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Articles

Analysis of Noise Intensity in the Work Environment as a Risk Factor for Increased Blood Pressure in Workers

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Abstract

Farmers generally use rice mills as a tool to separate rice husks. The main driver of the rice milling machine is a diesel engine, which makes a lot of noise. Noise intensity that exceeds the threshold value can cause health problems for workers in the form of increased blood pressure. This study aimed to analyze the effect of noise intensity in the work environment on improving blood pressure. This research is an analytical observational study using a cross-sectional approach. The total population in this study was 40 workers. Proportionate Stratified Random Sampling is the sampling technique in this research, with a sample size of 37 respondents. Data collection techniques include interviews, measuring noise intensity, and measuring blood pressure. Data analysis used Wilcoxon test and Spearman correlation test, where the test criteria for H0 are accepted if $p > 0.05$ and H0 is rejected at $p < 0.05$. Based on the results of research conducted at a rice mill in Driyorejo District, Gresik Regency, it can be concluded that there is a difference between blood pressure (systolic and diastolic) before and after work. There is an influence between noise intensity, work period, age, smoking habits, and hereditary history. There was no effect between exposure time and increased blood pressure.

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Introduction

Rice milling is one of the stages after rice harvest, which consists of a number of processes, and using modern technology speeds up farmers' work. The main driver of the rice milling machine is a diesel engine. When a diesel engine is operating, the engine makes a loud noise. World Health Organization (WHO) in 2022 stated that noise is the second largest environmental factor that has the potential to endanger human health, after air pollution**.** Noise is one of the environmental factors that can affect human health, especially in the workplace. Many studies have shown that noise is a severe threat to cardiovascular health. Noise in the workplace not only causes hearing loss but can also affect workers' blood pressure, potentially leading to hypertension and other health problems. The impact of noise on human health includes physiological, psychological, communication disorders, balance disorders, and effects on hearing. Physiological problems such as increased blood pressure (±10 mmHg), increased pulse rate, constriction of peripheral blood vessels, especially in the hands and feet, and can cause pallor and sensory disturbances [1]. Some factors influence an increase in blood pressure, namely length of exposure

to noise, work period, age, smoking habits, hereditary history, alcoholic drinks, stress, and frequent consumption of excess salt.

A study conducted by Moghadam revealed a strong relationship between noise and increased blood pressure. This study states that noise causes a stress response, which increases the secretion of catecholamines and cortisol. Several physiological responses have been linked to the non-auditory effects of noise[2].This research shows that workers who are exposed to high levels of noise at work have a greater risk of experiencing increased blood pressure than those who work in quieter environments.

Based on research conducted by Zainudin et al. on oil and gas company employees in Jambi showed that there was a relationship between noise intensity and blood pressure. Based on the results of noise intensity measurements, it was found that 32 noise intensity measurement points exceeded the threshold value (> 85 dB(A)). The research results showed that 31 out of 60 workers experienced increasesed blood pressure after being exposed to noise in the work area. This is because the compressor engine does not have a sound dampening device, so the noise intensity becomes higher[3]. Research conducted by Zainudin et al. less focus on factors that can be confounding variables that can cause an increase in blood pressure in workers.

While many studies have examined the impact of noise on blood pressure, several gaps still need to be filled. First, many studies focus more on general environmental noise such as traffic or urban noise, while relatively few studies examine workplace noise. This raises the question of how specific characteristics of workplace noise, such as duration and frequency of exposure, affect workers' blood pressure. Research conducted in developed countries with work environments that may differ from developing countries, therefore further research is needed that examines the impact of workplace noise in the context of developing countries to understand regional differences in the impact of noise on cardiovascular health.

Research conducted by Sari et al.shows that noise intensity that exceeds the NAB in the workplace can be reduced by using hearing protection equipment adapted to the workforce's work environment[4]. This matter suggests that more personalized and specific interventions may be needed to protect workers from the negative impacts of noise. This research aims to analyse the influence of noise intensity in the work environment on the increasing blood pressure of workers at rice mills in Driyorejo District, Gresik Regency, in 2024. By understanding this influence, more effective strategies can be developed to reduce the risk of increasing blood pressure among workers exposed to high noise levels.

Materials and Methods

Research subject. The subject in research is a workforce of 37 workers who are exposed to noise in 15 places milling in the District-Driyorejo Regency-Gresik.

Research design. Research classification applies observational analytical classification through testing hypotheses previously formulated to explain the influence between variables. Using a survey method with a cross-sectional approach, research on the independent variables and the dependent variable is carried out simultaneously. The sampling in this research was Proportionate Stratified Random Sampling, which aimed to obtain a sample that accurately represents the population at each rice mill.

Noise intensity measurement. The undesirable sound received at the rice mill originates from the activities of the rice mill diesel engine, which produces noise of more than 88 dB(A) for approximately 4 hours. Noise intensity is measured using an SLM tool, and the noise measurement point is determined at the worker's position when carrying out their work with the tool.

Blood pressure measurement. Worker blood pressure is obtained by measuring blood pressure before and after work using a sphygmomanometer. Blood pressure measurement points were carried out before and after work, respondents were asked to rest for five to ten minutes before starting work or after work.

Instruments and Equipment. The instrument of this research is the Sound Level Meter (SLM) Svantek svan 971, Sinocare BA-801 digital tensimeter, interview sheet, and noise intensity measurement results sheet.

Method of collecting data. Data collection techniques in this research include surveys, observations, interviews, noise intensity, and blood pressure measurements.

Data analysis. Analysis was collected from interview results with respondents, measurements of pressure when using-tensimeter and noise intensity measurement using SLM. The test used to determine blood pressure before and after exposure to noise uses the Wilcoxon test to determine the effect of noise intensity on increasing blood pressure and the influence between characteristics based on length of exposure, length of work, age, smoking habits, and hereditary history on improving blood pressure and using the SPSS 16 application using the Spearman correlation test.

Research Ethics. This research has passed the ethical test (Ethical Clearance) and received approval from the health research ethics committee of the Ministry of Health Surabaya Health Polytechnic with No. ethics 2108-KEPK.

Results

This research was conducted at a rice mill in Driyorejo District, Gresik Regency with a research sample of 37 workers. The following are the results of noise intensity measurements:

Table. 1

Results of Noise Intensity Measurements at Rice Milling Places

No	Characteristics	Frequency (n)	Percentage (%)
1	Noise		
	≤88 dB(A)	1	6.6
	≥88 dB(A)	14	93.3

Table 1 shows the results of noise intensity measurements at 15 places milling, most of which are ineligible because they exceed NAB (≤88 dB(A)). 93.3% of rice milling places (14 places) did not meet the requirements. The results of noise intensity measurements at rice milling sites that meet the requirements are 6.6% (1 site).

Blood pressure measurements were carried out before and after work on respondents using a blood pressure monitor. The following are the results of workers' blood pressure measurements:

Table. 2

Results of Blood Pressure Measurements (Systolic and Diastolic) of Workers Before and After Work

Blood pressure	Before work		After Work	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Normal (≤ 120 mmHg)	18	48.6	7	19
Prehypertension (121-139 mmHg)	17	46	19	51.3
Stage 1 Hypertension (140-159 mmHg)	2	5.4	11	29.7
Stage 2 Hypertension (160-179 mmHg)	0	0	0	0
Total	**37**	**100**	**37**	**100**

Table 2 shows the measurement results for blood pressure (systolic and diastolic) taken before work. The majority of 18 people (48.6%) had blood pressure in the normal category. In contrast, the blood pressure measurements (systolic and diastolic) taken after work showed that most respondents were in the prehypertension category, namely 51.3% (19 people).

Characteristics of workers in this study included length of exposure, length of service, age, smoking habits, and hereditary history of hypertension. The following are the results of interviews conducted with 37 respondents at 15 rice mills located in Driyorejo District:

Table. 3

Frequency Distribution of Length of Exposure, Years of Work, Age, Smoking Habits and Hereditary History of Hypertension of Workers at Rice Milling Plants

Variable	Category	Frequency (n)	Percentage (%)
Exposure time	Below average (<4 hours)	3	8.1
	Average (4 hours)	23	62.2
	Above average (>4 hours)	11	29.7
	Total	**37**	**100**
Years of service	≤ 3 years	18	48.6
	>3 years	19	51.4
	Total	**37**	**100**
Age	≤ 35 years old	13	35.1
	>35 years	24	64.9
	Total	**37**	**100**
Smoker Habits	Not a smoker	6	16.2
	Light smoker (<10)	5	13.5
	Medium smoker (10-20)	3	8.1
	Heavy Smoker (>20)	23	62.2
	Total	**37**	**100**
Hereditary History of Hypertension	There's a history	19	51.4
	No history	18	48.6
	Total	**37**	**100**

Table 3 shows that the majority of the characteristics of respondents' length of exposure is 4 hours, 23 workers (62.2%), for work period, it shows that the highest number of work periods is respondents with a work period of more than 3 years, 19 workers (51.4%).), of the 37 workers, 24 workers (64.9%) were over 35 years old, 23 workers (62.2%) had a smoking habit in the heavy smoker category, and 19 workers (52.4%) had a history of hereditary hypertension.

Analysis of differences in systolic and diastolic blood pressure using the Wilcoxon Signed Rank Test. This analysis test was carried out to see if there was no difference between blood pressure (systolic and diastolic) before and after working at a rice mill in Driyorejo District, Gresik Regency. The following are the results of an analysis of the difference in blood pressure (systolic and diastolic) before and after work:

Table. 4

Differences in Blood Pressure (Systolic and Diastolic) Before and After Working at a Rice Mill

	Blood pressure Systolic	Diastolic Blood Pressure
Z	-4.472	-4.472
Asymp. Sig. (2-tailed)	0.000	0.000

Based on table 4, it can be seen that the significance value of the difference in blood pressure (systolic and diastolic) before and after work is p = 0.000 < α = 0.05, which means H0 is rejected so there is a difference between blood pressure (systolic and diastolic) before work and blood pressure systolic after working at a rice mill in Driyorejo District, Gresik Regency.

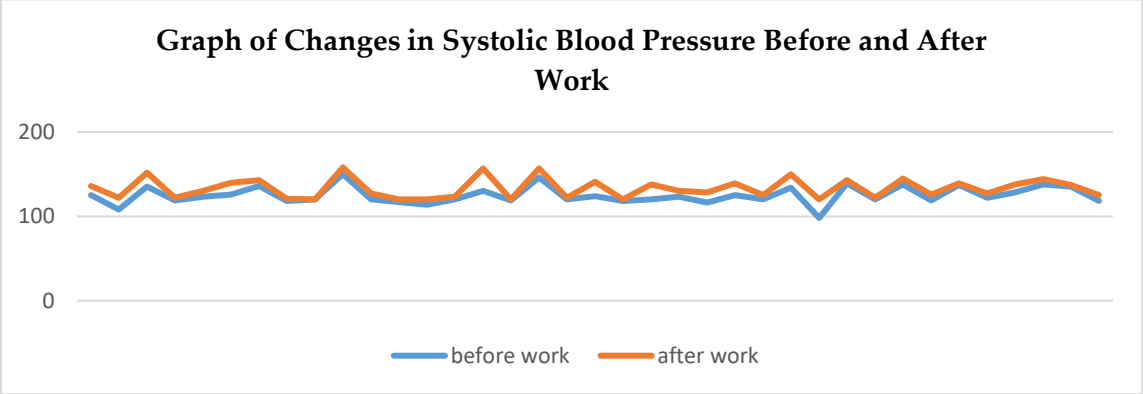

Figure 1. Graph of Changes in Systolic Blood Pressure Before and After Work

The results of systolic blood pressure measurements before work ranged from 98-150 mmHg with an average of 125 mmHg. Systolic blood pressure measurements after ranged from 120 mmHg – 158 mmHg with an average of 133 mmHg.

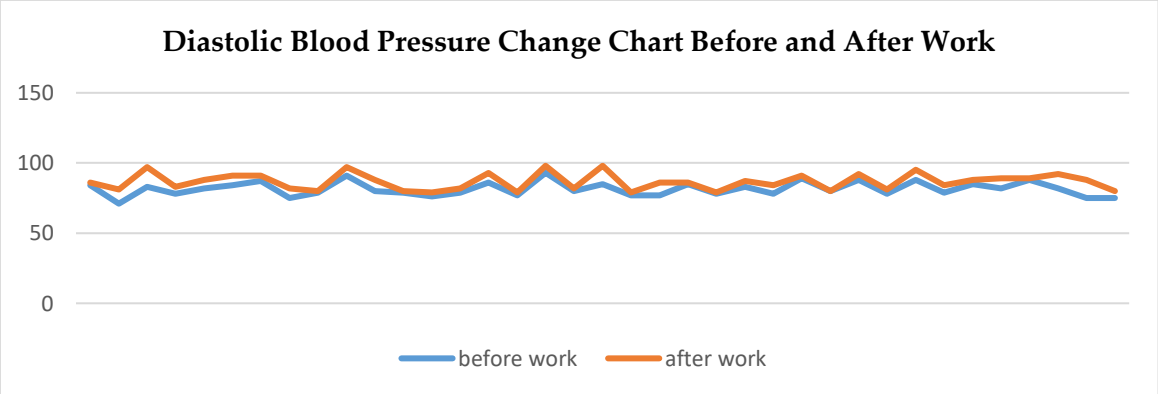

Figure 2.Chart of Changes in Diastolic Blood Pressure Before and After Work

The results of previous diastolic blood pressure measurements ranged from 71 mmHg – 93 mmHg with an average of 82 mmHg. The results of the diastolic blood pressure measurements after ranged from 79 mmHg – 98 mmHg with an average of 88 mmHg.

The following are the results of an analysis of the influence of workforce characteristics based on length of exposure, length of service, age, smoking habits and hereditary history of hypertension with increased blood pressure. Table 5 shows that the results of bivariate analysis using the Spearman correlation test show a significant influence of work period, age, smoking habits, hereditary history of hypertension, and noise intensity on increasing blood pressure. However, the length of exposure variable did not influence blood pressure.

Table. 5

Effect of Length of Exposure, Work Period, Age, Smoking Habits, Family History of Hypertension, and Noise Intensity on Increased Blood Pressure

Variable	Category	Blood pressure								Total		*p*
		Normal		Prehypertension		Stage 1 Hypertension		Stage 2 Hypertension				
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**0.127**
Exposure Time	(<4 hours)	2	66.7	1	33.3	0	0	0	0	3	100	
	(4 hours)	4	17.4	12	52.2	7	30.4	0	0	23	100	
	(>4 hours)	1	9.1	6	54.5	4	36.4	0	0	11	100	
	Total	**7**	**18.9**	**19**	**51.4**	**11**	**29.7**	**0**	**0**	**37**	**100**	
Years of service	≤3 years	7	38.9	9	50.0	2	11.1	0	0	18	100	**0.001**
	>3 years	0	0	10	52.6	9	47.4	0	0	19	100	
	Total	**7**	**18.9**	**19**	**51.4**	**11**	**29.7**	**0**	**0**	**37**	**100**	
Age	≤35 years	4	30.8	9	69.2	0	0	0	0	13	100	**0.005**
	>35 years	3	12.5	10	41.7	11	45.8	0	0	24	100	
	Total	**7**	**18.9**	**19**	**51.4**	**11**	**29.7**	**0**	**0**	**37**	**100**	
Smoking habit	Not a smoker	2	33.3	3	50.0	1	16.7	0	0	6	100	**0.011**
	Light smoker	2	40.0	3	60.0	0	0	0	0	5	100	
	Moderate smoker	1	33.3	2	66.7	0	0	0	0	3	100	
	Heavy smoker	2	8.7	11	47.8	10	43.5	0	0	23	100	
	Total	**7**	**18.9**	**19**	**51.4**	**11**	**29.7**	**0**	**0**	**37**	**100**	
Hereditary History of Hypertension	There's a history	1	5.3	8	42.1	10	52.6	0	0	19	100	**0,000**
	No history	6	33.3	11	61.1	1	5,6	0	0	18	100	
	Total	**7**	**18.9**	**19**	**51.4**	**11**	**29.7**	**0**	**0**	**37**	**100**	
Noise Intensity	Qualify	2	66.7	1	33.3	0	0	0	0	3	100	**0.049**
	Not eligible	5	14.7	18	52.9	11	32.4	0	0	34	100	
	Total	**7**	**18.9**	**19**	**51.4**	**11**	**29.7**	**0**	**0**	**37**	**100**	

Discussion

The bivariate analysis results of noise intensity and increased blood pressure on workers show an influence. The Spearman correlation analysis table shows a p-value of $0.049 < \alpha = 0.05$, which means there is an influence between intensity and an increase in blood pressure. This study's results align with research conducted by Zainudin in Jambi, showing that the significance value is $p = 0.002 < \alpha = 0.05$, confirming a relationship between noise intensity and increased blood pressure[3]. Zainudin's research is supported by the results of Fachrin's research, which states that there is a relationship between noise intensity and blood pressure in workers[5]. This research is similar to the results of research conducted by Megananda at PT Vale Indonesia[6]. In the research results section, Megananda states that there is an influence between noise intensity on blood pressure with a significance value of 0.000[6]. A study by Lendo showed a significant relationship between noise intensity and blood pressure in Touliang Oki Village. Exposure to high intensity noise can increase blood pressure by ± 10 mmHg[7].

The results of the test for differences in blood pressure (systolic and diastolic) of workers before and after using the Wilcoxon test showed that $p = 0.000 < \alpha = 0.05$, there was a difference between blood pressure (systolic and diastolic) before work and blood pressure (systolic and diastolic). After working on labour. This research is in line with Amin's study conducted in 2019, which stated that 39 out of 36 workers

at a rice mill experienced an increase in systolic blood pressure after being exposed to noise[8]. Power-Work-Those exposed may experience emotional stress due to noise, which is a stressor that increases blood pressure. The body perceives noise as a stressor and then produces the hormone cortisol, produced by the hypothalamus pituitary adrenal (HPA). Blood pressure increases as a result of excessive production of the hormone cortisol. This statement is supported by research stating that the average blood pressure (systolic and diastolic) before and after work was significantly different[9].

According to Sasongko, the increase in blood pressure is due to exposure to high noise from humans through the ear membrane (ear drum), and then towards the cochlea of the ear (cochlea). The cochlea aims to convert sound waves into electrical signals (electrical impulses) and transmit them through the auditory nerve to the brain. The heart supplies blood containing oxygen from the lungs to all tissues of the human body, including the brain. Therefore, Diastolic blood pressure increases when the heart muscle relaxes because the blood circulation is less than normal, and the blood vessels narrow. Exposure to noise exceeding the established standards isone of the factors that influences blood pressure with a relatively high prevalence in workers[10].

One type of pollution neglected in many countries is noise, which can affect human health. Most developing countries often lack effective laws and programs to prevent the negative health impacts of noise. One potential effect of noise on health is blood pressure[2]. According to Manalu, research shows that workers routinely exposed to noise above the threshold limit for more than five years, do not use hearing protection equipment, and have never received training related to their work, are at risk of experiencing increased blood pressure[11]. Moghadam stated that knoise causes a stress response, which increases the secretion of catecholamines and cortisol, and several physiological responses have been linked to the non-auditory effects of noise[2].

Noise in the work environment at rice mills is often a problem for workers, usually coming from machines such as generators. The relationship between noise intensity and increased blood pressure can occur due to direct exposure to machines such as diesel generators used in rice mills. Possible effort. This was done to reduce noise in the rice mill's working environment using a generator engineer, and technical engineering was carried out by installing silencers or buffers on devices that make noise. This is in line with Putri's research, which was carried out in PT. Surabaya DOK and Shipping (Persero), Technical control techniques can be applied to reduce noise in the PT production area. DOK, such as carrying out repairs and maintenance, replacing components that produce sound, lubricating moving parts, adding insulation with sound-absorbing material,-isolating equipment with how to keep him away from workers, as well as closing machine or install-barrier or barrier[12].

Rice mill owners at all rice mills do not provide ear protection (earplugs), so no workers use these tools to reduce the intensity of noise heard by the ears. This makes workers more vulnerable to exposure to noise. Using ear protection (earplugs) can effectively reduce noise in the workplace. Using earplugs will be more effective than earmuffs because earplugs can reduce noise by up to 30 dB(A). Ear protectors (earplugs) are more accessible to obtain, relatively cheaper, easy to use, do not limit head movement, and can be used to hear the voices of other workers when communicating so as not to cause technical errors at work and work accidents. The use of ear protection has been proven to reduce noise that exceeds the threshold. Research conducted by Sarisupports shows that noise intensity exceeding the NAB in the workplace can be reduced using hearing protection equipment adapted to the workforce's work environment[4]. Sumardiyono's research proves that stress caused by noise has an impact on increasing blood pressure, so using APT in workers is necessary so that blood pressure is stable when exposed to noise[13].

In the results of blood pressure measurements before work, some workers were in the normal category, but when blood pressure was measured after work, they became prehypertensive to stage 1 hypertension. This is not only caused by high noise intensity but can also be caused by other factors, namely work period, age, smoking habits and hereditary history of hypertension. Based on the results of the Spearman correlation

test, p = 0.001 < α = 0.05, indicating a significant influence between the characteristics of the work period and the increase in workers' blood pressure. After working in a workplace exposed to noise for many years, people will experience disturbances due to noise. This may indicate a direct relationship between work experience and time spent exposed to noise. This research is in line with research conducted by Irvani in Klapanunggal, Bogor Regency, there is a correlation between systolic blood pressure and length of service in limestone mining workers[14]. Noise heard by workers stimulates the nervous system and triggers the release of hormones that can increase blood pressure, especially systolic blood pressure which is more responsive. The body's adaptation process to a gradual increase in blood pressure causes a gradual increase in blood pressure, both systolic and diastolic. The duration of exposure to blood pressure is one of the risk factors that can cause an increase in blood pressure[14]. Based on Widya's research in 2018 workers with longer work experience are more susceptible to impacts caused by noise exposure. The longer workers work in environments with high noise levels, the greater their risk of experiencing health problems related to blood pressure. Work experience of more than five years tends to increase the risk more than work experience of less than five years[15]. Over a long period of work, respondents experienced problems with illnesses related to noise exposure, including frequently feeling irritated, increased blood pressure, vertigo, hearing loss and weakness. Interview results show that exposure to loud noise can cause emotional distress. This can impact the pituitary gland, adrenal glands, and autonomic nervous system, causing blood pressure to rise.

Based on the research results, there were 6 respondents who did not have a smoking habit, but 5 of these respondents also did not have a hereditary history of hypertension, but when the blood pressure was measured, it increased. The increase in blood pressure may be due to age factors. Based onThe results of the analysis of the influence of age characteristics on increasing blood pressure of workers at the rice mill resulted in p = 0.005 < α = 0.05. These results show that there is a significant influence between age characteristics and increased blood pressure in workers. This research is in line with research conducted by Nuraeni diClinic X Tanggerang City, the results show a significant relationship between age and hypertension[16]. This research is supported by research undertaken by Arini regarding the relationship between age and changes in blood pressure with samples aged between 20-59 years[17]. Most respondents were aged 40 to 49 years, and the youngest respondents were aged between 20-29 years. The results showed a significant correlation[17]. In old age, blood pressure usually increases due to decreased elasticity of the arteries[17]. According to research conducted by Uguy JM et al. in 2018 in Belang District, Minahasa Regency, age significantly influences increasing blood pressure. With increasing age, blood pressure tends to increase, and artery walls swell due to collagen buildup. As a result, blood vessels become stiff and narrow. Most research respondents were 45 years or older[18].

The increase in blood pressure may be due to age because the 5 respondents were over 40 years old. The body's metabolism will decrease after being over 40 years old. By the time you are 40 years old, body organs such as the liver and kidneys will experience a decline in performance, which can affect the body's metabolism. Increasing age causes the body's arteries to become stiffer and broader. This results in a decrease in the capacity and elasticity of blood vessels to accommodate blood. This reduction causes an increase in systolic pressure. Neurohormonal mechanisms such as the renin-angiotensin-aldosterone system change due to ageing, leading to increased peripheral plasma concentrations and glomerulosclerosis caused by intestinal fibrosis and ageing. Efforts that can be made to modify behaviour to prevent an increase in blood pressure include exercising diligently and reducing fatty and high-salt foods.

Based on the results of the Spearman correlation test regarding the influence of smoking habits on increasing blood pressure show that there is a significant influence. The Spearman correlation analysis table shows that the p-value is 0.011 < α = 0.05, which means that there is a significant influence between the characteristics of smoking habits and an increase in workers' blood pressure. This research is in line with research conducted by Dewi in Semarang, which shows that there is a relationship between smoking

habits and increased diastolic blood pressure[19]. After smoking the first cigarette, nicotine immediately increases blood pressure. Nicotine is absorbed by the lungs' tiny blood vessels and spread throughout the bloodstream. Nicotine reaches the brain in a short time. The brain responds by ordering the adrenal glands to release adrenaline. This hormone constricts blood vessels and makes the heart work harder due to increased pressure. According to Sheps, the impact of systolic and diastolic blood pressure can increase by as much as 10 mmHg after smoking two cigarettes[18]. Efforts that can be made to modify behaviour to prevent an increase in blood pressure include exercising diligently, stopping smoking and reducing fatty and high-salt foods. Increased blood pressure can also be caused by a hereditary history of hypertension, which shows there is a significant influence. The results of the Spearman correlation test showed that $p = 0.000 < \alpha = 0.05$, which means that there is a significant influence between the characteristics of a hereditary history of hypertension and an increase in energy blood pressure. The research results are in line with Setiandari's research Banjar Regency; the results obtained were $p = 0.001 < \alpha$ 0.005, so it can be concluded that family history and hypertension are related[20]. Someone who comes from a family with a history of hypertension and genetic factors has a higher risk of suffering from hypertension compared to someone from a family without a history of hypertension[21].

After measuring blood pressure before and after work on 18 respondents who did not have a hereditary history of hypertension. A total of 19 respondents had a hereditary history of hypertension, 10 respondents were included in the stage one hypertension blood pressure category. Based on the results of research through interviews with 37 respondents, several elderly respondents did not know for sure whether their family had a hereditary history of hypertension or not. This is what causes this research to lack validity, therefore it needs to be carried out selecting respondents who are more appropriate to the study of other researchers. Someone who has a family history of hypertension is twice as likely to have hypertension. Efforts that can be made to modify behaviour to prevent an increase in blood pressure include exercising diligently and reducing fatty and high-salt foods.

Based on the results of the Spearman correlation test on the length of exposure variable, a value of $p = 0.127 > \alpha = 0.05$ was obtained, indicating that there was no influence between the length of exposure and the increase in workers' blood pressure. The results of this research are based on research conducted by Zainudin and gas company employees. The results showed no significant relationship between prolonged noise exposure and blood pressure intensity. In research conducted by Zainudin there was no association between excessive exposure for more than 8 hours daily and increased blood pressure. This is because the Migas X company in Jambi already has rest breaks during working hours[3]. Based on the results of research conducted by Pangestu, different results were stated, such as a relationship between length of exposure to noise and blood pressure[5]. Prolonged exposure to noise that exceeds the threshold can increase blood pressure and heart rate[5]. This matter because when the sympathetic nerve is stimulated, it affects the arterioles and veins, causing vasoconstriction, which results in greater venous return. As a result, stroke volume, or stroke volume, increases, and cardiac output increases, increasing blood pressure[5].

In some places, rice mills do not turn on the rice mill machine continuously during working hours because the operation of the rice milling machine adjusts the stock of grain to be processed. The noise produced by rice milling machines is usually of high intensity[22]. This makes it possible that prolonged noise exposure is not correlated with increases in blood pressure. Continuous noise exposure can disrupt the physiological function of muscle tissue and encourage the heart to pump more blood throughout the body.

Conclusions

Based on the results of research conducted at a rice mill in Driyorejo District, Gresik Regency in 2024, it can be concluded that there is a difference between blood pressure (systolic and diastolic) before

and after work. There is an influence between length of service, age, smoking habits, hereditary history of hypertension, and noise intensity on increasing workers' blood pressure. At the same time, there is no influence between the length of exposure to noise and increasing workers' blood pressure at a rice mill in Driyorejo District, Gresik Regency.

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Conflicts of Interest:
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References

[1] C. D. Sucipto, *Keselamatan dan Kesehatan Kerja*, 1st ed. Yogyakarta: Gosyen Publishing, 2014. [Publisher]

[2] B. Otoghile, J. Ediale, N. O. Ariyibi, and O. O. Otoru, "Effects of Occupational Noise on Blood Pressure," *Glob. J. Health Sci.*, vol. 11, no. 3, pp. 63–67, 2019. [Crossef] [Publisher]

[3] M. Zainudin, P. Sahara Harahap, and E. Mirsiyanto, "Analisis Intensitas dan Lama Paparan Kebisingan dengan Peningkatan Tekanan Darah pada Karyawan Perusahaan Migas X di Jambi," vol. 60, pp. 65–76, 2020. [Crossef] [Publisher]

[4] E. Sari, Demes Nurmayanti, and Faizatul Ummah, "Alat Pelindung Telinga (Ear Muff) Dalam Mereduksi Tekanan Darah Tenaga Kerja Terpapar Kebisingan," *Gema Lingkung. Kesehat.*, vol. 20, no. 2, pp. 90–97, 2022. [Crossef] [Publisher]

[5] S. A. Fachrin and A. Nurlinda, "Faktor Yang Berhubungan Dengan Tekanan Darah Pekerja Yang Terpajan Kebisingan Pada Pekerja Di PT. Industri Kapal Indonesia (Persero)," *Wind. Public Heal. J.*, vol. 2, no. 5, pp. 1195–1202, 2021. [Crossef] [Publisher]

[6] A. F. Megananda and T. Suwandi, "The Influence of Noise Intensity and Age to the Employees' Blood Pressure at Heavy-Duty Shop and EHS Department," *Indones. J. Occup. Saf. Heal.*, vol. 8, no. 2, pp. 168–177, 2019. [Crossef] [Publisher]

[7] C. Lendo, S. S. Maddusa, and S. Sekeon, "Hubungan antara Intensitas Kebisingan dengan Tekanan Darah dan Denyut Nadi pada Pekerja Industri Mebel di Desa Touliang Oki," *KESMAS J. Kesehat. Masy. Univ. Sam Ratulangi*, vol. 11, no. 2, 2022. [Publisher]

[8] M. A. Yenida, Rita, "Perbedaan Tekanan Darah Sebelum Dan Sesudah Pekerja Terpajan Kebisingan Di Penggilinganpadi Dan Kopi," *J. Telenursing*, vol. 1, no. 1, pp. 27–37, 2019. [Crossef] [Publisher]

[9] F. 'Izza Luthfiyah and N. Widajati, "Luthfiyah, F. 'Izza, & Widajati, N. (2019). Analisis Peningkatan Tekanan Darah pada Pekerja yang Terpapar Kebisingan. Journal of Health Science and Prevention, 3(1), 1–9, 2019. [Crossef] [Publisher]

[10] Z. S. H. Rangkooy, P. Rashnoudi, "The Effect of Noise on Hearing Loss and Blood Pressure of Workers in a Steel Industry in the Southwest of Iran," *Occup. Hyg. Heal. Promot.*, vol. 5, no. 4, pp. 371–384, 2022. [Crossef] [Publisher]

[11] E. Prasetya, Z. F. Ahmad, and S. S. I. Nurdin, "Airport Noise Level and Its Effect on Blood Pressure on the Gorontalo Community," *Jambura J. Heal. Sci. Res.*, vol. 4, no. 1, pp. 500–509, 2022. [Crossef] [Publisher]

[12] D. N. Hafidah Destiani Putri, Rusmiati, "Paparan kebisingan, umur, masa kerja, dan pemakaian APT terhadap ambang pendengaran pekerja," *GEMA Lingkung. Kesehat.*, vol. 17 (2), pp. 80–86, Jul. 2019. [Publisher]

[13] B. Iftitah, R. Rachmaniyah, D. Nurmayanti, K. Khambali, and W. Winarko, "Intensitas Kebisingan,

Ambang Dengar dan Keluhan Subjektif Tenaga Kerja Bagian Pencucian Ruang Laundry Rumah Sakit di Surabaya," *JPP (Jurnal Kesehat. Poltekkes Palembang)*, vol. 18, no. 2, pp. 178–185, Dec. 2023. [Crossef] [Publisher]

[14] A. W. Irvani, M. Citrawati, and N. Nugrohowati, "Gambaran Faktor Risiko Tekanan Darah Sistolik Pada Pekerja Tambang Batu Kapur Di Klapanunggal, Bogor, Jawa Barat," *Maj. Kedokt. Andalas*, vol. 43, no. 2, 2020, doi: DOI: https://doi.org/10.25077/mka.v43.i2.p95-104.2020. [Crossef] [Publisher]

[15] N. Maulina, R. Sofia, and N. Zulfa, "Hubungan Paparan Kebisingan Terhadap Perubahan Tekanan Darah Pada Pekerja Pabrik Pengelolaan Batu Di Kabupaten Aceh U tara Tahun 2022," *J. Ilm. Mns. Dan Kesehat.*, vol. 5, no. 3, pp. 426–434, 2022. [Crossef] [Publisher]

[16] E. Nuraeni, "Hubungan Usia Dan Jenis Kelamin Beresiko Dengan Kejadian Hipertensi Di Klinik X Kota Tangerang," *J. JKFT*, vol. 4, no. 1, p. 1, 2019. [Crossef] [Publisher]

[17] N. Arini, B. Wispriyono, and T. Ashar, "Paparan Kebisingan dan Perubahan Tekanan Darah Pekerja Di Bagian Kilang Area PT. Pertamina RU II Dumai," *J. Kesehat. Lingkung.*, vol. 11, no. 2, pp. 64–71, 202. [Publisher]

[18] A. F. Rahmatika, "Hubungan Kebiasaan Merokok Dengan Kejadian Hipertensi," *J. Med. Hutama*, vol. 8, no. 7, pp. 706–710, 2021. [Publisher]

[19] A. T. Dewi, T. Joko, and Y. H. Darundiati, "Hubungan Intensitas kebisingan di lingkungan kerja dengan peningkatan tekanan darah pada pekerja Pt X Semarang," *J. Kesehat. Masy.*, vol. 9, no. 6, pp. 832–840, 2021. [Crossef] [Publisher]

[20] E. S. L.O, A. Widyarni, and A. Azizah, "Analisis Hubungan Riwayat Keluarga dan Aktivitas Fisik dengan Kejadian Hipertensi di Kelurahan Indrasari Kabupaten Banjar," *J. Ilm. Univ. Batanghari Jambi*, vol. 20, no. 3, p. 1043, 2020. [Crossef] [Publisher]

[21] I. H. Zainab, "Relationship Between Heritage History And Smoking Habits With Hypertension Incidence," *J. life birth*, vol. 7, pp. 70–78, 2023. [Crossef] [Publisher]

[22] M. Y. Putri *et al.*, "Pengaruh Intensitas Kebisingan Terhadap Gangguan Pendengaran Pada Pekerja Penggilingan Padi Mauril," *Hum. Care J.*, vol. 9, no. 1, pp. 97–107, 2024. [Crossef] [Publisher]