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Noise Mapping and Noise Influence on Blood Pressure and Pulse of Workers in a Power Plant Company in Kendari

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Abstract

The Power Plant Company in Kendari is a government-owned company that operates diesel engines as power plants located in Wua-Wua District, Kendari City and is one of the industries that produce high noise. This is because diesel engines as power plants are used to meet the electricity needs of Kendari City residents. The study aimed to describe the noise intensity which is then illustrated with noise contour map and to know the difference of blood pressure and pulse as the result of exposure to noise intensity in workers in an The Power Plant Company, Kendari. The study was an observational analytic study with cross sectional study design. The sample of the study were 54 people. The measuring instrument used was the Sound Level Meter Lutron SL-4001 and questionnaire. The analysis used was the Mann Whitney U test. The results showed that the noise level in this area ranges from 62-96 dB range. The highest noise level 92-96 dB was in the Engine Room and the Engine Rental room.

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Based on the Mann Whitney U test, there was a difference in blood pressure based on the level of noise intensity on the workers in The Power Plant Company, Kendari with p value = 0,000, and there was a difference of the pulse based on the level of noise intensity of the workers in The Power Plant Company, Kendari with p value = 0,000. Conclusion; The level of noise intensity in the industry can affect the blood pressure and pulse of exposed workers. Recommendation; workers are expected to be obliged to use Ear Protector in the red zone.

Keywords: Noise; Blood Pressure; Pulse.

1. Introduction

In the work environment, noise is an occupational health problem that always arises in large industries. In addition to affecting hearing loss, high noise intensity can also result in loss of concentration, loss of balance and disorientation, fatigue, communication disturbances, sleep disturbances, body physiological disorders, and visceral effects, such as changes in heart rate/increased pulse rate, blood pressure changes and level of sweat expenditure.The Power Plant Company in Kendari City is an government-owned company and operated diesel-powered electricity corporation located in Wua-Wua District, Kendari City, South-east Sulawesi Province that is one of the industries that produces high noise. In carrying out its functions, The Power Plant Company, Kendari City is aimed at seeking the generation of electricity distribution, distributing of electricity and encourage the increase of economic activity. With such a large work area and the total number of subscribers up to now reaching ± 1.7 million subscribers, this is clearly a challenge for the company [1].To meet the needs of electricity in Kendari City, The Power Plant Company used a large intensity and a large number diesel engines as its power plant. The use of several diesel engines as a power plant makes the area in The Power Plant Company in Kendari City has high noise level. Therefore this study needs to be done to know the noise intensity at The Power Plant Company Kendari which was describe with a noise mapping. Noise mapping was to determine the pattern of noise spread that occurs in the area of the environment of The Power Plant Company Kendari, so that it was known the maximum time limit works in accordance with labor noise standards and noise control efforts could be carried out by earmuff or earplug which refered to be the result of mapping. Noise mapping was done by measuring the noise intensity using the Sound Level Meter (SLM) Lutron SL-4001. The noisy measuring points were measured with square models every 10 meters with the grid method. The data obtained was integrated with the application which would help create noise mapping maps. The results of study conducted by Ismila and his colleagues (2014) in Nigeria found that exposure to noise significantly increased systolic blood pressure but did not have a significant increase in diastolic pressure of the workers [2]. Similarly, the results of Singhal's research and his colleagues (2009) in India mentioned that there was a significant change in systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse pressure and heart rate in factory workers [3]. Noisy exposure induces stimulation and increases sympathetic nerve activity. If the stimulus is temporary then the body will recover within a few minutes or hours. But if the exposure is long and repeated it can lead to changes in the blood circulation system that settled [4]. The sympathetic nerve affects the functioning of the heart and blood vessels and its pemacunya causes increased heart frequency, increased cardiac muscle strength and vasoconstriction of resistant blood vessels [4]. Long exposure to noise during work shifts has effects on heart rate, systolic blood pressure, and diastolic blood pressure of the worker. increased blood pressure and worker heart rate have been detected during and after exposure to high level noise. During

exposure to noise, the endocrine system is known as a stress indicator may change, and this change leads to an increase in blood pressure, heart rate, and stress hormones [5]. Noise industrial can impact for workers health. In an The Power Plant Company Kendari, the noise intensity was quite high.

2. Materials and Method

1.1. Study design and sample

The study used an analytic observational approach with a cross sectional design [6]. This study was conducted in The Power Plant Company Kendari. The sampling technique used in this study was the exhaustive sampling which is the sampling scheme where the researcher takes all the subjects from the source population as the sample to be researched, where if the population number is less than 100 people should be taken entirely so that the research is the population research [7]. The sample in this study is the total population of 42 people.

1.2. Procedure

Research stages include the following stages:

- Stage of preparation

1) Prepare the SLM measurement (Sound Level Meter) sheet at some point and answer sheet for the respondent.
2) Prepare equipment to be used for measurements such as meter, SLM, and tensimeter.
3) Preliminary survey to the research site to see the condition of the workplace, work process, labor conditions and to measure blood pressure and work pulse.

- Implementation stage

a. Noisy mapping

1) Determination of point measurement by distance using grid method
2) The point of measurement location is made with interval distance of 5 meters as much as 210 observation points assisted by GPS to determine the point coordinate
3) Measurement of noise level at the study site
4) Input data to application/software
5) Contour map

b. Blood pressure and pulse rate

1) Fill in the respondent's data sheet covering age, sex, length of service, duration of exposure, smoking history and use of ear protector and emotional disorder measurement questionnaire.
2) Measuring blood pressure and labor pulse with Digital Tensimeter.

1.3. Statistical analysis

Bivariate analysis was conducted on two variables, namely independent variables and dependent variables that were suspected to be correlated or correlated. To determine the statistical test should to know the normality of data. Test the normality of the data used Kolmogorov-Smirnov Test. If the p value (sig) of the analysis result is >0.05, then the data was normally distributed, but if <0.05, then the data was not normally distributed. If the study data was normally distributed, then using Independent Samples T-Test as the statistic test, the decision of Independent Samples T-Test was by the criterion of the null hypothesis rejection test (H_0) if the significant value of p-value ≤0,05 and p-value >0.05 then H_0 is accepted. If the data was not normally distributed, then use the alternative test using Mann-Whitney U test with the criterion of the null hypothesis rejected test (H_0) if the significant value of p-value (≤0,05) and p-value (> 0,05) then H_0 is accepted.

3. Results

3.1. Noise Mapping

The result of measuring noise intensity at the Power Plant Company of Wua-wua, Kendari City were known the highest intensity is 96 dB which is located inside the building/engine room and building "Sewa Tama" (on visible map of which part is red) (November 21, 2017), while the lowest noise intensity was 62 dB can be seen located in the maintenance building/room, operating room, and space logistics staff (on visible map of which part is green). The noise intensity in an Indonesian government-owned and operated electricity corporation located in Wua-Wua District, Kendari City in November 2017 (Figure 1).

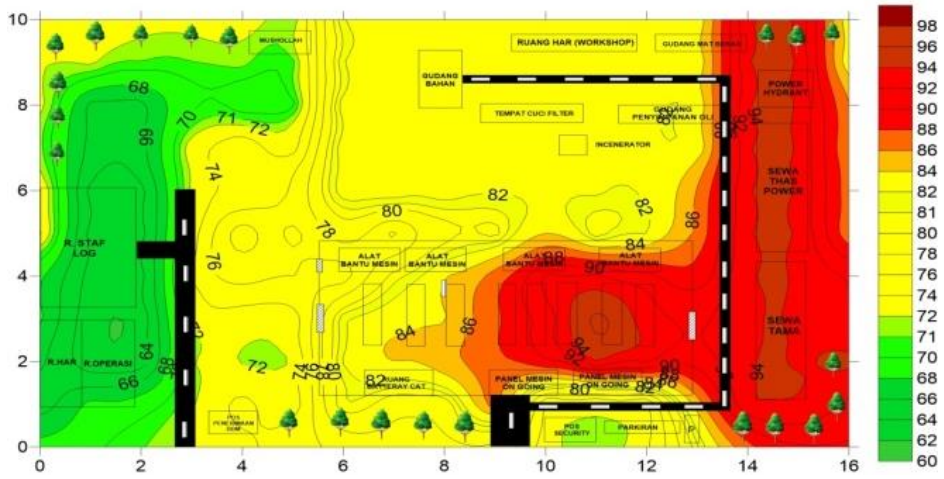

Figure 1: Noise Mapping in an Power Plant Company Kendari City in November 2017

3.2. Respondent Characteristics

The descriptive characteristics of the respondent and the noise intensity are presented in Table 1.

Table 1: Distribution characteristic of the sample (n=54)

Variable		N	%	Min	Max	Mean
Age	<40 years	43	79,63	18	50	32,54
	≥40 years	11	20,37			
Period of work	<10 years	40	74,07	1	24	8,22
	≥10 years	14	25,93			
Duration of Work	≤8 hours	53	98,14	6	12	7,94
	>8 hours	1	1,86			
Blood Pressure	<120 mmHg	22	40,74	100	150	121,48
	120-139 mmHg	20	37,03			
	>149 mmHg	12	22,23			
Pulse (pulse per minute)	<70	7	13,0	61	133	95,5
	70-89	19	35,2			
	90-109	10	18,5			
	≥110	18	33,3			
Noise Exposure	≤85 dB	33	61,1	58	92,7	70,17
	>85 dB	21	38,9			

Based on the Kolmogorov-Smirnov test, it is known that blood pressure and pulse was not distributed normally (sig <0,05). So, to test the hypothesis used Non-Parametric test by using Mann-Whitney test. Based on statistical test using Mann-Whitney U test obtained at intensity ≤85 dB there were 33 respondents exposed with the mean rank of 17,53. While at the intensity >85 dB there were 21 respondents with the mean rank of 43.17. Based on the Mann-Whitney U test obtained p-value of 0.000 indicating that there was a significant difference in blood pressure based on the noise intensity on the technicians/workers in The Power Plant Company, Kendari City. Based on Mann-Whitney U test obtained p-value of 0.000 indicating that there was a significant difference of pulse based on the noise intensity on the technicians/workers in The Power Plant Company, Kendari City.

4. Discussion

Noise is defined as "unwanted sound", for example, a sound that prevents the sounds from being desired, such as music, conversation, commands, etc., or which causes discomfort to the body [8]. Power Plant Company is a government-owned company which is a diesel generator company. Noise produced due to this activity is quite high, where the results of noise measurements obtained noisy intensity ranging from 62-98 dB. Based on figure 1 can be seen noise zone due to diesel engine in The Power Plant Company, Kendari. Green color is the safest zone compared to other zones, where the noise intensity ranges from 62 dB to 72 dB. So in this zone workers are not required to use the Ear Protective Tool. Yellow was a zone that is still considered safe and has not passed the threshold value set by the Decision of The Environment Minister No.48 in 1999. This yellow zone was a zone with a noise intensity level of 73 dB - 84 dB. In this zone workers are also not required to use Ear Protective Tool, but it may be advisable to use ear plugs to reduce exposure to existing noise, even though it has not exceeded the threshold value. However, in the red zone, all workers in the area were expected to use Ear Protective Tool (ear muff) because the noise level generated by the diesel engine at that portion was very high, exceeding the set Threshold Value (TV) stipulated in the Decree of the Minister of Manpower of the Republic of Indonesia No: Kep-51/Men/1999 concerning the Threshold Value of Physical Factors in the Workplace and is a standard in the Indonesian National Standard (SNI) 16-7063-2004, namely 85 dB [9]. This red zone has a noise intensity between 85-96 dB. The cause of this red zone/area had a very high level of noise compared to

other areas was because the area was located diesel engines, both belonging to The Power Plant Company itself (Machine Room) or the machines that rented (Tama Rent Room). So that area was very noisy. Workers working in the engine room and rental space were expected to be required to use Ear Protective Tool in view of adverse noise impacts on health. Noise could cause various effects. Some of the effects that could be caused by noise were psychological effects, communication disorders, and physiological effects. Physiological effects, noise could increase blood pressure and heart rate, reduce hearing sharpness, ear pain, nausea, impaired muscle control, and others [10]. In addition to hearing loss, noise could also affect blood pressure and heart rate. Increasing noise levels caused stress reactions with variations in heart rate and blood pressure [11]. Noise can be responded by a brain that experiences this as a threat or stress, which is then associated with the release of stress hormones such as epinephrine (a catecholamine hormone secreted by the adrenal glandular part and a neurotransmitter released by certain neurons that actively work on the nervous system central), norepinephrine (one of nature's catacolamines) and cortisol (the main natural glucocorticoids synthesized in the fasciculata cortex adrenalis zone, affect the metabolism of glucose, protein, and fat and have significant bicoid mineralocorticoid activity). Stress affects the nervous system which then affects the heart beat, which results in changes in blood pressure. Repeated stress can make the blood pressure change settled. Increased persistent blood pressure will result in hypertension [12]. In experimental research conducted by Monsefi **a**nd his colleagues (2006) it is reported that there has been a significant increase in the extent and volume of the adrenal cortex of white rats due to exposure to noise of 100 dB intensity for 8 hours in 30 days, indicating that noise is one of the stressors psychobiologic physical that can manipulate HPA activity (Hypothalamus Adrenal Hypophisis), which acts to regulate the autonomic system including blood pressure [13]. In this research, statistical tests Mann-Whitney U was used to know or to test the noise intensity to blood pressure hypothesis at The Power Plant Company, KendariCity used. Mann-Whitney U test was used as an alternative to the t-test unrelated (independent t-test) because the blood pressure data and the pulse data was not normally distribution, so it is not eligible to be tested by unpaired t-test. Statistical test results with Mann-Whitney U test p-value of 0,000. This means that H_0 was rejected and Ha accepted so that there was a significant difference between respondent's blood pressure at noise level > 85 dB with respondent's blood pressure at noise level ≤85 dB on technician at The Power Plant Company, Kendari City. The results of this study was in line with the research conducted Tetehuka **a**nd his colleagues (2013) about the relationship of noise with changes in blood pressure in the labor of production at PT. Sermani Steel Makassar showed that there was a significant relationship between noise intensity with blood pressure change by using Chi-Square test obtained p value = 0,012 (p <0,05) [14]. The results of this study is also eye to eye with the research conducted by Sinaga **a**nd his colleagues (2013) about the analysis of increased blood pressure due to noise at the operator at the factory Ammonia IB PT. Fertilizer Sriwidjaja Palembang, that there was an increase in blood pressure relationship with noise intensity [15]. The actual mechanism for increase in blood pressure is not yet completely understood but it may be due to the following mechanism: The catecholamines released from adrenal medulla as a result of activation of adrenergic system, the effect of suprarenal glands steroids, angiotensin and also the direct effect of noise on arterial wall tension influences the blood pressure and heart rate. Stimulation by noise, through sympathetic nervous system, causes an elevation of blood pressure by an increase in total peripheral resistance and myocardial contractility The repeated stimulation with noise could then accelerate the development of structural vascular changes in the peripheral resistance vessels and by this mechanism create a permanent blood pressure

elevation to hypertensive levels [3]. The result of statistical test with Mann-Whitney U test, obtained p-value equal to 0.000. This means that H_0 was rejected and Ha accepted so that there was a significant difference of respondent's pulse at noise level >85 dB) with respondent pulse at noise level ≤85 dB) on technician at The Power Plant Company, Kendari City. According to Sander and McCornick (1993) high-intensity noise can also cause health problems, such as: increased blood pressure and heart rate. In general, high-pitched noise is very disturbing, especially the discontinuous or suddenly (suddenly) and unpredictable may lead to physiological reactions, such as: increased work pulse, increased blood pressure (approximately 10 mmHg) [16]. The impact of noise can increase the pulse rate. Increased pulse rate may indicate the workforce has a physical, mental, fatigue, workload, infection or increased risk of stroke, ischemic heart disease, cardiac arrhythmias, and so on. If this is not immediately controlled, it will cause work accidents, thus lowering work productivity resulting in material losses [17]. Technical control at the receiver can be used by using Personal Protective Equipment (PPE) in the ear of workers, such as ear muffs or ear plugs. PPE can protect workers. PPE is usually used only when workers are at work locations with noise levels above TV [10]. Ear plug can reduce noise up to 30 dB. Ear muff can reduce noise up to 40-50 dB [8].

5. Conclusions

The noise level at Power Plant Company ranges from 62 to 98 dB. There was a difference in blood pressure based on the noise intensity of the technician in The Power Plant Company, Kendari City with p-value 0.000. There was a difference of pulse pressure after work based on the noise intensity on the technician in The Power Plant Company, Kendari City with p-value 0,000.

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