison thus, to produce a more creditable findings to support the research purposes.

v. A continuous study is recommended for future research as the development of hearing loss symptoms among construction workers can be in long term implications which the current collected data could change over the years.

vi. Future research on the risk factors of hearing loss symptoms can include the examination of ergonomic factors that contributing to hearing loss in the construction site such as layout of the workplace, the work condition, working practices and design of power tools used for construction activities as a contributing factors to hearing loss symptoms among construction workers.

5.3.2 Recommendation For Organization (SQS)

The recommended measures that can be taken for the management of construction noise are summarized as below:

i. Providing HPDs to the construction workers is insufficient to prevent the development of hearing loss symptoms. Therefore, ensuring regular inspections on HPDs are the key to maintain its effectiveness again noise exposure in construction sites.

ii. Introducing more awareness campaigns and Noise-related Talks for the construction workers who are exposed to construction noise, hence perceiving the harmful effects of noise to health.

iii. Implementation of job rotations on workers who exposed themselves to high noise levels with the aim to reduce the total duration of excessive noise exposure in construction site.

iv. Noise-related training such as proper use of HPD, hearing conservation program, or training related to recognizing early sign of hearing loss shall be regularly conducted as a refreshment training to increase the risk perception and risk behavior of workers on occupational noise exposure.

v. Implement substitution controls such as substituting the jackhammer with a demolition robot for the hacking activities to prevent the workers from exposing to occupational noise.

vi. Frequently send those who are involved in any construction activities that generate high levels of noise to audiometric testing to ensure their hearing status is not affected by occupational noise.

vii. Promote a cooperative supportive culture by encouraging engagement from employees in decision-making process for occupational noise related matters.

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APPENDICES

APPENDIX A: Survey Questionnaire

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DU012(A)

Borang Kaji Selidik Pendedahan terhadap Bunyi Bising dan Masalah Pendengaran di Tapak Pembinaan

NO. ID PEKERJA : .....

TARIKH : .....

TANDA TANGAN : .....

ARAHAN SOALAN:

1. Borang soal selidik ini mengandungi beberapa bahagian iaitu:
   BAHAGIAN A: MAKLUMAT DIRI
   BAHAGIAN B: MAKLUMAT PEKERJAAN
   BAHAGIAN C: MAKLUMAT GAYA HIDUP
   BAHAGIAN D: GEJALA KEHILANGAN PENDENGARAN

2. Anda diminta untuk menjawab semua soalan yang ada di dalam buku ini.
3. Untuk menjawab, sila tandakan jawapan di bahagian jawapan yang telah disediakan.
4. Borang soal selidik hendakalah dikembalikan kepada penyelidik setelah selesai menjawab semua soalan.

BORANG PERSETUJUAN RESPONDEN

Saya……
…… No Kad Pengenalan. ……
beralamat……
……
……
dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam menyertai penyelidikan klinikal *(pengajian klinikal/ pengajian soal selidik/ percubaan ubat-ubatan) seperti yang disebut di atas.

Saya telah diberi penjelasan secara menyeluruh mengenai dasar penyelidikan klinikal dari segi metodologi, risiko dan komplikasi (seperti tertulis pada Helaian Penerangan Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang dijalankan ke atas sampel yang diambil dari saya.

*potong yang tidak berkenaan

Tandatangan ……
(*Responden*)
Tarikh :……

Tandatangan ……
(*Saksi*)
Nama :……
No. K/P: ……

Saya mengesahkan bahawa saya telah menerangkan kepada responden sifat dan tujuan penyelidikan klinikal tersebut di atas.

Tarikh …… Tandatangan ……
(*Penyelidik*)

Untuk kegunaan penyelidik

BAHAGIAN A: MAKLUMAT DIRI

1.1	No. Telefon	:	**A 1.1**
1.2	Umur	: ☐☐ tahun	**A 1.2**
1.3	Bangsa	: 1. ☐ Melayu 2. ☐ Cina 3. ☐ India 4. ☐ Lain-lain	**A 1.3**
1.4	Warganegara	: 1. ☐ Warganegara 2. ☐ Bukan warganegara	**A 1.4**
1.5	Status	: 1. ☐ Bujang 2. ☐ Berkahwin 3. ☐ Bercerai	**A 1.5**
1.6	Pendidikan	: 1. ☐ Tidak Bersekolah 2. ☐ Rendah/UPSR 3. ☐ Menengah/PMR/SPM/STPM 4. ☐ Sijil/Diploma/Ijazah	**A 1.6**
1.7	Tinggi	: ☐☐☐ cm	**A 1.7**
1.8	Berat	: ☐☐ kg	**A 1.8**

BAHAGIAN B: MAKLUMAT PEKERJAAN

2.1 Pernahkah anda bekerja di tempat lain sebelum ini? **B 2.1**

1. ☐ Ya 0. ☐ Tidak

2.2 Apakah jawatan dahulu? **B 2.2**

_____

2.3 Berapa lamakah anda telah bekerja sebagai (pekerjaan dahulu seperti di atas)? **B 2.3**

_____ tahun

2.4 Adakah anda terdedah kepada **BUNYI BISING** (pekerjaan dahulu) seperti di bawah: **B 2.4**

1. ☐ Ya 0. ☐ Tidak

2.5 Apakah jawatan anda sekarang? **B 2.5**

_____

2.6 Berapa lamakah anda telah bekerja sebagai (pekerjaan seperti di 2.5)? **B 2.6**

_____ tahun

2.7 Berapa lamakah anda bekerja di sini? **B 2.7**

_____ tahun

2.8 Shift kerja: **B 2.8**

1. ☐ Normal
2. ☐ Shift

2.9 Adakah anda bekerja lebih masa (OT)? **B 2.9**

1. ☐ Ya 0. ☐ Tidak

2.10 Jika Ya, secara purata, berapa kerap anda bekerja lebih masa? **B 2.10**

0. ☐ Tiada 1. ☐ 1-3 kali sebulan

2. ☐ 3-5 kali sebulan 3. ☐ Lebih dari 5 kali sebulan

2.11 Berapa harikah anda bekerja dalam seminggu? **B 2.11**

_____ hari

2.12 Berapa jamkah anda bekerja dalam sehari? **B 2.12**

_____ jam

2.13 Adakah anda terdedah kepada **BUNYI BISING** (pekerjaan sekarang) seperti di bawah: **B 2.13**

1. ☐ Ya 0. ☐ Tidak

2.14 Adakah anda memakai **Alat Pelindung Telinga** semasa terdedah dengan bunyi bising? **B 2.14**

1. ☐ Ya 0. ☐ Tidak

2.15 Adakah anda sertai Latihan-latihan yang berkenaan dengan **BUNYI BISING** sebelum ini? **B 2.15**

1. ☐ Ya 0. ☐ Tidak

2.16 Adakah **Alat Pelindung Telinga** sentiasa diganti sekiranya rosak? **B 2.16**

1. ☐ Ya 0. ☐ Tidak

BAHAGIAN C: MAKLUMAT GAYA HIDUP *(LIFESTYLE)*

3.1 Adakah anda mengambil sebarang jenis dadah? **C 3.1**

1. ☐ Ya 0. ☐ Tidak

3.2 Adakah anda merokok? **C 3.2**

1. ☐ Ya 0. ☐ Tidak

Jika ya, _____ batang sehari

3.3 Adakah anda melakukan sebarang aktiviti fizikal? **C 3.3**

1. ☐ Ya 0. ☐ Tidak

Jika ya, nyatakan: _____

3.4 Adakah anda mengalami kesukaran untuk tidur? **C 3.4**

1. ☐ Ya 0. ☐ Tidak

3.5 Adakah anda mengalami gangguan ketika tidur? **C 3.5**

1. ☐ Ya 0. ☐ Tidak

Jika ya, nyatakan: _____

3.6 Adakah anda mengidap kencing manis? **C 3.6**

1. ☐ Ya 0. ☐ Tidak

3.7 Adakah anda mengidap penyakit kardiovaskular? **C 3.7**

1. ☐ Ya 0. ☐ Tidak

BAHAGIAN D: GEJALA KEHILANGAN PENDENGARAN

No item.	Pernyataan	YA (4)	KADANG-KADANG (2)	TIDAK (0)
4.1	Adakah masalah pendengaran menyebabkan andakurang menggunakan telefon seperti yang anda inginkan?			
4.2	Adakah masalah pendengaran menyebabkan andaberasa malu apabila berjumpa dengan orang yanganda baru kenal?			
4.3	Adakah masalah pendengaran menyebabkan andamengelakkan diri dari kumpulan orang ramai?			
4.4	Adakah masalah pendengaran menyebabkan anda cepat marah?			
4.5	Adakah masalah pendengaran menyebabkan andaberasa kecewa apabila berbual dengan ahli keluarga anda sendiri?			
4.6	Adakah masalah pendengaran ini menyebabkananda mengalami kesukaran apabila menghadiri majlis keramaian?			
4.7	Adakah masalah pendengaran menyebabkan andasukar untuk mendengar/memahami kehendak rakan sekerja/pelanggan?			
4.8	Adakah anda berasa tidak berupaya disebabkanmasalah pendengaran yang dihadapi?			
4.9	Adakah masalah pendengaran anda menyukarkananda ketika melawat rakan-rakan, keluarga dan jiran-jiran?			
4.10	Adakah masalah pendengaran membuatkan andakecewa apabila berbual dengan rakan sekerja/pelanggan?			

4.11	Adakah masalah pendengaran menyebabkan andamengalami kesukaran apabila menonton wayang atau teater?			
4.12	Adakah masalah pendengaran menyebabkan andagugup?			
4.13	Adakah masalah pendengaran menyebabkan andakurang berjumpa rakan-rakan, keluarga dan jiran- jiran sekerap yang anda mahukan?			
4.14	Adakah masalah pendengaran menyebabkan andaberbalah dengan ahli keluarga anda?			
4.15	Adakah masalah pendengaran menyebabkan andasukar untuk mendengar siaran TV atau radio?			
4.16	Adakah masalah pendengaran menyebabkan andatidak lagi keluar membeli-belah sekerap yang andamahu?			
4.17	Adakah masalah dan kesukaran berkaitan pendengaran membuatkan anda sangat kecewa?			
4.18	Adakah masalah pendengaran membuatkan andamahu bersendirian?			
4.19	Adakah masalah pendengaran membuatkan andakurang berbual dengan ahli keluarga berbanding dari yang anda inginkan?			
4.20	Adakah anda merasakan bahawa kesukaran yangdisebabkan masalah pendengaran ini membataskan atau menghambarkan kehidupan peribadi dan sosial anda?			
4.21	Adakah masalah pendengaran menyebabkan anda mengalami kesukaran ketika berada di dalam kedaimakan bersama keluarga atau rakan-rakan?			
4.22	Adakah masalah pendengaran ini menyebabkananda mengalami tekanan perasaan?			

4.23	Adakah masalah pendengaran ini membuatkan anda kurang kerap mendengar siaran TV atau radio berbanding daripada yang anda inginkan?			
4.24	Adakah masalah pendengaran menyebabkan anda tidak selesa apabila berbual dengan rakan-rakan?			
4.25	Adakah masalah pendengaran ini menyebabkan anda merasa terpinggir apabila anda berada bersama sekelompok orang ramai?			

TIDAK = 0 **KADANG-KADANG = 2** **YA = 4**

Keseluruhan #skor untuk SOSIAL (S); _____/ 48 =_____

Keseluruhan #skor untuk EMOSIONAL (E);_____/ 52 =_____

Keseluruhan #skor;_____ /100

0 (tiada masalah) ke 100 (keseluruhan bermasalah):

0% hingga 16%	Tidak bermasalah
18% hingga 42%	Bermasalah pada tahap ringan ke sederhana
43% dan ke atas	Menghadapi ketidakupayaan yang ketara

~TAMAT~

TERIMA KASIH ATAS KERJASAMA ANDA

APPENDIX B: Ethical Approval Letter

UNIVERSITI TUNKU ABDUL RAHMAN DU012(A)
Wholly owned by UTAR Education Foundation Co. No. 578227-M

Re: U/SERC/282/2023

3 November 2023

Prof Dr Mohammed J. K. Bashir
Head, Department of Environmental Engineering
Faculty of Engineering and Green Technology
Universiti Tunku Abdul Rahman
Jalan Universiti, Bandar Baru Barat
31900 Kampar, Perak.

Dear Prof Dr Mohammed,

Ethical Approval For Research Project/Protocol

We refer to the application for ethical approval for your students' research projects from Bachelor of Science (Honours) Environmental, Occupational Safety and Health programme enrolled in course UGNB4916. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
1.	The Challenges Towards Complying with the OSH (Amendment) Act 2022 from the Perspective of Safety and Health Officer	Yew Li Bing	Ts Chin Yik Heng	3 November 2023 - 2 November 2024
2.	A Cross Sectional Study of Heat Stress Exposure, Heat-related Symptoms, and Kidney Health Among Kitchen Workers in Kampar	Abigail Koh Shu Hong	Dr Lim Fang Lee Co-supervisor: Dr Nurhanim Binti Abdul Aziz	
3.	Prolonged Standing and Musculoskeletal Discomfort Among UTAR Security Guards	Wong Yi Xun	Dr Putri Anis Syahira Binti Mohamad Jamil	
4.	Level of Traffic Related Air Pollutants (TRAP) and Respiratory Symptoms Among Security Guards	Karthiga Ahnan		
5.	Evaluation of Excessive Noise Exposure Among Construction Workers	Cheong Win Sern	Dr Nurhanim Binti Abdul Aziz	
6.	Fire Emergency Response and Preparedness Among UTAR Kampar Campus	Tan Xin Yee		

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

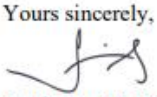
(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

Should the students collect personal data of participants in their studies, please have the participants sign the attached Personal Data Protection Statement for records.

Thank you.

Yours sincerely,



Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, Faculty of Engineering and Green Technology
Director, Institute of Postgraduate Studies and Research

APPENDIX C: Tentative Data Collecting Agenda

SUNWAY® CONSTRUCTION

UTAR UNIVERSITI TUNKU ABDUL RAHMAN

TENTATIVE DATA COLLECTING AGENDA

TUESDAY, 24 OCTOBER, 2023	
8.15am – 10.00am	Briefing regarding 'Excessive Noise Study' among the project team members. • Introduction to my thesis study. • Methodology (Define SEG) • Determining the SEG Group (1,2,3,4) • Expected outcomes • Hearing loss questionnaire review
10.00am – 6.00pm	Conduct data sampling according to Similar Expose Group 1. • Noise data sampling using Sound Level Meter. • Questionnaires among exposed workers (SEG 1).
WEDNESDAY, 25 OCTOBER, 2023	
9.00am – 6.00pm	Conduct data sampling according to Similar Expose Group 2. • Noise data sampling using Sound Level Meter. • Questionnaires among exposed workers (SEG 2).
THURSDAY, 26 OCTOBER, 2023	
9.00am – 6.00pm	Conduct data sampling according to Similar Expose Group 3. • Noise data sampling using Sound Level Meter. • Questionnaires among exposed workers (SEG 3).
FRIDAY, 27 OCTOBER, 2023	
9.00am – 6.00pm	Conduct data sampling according to Similar Expose Group 4. • Noise data sampling using Sound Level Meter. • Questionnaires among exposed workers (SEG 4).

TENTATIVE DATA COLLECTING AGENDA Inbox ×

Winsern <winsern5101@gmail.com>
to Alif, seowjy

Fri, Oct 20, 2023, 8:47 AM

Dear Aliff and Mr Seow,

My name is Cheong Win Sern from University Tunku Abdul Rahman, Kampar Campus. I am a Year 4 student majoring in Environmental, Occupational Safety and Health.

I had mentioned my data collection of excessive noise exposure among construction workers in SQS site from next Tuesday to Friday (24/10-27/10) to Mr Teh Hang Loong and Encik Alif Hamzah. Hence, the tentative of my data collecting agenda is attached below for your reference.

Kindly revert to me if there is any questions from your side and do expect delayed response from me as I am currently away for vacation in Pulau Tioman. Thank you.

Regards,
Cheong Win Sern

One attachment • Scanned by Gmail

Seow Jin Yen <seowjy@sunway.com.my> Fri, Oct 20, 2023, 8:54 AM

to Muhammad, Amirul, Joshua, me, Alif

Hi Win Sern,

Noted on the tentative agenda. My team will assist you on this matter. Please contact Alif when you begin

Thank you.

Best Regards,

Environmental, Safety & Health

Our Passion Our Pride

Seow Jin Yen
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