RELATIONSHIP BETWEEN NOISE AND BLOOD PRESSURE IN FINISH MILL WORKERS AT PT. SEMEN X

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Abstrak

Workplace noise is one of the common environmental problems, especially in heavy industries such as cement. Loud noise produced by machines and heavy equipment often exceeds the established Threshold Limit Value (TLV). High noise exposure can cause hearing loss, stress, and other health problems. One of the possible impacts is changes in blood pressure, which can increase the risk of cardiovascular disease. This study aims to explore the relationship between noise generated at the Finish Mill and workers' blood pressure, as well as to identify preventive measures that can be implemented to protect workers' health and improve working conditions at PT. Semen X. The method used in this study was a cross-sectional study conducted at PT. Semen X in July 2024. Based on the chi-square test, age, length of service, length of exposure, use of PPE, and medical history showed that workers' normal blood pressure was more common before work, while after work their blood pressure tended to increase. The conclusion of this study shows that the intensity of noise in the finish mill section is quite high and health disorders in blood pressure in workers show signs of hypertension or abnormal blood pressure fluctuations.

Keywords: Noise, Blood Pressure, Finish Mill, Chi-Square Test

Introduction

The cement industry plays an important role in infrastructure development and construction. Cement is a binding material used in the manufacture of concrete and mortar, and is a major component in various construction projects such as buildings, bridges, and roads. The cement production process involves several main stages, from raw material processing to the firing and grinding process. PT. Semen X, as one of the leading cement producers in Indonesia, plays an important role in providing high-quality construction materials. One of the tools that is the heart of the cement manufacturing process so that in order to produce the quality of a clinker, it is necessary to regulate optimum operating conditions, especially temperature parameters, is called a rotary kiln. Another reason why the Rotary Kiln is an important tool is because of its "extreme" operating conditions, especially in terms of temperature, so that handling errors will have fatal consequences. The heat and electricity consumed in this unit are the largest part of the total production costs. If the kiln stops operating, most of the other equipment cannot be run, especially those that utilize the remaining heat from the kiln. Given the importance of this combustion unit, adequate basic knowledge and skills (professionalism) and a reliable mental attitude

9

are needed to be able to control combustion operations with high productivity (Perdana Ts et al., 2022). Although its role is very important, it also has a negative value, namely it can cause noise. Noise in the workplace is one of the common environmental problems, especially in heavy industries such as cement. According to (Satoto, 2018) noise is an unwanted sound, including sounds caused by the side effects of industrial and transportation activities. Unconscious high-intensity noise has a serious impact on everyone. High noise exposure can cause hearing loss, stress, and other health problems. An example of the effects of noise is the risk of hearing damage (Damage Risk on Hearing) in a person caused by noise exposure due to high noise levels or excessive cumulative exposure time (Hendrawan, 2020). Noise levels that exceed the threshold value can lead to hearing loss and the risk of temporary or permanent ear damage after exposure for a certain period of time without the use of adequate protective equipment. This potential risk has encouraged governments in various countries to create regulations that limit industrial workers' noise exposure (Silviana et al., 2021). According to (Nasution, 2019) Noise sources are categorized as follows: environmental noise (sounds caused by human activities, such as airports, industry and other activities), industrial noise (sounds produced by machines and heavy equipment used to carry out industrial production, social noise (caused by human activities in social contexts, such as music concerts, household activities and events involving many people) and natural noise (caused by natural phenomena, such as strong winds, lightning and sea waves).

Long-term exposure to noise can cause various health problems. Noise is an unwanted sound that can have an impact on the health, safety, and comfort of humans and their surroundings. Other health problems that can be obtained from noise exposure can cause physiological disorders such as dizziness, psychological disorders such as difficulty sleeping, communication and hearing (Hutagalung, 2017). According to (Darlani & Sugiharto, 2017) The effect of noise on humans also risks causing physiological disorders such as sleep disorders and increased blood pressure, psychological disorders, pathological disorders in body organs, and communication disorders. Noise in the workplace can also reduce the comfort of work productivity, hearing disorders and can increase blood pressure or hypertension. Exposure to noise makes the majority of people experience abnormalities in controlling their emotions, which can ultimately increase stress in a person (Situmorang, 2020). Research conducted by Ceren Lendo et al. in 2022 on "The Relationship between Noise Intensity and Blood Pressure and Pulse Rate in Furniture Industry Workers in Touliang Oki Village" stated that the results of noise measurements showed that the highest noise intensity was 97.9 dB and the lowest noise intensity was 71.8. The average noise has exceeded the NAB (85dB) which is 86.8 dB. The results of blood pressure measurements showed that those with normal blood pressure were 9 respondents with a percentage of 15.0% and those with abnormal blood pressure were 51 respondents with a percentage of 85.0% (Lendo et al., 2022).

According to the Decree of the Minister of State for the Environment Number. KEP-48/MENLH/II/1996 concerning Noise Level Standards, it is defined as unwanted sound from certain activities or work in a certain period of time that causes disturbance to humans and reduces environmental comfort, which can cause reduced hearing intensity, cause cardiovascular disorders and can cause deafness (Dewi et al., 2021). There are several other factors that can affect blood pressure, namely 1. heat stress (heat stress in a hot work environment, the body will experience evaporation and sweat which is accelerated by the dilation (vasodilation) of peripheral blood vessels and vasoconstriction of deep blood vessels which is accompanied by increased blood pressure (Lestari et al., 2018). 2. obesity (blood pressure due to obesity due to the influence of the interaction between sodium retention, and activating the sympathetic nervous system which affects insulin resistance and results in hyperinsulinemia which disrupts vascular function, causes sodium retention disorders and then increases blood pressure (Batara et al., 2016). 3. smoking (can increase heart rate and cause vasoconstriction (narrowing) and ultimately can cause increased blood pressure (Erman et al., 2021).

Loud noise that causes noise with a threshold value exceeding the predetermined NAB is very dangerous for workers. In addition to causing work accidents, noise also has the potential to cause

occupational diseases. Therefore, researchers are interested in conducting research to implement the theories that have been learned in lectures directly in the workplace. Researchers want to describe aspects related to noise and blood pressure. In this case, researchers are conducting a residency with the title "The Relationship Between Noise and Blood Pressure in Finish Mill Workers at PT. Semen X".

Based on the background, the objectives of this study include general objectives and specific objectives. The general objective of this study is to determine the relationship between noise and blood pressure of workers at PT Semen X. While the specific objectives of this study are (1) to identify the intensity of noise in the finish mill section at PT Semen X. (2) to identify health disorders of blood pressure in finish mill workers at PT Semen X. (3) to identify the relationship between noise and blood pressure for finish mill workers at PT Semen X.

Method

This study uses a cross-sectional research design with a secondary data analysis approach. The data source comes from the data "noise survey with blood pressure on finish mill workers at PT. Semen X" where the researcher is part of the research team. The study was conducted at PT. Semen X.

Data collection was conducted in July 2024, there were three stages, namely observation, interviews and questionnaires. Observation is a method of collecting data through direct observation, phenomena, or behavior in the field. Interviews are a technique that allows researchers to understand the perspectives, experiences, feelings, or opinions of respondents in more detail. Interviews are often used in qualitative research, especially when researchers need more subjective and detailed data. A questionnaire is a data collection technique that involves giving a series of written questions to respondents to fill in themselves. This technique is widely used in research to save time and money and can also collect data from more respondents (Siti Romdona, Silvia Senja Junista, 2024). In this study, observations were conducted to determine the situation at the data collection site. This study was carried out on 42 male workers as research samples. Then interviewed 42 workers. And gave questionnaires to 42 workers who were used as samples to obtain valid data. Data analysis in this study was carried out simultaneously with the data collection process. After the data collection was completed, a transcript was carried out.

Result

Noise measurements were carried out in an open area, and 3.5 meters away from the building wall to avoid sound reflection. The height of the Sound Level Meter is between 1.2 - 1.5 meters (chest height). The microphone on the sound level meter is directed at the noise source. Measurements were taken during sunny weather with wind speeds that were not too strong. The average values obtained from each column in 1 minute which were taken for 10 minutes and read every 5 seconds were as follows: 87.9; 88.9; 88.9; 88.7; 88.9; 87.8; 88.0; 88.6; and 88.4. Noise measurements were carried out in the finish mill section for 10 minutes, the total average value of the measurements obtained was 88 dBA and the exposure time per day that workers could accept was 4 hours. The results of the univariant noise intensity test in the finish mill section, the chi-square test can be seen in the following table:

Table 1 Univariate Test of Noise Intensity in the Finish Mill Section in July 2024

		Frequency	Percent	Valid percent	Cumulative percent
Valid	> 85 DB	42%	100.0%	100.0%	100.0%

In the table above, it can be seen that blood pressure before work is in the valid category > 85dB. Meanwhile, the chi-square test table for noise intensity based on blood pressure before and after work can be seen in the following table:

Tabel 2 Chi-Square Test of Noise Intensity Based on Pressure Before Working

			Noise Intensity in Finish Mill	Total
			> 85 Db	
Blood Pressure Before Work	Normal < 120 dan < 80	Count	9	9
		% of Total	21.4%	21.4%
	Prehypertension 120-139 and 80-90	Count	20	20
		% of Total	47.6%	47.6%
	Hypertension Grade 1 140-159 and 90-99	Count	12	12
		% of Total	28.6%	28.6%
	Hypertension Grade 2 > 160 or > 100	Count	1	1
		% of Total	2.4%	2.4%
Total		Count	42	42
		% of Total	100.0%	100.0%

Tabel 3 Chi-Square Test of Noise Intensity Based on Pressure After Working

			Noise Intensity in Finish Mill	Total
			> 85 Db	
Blood Pressure After Work	Normal < 120 and < 80	Count	2	2
		% of Total	4.8%	4.8%
	Prehypertension 120-139 and 80-90	Count	26	26
		% of Total	61.9%	61.9%
	Hypertension Grade 1 140-159 and 90-99	Count	13	13
		% of Total	31.0%	31.0%
	Hypertension Grade 2 > 160 or > 100	Count	1	1
		% of Total	2.4%	2.4%
Total		Count	42	42
		% of Total	100.0%	100.0%

Discussion

Noise is one of the risk factors of the work environment that can have a negative impact on workers' health. In the cement industry, especially in the finish mill section, noise levels can reach 85-100 dB or more, which exceeds the threshold recommended by WHO and OSHA. One of the health impacts that can arise from excessive noise exposure is increased blood pressure or hypertension.

Excessive noise exposure can stimulate the sympathetic nervous system, which results in the release of stress hormones such as adrenaline and cortisol. These hormones can increase heart rate and constrict blood vessels, which ultimately lead to blood pressure. The body's response to noise involves vasoconstriction, which increases peripheral resistance and causes blood pressure to rise. Continuous noise can also cause anxiety, irritability, and emotional stress, all of which contribute to long-term increases in blood pressure.

Several studies have shown that workers exposed to high noise (above 85 dB) are at higher risk of developing high blood pressure compared to those working in quieter environments. One relevant study is a study conducted by Ceren Lendo et al. in 2022 regarding "The Relationship between Noise Intensity and Blood Pressure and Pulse Rate in Furniture Industry Workers in Touliang Oki Village" which states that statistical tests on the relationship between noise and blood pressure were obtained at

a p value of 0.000. If someone who has been exposed to noise tends to experience stress, it can trigger an increase in blood pressure that persists if the noise occurs continuously and for a long period of time.

The Chi-square test in this study also states that in the category of blood pressure before work there are normal columns (<120 and <80), prehypertension (120-139 and 80-90), grade 1 hypertension (140-159) and 90-99), grade 2 hypertension (> 160 or > 100). In the category of blood pressure before work in the normal column, there are 9 with a percentage of 21.4%, prehypertension with a percentage of 47.6%, grade 1 hypertension with a percentage of 28.6% and grade 1 hypertension with a percentage of 2.4%. While the intensity of noise based on blood pressure after work shows that in the normal column there is a percentage of 4.8%, prehypertension of 61.9%, grade 1 hypertension of 31.0%, and grade 2 hypertension of 2.4%. Based on the results of these percentages, it can be seen that noise affects the blood pressure of PT workers. Semen X. The results obtained in this study are in line with research conducted by Ceren Lendo et al., (2022) which states that exposure to high intensity noise can result in an increase in high blood pressure (10 mmHg).

Noise in the finish mill section has a significant impact on workers' health, especially in increasing the risk of high blood pressure. Therefore, noise prevention and control measures need to be implemented to maintain workers' cardiovascular health and improve workplace safety and productivity.

Conclussion

Long-term exposure to noise exceeding 85 dB can trigger a physiological stress response, causing an increase in systolic and diastolic blood pressure. Because according to (Wulandari & Samara, 2023) systolic blood pressure occurs when the ventricles contract and pump blood into the arteries. Then according to (Amiruddin et al., 2015) diastolic blood pressure occurs when the ventricles relax again (relaxation) and are filled with blood from the atrium. Sympathetic nervous system activity due to noise causes vasoconstriction (narrowing of blood vessels), increasing blood pressure. Increased stress hormones such as adrenaline and cortisol can trigger hypertension. Workers who are exposed to noise for a long time (more than 8 hours per day) have a higher risk of developing hypertension. The longer a worker is in a noisy environment, the more likely their blood pressure is to increase. Continuous exposure to noise without control can increase the risk of coronary heart disease, stroke, and other cardiovascular disorders.

But there are ways to minimize noise levels, namely by carrying out several stages as follows. Recording noise levels (by measuring noise levels at predetermined time intervals), planning barriers (based on the LSM value that has been obtained, then the noise value that exceeds the NAB needs to be reduced by making barrier material to block sound), determining the height of the barrier (this is useful so that the barrier works effectively and sound is ensured not to escape), noise reduction by ear protection equipment (noise control that has been carried out by the related company in the rewinder machine area is the use of ear protection equipment in the form of ear plugs (Dinda Nur Aulia Septiani, 2017). The use of personal protective equipment (PPE) such as earplugs or earmuffs is very important to reduce the impact of noise. Regular work rotation and rest can help reduce stress due to noise. Noise control in the workplace such as installing soundproofing and machine maintenance can help reduce noise levels. Health checks are also needed to detect early signs of hypertension and prevent further complications.

Noise exposure in the finish mill work environment has a close relationship with increased blood pressure in workers. Therefore, noise control and health protection strategies are needed to prevent long-term negative impacts on workers' cardiovascular health.

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