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Understanding Prevalence and Contributing Factors to Hearing Impairment Among Palm Oil Mill Workers in East Coast Sabah

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ABSTRACT

Background The prevalence of hearing impairment among palm oil mill workers underscores the urgent need for comprehensive investigation and intervention. This cross-sectional study, conducted in the East Coast region of Sabah, Malaysia, delved into the factors contributing to this concerning trend. **Objectives:** This aims to explore the multifaceted aspects of hearing impairment among palm oil mill workers, emphasizing the importance of understanding noise exposure and hearing comprehencive program (HCP). **Methods:** A total of 262 high-noise-level operators from five selected Palm Oil Mills participated voluntarily. The methode of the study included hearing tests, analyzing noise reports, and using surveys. **Result:** 12.97% of participants experienced hearing impairment, with Palm Oil Mill A registering the highest rate at 47.82%, indicating significant variations across mills and job roles. Specifically, Engine Drivers had the highest prevalence of hearing impairment, at 26.67%. Additionally, participants with No Education or UPSR/Primary School education levels exhibited the highest rates of hearing impairment, at 16.98% and 16.95% respectively. The study also found a weak but significant positive correlation (r=0.416) between noise exposure and audiometry frequency. In terms of compliance with the HPC, Palm Oil Mill E (POM E) and Palm Oil Mill A (POM A) received low ratings, indicating poor compliance. These mills also had the highest noise levels, exceeding the permissible exposure limit (PEL). On the other hand, POM C, POM B, and POM D showed good compliance with the program, possibly due to effective hearing protection measures already in place. **Conclusions:** This study underscores the critical need for enhanced regulations, better control measures, and increased awareness to mitigate hearing impairment risks among palm oil mill workers. Future research should delve deeper into factors influencing hearing impairment and evaluate the effectiveness of existing HCPs. Comprehensive studies focusing on HPD practices and awareness programs are essential to inform targeted interventions and enhance workplace safety in the palm oil industry.

Keywords: noise exposure, hearing imparment, induced hearing loss; noise legislation; palm oil; Malaysia; exposure level

1. Introduction

Malaysia, renowned as one of the world's leading palm oil producers, has witnessed an extraordinary expansion of its palm oil industry, particularly in the fertile state of Sabah on the northern part of Borneo (Ghulam et al., 2022; Latifi et al., 2014). The East Coast of Sabah, adorned with sprawling palm oil estates and bustling mills, stands as a vital hub for this thriving sector, contributing significantly to Malaysia's economic prosperity (Latifi et al., 2014).

Palm oil, derived from the oil palm tree's fruit, is a versatile commodity utilized in a myriad of products, ranging from food items to cosmetics and biofuels (Latifi et al., 2014). While this industry bolsters the nation's agricultural output and export earnings, it poses a substantial challenge to the well-being of its workforce, particularly in the context of occupational hazards such as hearing impairment (Daniel et al., 2021). In the manufacturing sector, where approximately 40% of the workforce contends with excessive noise levels, palm oil mills in East Coast Sabah emerge as particularly challenging environments (Ammar et al., 2022; Noraita Tahir, 2014).

Amidst the clatter and hum of palm oil mill complexes, where crushers, extractors, sterilizers, and centrifuges orchestrate the intricate process of palm oil extraction, the risk of hearing impairment has become a growing concern (Ammar et al., 2022; Juwarna et al., 2018). The relentless and heightened noise levels experienced by the diligent workers in these environments have the potential to cause irreversible damage to their hearing health (Juwarna et al., 2018).

The economic significance of the palm oil industry in Sabah cannot be overstated, providing livelihoods and income to countless individuals. However, this prosperity comes at a cost, especially for those laboring on the frontlines of palm oil production (Juwarna et al., 2018). From receiving freshly harvested fruit bunches to the meticulous stages of oil extraction and purification, the labor of palm oil mill workers is synonymous with the constant symphony of machinery, underscoring the occupational hazards they face (Juwarna et al., 2018).

The palm oil sector in Malaysia operates within the framework of stringent regulations, primarily dictated by the Occupational Safety and Health Act 1994 (Act 514) and the Occupational Safety and Health (Noise Exposure) Regulations 2019 (Department of Occupational Safety and Health, 1994; Department of Occupational Safety and Health, 2019). These regulations encompass a spectrum of provisions, including permissible exposure limits, monitoring protocols, compliance procedures, provision of hearing protection equipment, implementation of audiometric testing programs, employee education, and training, alongside other safety measures (Department of Occupational Safety and Health, 1994; Department of Occupational Safety and Health, 2019).

According to the Factories and Machinery Act (FMA), hearing impairment is characterized by the average permanent hearing threshold level (HTL) of an employee at frequencies 0.5 kHz, 1 kHz, 2 kHz, and 3 kHz, with a shift of 25 dB or more from the standard audiometric reference level. In contrast, the orld Health Organization (WHO) definition extends the frequency range to 4 kHz while maintaining the criterion of a 25 dB or greater shift. Furthermore, the WHO introduces a nuanced classification system for the degree of hearing impairment, stratifying it into none, slight, moderate, severe, and profound levels (Ghulam Kadir & Ahmad, 2021).

Adding to the discourse, the Industry Code of Practice (ICOP) for Management of Occupational Noise Exposure and Hearing Conservation 2019 aligns with the Guidelines on Management of Occupational Noise-Related Hearing Disorders , specifying that hearing impairment is determined by the arithmetic average of the permanent hearing threshold level at frequencies 500 Hz, 1000 Hz, 2000 Hz, and 3000 Hz.

Similar to the FMA and WHO standards, a shift of 25 dB or more from the standard audiometric reference level is the critical parameter (DOSH, 2021; Industry Code of Practice, 2019).

The legislation mandates comprehensive noise exposure monitoring to assess and manage risks effectively (Han, 2017). Evaluation methodologies include endorsed questionnaires, on-site observations, and specialized equipment deployment (Han, 2017). The regulations set a daily noise exposure limit of 85 dB(A), a daily personal dose surpassing 50%, a maximum sound pressure level surpassing 115 dBA, or a peak sound pressure level surpassing 140 dBC for 8 hours to mitigate the risk of hearing impairment, with employers obligated to implement noise reduction measures if this limit is exceeded. This involves engaging professionals for thorough noise risk assessments, aligning with the overarching goal of safeguarding workers from excessive noise-induced risks (Department of Occupational Safety and Health, 2019; Han, 2017).

A study conducted by Chen et al. (2007) revealed that the combined effects of high noise exposure and heat stress lead to a notable acceleration in the rate of hearing deterioration. In a previous investigation, Kumar et al. (2008) examined noise exposure in Indian oil mills, conducting thorough analysis and assessment. Kumar et al. (2008) observed that workers consistently face elevated noise levels, predominantly characterized by low-frequency noise. Elevated noise pressure levels stand out as a significant aspect of noise pollution in Palm Oil Mills. Ying's review (2016) emphasized that palm oil mills often present various hazards, including increased noise exposure, slippery surfaces, potential fire or explosion risks, and extreme heat conditions. The presence of extreme temperatures in the workplace can induce heat stress, whether due to excessively high or low temperatures. On the contrary, Naeini & Tamrin (2014) discovered that noise levels significantly contribute to heightened stress levels among employees in palm oil mills. This underscores the crucial role of managing noise levels in maintaining employee well-being.

It is crucial to mitigate this risk, the establishment and strict adherence to a comprehensive Hearing Conservation Program (HCP) is paramount. A robust HCP encompasses a range of interconnected components, each contributing to the reduction of noise exposure and the protection of workers' hearing (Feder et al., 2017). These components include continuous noise monitoring, strategic engineering controls, proper use of personal protective equipment (PPE), educational initiatives, regular audiometric testing, and a perpetual process of program assessment and improvement. Assessing the efficacy of a hearing conservation program within a palm oil mill involves a comprehensive audit, which yields valuable insights into the program's compliance level (Ghulam Kadir & Ahmad, 2021). This audit serves as a pivotal tool for evaluating the extent to which the program is effectively safeguarding the hearing health of employees and adhering to established standards. The audit's findings are then translated into a numerical rating system, whereby a nuanced classification of program performance is derived Weier, 2020.

This article delves into the pressing issue of hearing impairment among palm oil mill workers in East Coast Sabah. By exploring the prevalence and contributing factors to this occupational health concern, this article aims to shed light on the challenges faced by these workers. Recognizing the severity of this occupational hazard, this article aims to explore the multifaceted aspects of hearing impairment among palm oil mill workers, emphasizing the importance of understanding noise exposure and hearing comprehencive program (HCP). Palm oil mill workers, aside from those engaged in unloading tasks, face chronic exposure to alarmingly high noise levels, posing significant risks to their auditory health (Ammar

et al., 2022; Andre Tuo, 2014). The prevalence of hearing impairment among these workers necessitates a detailed examination of the specific factors contributing to this concerning trend.

2. Materials and Methods

This cross-sectional study was conducted in the East Coast region of Sabah, Malaysia, from January 2018 to March 2020. The study focused on high noise level operators working in the operation line of selected Palm Oil Mills. A total of 262 participants from five Palm Oil Mills voluntarily participated in the study. The selected mills were located in Labuk/Sugut, Sandakan, Kinabatangan, and Lahad Datu, covering approximately 20% of the total number of Palm Oil Mills in the region.

The sample size calculation followed the method outlined by Apiradee Sriopas et al. (2017), with an estimated prevalence of 9.4% and a desired precision of 0.05. The calculated sample size was 130 respondents, and after accounting for a 20% dropout rate, a total of 156 participants were targeted for the study. The study included 262 participants from five selected Palm Oil Mills, applying inclusion criteria such as workers aged 18 and above with a minimum of 6 months of experience in the mill and no pre-existing hearing-related medical conditions. Workers underwent screening audiometric tests, and those with existing deafness or chronic middle ear infection were excluded.

This cross-sectional study was conducted by analysing data from noise risk assessment reports of the selected mill, screening audiometric data from workers and adopted questionnaire (Rasasoran et al., 2021), and noise audit to analyses the compliance level. Sampling was conducted using Universal Sampling, where workers with a minimum of 6 months of experience in the Palm Oil Mill with high noise levels (91-140 dBA) were included. Workers with existing deafness or chronic middle ear infection confirmed by a doctor's records were excluded from the study.

Participants were asked directly about their consent and voluntary participation. Participants were explained that they will not lose any benefits if they decided not to participate. Participants were provided with detailed explanation regarding the study protocol. If the participants agreed to join, their consent form were collected. This study was approved by the Medical Research Ethics Committee of Universiti Malaysia Sabah (reference: JKEtika 3/23(11)). All the participants were provided with research information and voluntarily signed the research and publication consent forms before data collection.

The team consists of head of researcher, research assistance and an audiologist. Before entering the oil palm location for data collection, the research team had a meeting and discussion with the oil palm's Safety Health Officer. All participants also were given Noise Exposure training before the data collection.

2.1 Study Tools

2.1.1 Audiometry

Pure Tone Audiometry (PTA) Test was performed using Audiometer GSI 18. This calibrated audiometer met the specifications according to ISO 389-3 1994 / American National Standard Specification for Audiometers (S3.6-1969). Audiometric testing of the participant was conducted in an audiometric booth. The hearing threshold was examined by qualified audiologist. Pure-tone air conduction audiometry was performed to determine the hearing thresholds in the frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz for both ears of all participant using an audiometer with earmuffs. The measurement of hearing thresholds was done in 5 dB increments.

The audiometric reports were assessed for the Similar Exposed Group (SEG) or work units that exceeded the Noise Exposure Limit (NEL) based on the Noise Risk Assessment (NRA) report.

2.1.2 Noise Exposure

As a component of the Occupational Safety and Health (Noise Exposure) Regulations 2019 – specifically Regulation 4 (Noise Risk Assessment) – a comprehensive evaluation of noise risk was conducted for the Palm Oil Mill. This assessment was executed using authorized equipment possessing valid calibration certificates. Guided by the noise risk assessment report, both area and personal noise risk evaluations necessitated prior coordination with the premises' occupant before conducting the assessment. Key aspects such as the operational sequence on the sampling day, employee categorization and grouping, the selection of employees, and other pertinent details within the evaluation were all predetermined in advance of the assessment process (Rasasoran et al., 2021).

2.1.2 Noise Audit/ hearing conservation programs

The compliance level of the Hearing Conservation Program was (HCP) was assessed using a rating scale. The compliance levels were assessed based on a rating scale: a rating of more than 2.5 was considered good, 1.5 to 2.4 points was moderate, and a rating lower than 1.5 was considered poor. The HCP program includes an audit maintaining records of measures taken to safeguard employees from noise hazards. Evaluating the HCP is aim to determine the effectiveness and identify areas for improvement.

2.2 Data Analysis

All data were analysed using Statistical Package for Social Science (SPSS) version 24.0 for statistical analysis and hypothesis testing. All the demographic data were expressed as means and standard deviation (±SD). While all the categorical variables will be expressed as frequencies and percentages. The accepted level of significant was set at $p < 0.05$.

3 Results

3.1 Prevalence of hearing impairment

A. Overall prevalence of Hearing impairment: 34 / 262 = 12.97%

B. Prevalence of HI by palm oil mill

Table 1: Data prevalence of HI by palm oil mill

Mill Location	No. HI	No. respondent	Prevalence of HI by Palm Oil Mill (%)
Palm Oil Mill A	11	23	47.82
Palm Oil Mill B	4	62	6.45
Palm Oil Mill C	7	91	7.69
Palm Oil Mill D	3	34	8.82
Palm Oil Mill E	9	52	17.30

Table 1 shows that Palm Oil Mill A (47.82%) have the highest prevalence of hearing impairment

Table 2: Data of prevalence of HI by job position

Job Position	No. HI	No. respondent	Prevalence of HI by job position (%)
Process Operator	11	98	11.22
Boiler	1	25	4

Engine Driver	4	15	26.67
Fruit Grader	3	19	15.79
Storekeeper	1	6	16.67
Weighbridge Operator	0	8	0
Foreman/ Fitter/ Chargeman/ Apprentice/ Lab Attendant	14	59	23.73

D. Prevalence of HI by level of education

Table 3: Data of Prevalence of HI by level of education

Level of education	No. HI	No. respondent	Prevalence of HI by level of education (%)
No Education	9	53	16.98
UPSR/Primary School	10	59	16.95
SPM/Secondary School	14	131	10.69
Diploma	1	16	6.25
Degree	0	3	0

Table 1,2 and 3 show the characteristics of the study subjects according to the exposure levels. Number of HI was determined on palm oil mill, job description and level of education.

3.2 Noise Exposure Assessment

Noise Assessment Report (NRA report) was referred to determine the noise exposure of all the Palm Oil Mill. As in Noise Regulation 2019, excessive noise is described as "daily noise exposure level exceeding 82 dBA or daily personal noise dose exceeding fifty percent, or maximum sound pressure level exceeding 115 dBA at any time, or peak sound pressure level exceeding 140 dBC. While Noise Exposure Limit (NEL) was described as "daily noise exposure level exceeding 85 dBA (Lex 8hr) or daily personal noise dose exceeding 100 percent, or maximum sound pressure level exceeding 115 dBA at any time (Max), or peak sound pressure level exceeding 140 dBC (Peak) (Noise Exposure Regulation, 2019). As objective one of this study is to determine the noise exposure levels in Palm Oil Mill mills at East Coast of Sabah, the Lex 8hr, Max and Peak noise level were present in the data below.

Table 4: ANOVA of Lex 8hr (db) for five Palm Oil Mill

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	326.916	4	81.729	3.658	0.011
Within Groups	1072.427	48	22.342		
Total	1399.343	52			

Table 4 shows the ANOVA of Lex 8hr for five Palm Oil Mill. The data shows there a significant different (p=0.11) between the Palm Oil Mil.

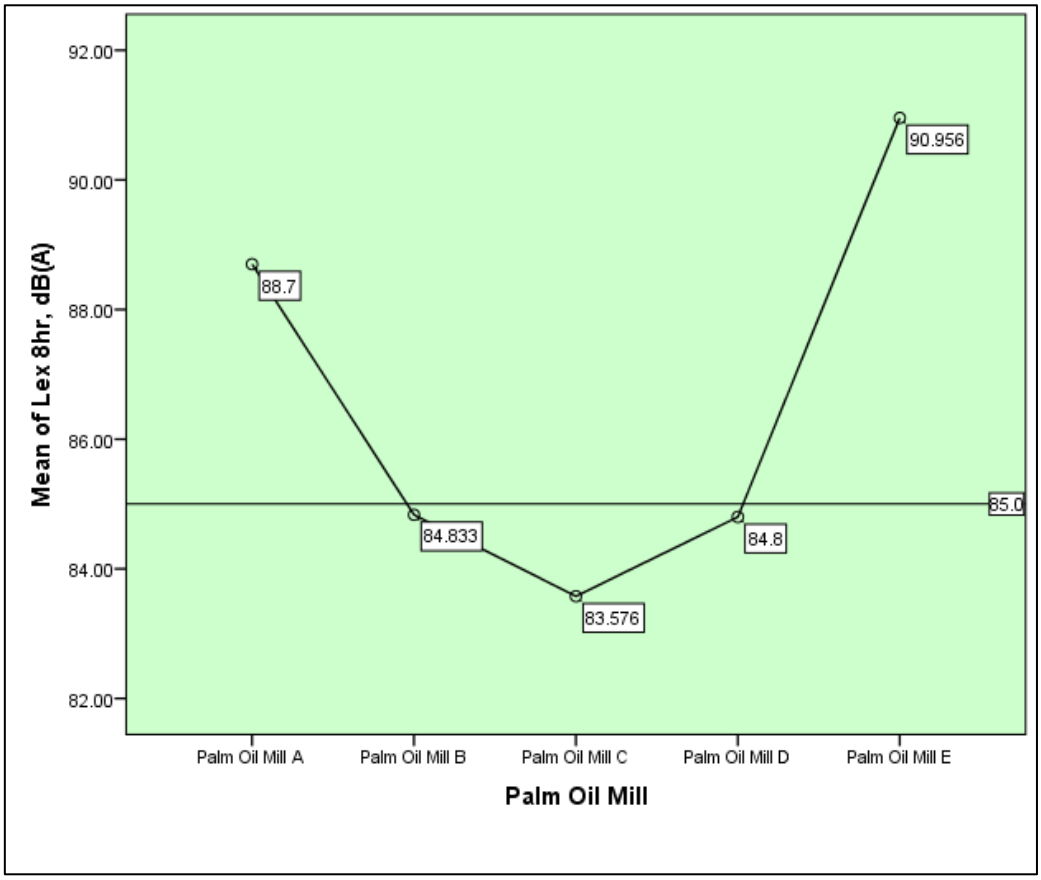

Figure 1: Lex 8r noise level of the five palm oil

Figure 1 above shows that Palm Oil Mill E (90.96 dB (A)) and A (88.70 dB (A)) have high noise level (85 dB A)) compare to Permissible Exposure Limit (PEL) (< 85 dB (A)).

Table 5: ANOVA of Maximum Noise Level (dB(A)) for five Palm Oil Mill

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2332.153	4	583.038	15.447	0.000
Within Groups	1811.692	48	37.744		
Total	4143.845	52			

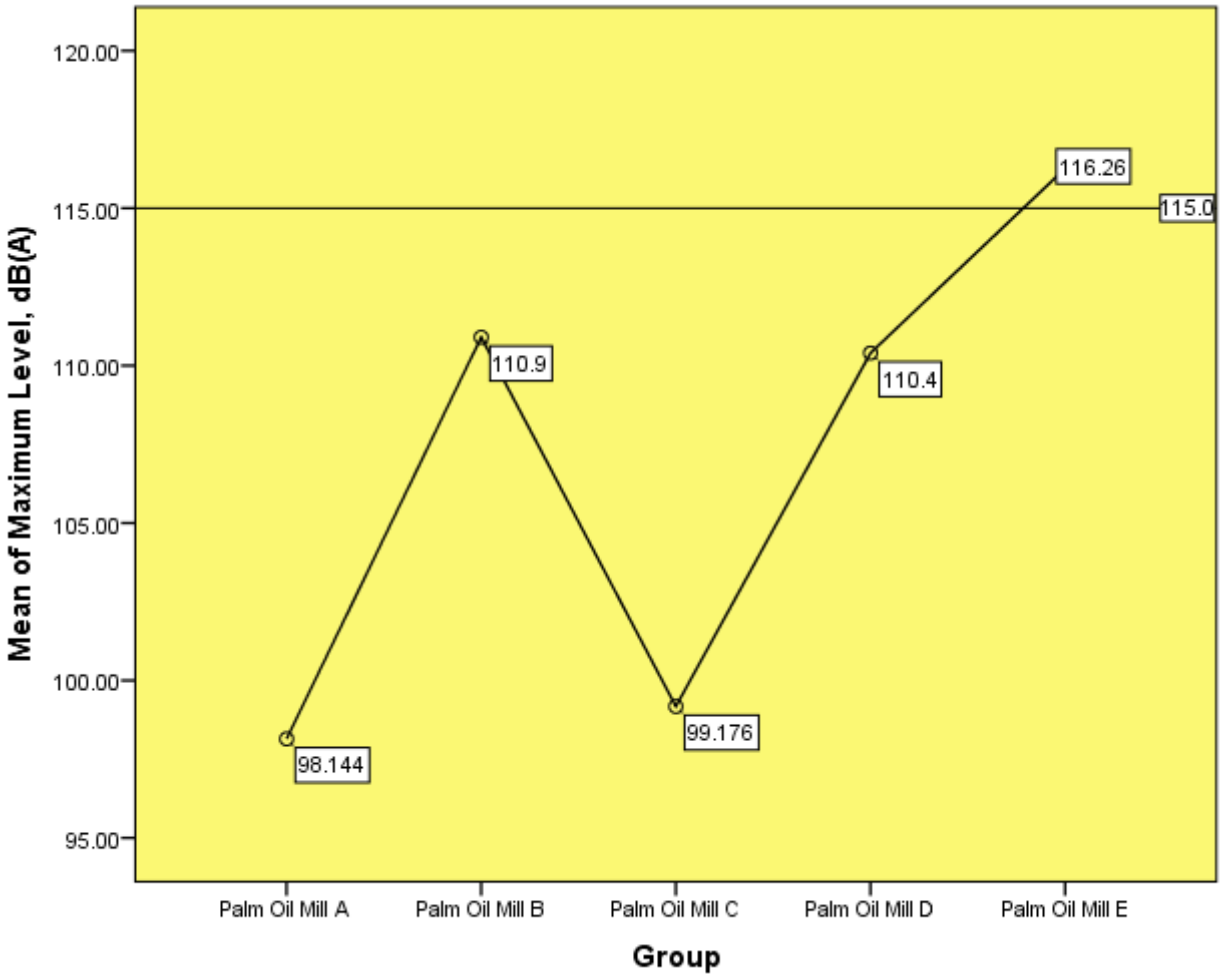

Figure 2: Maximum noise level of the five palm oil

Figure 2 above shows that Palm Oil Mill E (116.26 dB (A)) have high noise level (85 dB A)) compare to Permissible Exposure Limit (PEL) (< 115 dB (A)).

Table 6: ANOVA of Peak Noise Level (dB(A)) for five Palm Oil Mill

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	608.135	4	152.034	3.395	0.016
Within Groups	2149.815	48	44.788		
Total	2757.950	52			

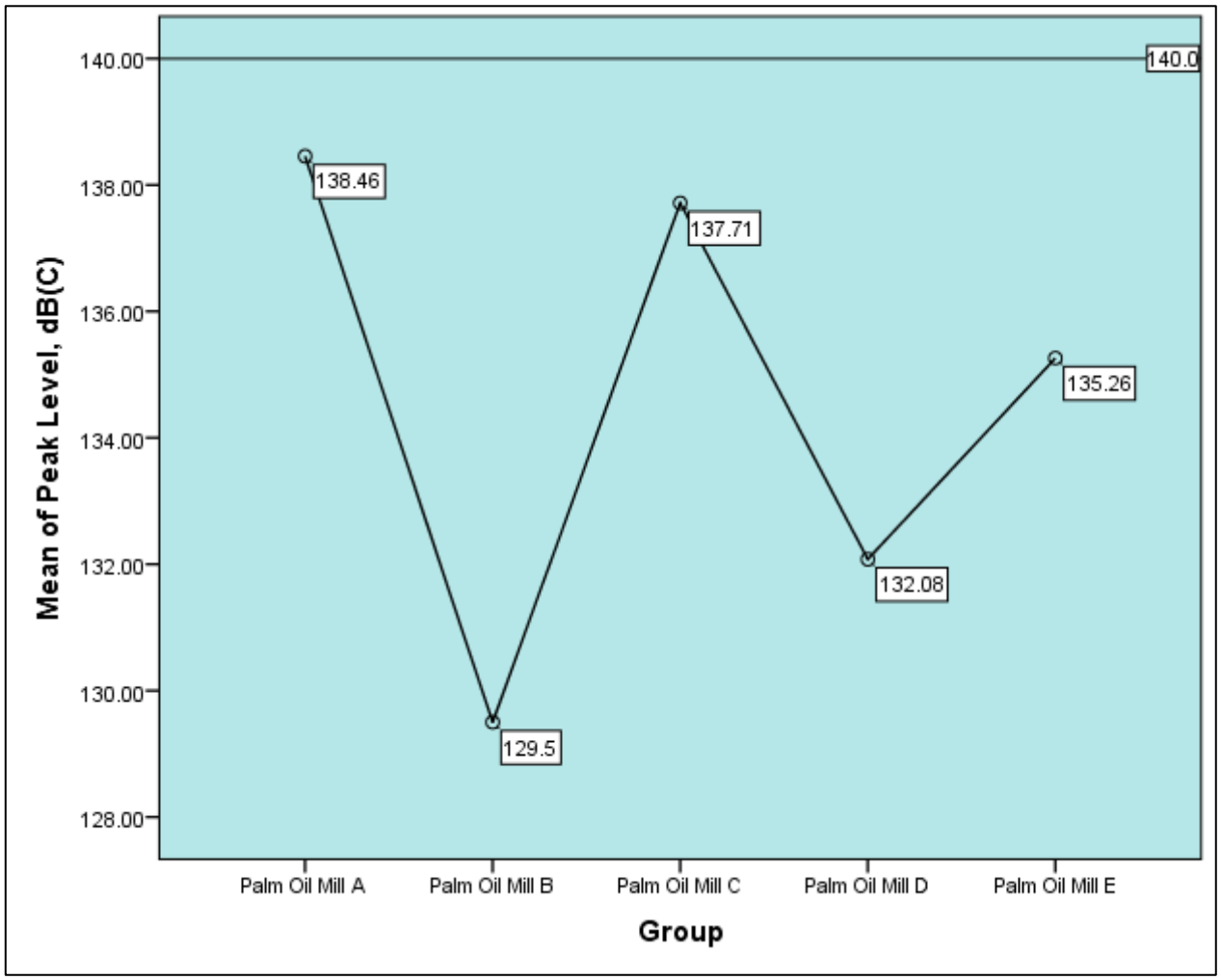

Figure 3: Peak noise level of the five Palm Oil Mil

Figure 3 above shows all the palm oil mill have peak noise level under control, which is under the Permissible Exposure Limit (PEL) (< 115 dB (A)).

3.2 Noise Exposure and Hearing Impairment

The association between noise exposure and hearing impairment among high noise level operators in Palm Oil Mill at East Coast of Sabah.

Table 7: Descriptive Statistics for noise and audiometry			
	Mean	**Std. Deviation**	**N**
Noise Exposure Level	107.0823	9.49268	262
Audiometry Frequency	22.2581	9.38378	262

Table 8: Correlations between maximum noise and audiometry frequency			
		Maximum Noise	Audiometry Frequency
Maximum Noise	Pearson Correlation	1	.416**
	Sig. (2-tailed)		.001*

	N	262	262
Audiometry Frequency	Pearson Correlation	.416**	1
	Sig. (2-tailed)	.001*	
	N	262	262
**. Correlation is significant at the 0.01 level (2-tailed).			

A Pearson product-moment correlation was run to determine the relationship between noise exposure and audiometry frequency. Table 8 shows there are positive significant correlation between noise exposure and audiometry frequency (r=0.416, n=62, p=0.001). However, the, correlations are very week.

3.3 The compliance level of hearing conservation program in Palm Oil Mill mills at East Coast of Sabah.

The following report presents an analysis of the compliance level of the Hearing Conservation Program (HCP) from each palm oil mills (POMs) and noise exposure in five different POMs. The compliance levels were assessed based on a rating scale: a rating of more than 2.5 is considered good, 1.5 to 2.4 points is moderate, and a rating lower than 1.5 is considered poor. Noise exposure levels were measured in decibels (dB) and compared to the permissible exposure limit (PEL) of 85 dB.

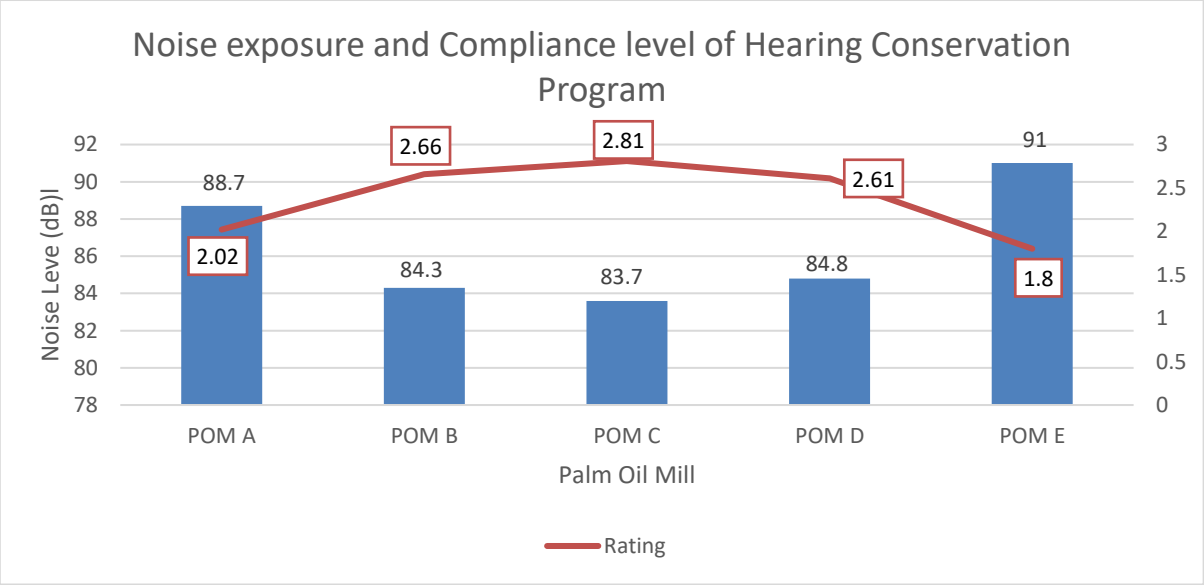

Figure 4: Graph of noise exposure and compliance level of hearing conservation program.

The compliance level of the Hearing Conservation Program was assessed using a rating scale. POM E received the lowest rating, with a score of 1.8, signifying a poor compliance level. POM A also had a relatively low rating of 2.02, which falls in the moderate category. Among the five palm oil mills, POM E exhibited the highest noise level, measuring 91 dB, which exceeded the PEL of 85 dB. POM A followed closely with a noise level of 88.7 dB, also surpassing the PEL. conversely, POM C had the lowest noise level at 83.7 dB, followed by POM B at 84.3 dB and POM D at 84.8 dB.

All three of these mills remained below the PEL. POM E received the lowest rating, with a score of 1.8, signifying a poor compliance level. POM A also had a relatively low rating of 2.02, which falls in the moderate category. In contrast, POM C achieved the highest rating of compliance, with a score lower than

2.5, indicating a good level of compliance. POM B scored 2.66, also reflecting a good rating, and POM D scored 2.61, which falls into the same category.

The results indicate that POM E and POM A, with the highest noise exposure levels, have relatively poor compliance with the Hearing Conservation Program. This suggests a need for stronger measures and interventions to improve hearing protection practices in these mills. POM C, POM B, and POM D, with lower noise exposure levels, demonstrated good compliance with the program. This may be attributed to effective hearing conservation practices and measures in place. It is crucial for POM E and POM A to implement more robust hearing protection programs, given the high noise levels and the associated risks to the workers' hearing health. In summary, the compliance level of the Hearing Conservation Program varies among the five palm oil mills, with POM C, POM B, and POM D exhibiting good compliance. POM E and POM A, which also have the highest noise exposure levels, need to prioritize and enhance their hearing conservation efforts to ensure the safety and well-being of their workers.

4 Discussion

4.1 Prevalence of hearing impairment

Present study show an overall workers exposed to daily noise level exceeding the hearing impairment from the five palm oil mill is only 12.97%, which male participants is 13.87% and female participants is 4.17%. Palm Oil A (47.82) have the highest percentage of hearing impairment, followed by Palm Oil E (17.30), Palm oil D (8.82%), Palm oil C (8.82) and the lowest is palm oil B (6,45%). Comparing by job position, engine driver (26.67 %) have the highest prevalence of hearing impairment, followed by Foreman/ Fitter/ Chargeman/ Apprentice/ Lab Attendant (23.73%), storekeeper (16.67%), fruit grader (15.79%), proses operator (11.22%) and boiler (4%). Weighbridge Operator shows zero prevalence of hearing impairment for the job position.

Prevalence of hearing impairment can be lower by strengthened regulations, better control measures and increased awareness or knowledge and perception of the workers (Sirri et al., 2022). According to the International Labour Organisation (2014), hearing impairment can affect the workers exposed to loud noise. There are numerous factors, such as loud noise, high frequency, working hours, years of service, and others, that can simply cause someone to develop hearing impairment (Sirri et al., 2022; Ananda and David, 2021; Amar et al., 2019; Permenaker, 2018; WHO, 2015). The degree of the effect also can be vary due to the cause. It depends on a number of personal characteristics, including gender, age, race or ethnicity, heredity, and general health issues (Ananda and David, 2021; Permenaker, 2018).

Juwarna et al in 2018 conduct a cross sectional study at palm oil mill in Indonesia. In their study, is shows that although 75% of the workers expose to daily noise level above the PEL, however, the hearing impairment prevalence is low (35%). While cross sectional study by Sirri et al (2022) at palm oil mill in Malaysia reported that, there are much higher prevalence hearing impairment with 50.8%. Similar to the present study Both Juwan et al.,(2018) and Sirri et al., (2022) study studies defined hearing impairment using the average hearing threshold at frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz.

4.2 Noise Exposure Assessment

In this present study noise exposure level was record using personal exposure monitoring. Variations in the degree of noise exposure for people with comparable job descriptions were summarises in their range of noise level as tabulate in Chapter 4 (Sirri et al., 2022). As stated in Noise Regulation 2019, excessive noise is described as "daily noise exposure level exceeding 82 dBA or daily personal noise dose exceeding fifty percent, or maximum sound pressure level exceeding 115 dBA at any time, or peak sound pressure

level exceeding 140 dBC. Therefore, in this present study these three ranges of noise level were record and the data were analyse using ANOVA to report the relationship between palm oil mills. All noise level range, Lex 8 hrs ($p=0.11$), maximum noise level ($p<0.05$) and peak noise level ($p=0016$) show that, there are significantly different of noise level between each palm oil mill.

Comparing between the 5 palm oil mill, palm oil mill E has highest number of noise level for Lex 8 hr (90.956 dBA) and maximum noise level (116.26 dBA). Both are above the PEL. Palm oil mill A also shows the noise level for Lex 8hr (88.7 dBA) is high compare to others palm oil mill and above the PEL. Noise exposure is one of the indicators that contribute to NIHL with can lead to HI (Sirri et al., 2022; Pelegrin et al., 2015; Tahir et al., 2014)

A cross-sectional study conducted by Sirri et al in 2022, used noise risk assessment reports and audiometric data of the workers. The three noise range level (Lex 8 hrs, Maximum noise level, Peak Noise Level) were diagnose for three different noise exposure level. They found that, noise exposure level are predictors to Noise Induced hearing impairment among workers and the risk of developing hearing impairment was high even for workers who work on high noise exposure level.

4.3 Noise Exposure and Hearing Impairment

The results show that there are positive significant correlation between noise exposure and audiometry frequency ($r=0.416$, $n=62$, $p=0.001$). However the, correlations are week (0.4216). Expose to the high noise level daily can be a strong factor that contribute to hearing impairment (Ananda and David, 2021). Noise if one most common hazard in palm oil mill industry. In mill, workers deal with machine, compressors and other noise-producing equipment and instrument (WHO, 2017a). As workers exposed to the noise more than 85 dB daily, can contributed to hearing impairment (Hidayat et al., 2019). Thus we can see the correlation of workers exposing to the high noise level have high tendency to hearing impairment.

In 2018, Asaritaminaziah and Siti Marwani conduct a study on workers who are exposed to high noise level were at risk of hearing impairment. Their cross-sectional study was conducted to investigate the noise exposure level and hearing symptoms among workers exposed to noise in a teaching hospital. Total 20 laundry workers and 17 mechanical cutters were recruited into this study. Noise exposure levels were measured using noise dosimeter for 8 hours and information on hearing symptoms were gathered using a modified questionnaire adopted from the American Speech Language Hearing Association (ASHA). Their results show a significantly higher mean noise level (85±2 dB(A)) among mechanical cutters as compared to laundry workers (80±3 dB(A)), $p=0.001$ although the former had shorter duration of noise exposure (20±3 hours per week vs. 28±12 hours per week). Their study also reported that, fourteen (70%) laundry workers and six (35%) mechanical cutters having hearing problem in noisy background. Higher proportion of laundry workers ($n=8$, 57%) had reported hearing symptoms compared to mechanical cutters ($n=6$, 43%) and longer work years was found to be significantly associated with hearing symptoms ($p=0.049$). The researchers conclude that, there is a need of appropriate education and training on noise exposure, hearing impairment and hearing protection devices usage in the workplaces.

Danial et al in 2021 conduct a cross-sectional study on 312 participants from five Palm Oil Mill mills in Sabah. They used Audiometric tests, validated questionnaires and sound level meters. They found that 75% ($n = 234$) of the participants were diagnosed with hearing impairment. Most of them were mean duration of employment of 16.2 years and mean noise exposure of 96.1 dB(A). The significant factors associated with hearing impairment were smoking ($p = 0.001$), works with noisy machinery ($p = 0.005$), lower level of noise exposed ($p = 0.015$), longer duration of employment ($p = 0.001$), and longer overtime

hours per week (p = 0.001). They conclude that the prevalence of hearing impairment among workers in the noise-exposed Palm Oil Mill industries was high. They also remind to do annual audiometry testing and job rotation from noise-exposed workstations. They also suggest for a smoking cessation program which they believe can help but reduction of noise from the source by engineering control is still the best method.

4.4 The compliance level of hearing conservation program in Palm Oil Mill mills at East Coast of Sabah.

The data presented in this study underscores the significance of the compliance level of hearing conservation programs within the palm oil mills (POMs) of the East Coast of Sabah. These programs are a crucial component of occupational health and safety, designed to protect the hearing health of workers who works in environments characterized by high noise levels.

The data shows that POM with high compliance rating, have the lowest noise level, while POM with poorest rating expose to the high nose level and above PEL. The data reveals a notable correlation between the Palm Oil Mill with elevated noise levels and a diminished level of compliance with the hearing conservation program. This connection suggests that the higher noise levels can be attributed, at least in part, to subpar compliance. Insufficient oversight and supervision further contribute to this situation, ultimately compromising the safety of the workers.

The correlation observed between compliance and noise exposure levels is a sobering revelation. It suggests that inadequate commitment to hearing conservation measures within certain POMs directly contributes to elevated noise levels. Such high noise levels not only jeopardize the well-being of the workforce but also contravene regulatory limits, ultimately compromising workplace safety. The essence of hearing conservation programs lies in their ability to provide a structured approach to noise management. They encompass a range of preventive and protective measures, including regular noise exposure assessments, the use of personal protective equipment (PPE) like hearing protection devices (HPDs), education and training initiatives, and comprehensive audiometric testing. However, the efficacy of these programs hinges on both their implementation and adherence.

The data further illuminates that POMs with lower compliance ratings expose their workers to noise levels that surpass permissible exposure limits (PELs). This failure to adhere to PELs not only raises concerns about worker safety but also poses significant legal and regulatory challenges. In essence, it creates an environment where the risk of hearing impairment is unacceptably high.

Furthermore, inadequate compliance is indicative of a broader issue – the insufficient education and awareness among workers regarding the consequences of hearing impairment and the protective measures available. This knowledge gap represents a substantial barrier to effective hearing conservation. Workers who lack awareness are less likely to take necessary precautions, such as wearing HPDs consistently.

Therefore, addressing these compliance issues is not solely about meeting regulatory requirements; it's about safeguarding the health and well-being of the workforce. The data suggests that there is a pressing need for comprehensive compliance strategies that encompass not only POM management but also worker education and awareness programs.

Similarly, to study in 2017 by Tantranont and Codchanak. They conducted a study focusing on the use of hearing protection devices (HPDs) among industrial workers in Thailand. The study identified perceived hearing status and interpersonal factors as key indicators influencing HPD usage. These findings offer valuable insights for interventions aimed at promoting consistent HPD usage and preventing noise-

induced hearing loss in work settings. The research was carried out across 15 manufacturing plants in Thailand, with a randomly selected sample of 268 workers exposed to harmful noise levels requiring regular HPD usage. Through logistic regression analysis, the study pinpointed two main predictors: perceived hearing status and interpersonal dynamics (specifically, role modeling and interpersonal support). These predictors accurately classified 63.4% of cases, underscoring the importance of addressing workers' perceived hearing status and interpersonal influences in designing effective interventions for encouraging regular HPD usage. The study highlights the significant role of role modeling and interpersonal support in fostering compliance with HPD use.

5 Conclusion

Palm oil mill workers face the risk of hearing impairment due to prolonged exposure to high noise levels in their work environment, stemming from machinery and equipment. This study aims to explore the prevalence of of hearing impairment among palm oil mill workers in the East Coast of Sabah, focusing on five specific mills. It also investigates contributing factors, including noise exposure and the effectiveness of hearing conservation programs.

Recommendations for future research include a deeper exploration of factors associated with hearing impairment, specifically examining the relationship between hearing impairment and HPD practices. Assessing the effectiveness and adherence to HPD usage among palm oil mill workers could offer valuable insights for enhancing hearing protection measures.

Additionally, future research should evaluate the presence and impact of existing hearing conservation programs within palm oil mills. This involves assessing awareness, implementation, and potential gaps or areas for improvement in hearing conservation measures. To contribute to a better understanding of hearing impairment among palm oil mill workers, detailed and comprehensive studies on factors related to HPD practices and existing hearing conservation programs are essential. Insights gained can inform targeted interventions and strategies to reduce the prevalence and impact of hearing impairment in this industry.

Examining the effectiveness of hearing conservation programs is crucial, involving education, training, and regular screenings. Assessing their presence and impact in palm oil mills can identify potential areas for improvement. Given the lack of reliable noise exposure data from official sources in Malaysia, adopting exploratory techniques in future research can deepen understanding of employee experiences in high-noise work environments. Further research could delve into audiometric test results to uncover the underlying causes of workplace-related hearing impairments, contributing to preventing similar issues in the future. In conclusion, this study successfully achieved its primary objectives, shedding light on critical aspects of workplace safety related to noise exposure in Sabah's palm oil mills.

For future studies, a comprehensive exploration of the prevalence and contributing factors to hearing impairment among palm oil mill workers in East Coast Sabah, with a specific focus on noise exposure, HPD practices, and hearing conservation programs, would enhance occupational health and safety measures in the palm oil industry. Addressing limitations by conducting interviews and broadening the sample size to include mills from other states can provide diverse perspectives and contribute to a more comprehensive understanding of this national concern.

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