

## THE CORRELATION OF INDIVIDUAL FACTORS WITH HIGH BLOOD PRESSURE OF INDUSTRIAL PAINTERS AT A LAND TRANSPORTATION MANUFACTURING COMPANY

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### Abstract

**Introduction:** The use of lead-based paint in the manufacturing process on land transportation production contributed to the decline of ambient air quality. The amount of lead level in the painting area exceeded the allowed Threshold Limit Value (TLVs). Excessive lead exposure will provoke the escalation of blood lead levels. Even in a small amount, a lead will cause cardiovascular disorder inside the human's body and raise blood pressure. The research aims to analyze the correlation between environmental factors and individual factors of industrial painters with high blood pressure. **Methods:** The research used a quantitative method and a cross-sectional design. It involved the whole industrial painters and administration workers at the Internal Control Division. Samples were taken from 20 workers determined using simple random sampling. Independent variables were air lead level, age, healthy family history of hypertension, nutritional status, caffeine consumption, and smoking frequency. Dependent variables were blood lead level and blood pressure. The data obtained from laboratory tests and questionnaires were analyzed using Fisher's Exact Test. **Results and Discussion:** Correlations were proven to exist between lead level in the work environment and lead level inside the painters' blood ( $p = 0.663$ ). Family history of hypertension ( $p = 0.016$ ) and nutritional status ( $p = 0.031$ ) were correlated to the Blood Lead Levels (BLLs), whereas BLLs ( $p = 1.000$ ), age ( $p = 0.158$ ), caffeine consumption habit ( $p = 1.000$ ), and smoking frequency ( $p = 0.663$ ) were not correlated to the blood pressure. **Conclusion:** The work environment's lead level was correlated with BLLs but did not correlate with blood pressure. Family history of hypertension and nutritional status were the individual factors that correspond with high blood pressure in industrial painters.

## INTRODUCTION

An increase and variation of human needs impact the industrial world's development; meanwhile it cannot be denied that human physical health and environmental conditions are being threatened causes by industrial activity. Chemicals are one of the hazards exposure from environmental work factors that can threaten workers' health. These hazards resulted from the use of many chemicals compounds and their derivatives in the work environment. The type of chemical contaminants in the work environment are gases, vapors, and particulates (1). Lead is a metal particulate used to manufacture specific products such as batteries, cable coatings, radiation shields, ammunition, and coloring products such as paint (2). The lead's function is to paint as a coloring agent or pigment, an anti-rust agent, and a drying catalyst. The primary sources of lead exposure in humans generally come from lead-based paints, makeup tools, toys, household dust, contaminated soil, and factory waste emissions (3). The land transportation manufacturing, there is one production activity that increases the risk of decreasing the work environment's quality, such as painting activity. The spraying method is often used in the assembly industry because of processing time and its quality. However, this method will accumulate more lead particles in the air (4). The presence of lead in the air in the work environment can be dangerous for workers because lead can quickly enter the body through the respiratory tract (5).

The amount of 95% of the lead that is exposed to the human's body will accumulate in the blood; furthermore, blood is a gold standard specimen for determining lead content in the body (6). Lead can be in the form of pure metal or the form of inorganic and organic compounds. In both inorganic or organic forms, lead can still cause the same detrimental impact on living things, and thus it is classified as hazardous and toxic materials. Toxic effects on various organ functions due to the presence of lead metal in the body still harm various systems even though only a slight lead is absorbed (7).

A good work environment always keeps a threshold limits value of lead level in the air no more than at 0.05 mg/m<sup>3</sup>. Research on workers from two electronics equipment manufacturing companies in Iran found that the lead concentration in the air had a significant correlation with the level of lead in the blood of workers (8). The higher the lead level in the environment, the higher the BLLs in the worker's body (9). The National Institute for Occupational Safety and Health (NIOSH)

states that a person is said to have high lead levels in their blood when it reaches  $\geq 10$   $\mu\text{g/dL}$ . The National Health and Medical Research Council (NHMCR) determined that lead levels  $>10$  mg/dL can harm blood pressure, kidney function, blood cells, brain function, and nervous system performance. Lead exposure at low to moderate levels for a long time can affect cardiovascular system disorders to hypertension (10).

An epidemiological and clinical study of workers in the electronic equipment manufacturing and mining industries in China found a correlation between chronic lead exposure in workers with a minimum working period of 1 year and increased blood pressure (11). The effect of lead exposure on blood pressure is more predominantly caused by chronic exposure than acute exposure. Chronic exposure occurs when the lead is accumulated in the human body and persists in the human body for many years, whereas the length of time a person is exposed to lead affects the increase in lead levels in the body (12). Another study conducted on industrial painters in the bus assembly in Semarang stated that BLLs were significantly associated with increased diastolic blood pressure (13).

The 2018 Indonesian Basic Health Research stated that the prevalence rate for Indonesians aged  $> 18$  years and experiencing high blood pressure was 34.11% (14). This prevalence increased by 8.31% compared to the data reported in the 2013 Basic Health Research results. As many as 95% of high blood pressure cases are essential hypertension. Essential or primary hypertension is high blood pressure caused by genetic and environmental factors, obesity factors, stress, poor lifestyle, and consumption patterns (15).

PT. X is the first company engaging in manufacturing land transportations such as trains and buses in Southeast Asia. Based on information from the company representatives and preliminary observations made, this company has increased sales domestically and abroad almost every year. The increasing market demand has an impact on the massive production activities. In manufacturing and assembling products, there are activities for painting carriages, locomotives, bus bodies, and engines using lead paint with the spraying method, which occurs every day or five working days per week in a workshop building. This can increase the risk of lead particulates in the paint through the worker's breathing, resulting in cardiovascular health problems, particularly high blood pressure. This study aims to analyze the lead exposure in the work environment to the human health effect.

**METHODS**

This type of study was an analytical observational with a cross-sectional design. All variables were taken at the same time, and respondents did not receive any treatment. The research was conducted in October-November 2020.

This study included all industrial painters for the painting workshop, specifically in the machine painting section and administrative officers at the Internal Control Unit Division. The respondents should meet the inclusion criteria to participate in this study. The criteria were male workers working at spraying activity least one year, willing to have their blood drawn, and willing to become respondents voluntarily. A total of the sample would calculation using the Slovin formula, and twenty workers were obtained. The technique used to obtain the sample is the simple random sampling method. Of the twenty workers, twelve workers are industrial painters, and eight workers were an administrative officers.

The variables in this study included air lead levels, BLLs, age, nutritional status, family history of hypertension, smoking degree, caffeine consumption habits, and blood pressure. Data were collected by measuring lead levels in the air and the blood, measuring blood pressure, and interviews with questionnaires. Taking air samples was carried out using a High-Volume Atomic Sampler (HVAS) by expert staff from Technical Implementation Unit Laboratory Surabaya. Taking blood samples and measuring blood pressure was done by a health worker from the Sarana Medika Laboratory. The Mechanical Laboratory will analyze respondents' blood samples that have been taken, and Calibration Laboratory in Sidoarjo with the Atomic Absorption Spectroscopy (ASS) method to determine BLLs.

The measurement of lead levels in the air will be compared with the Threshold Value (TLV) of the Ministry of Manpower's regulation number five in 2018. The laboratory measurements of BLLs will be compared with the World Health Organization (WHO) standards in 2010. The statement supported by the National Toxicology Program (NTP) statement in 2012 that BLLs were high and could pose a risk to adult blood pressure if more than 10 µg/dL and regular less than 10 µg/dL. The results of blood pressure measurements will be compared to the American Heart Association (AHA) statement in 2017, where a person was categorized as having high blood pressure if the condition for systolic blood pressure is ≥140/90 mmHg, while diastolic blood pressure is ≥ 90 mmHg. The data collected were analyzed to know the relationship between individual factors and BLLs with workers' blood pressure using Fisher's Exact test. This

study has passed the ethical clearance test from the Health Research Ethics Commission of the Faculty of Dental Medicine, Universitas Airlangga, Surabaya, with ethical certificate number: 450/HRECC.FODM/X/2020.

**RESULTS**

**Air Lead Levels in the Work Environment of Land Transportation Manufacturing Company**

Table 1 shows the results of air quality measurements at 5 sample points (4 points in the painting area and 1 point in the administrative area) in the Intern Supervision Division's office room. The more expansive workshop building and the moving activities of industrial painters are the reasons for using the air's average lead levels to show the air's measurement results from the painting area. The result showed a 0.06834 mg/m<sup>3</sup> lead level which exceeds the acceptable TLVs that is 0.05 mg/m<sup>3</sup>. Meanwhile, the Internal Control Division office had a lead level of 0.00046 mg/m<sup>3</sup> within the safe limit or below TLVs.

**Table 1. Measurement Result of Lead Levels in Work Environment using HVAS in the Working Area of Land Transportation Manufacturing Company Workers**

Painting Workshop	Measurement Result
1 <sup>st</sup> Point	0.10822 mg/m <sup>3</sup>
2 <sup>nd</sup> Point	0.00629 mg/m <sup>3</sup>
3 <sup>rd</sup> Point	0.00046 mg/m <sup>3</sup>
4 <sup>th</sup> Point	0.15839 mg/m <sup>3</sup>
Average Count	<b>0.06834 mg/m<sup>3</sup></b>
Internal Control Division Office	<b>0.00046 mg/m<sup>3</sup></b>

**Frequency Distribution of BLLs and Individual Factors of Workers in the Land Transportation Manufacturing Company**

The distribution of BLLs and individual factors, namely age, nutritional status, family history of hypertension, caffeine consumption habits, and smoking status, are shown in Table 2. The variable of BLLs found that 5 out of 12 industrial painters had BLLs ≥ 10 µg/dL. There are eight administrative officers, and none of the workers has BLLs ≥ 10 µg/dL. The most dominant age variable for industrial painters in this study was six workers (50%) in the age range of 26-35 and 4 workers (50%) in the administrative officers. For the nutritional status, variable found that most industrial painters (91.67%) had normal nutritional status. At the same time, obese workers were more dominant than administrative officers (50%).

Concerning the history of hypertension, the industrial painters mostly did not have family members (father, mother, or both) who suffer from hypertension (15.00%). The majority of administrative officers have a family history of hypertension (2 out of 3 workers). For the caffeine consumption variable, the industrial

painters had a habit of consuming caffeine in the form of coffee drinks more than 2 cups per day as many as nine workers (75.00%), and the majority of administrative officers did not have this habit as many as five workers (63.50%). The smoking habit variables were stated in the non-smoking, mild, moderate, and severe status. Based on Table 2, most workers were light smokers, as many as seven workers (58.33%), and in the administrative officers, dominated by non-smokers as many as six workers (75%).

**Table 2. Frequency Distributions of BLLs dan Individual Factors on Land Transportation Manufacturing Company Workers**

Characteristics	Workers				Total	
	Painting		Administration		n	%
	n	%	n	%		
<b>Blood Lead Levels (BLLs)</b>						
<10 µg/dL	7	46.67	8	33.33	15	75.00
≥10 µg/dL	5	100.0	0	0	5	25.00
<b>Total</b>	<b>12</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>
<b>Age</b>						
16-25	2	16.67	1	12.50	3	15.00
26-35	6	50.00	2	16.67	8	40.00
36-45	2	16.67	1	12.50	3	15.00
46-55	2	16.67	4	50.00	6	30.00
<b>Total</b>	<b>12</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>
<b>Nutritional Status</b>						
Normal	11	91.67	2	25.00	13	65.00
Overweight	1	8.33	2	25.00	3	15.00
Obesity	0	0	4	50.00	4	20.00
<b>Total</b>	<b>12</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>
<b>Family History of Hypertention</b>						
Yes	0	0	3	100.00	3	15.00
No	12	70.59	5	29.41	17	85.00
<b>Total</b>	<b>12</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>
<b>Coffee Consumption (&gt;2 cups a day)</b>						
Yes	9	75.00	3	37.5	12	60.00
No	3	25.00	5	62.50	8	40.00
<b>Total</b>	<b>12</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>
<b>Smoking Status</b>						
Non-Smokers	2	25.00	6	75.00	8	40.00
Mild	7	87.50	1	12.50	8	40.00
Moderate	3	75.00	1	25.00	4	20.00
<b>Total</b>	<b>12</b>	<b>100.00</b>	<b>8</b>	<b>100.00</b>	<b>20</b>	<b>100.00</b>

**Cross-tabulation of Air Lead Levels in the Work Environment with BLLs of Workers in the Land Transportation Manufacturing Company**

This study obtained the measurement results of lead levels in the air using HAVS shown in Table 1. The workshop warehouse had a lead level that exceeded the TLVs. The lead content in the air at the Internal Control Division office was at a safe limit. Based on the cross-tabulation results, five out of 12 workers working in the workshop warehouse had BLLs ≥10 µg/dL, and the total number of workers who worked in the Internal Control Division office were eight people with BLLs of ≤ 10 µg/dL.

**Table 3. Cross Tabulation Between Lead Levels in The Work Environment and BLLs of Land Transportation Manufacturing Company Workers**

Lead Levels in Work Environment	Blood Lead Levels (BLLs)				Total		P
	≤10 µg/dL		>10 µg/dL		n	%	
	n	%	n	%			
≤0,05 mg/m <sup>3</sup>	15	100.00	0	0	15	75.00	0.055
>0,05 mg/m <sup>3</sup>	0	0	5	100.00	5	25.00	
<b>Total</b>	<b>15</b>	<b>90.00</b>	<b>5</b>	<b>10.00</b>	<b>20</b>	<b>100.00</b>	

**Cross-tabulation of BLLs and Individual Factors with Blood Pressure of Land Transportation Manufacturing Workers**

Based on Table 4, this study examined the correlation between six variables and workers' blood pressure. Of the five variables, based on the results of the Fisher's Exact test, 4 variables, namely BLLs (p = 1,000), age (p = 0.158), consumption of caffeine (> 2 cups of coffee/day) (p = 1,000), and smoking frequency (p = 0.663), had no correlation with blood pressure. The two other variables correlated with blood pressure were nutritional status (p = 0.031) and family history of hypertension (p = 0.016). Based on the data, only two out of 20 workers had high blood pressure. Both of them from administrative officers who had obese nutritional status and over 46 years old.

**Table 4. Cross Tabulation Between Individual Factors and Blood Pressure of Land Transportation Manufacturing Company Workers**

Variables	Blood Pressure				Total		p value
	<140/90 mmHg		≥140/90 mmHg		n	%	
	n	%	n	%			
<b>Blood Lead Levels (BLLs)</b>							1.000
<10 µg/dL	13	86.67	2	13.33	15	75.00	
≥10 µg/dL	5	100.00	0	0	5	25.00	
<b>Age</b>							0.158
16-25	3	100.00	0	0	3	15.00	
26-35	8	100.00	0	0	8	40.00	
36-45	3	100.00	0	0	3	15.00	
46-55	4	66.67	2	33.33	6	30.00	
<b>Nutritional Status</b>							0.031
Normal	13	100.00	0	0	13	65.00	
Overweight	3	100.00	0	0	3	15.00	
Obesity	2	50.00	2	50.00	4	20.00	
<b>Family History of Hipertention</b>							0.016
Yes	1	33.33	2	66.67	3	15.00	
No	17	100.00	0	15.40	17	85.00	
<b>Coffee Consumption (&gt;2 cups a day)</b>							1.000
Yes	11	91.70	1	8.30	12	60.00	
No	7	87.50	1	12.50	8	40.00	
<b>Smoking Status</b>							0.663
Non-Smoker	7	87.50	1	12.50	8	40.00	
Mild	8	100.00	0	0	8	40.00	
Moderate	3	75.00	1	25.00	4	20.00	
<b>Total</b>	<b>18</b>	<b>90.00</b>	<b>2</b>	<b>10.00</b>	<b>20</b>	<b>100.00</b>	

## DISCUSSION

### Correlation Analysis of Lead Levels in the Work Environment with BLLs

Lead exposure in the workplace was measured from the lead level in the air and BLLs to reduce possible risk, considering that lead is a dangerous and toxic metal chemical to humans. Based on the results of measurements at 5 points, four exposed points were wider, and two of them were workshop buildings for painting activities that had more than 0.5 mg/m<sup>3</sup> lead level in the air. The mobilization of industrial painters in the workshop buildings was relatively high. For the analysis, the average lead content in the workshop buildings was calculated to represent the result. In the Internal Audit Division office, measurements were only made at 1 point, considering the office space's size was not too large. Meanwhile, in the measurement of lead levels in the blood, it was found that five workers who were industrial painters had lead levels of more than ten µg/dL.

The analysis showed a relationship between the levels of lead in the air and the blood. This findings was supported by research on car industrial painters in Surabaya, which also stated a strong relationship between air lead and lead in the workers' blood (9). It was strengthened by other studies on the metal casting industry in Klaten, which also stated a correlation between lead in the air and lead in the blood ( $p = 0.019$ ) (16). Furthermore, workers in electronics manufacturing companies in Iran also showed the correlation significantly with p-value of 0.016 (8). The spraying method was considered the most effective and had the best results but could cause a higher average lead level in the painting area and for a long time exposure would increase health effect (9). About 40% of the air's lead levels entered through the respiratory tract, and as much as 95% were bound by red blood cells. The accumulated nature of leads and the minimal excretion of lead in the body lead to increased lead levels from year to year (12).

### Analysis of the Correlation between BLLs and Individual Factors with Blood Pressure

In this study, BLLs had no correlation with blood pressure. None of the workers with BLLs  $\geq 10$  µg/dL had high blood pressure. Two administrative officers suffered high blood pressure. This statement was in line with previous research on industrial painters in Semarang that there was no significant relationship between BLLs and systolic blood pressure (13). The presence of lead in the human body could increase the risk of health problems

such as high blood pressure (2); however, high blood pressure could happen to anyone. Lead exposure was not a significant factor, but it could increase a person's risk of having high blood pressure (6). Other factors that caused high blood pressure include heredity, increasing age, nutritional status, lifestyle, and food intake, which could be burdensome for the heart (17). Industrial painters who used lead-based paints were still a group of workers at risk of developing high blood pressure. There was a significant association between blood pressure and Reactive Oxygen Species (ROS) production in the kidneys. It resulted in increased oxidative stress that bound nitric oxide, the cause of the narrowing of blood vessels, as well as derivatives of the ability of hemoglobin to bind O<sub>2</sub> (18-19).

The worker's age and blood pressure did not show any correlation. High blood pressure generally began to appear when a person reached middle age over 35 years, and men suffered more from high blood pressure at a younger age than women. As many as two workers (10%) experienced high blood pressure, and they came from the 45-55 years old. Two industrial painters had lead levels of  $\geq 10$  µg/dL and were at a risky age but did not have high blood pressure. This study's results were in line with Chasanah's and Syarifah's studies, which found no significant relationship ( $p = 0.682$ ) between age and blood pressure degree (20). The study was carried out on public transport drivers in Palembang City in 2016, where it was concluded that there was no significant relationship between age and incidence of hypertension (21).

Age did affect a person's blood pressure because the older a person was, the easier it would be to increase blood pressure. However, at a risky age, blood pressure could still be controlled by maintaining a healthy diet, increasing exercise intensity, and regularly carrying out blood pressure checks (17). This study contradicted the previous research on hypertensive patients in Sidoarjo. It found a significant relationship between the age variable and the incidence of hypertension (22). The increasing age of a person caused decreased blood vessels' elasticity and kidney function as a regulator of normal blood pressure (23). However, another conclusion showed that 87% of respondents with high blood pressure were aged 60 years and over (22).

In this study, the differences between nutritional status and blood pressure were shown concerning the effects of lead exposure in the work environment. The nutritional status, which was the variable of this study, was divided into normal and abnormal (fat and obese). The two administrative workers who had high blood

pressure were workers with abnormal nutritional status. Meanwhile, 11 industrial painters (92%) had normal nutritional status. Only one painter who had a lead level of  $\geq 10$   $\mu\text{g/dL}$  had an abnormal nutritional status, so that nutritional status was correlated to an increase in blood pressure. Previous studies also showed similar results that there was a relationship between Body Mass Index (BMI) and hypertension (24) and studies in patients at the Pertamedika Sinabung Clinic. It also concluded that there was a relationship between BMI and systolic blood pressure ( $p= 0.000$ ) and diastolic blood pressure ( $p= 0.005$ ) (25).

Increased blood pressure was closely related to the habit of consuming high-fat foods. A large amount of fat in the blood causes blockage of blood vessels. Narrowing of the blood vessels due to fat blockages will further force the heart to pump blood more forcefully than usual. Body mass will further increase the blood volume needed to supply  $\text{O}_2$  and nutrients to all tissues. The increase in blood volume demands greater pressure on the artery walls than people with a normal mass body (26). Workers who were at high risk of exposure to lead should be workers with a low body fat content because the presence of lead concentration inside the blood reduced hemoglobin's ability to bind oxygen ( $\text{O}_2$ ) (27). The weak ability required the heart to pump blood more strongly to meet the tissue's needs for  $\text{O}_2$ .

Family history of hypertension referred to whether family members ever experienced hypertension. Those with a history of hypertension had high blood pressure. Two out of seven workers who had a family history of hypertension had high blood pressure. In contrast, none of the industrial painters with more than 10  $\mu\text{g/dL}$  BLLs had family history of hypertension. It was in line with the previous study that a family history of hypertension and high blood pressure were related to abnormalities in blood pressure (28). Family members who had a history of hypertension increase their chance of developing hypertension by 1.518 times than those who did not (29).

In primary hypertension, family history increased a person's risk of developing high blood pressure conditions. Heredity affected blood pressure increase through several genetic activities in vascular regulation and sodium reabsorption activity by the kidneys (30). If one parent had high blood pressure, the child would have a 25% chance for life, whereas a person's chances increase to 60% (31). It was important to carry out an initial medical check-up to determine the worker's medical history to prevent vulnerable workers' placement in high-risk work areas.

There was no correlation between caffeine consumption habits and the workers' blood pressure. The habit of consuming caffeine referred to the worker's habit of consuming  $>2$  cups of coffee per day. A total of 12 workers (85%) consumed coffee out of 2 workers who had high blood pressure, one worker was a worker who has the habit of consuming coffee and one other worker did not. A meta-analysis study of 8 articles that discussed the risk of hypertension due to coffee consumption concluded that there was no correlation between coffee consumption and the incidence of hypertension, and coffee consumption was inversely related to the risk of hypertension. The risk was due to hemodynamic and hormonal exposure to caffeine that occurs continuously for a long time in a person who had consuming coffee every day, making the complex hormones keep stable blood pressure (32). Another study involving young adult respondents also stated no relationship between coffee consumption habits and blood pressure even though most respondents had a coffee consumption habit of 200-300 mg per day (33). Another previous study suggested that caffeine consumption should be limited because it could inhibit antihypertensive drugs being consumed (34). This information was important if workers with BLLs  $\geq 10$   $\mu\text{g/dL}$  did not experience high blood pressure because of antihypertensive drugs. It was recommended that workers should reduce their coffee consumption.

This study showed no relationship between smoking status and blood pressure. The status of smoking referred to a person's smoking rate, classified as light smokers, moderate smokers, and heavy smokers. It was obtained from the multiplication of the average number of daily cigarettes and the length of years of being a smoker. Eight out of twelve workers were light smokers. Of the two workers with high blood pressure, one worker was a non-smoker, and the other worker was a heavy smoker. Other research that supported this statement was in the adult community in Jati Luhur, Bekasi, which stated that smoking with hypertension did not have a significant relationship (29). The risk of hypertension in smokers was more focused on the number and types of cigarettes smoked per day. It was relevant to the study, which found no relationship between smoking duration and the incidence of essential hypertension in male respondents over 18 years old (35).

A study on adult men discovered a relationship between smoking and hypertension with a p-value of 0.039 (36). Nicotine is a toxic substance in cigarettes that triggers the adrenal glands and brain to produce the hormone adrenaline. The hormone adrenaline works by constricting blood vessels' diameter, forcing the heart to

work faster to supply blood throughout the body, causing blood pressure to increase (37). Carbon monoxide (CO) in cigarette smoke also affects blood pressure because blood is more likely to bind CO than O<sub>2</sub> (38). This condition could be exacerbated if the worker's body contains lead concentration inside the blood, which can reduce hemoglobin's ability to bind O<sub>2</sub>, causing a lack of O<sub>2</sub> in body tissues, resulting in more complex work of the heart in pumping blood. Quitting smoking is an option to reduce the risk of high blood pressure (39), especially in workers who have a high risk of exposure to lead at the workplace such as painting areas.

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### CONCLUSION

It can be concluded that the painting area had an average level of lead in the air that exceeded TLVs. Workers with a BLLs content above 10 µg/dL came from the painting area. It was also found that the lead level in the air was related to the BLLs. Furthermore, the variables correlated with blood pressure were family history of hypertension and nutritional status. In this study, lead exposure was not a factor that caused high blood pressure because most industrial painters did not have family history of hypertension and had normal nutritional status. But, exposure control still needs to be done as lead has an acute effect. To reduce the health risk due to lead exposure to painting workers, it is recommended that company must ensure all the painting workers don't have family hypertension background and or abnormal nutritional status. As prevention too, the company should conduct socialization about the effects of lead exposure on health, rotate workers to different divisions, and conduct routine exercise to control their blood pressure, and provide the high calcium food that can inhibit the absorption of lead into the body.

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