

Analysis of Factors Related to Levels of Lead in Urine Mechanical Official Workshops in Banjarbaru City Area

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ABSTRACT

Lead (Pb) is a class of heavy metals that are most commonly used in the motor vehicle industry because lead reacts easily with other compounds. These compounds produce accumulative neurotoxic toxins that are very harmful to the human body. Workshop mechanics are potentially at risk of lead poisoning. Lead can enter the body through absorption mechanisms (respiratory tract, digestion, and skin). Lead is distributed in the body and eliminated 60% through the kidneys then excreted into urine. The purpose of this study was to analyze the factors related to lead levels in the urine of authorized workshop mechanics. This study is a quantitative study with a cross sectional design on 50 respondents of authorized workshop mechanics in Banjarbaru City area by total sampling. Data were analyzed using Spearman Rho test with 95% CI. There was a concentration of lead in the urine of authorized workshop mechanics between 0.024-0.062 mg/L. The results of correlation analysis of age (p-value 0.705), tenure (p-value 0.550) and smoking habits (p-value 0.565) did not have a significant correlation with urine lead levels. There is no relationship between age, length of service and smoking habits on urine lead levels of authorized workshop mechanics in Banjarbaru City area.

Keywords: Lead, workshop mechanics, heavy metal

INTRODUCTION

The city of Banjarbaru is one of the cities that has a strategic market share in the development of motorcycle authorized repair shops. The rapid development of the official motorcycle repair shop business has caused many repair mechanics to be vulnerable to lead exposure. This is because the discharge of gases from motor vehicle waste, which contains lead, has the potential to cause a dangerous risk of lead poisoning.

Lead (Pb) poisoning often occurs in high-risk groups, one of which is workshop workers because they have the potential risk of being exposed to pollution from exhaust gases and waste from vehicles containing lead.^{1,2} Lead levels in a person's body can be affected by lead in a person's body can be affected by lead in the air, because exposure to lead from vehicle exhaust fumes produces high lead levels.² fumes produces high lead levels.^{3,4}

According to Sari et al (2013) Approximately 70% of air pollution in Indonesia

is caused by motorized vehicles emitting smoke from motorcycle exhausts, which contain hazardous substances that have a toxic effect on human health.⁵ The impact of chronic lead poisoning in humans results in decreased libido, decreased fertility (male and female), miscarriage and premature birth, intelligence problems, hypertension, cardiovascular disease, more aggressiveness, and impaired kidney function.⁶ This is because lead has accumulative neurotoxic properties in humans.⁷

Lead is a very dangerous substance and its effects are toxic to the human body. Many factors can affect the accumulation of these substances into the body. References related to these issues are still difficult to obtain because related research is still very rare but various factors can appear and relate to lead levels in the body including age, smoking habits, and tenure.^{8,9}

Young people are generally more sensitive to lead activity, while older people have a higher sensitivity to lead exposure

because, as people get older, their immune systems decrease, so that lead concentrations quickly accumulate in body tissues.⁸ Based on study results Adejumo et al., (2017) There is a significant relationship between age and lead levels.¹⁰

The habit of smoking causes a decrease in the function of the cilia, so that lead-contaminated air will easily enter the lungs and then bind to the blood and flow to all parts of the body.¹¹ This causes 90% of the lead to be easily distributed in the lungs and results in interference with the process of hemoglobin synthesis.¹² Study Muliyadi et al (2015) has proven that there is a relationship between smoking habits and lead levels.³

The working period allows it to affect the amount of lead exposure because the more often workers receive exposure, the more lead accumulates in the body. In this case, the lead exposure that enters the body is normally 0.3 g/dL per day; if lead exposure is 2 g/dL per day, it takes 3 to 6 years to get a toxic effect on the body, whereas if lead exposure is 3.5 g/dL per day, it takes only a few months for lead to accumulate in the body.^{11,2} Based on studies (Rachmawati, 2020) Workers who have relatively shorter working lives have lower lead levels, while for those with relatively long working lives, lead levels will increase.⁹

On the other hand, lead that enters the body will affect heme synthesis through inhibition of heme synthesis enzymes such as d-aminovulinate dehydratase (ALAD), ferrochelataze, the use of coproporphyrin and protoporphyrin IX, and non-heme Fe in erythrocytes.¹³ Blood containing lead then enters the glomerulus, which is part of the kidney. Blood containing lead is then excreted and becomes urine, so that lead content can be known through urine.¹⁴ Study Patharkar et al., (2019) stated that lead, which inhibits enzymes during the heme synthesis process, will increase lead levels in the urine by 73,61%.¹⁵

Workshop workers are potentially at risk of exposure to pollution from exhaust gases and vehicle waste containing lead. Lead exposure experienced by garage mechanics occurs through the fumes of vehicles being repaired and is very dangerous because it can poison the environment and affect the entire human body system.

Therefore, it is necessary to conduct in-depth research related to the effect of lead exposure that occurs from motorized vehicles on workshop workers and the factors that influence it. The purpose of this study was to determine the relationship between age, length of service, and smoking habits on urine lead

levels of authorized repair shop mechanics in Banjarbaru City.

METHOD

This type of research is quantitative research with a cross sectional research design. Because this research studies the correlation between exposure or risk factors (independent) with consequences or effects (dependent), with data collection carried out simultaneously at one time between risk factors and their effects (point time approach). In this study, the risk variable data were age, working period, smoking habit, and the effect variable data were urine lead levels of workshop mechanics who were examined at the same time.

The research sample was the urine of 50 official workshop mechanics in the Banjarbaru City area because Based on the results of field observations and interviews to motorcycle repair shops in the Banjarbaru City area, the number of authorized workshops in the Banjarbaru City area is 9 workshops, with a total of 50 mechanics. it is in accordance with the choice of sampling technique that uses technique being total sampling. The samples taken are those who meet the inclusion criteria, namely, work as official repair mechanics, are in charge of repairing motorized vehicles, and are willing to become research objects.

Data collection techniques included interviews using a questionnaire created and modified from similar studies to input data related to age, length of service, and smoking habits, then urine samples were analyzed for lead levels. The source of data in this study was primary data, and then the urine sample was analyzed in the Chemical and Biomolecular Biology Laboratory of Lambung Mangkurat University, Banjarbaru.

The method of data analysis uses the Spearman rho test using the SPSS data processing program because After passing the normality test, the data was not normally distributed, so the Spearman rho test was carried out. The variable measured was the level of lead in the urine using the UV-Vis spectrophotometer method.

Measurement of lead levels in urine was carried out by taking a urine sample of 20 ml and then putting it in a glass beaker and adding 10 ml of HNO₃ slowly, then heating the mixture in a fume hood until the red acid disappeared and the sample was removed and then cooled. After the cold sample was added, 5 ml of 0.4 HCL were heated until the smoke color turned white and the sample became clear, then the sample was measured.

RESULT AND DISCUSSION

Based on the results of the study, it was found that the educational level of SMK/SMA

was higher than that of SMP. Meanwhile, the working time of all workshop mechanics is under 8 hours. Table 1 shows the specifics.

Tabel 1. Characteristics of education and length of work experience of official workshop mechanics in the City of Banjarbaru

Characteristics	Frequency (n)	Percentage (%)
Level of education		
Basic School	0	0
Elementary School	6	12
Hight School	44	88
Diploma/ Undergraduate	0	0
Length of working		
< 8 hours	50	100
> 8 hours	0	0

The average age of official workshop mechanics is young, with an average working period of > 5 years. Meanwhile, the smoking habit of official mechanics is to smoke

cigarettes every day. The average lead level obtained was 0.0374 mg/L, the lowest was 0.020 mg/L, and the highest was 0.060 mg/L.

Tabel 2. Descriptive data on age, years of service, smoking habits, and lead levels of mechanics at official workshops in the City of Banjarbaru

Variable	Mean	Minimum	Maksimum	Amount (n)
Age	27	18	52	50
Working Period	6	1	22	50
Smoking habit	8	0	20	50
Lead Level	0.037	0.020	0.060	50

The relationship between age, years of service, and smoking habits and lead levels is presented in table 3. According to the results of statistical tests, age, years of service, and smoking habits did not significantly affect lead levels in the urine of official mechanic workshops in the Banjarbaru City area, and there was no evidence of a causal relationship at a 95% confidence level.

Lead is the group of heavy metals most commonly used in the motor vehicle industry because lead easily reacts with other compounds to form various lead compounds, such as in motorized vehicle engines that produce combustion to form lead salts (chlorine, bromine, and oxide). The impact of

the formation of lead salts will produce toxic compounds that are cumulatively neurotoxic, which are very dangerous for the human body and can poison the human body system.⁷

Based on decree of the minister of health of the Republic of Indonesia Number 1406/MENKES/IX/2002 the threshold value for lead levels in the urine that is allowed in the human body is 0.15 mg/L. Based on the results of the examination and calculations, it was found that the respondent's urine lead level was <0.15 mg/L, with an average lead level obtained of 0.0374 mg/L, the lowest was 0.020 mg/L and the highest was 0.060 mg/L. So it is known that urine lead levels in official mechanic workshops are normal.

Tabel 3. Relationship between age, years of service, and smoking habits on lead levels

Relations	P-value	Correlation coefficient (r)	Decision
Age on urinary lead levels	0,705	0,055	There is no correlation
Working time on urine lead levels	0,550	0,087	There is no correlation
Smoking habits on urinary lead levels	0,565	-0,083	There is no correlation

Information: *) = $p > 0,05$ (meaningless)

Lead exposure experienced by workshop mechanics occurs through the smoke of the vehicle being repaired because the mechanic must make carburetor adjustments, which requires the engine to be turned on and the mechanic to sit adjacent to the vehicle being repaired, thus originating the process of lead metal exposure from vehicle exhaust emissions. motor, and the result of changing motor engine oil with a concentration of around 25% lead will be in the engine, and the other 75% will pollute the air as exhaust fumes. Lead can be found in high concentrations in the body

due to the ease with which it enters the body through the respiratory, digestive, and skin tracts.^{16,17)}

Lead that enters the blood vessels of the lungs will bind to the blood in the lungs and then be circulated throughout the tissues and organs of the body. Approximately 95% of the lead in the blood will be bound by erythrocytes, so that lead will inhibit hemoglobin synthesis. Lead that has been distributed into the body will then be metabolized and excreted through the urine.^{12,18}

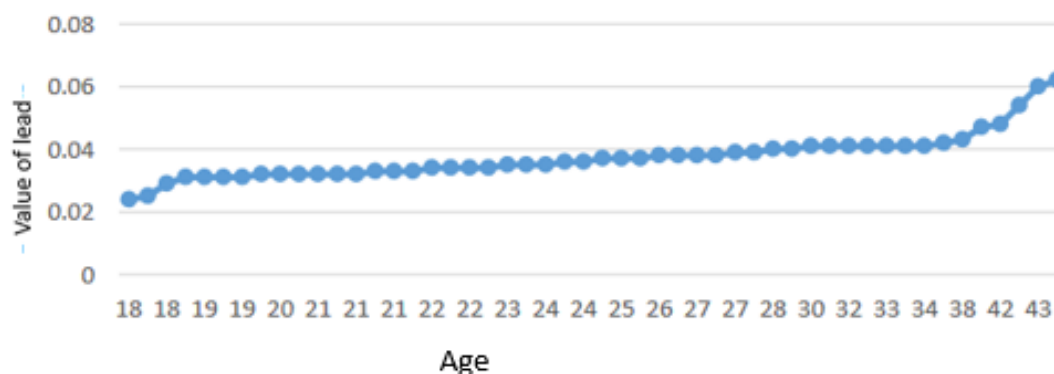


Figure 1. Graph of age against lead levels

Age is the period between birth and the present that places individuals in a developmental sequence. In this research study, Age is not significantly related to lead levels in the urine of authorized mechanic workshops in the Banjarbaru City area. lead exposure at the age that enters the body of the mechanic of the official workshop is still in the normal category. Based on the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES/IX/2002 the threshold of urine lead levels allowed in the human body is 0.15 mg/L. The results of this study are in line with the research of Mulyadi et al. (2015) which states that age is not related to lead levels in car painting workshop workers (p-value 0.359).³ The results of this test can be concluded that the older a person's age, the The increase that

occurs in this study towards the accumulation of lead in a person's body is still within the threshold of normal values.

The age variation of each respondent to start a profession as an authorized workshop mechanic is not the same. The average age of authorized garage mechanics is 27 years old, the youngest age is 18 years old and the oldest age is 52 years old, meaning that authorized garage mechanics are young.

At the age of 18 to 19 years, the tendency of workshop mechanics to be exposed to lead is still within normal limits with a level of 0.020 mg/L, but at the age of 19 to 34 years, the tendency of lead exposure increases with an increase of (11%). increased with an increase of (11%) with a level of 0.036 mg/L and at the age of 35-54 years, the tendency of

lead exposure increased with a level of 0.020 mg/L. 35-54 years of age, the tendency to increase lead exposure further increased (19%) with a level of 0.060 mg/L. It can be concluded that the increasing trend of lead exposure from young to old age results in the accumulation of lead exposure results in the accumulation of lead exposure in the body. Based on the results obtained, the tendency of the increase in accumulated lead levels in mechanics of

authorized workshops is still within the normal threshold. mechanics of authorized workshops is still within the normal threshold. Therefore, lead exposure that from motor vehicle repairs and motorized exhaust emissions to lead concentrations accumulated in the body is not yet to the concentration of lead accumulated in the body has not reached a large large concentrations.

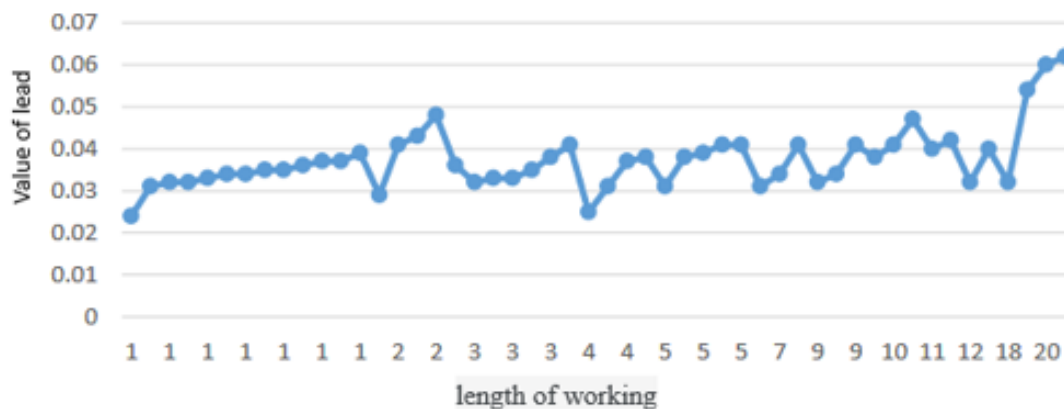


Figure 2. Graph of working period against lead level

Although age has no effect on lead levels in the urine of official workshop mechanics, lead levels have been found to increase in the oldest age group. This is because old age makes people more sensitive to lead exposure than young age because the activity of biotransformation enzymes decreases with age. The age and resistance of certain organs are reduced by the effects of lead. The older a person is, the higher the concentration of lead that accumulates in body tissues.⁹

According to Sari et al., (2016) every individual has immunity to receiving lead exposure, so it is not based on the age of each individual.¹¹ In addition, the variation in age for each respondent to start the profession as an official repair mechanic is not the same. The average age of official mechanics is 27 years; the adult age is 18 years; and the oldest is 52 years. This means that the official workshop mechanic is young. According to Qoriah et al., (2015) Young people are 17–34 years old, and old people are 35–54 years old. As a result, lead exposure from motor vehicle repairs and motorized gas exhaust emissions has not resulted in a significant accumulation of lead in the body.¹⁸

Working period, namely the period or length of time a person works as an official mechanic and is actively involved in repairing motorized vehicles. Years of service had no significant relationship to lead levels in the urine of mechanics from official workshops in the

Banjarbaru City area, according to the results of an analysis of the relationship between years of service and lead levels in the urine of official mechanic workshops. Lead exposure during the working period that enters the body of the mechanic of the authorized workshop is still in the normal category. Based on the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES/IX/2002 the threshold of urine lead levels allowed in the human body is 0.15 mg/L. The results of this study are in line with the results of the study of Qoriah et al. (2015) The working period is not related to lead (Pb) levels in the body with a value (p -value 1.000).¹⁸ The results of this test indicate that the longer a person's working period in doing motorcycle repair work, the more lead exposure in a person's body will increase, an increase that occurred in this study towards lead accumulation.

However, the relationship between working period and lead accumulation is not a triggering factor for high levels of lead in the bodies of mechanics in authorized repair shops. This is because in the interview results, the average worker works 8 hours a day for six working days. Workshop mechanics repair motorized vehicles start working at 08.00-16.00 and break time at 12.00-13.00 for lunch to rest. During the break time, workshop mechanics consume more nutritious foods and consume enough water to replace lost body fluids. According to Pratiwi et al. (2021) the intake of

each worker on a daily basis to lead exposure will vary. in a person's body is still within the threshold of normal values.¹⁹

Data was obtained that the newest official workshop mechanic's working period of 1 year had a lead level of 0.020 mg/L while the longest 22 years had a lead content of 0.060 mg/L with an average of 6 years of work of 0.037 mg/L. This shows that lead can be accumulative in the body.

Official workshop mechanics who are in charge of repairing motorized vehicles and are often exposed to pollution from motorized vehicle exhaust emissions may be able to influence the amount of lead exposure pollution because the more frequent and continuous exposure is received, the more lead will accumulate in the body.

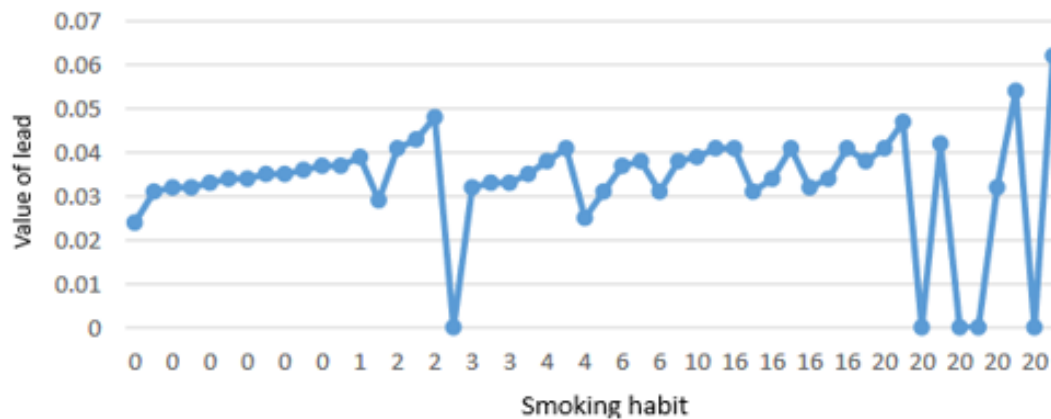


Figure 3. Graph of smoking habits against lead levels

The smoking habit is a permanent activity of inhaling and exhaling cigarette smoke through a pipe or cigarette that is formed through four stages, namely: level preparation, initiation, becoming a smoker dan maintenance of smoking.²⁰ It is known that the range of smoking habits in consuming cigarettes 0-7 cigarettes per day shows the presence of lead exposure that enters the body of authorized workshop mechanics of 0.022- 0.036 mg/L, while the range of smoking habits in spending cigarettes 9-20 cigarettes per day lead exposure that enters the body amounted to 0.038-0.060 mg/L, with an average smoking habit of smoking 8 cigarettes per day to lead levels that enter the body is 0.037 mg/L. This shows that there is an increase in lead exposure in smoking habits to lead levels in the body.

Lead exposure to smoking that enters the body of authorized workshop mechanics is still in the normal category. normal category. Based on the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES/IX/2002 the threshold of urine lead levels allowed in the human body is 0.15 mg/L. Based on the results of the analysis of the relationship between smoking habits and lead levels in the urine of official mechanic workshops, it was shown that smoking habits were not related to lead levels in the urine of official mechanic workshops in the Banjarbaru

City area. Official workshop mechanics always smoke cigarettes in their daily activities, so smoking has become a habit. Even during recess, smoking is used as an alternative to relieve tired physical condition after completing motor vehicle repairs. The results of this smoking habit study are in line with the research of Devyana D.W et al (2021) which states that there is no significant relationship between smoking habits and lead levels in the body (p-value 0.574).²¹ This result is corroborated based on the study of Rantesalu, (2021) smoking habits are not significant to lead levels in the body (p-value > 0.05).² So the results of this test can be concluded that the number of cigarettes smoked in one day shows that lead exposure to a person's body will increase, the increase in accumulated lead levels in this study is still within the threshold of normal values.

Based on the results of interviews and direct communication with official repair mechanics in the Banjarbaru city area, the daily habits of most mechanic workers always include nutritious food, multivitamins, and drinking enough water. This is because the official repair shop company understands the gap and the health of its workers, and the average official workshop mechanic consumes 8 cigarettes per day according to the provisions of the World Health Organization for light smokers (1-10 cigarettes), medium smokers

(11–20 cigarettes), heavy smokers (21–30 cigarettes), and very heavy smokers (more than 31 cigarettes). So it is stated that the habit of smoking in official workshop mechanics in the Banjarbaru City area is still included in the "light smoker" category.

According to Rachmawati et al., (2016) The amount of lead in the body is related to smoking habits. Cigarettes can increase the level of lead in a person's body because consumption of cigarettes every day increases the risk of lead inhalation as a result of cigarette smoke.⁸ The process of inhalation through the absorption phase (respiratory tract) is influenced by three processes: deposition, mucociliary cleaning, and alveolar cleaning. Larger particles are more readily deposited in the upper respiratory tract than smaller particles. Mucociliary clearance carries particles in the upper respiratory tract to the nasopharynx, where they are swallowed. On average, 10–20% of inhaled lead is absorbed through the lungs.²² The chemical compounds contained in cigarettes cause gas exchange to become very difficult and decrease the function of the cilia so that it interferes with the process of regeneration of epithelial cells, and the cilia cannot filter polluted air when lead enters the lungs, so the higher the smoking habit, the higher the levels. lead in the body.¹¹

CONCLUSION

From the results of research conducted on workshop mechanics, it was found that there was no relationship between age, tenure and smoking habits on urinary lead levels in mechanics of authorized mechanics in the Banjarbaru City area. Suggestions for future research are to analyze other factors that may be related to urine lead levels and use nail or hair samples.

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