



Comparison of Noise Intensity and Smoking Habits on the Incidence of NIHL (Noised Induced Hearing Loss) in Workers in the Production and Non-Production Sections of PT Kayu Perkasa Raya Juwana Pati

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Abstract. Noise-induced hearing loss (NIHL) is hearing loss resulting from exposure to noise with a fairly loud intensity over a long period of time, usually due to noise from the work environment. Currently, NIHL is still a major problem in developed countries. Based on the National Committee for the Management of Hearing Loss and Deafness, Indonesia has the highest ranking of NIHL incidence in Southeast Asia. Risk factors for NIHL include high noise intensity (>85dB), long exposure to noise (>8 hours/day), smoking habits, not using ear protection when in noisy places, and comorbid factors such as hypertension and Diabetes Mellitus. The production room at PT Kayu Perkasa Raya has a noise intensity of >85 dB, which has the potential to cause NIHL incidents for workers. The purpose of this research is to determine the comparison of noise intensity and Smoking Habits on the Occurrence of NIHL in workers in the production and non-production sections of PT. Kayu Perkasa Raya Juwana Pati. This research method is quantitative research with an analytical observational design, with a cross sectional approach. Primary data was obtained from filling out the respondent's form, measuring environmental noise intensity using a sound level meter, and data on the respondent's hearing threshold using an audiometer. This research showed that there was no significant relationship between noise intensity and smoking habits on the incidence of NIHL in PT. Kayu Perkasa Raya Juwana Pati workers.

Keywords: NIHL, Noise, Smoking Habit, Hearing Loss.

1. Introduction

In general, noise is unwanted sound [1][2]. Noise can arise from the use of household electronic devices, the use of motorbikes, or noise in living environments, for example in areas close to train stations. Apart from that, noise can also be found in workplaces such as factories or industries [3]. Exposure to noise with an intensity that exceeds the threshold

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G. Setya Ayu Putri et al. (eds.), *Proceedings of the 2nd Lawang Sewu International Symposium on Health Sciences: Medical Laboratory Technology (LSISHS-MLT 2023)*, Advances in Biological Sciences Research 40, https://doi.org/10.2991/978-94-6463-457-0_15

value (NAB), namely ≥ 85 dB, can damage the cochlea, causing neural deafness, known as Noise-induced hearing loss (NIHL) [1][4].

NIHL is hearing loss resulting from exposure to noise with a fairly loud intensity over a long period of time. NIHL is usually caused by noisy work environments [5]. Hearing impairment in NIHL is nervous deafness or also called sensorineural hearing loss (SNHL) and bilateral (Both sides of the ear) [1].

Noise-related hearing impairment is still a major problem in developed countries, such as the United States [6]. In 2014, there were about 18,000 people in the UK to have NIHL [7]. According to WHO data, in 2018, there were 466 million people suffering from hearing impaired. The WHO estimates that the prevalence of people in Asia-Pacific, South Asia, and Africa is four times greater than in other parts of Asia [6]. According to the National Committee on Hearing and Deafness Management, Indonesia is ranked highest in Southeast Asia, with approximately 36 million people suffering from noise-related hearing impairment [7].

Diagnosis of NIHL is obtained from anamnesis history of hearing loss, communication disorders, tinnitus, as well as exposure to noise in the work or living environment for >5 years. Otoscopy showed no abnormalities. Pure tone audiometry in early phase NIHL shows the presence of a notch at 4000Hz. Advanced phase NIHL shows a decrease in hearing threshold at high frequencies of more than 3000Hz [1].

PT. Kayu Perkasa Raya is a company in the wooden furniture industry which has around 100 employees. There are 50 workers in the production section, and 40 non-production workers, the rest work in the company management section. Production workers work using machines with a noise intensity of ≥ 85 dB, so they are at risk of suffering from NIHL. Until now, this worker has never had a hearing screening. This study aims to determine the comparison of noise intensity and smoking habits with the incidence of NIHL (noised induced hearing loss) in workers in the production and non-production sections of PT Kayu Perkasa Raya Juwana Pati.

2. Methods

This research is a quantitative research with analytical observational methods, with a cross sectional approach. It was conducted at PT. Kayu Perkasa Raya Juwana Pati, in December 2022. Primary data was obtained from filling out the respondent's form, measuring environmental noise intensity using a sound level meter, and data on the respondent's hearing threshold using an audiometer. The tool used is a calibrated LK-225 LCD Digital Audiometer. The data analysis used was univariate analysis and bivariate analysis using the Chi Square test. This research was conducted after the issuance of a letter from the Ethics Commission of the Faculty of Medicine, Muhammadiyah University of Semarang No. 105/EC/KEPK-FK/UNIMUS/2022.

Sampling was carried out using a total sampling technique from production and non-production workers. Inclusion criteria: Age 17-65 years, willing to be a respondent, not using ear protection when working. Exclusion Criteria: Exposure to noise outside the work environment, suffering from congenital abnormalities, currently suffering from ear inflammation, uncooperative respondents. 82 samples were obtained consisting of 48 samples in the production section, and 34 samples in the non-production section.

3. Result

Table 1 shows that based on age characteristics, the largest number of production groups was the 41-50 year age group, amounting to 14 samples (29.1%). Based on the age characteristics of the non-production group, it was found that the majority were in the 31-40 year age group, amounting to 13 samples (38.5%). Based on gender characteristics in the production group, it was found that the majority were men, amounting to 28 samples (58.3%). Based on gender characteristics in the non-production group, it was found that the majority were men, amounting to 18 samples (52.9%).

Based on noise exposure in the production group, it was found that 48 samples (100%) were exposed to noise ≥ 85 dB, and no samples were exposed to noise < 85 dB. In the non-production group, 34 samples (100%) were exposed to noise < 85 dB, and no samples were exposed to noise ≥ 85 dB (0%). Based on the smoking habit factor in the production group, it was found that 20 samples (41.7%) had a smoking habit, while 28 samples (58.5%) did not have a smoking habit. Based on the smoking habit factor in the non-production group, it was found that 13 samples (38.2%) had a smoking habit, while 21 samples (61.8%) did not have a smoking habit.

Table 1. Sample characteristics and frequency based on age, gender, noise exposure and smoking habit

Characteristics and Frequency	Production		Non Production		Total	
	n	%	n	%	n	%
Age (years old)						
17-30	11	22.9	5	14.7	16	19.5
31-40	12	25	13	38.4	25	30.4
41-50	14	29.1	7	20.5	21	25.6
51-65	11	23	9	26.4	20	24.5
Gender						
Man	28	58.3	18	52.9	46	56.1
Woman	20	41.7	16	47.1	36	43.9

Intensity of noise exposure						
≥ 85 dB	48	100	0	0	48	58.5
< 85 dB	0	0	34	100	34	41.5
Smoking habit						
Yes	20	41.7	13	38.2	33	40.2
No	28	58.3	21	61.8	49	59.8
NIHL Incidence						
Yes	12	25	4	11.8	16	19.5
No	36	75	30	88.2	66	80.5

Based on the incidence of NIHL, in the production group there were 12 samples (25%) suffering from NIHL, while 36 samples (75%) did not suffer from NIHL. There were 4 samples (11.8%) of non-production workers suffering from NIHL, while 30 samples (88.2%) did not suffer from NIHL

Table 2 shows that of the 16 samples suffering from NIHL, 12 samples (75%) were exposed to noise intensity >85dB, while 4 samples (25%) were not exposed to noise. A total of 66 samples did not suffer from NIHL, 36 samples (54.5%) of them were exposed to noise. Testing the relationship between the intensity of noise exposure and NIHL using the chi square test obtained a value of $p = 0.227$ which can be concluded that there is no significant relationship between exposure to noise intensity and the incidence of NIHL (because $p > 0.05$). An odds ratio of 2.50 means that workers exposed to noise ≥85 dB have a risk of suffering from NIHL of 2.5 times compared to those exposed to <85 dB.

Table 2. Relationship between noise intensity and NIHL.

Noise Intensity ≥ 85 dB	NIHL				p	OR (95% CI)
	Yes		No			
	n	%	n	%		
Yes	12	75.0	36	54.5	0.227 [‡]	2.50 (0.73-8.56)
No	4	25.0	30	45.5		

Table 3 shows that in the production group, there were 12 samples suffering from NIHL. A total of 4 samples (33.3%) had a smoking habit and 8 samples (66.7%) did not have a smoking habit. A total of 36 samples did not suffer from NIHL, 16 samples (44.4%) of them had a smoking habit and the remaining 20 samples (55.6%) did not have a smoking habit. A chi square test was carried out and the value of $p = 0.735$ was carried out, which means that there was no significant relationship between smoking habits and the incidence of NIHL in production group workers.

Table 3. Relationship between smoking habit with NIHL in the production workers

Smoking Habit	NIHL				p	OR (95% CI)
	Yes		No			
	n	%	n	%		
Yes	4	33.3	16	44.4	0.735¥	0.63 (0.16-2.46)
No	8	66.7	20	55.6		

Table 4 shows that in the non-production group there were 4 samples who suffered from NIHL, 3 samples (75.0%) of whom had a smoking habit and 1 sample (25%) did not have a smoking habit. A total of 30 samples did not suffer from NIHL, 10 samples (33.3%) of them had a smoking habit while 20 samples (66.7%) did not have a smoking habit. Carrying out a chi square test, the value of $p = 0.145$ was carried out, it can be concluded that there was no significant relationship between smoking habits and the incidence of NIHL in the non-production group.

Table 4. Relationship between smoking habit with NIHL in the non production workers

Smoking Habit	NIHL				p	OR (95% CI)
	Yes		No			
	n	%	n	%		
Yes	3	75,0	10	33,3	0,145¥	6,00 (0,55 –65,29)
No	1	25,0	20	66,7		

4. Discussion

Based on research conducted at PT. Kayu Perkasa Raya Juwana, the characteristics of workers based on the age group in the production section were found to be mostly in the 41-50 year age group. This is because young workers in the production section are prioritized due to the workload is heavier compared to non-production section.

The division of age groups in this study is different from research by Septiana et al, where this study determined the age inclusion criteria to be 17-65 years [8]. This is due to considering validity, where a person has legally signed an informed consent if they are ≥ 18 years old or married [9]. This study did not include samples aged ≥ 65 years to exclude the possibility of presbycusis which could be a confounding factor in the study. Presbycusis is nerve deafness due to the process of cochlear degeneration, which occurs in the age group >65 years [10].

Based on gender characteristics, this research obtained data that in the production and non-production groups there were more male workers. This is in accordance with Kozova et al's

research which states that male workers are more productive in rough and heavy work [11]. This is also in accordance with the PT. Kayu Perkasa Raya Juwana Pati program that male workers are given priority, considering the wood business sector. and this furniture requires quite heavy physical work, especially in the production part.

This study found that there was no significant relationship between exposure to noise intensity and the incidence of NIHL. The results of this study are different from research conducted by Marisdayana et al which examined 61 workers, and found a significant relationship between exposure to noise intensity and the incidence of hearing loss in PT. X employees [12]. This difference occurred due to differences in location and research sample. PT Kayu Perkasa Raya Juwana workers are in districts with poorly adhered to office hours, resulting in noise exposure <8 hours per day. The work environment in the production group at PT. Kayu Perkasa Raya Juwana Pati has a noise intensity of 85-87 dB. Workers work an average of 6-7 hours per day with flexible rest periods of around 1 hour.

The permissible noise intensity exposure according to WHO regulations is a maximum of 85 dB with a maximum exposure time of 8 hours per day [6]. The intensity of noise exposure exceeding this limit can cause damage to the organ of Corti which will result in sensorineural deafness. NIHL in workers can be prevented by wearing ear protection while working.(1) Unfortunately, currently none of the production workers use ear protection. This is because there is no awareness about the dangers of exposure to noise for the ears, and there are no regulations on using ear protection from companies [13].

Research by Anggrini (2022) states that there is a significant relationship between the use of ear protection equipment and the incidence of hearing loss in textile factory workers [13]. The use of appropriate ear protection equipment can reduce noise by preventing sound from reaching the tympanic membrane, so that the sound intensity received by the cochlea is reduced by 30 dB [1].

Smoking habits risk hearing loss. Nicotine and carbon monoxide on Cigarettes can reduce oxygen perfusion into the middle ear so that occurs damage to hair cells and cochlea, Apart from that, free radicals are produced Cigarettes can also damage hair cells [14]. This is influenced by daily smoking frequency, type of cigarette, and number of daily cigarettes.

This study found that there was no significant relationship between smoking habits and the incidence of NIHL in both the production and non-production groups. The results of this study are not in accordance with research conducted by Maesyara et al, which found that there was a significant relationship between smoking habits and the incidence of NIHL. This difference in results is due to the different sample sizes. Research by Maesyara et al, had a larger sample size of 122 samples, and 61 of them had smoking habits. This research was conducted on 82 samples, of which only 33 samples had the habit of smoking [15]. This difference caused by the samples were women, who did not smoke. Only part of the sample in this study had the habit of smoking.

This study has several limitations. First, audiometric examinations cannot be performed in ideal settings. This deficiency provides potential errors in diagnosing NIHL. Second, several variables such as age, length of service, use of ear protection and smoking were obtained from filling out questionnaires by respondents. This gives rise to a factor of subjectivity (honesty) in the results of observing these variables. Third, other risk factors such as a history of comorbid diseases were not studied. Fourth, the female sample was included in the group who did not have a smoking habit, even though they were exposed to cigarette smoke at home or at work.

5. Conclusion

Production workers at PT. Kayu Perkasa Raya are exposed to production machine noise with an intensity of $>85\text{dB}$. However, all workers do not wear ear protection when working. This causes the risk of NIHL in workers. Despite this, only a small percentage of production workers suffer from NIHL. There was no significant relationship between noise intensity and the incidence of NIHL in PT Kayu Perkasa Raya Juwana Pati workers. There is no significant relationship between smoking habits and the incidence of NIHL in production and non-production workers at PT. Kayu Perkasa Raya Juwana Pati.

Authors' Contributions. All authors contributed equally to this work.

Acknowledgments. The author would like to thank the PT. Kayu Perkasa Raya for their supporting in completing this research.

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