



Factors Related To Blood Lead Levels In Women Of Childbearing Age In The Working Area Of Bandarharjo Community Health Center, North Semarang City

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ABSTRACT

Increasing development in all fields and aspects to date, apart from providing positive benefits, also leaves negative impacts on the environment. One of the sectors that is growing rapidly at present is the increase in development in the industrial sector. The city of Semarang itself is one of the cities located on the north coast of the Java Sea which is densely industrialized

and has an impact on the increasing amount of waste produced by production and is a negative impact of industrial development. This type of research is an analytic observational study with a cross sectional design which aims to determine the factors associated with blood lead levels, namely drinking water sources, nutritional status, and history of exposure to cigarette smoke. The number of samples in this study were 67 women of childbearing age who were obtained using purposive sampling technique. The data analysis used was univariate and bivariate with the chi square test, t-test, and the Spearman test. The results showed that there was no relationship between nutritional status ($p = 0.333$), source of drinking water ($p = 0.273$), and a history of exposure to cigarette smoke ($p = 0.305$).

Key words: Blood Lead Levels, Drinking Water Sources, Nutritional Status, History Of Exposure To Cigarette Smoke, Women Of Childbearing Age

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INTRODUCTION

Lead is a type of heavy metal that occurs naturally, is available in the form of ores, and also in volcanic sparks. Lead can enter the body through inhalation, absorption, and ingestion. (WHO, 2012) Exposure to heavy metal lead can accumulate in the human body such as in nails, bones, teeth, hair, urine and blood. Children, women of childbearing age, pregnant women, and workers in industry are more likely to be poisoned with heavy metal lead than other groups (Kessel and Connor, 1997).

Lead can damage several functions of the kidneys, liver, damage the nervous system, interfere with the development of red blood cells, blindness and even mental retardation. The main target organs for lead (Pb) are the hematopoietic system, central nervous system, peripheral nervous system, and kidneys. (Suksmerri, 2008) The level of lead, if it is absorbed into the body, cannot be destroyed, but remains in the body. so that later it is removed through the excretion process. The excretion process of lead in the body is very slow so that lead can easily accumulate in the body. (Agricultural Development Research Institute, 2016) Primary and secondary prevention of lead exposure among Women of childbearing age is needed to prevent neurobehavioral development disorders and cognitive skills in their children. (CDC, 2004)

METHOD

The research design used in this study was an observational analytic study, with a cross sectional study design. The population in this study were women of childbearing age ranging in age from 14-49 years who live in the coastal areas of North Semarang, especially in the working area of the Bandarharjo Community Health Center, namely Kelurahan Kuningan, Kelurahan Dadapsari, Kelurahan Bandarharjo, and Kelurahan Tanjung Mas. The sampling technique used in this study was purposive sampling with a total sample of 67 women of childbearing age who were in the working area of the Bandarharjo Community Health Center, North Semarang District, Semarang City.



RESEARCH RESULT

Characteristics of Respondents

Table 1. Education Level

No.	Education Level	Total	Percentage (%)
1.	Graduated from Elementary School / Madrasah Ibtidaiyah	12	17,9
3.	Completed Junior High School / Madrasah Tsanawiyah	29	43,3
5.	Completed High School. Vocational High School	26	38,8
Total		67	100.0

Table 2. Age and Nutritional Status

Based on table 1, it shows that the education level of the respondents in this study the highest number of junior high school graduates / Madrasah Tsanawiyah was 29 people (43.3%), while the lowest was 12 people (17.9%) graduated from Elementary School / Madrasah Ibtidaiyah.

No.	Variable	n	Mean	SD	Median	Min	Max	<i>p</i> (normalitas)
1.	Age	67	29,22	8,479	28	15	49	0,2
2.	Body Mass Index Value	67	25,13	4,473	24,95	17,64	40,52	0,2
3.	Lead Levels in Blood	67	74,84	12,49	75,3	45,5	99,7	0,2

Based on table 2, it shows that the age of the youngest woman of childbearing age is 15 years and the oldest is 49 years. The distribution of data on the age of women of reproductive age was normal ($p > 0.05$) with a mean of 29.22 and a standard deviation of 8.479. The nutritional status category of respondents is seen based on the respondent's Body Mass Index (BMI). The highest body mass index value was 40.52 (overweight) and the lowest was 17.64 (underweight). The distribution of the Body Mass Index value data is normal ($p > 0.05$) with a mean of 25.13 and a standard deviation of 4.473. The lowest blood lead level was 45.5 $\mu\text{g} / \text{dl}$ and the highest was 99.7



$\mu\text{g} / \text{dl}$. The data distribution of lead levels in the blood was normal ($p > 0.05$) with a mean of 74.84 $\mu\text{g} / \text{dl}$ and a standard deviation of 12.49.

Table 3. Respondents' Occupation

No.	Profession	Total	Percentage (%)
1.	Housewife	55	82,1
2.	Labor	8	11,9
4.	Private employees	4	6,0
Total		67	100,0

Based on table 3, it shows that of the 67 female respondents of childbearing age in the work area of the Bandarharjo Community Health Center, North Semarang District, there are 55 people (82.1%) who work as housewives, 8 people (11.9%) as laborers, and 4 people (6%) as private employees.

Table 4. History of exposure to cigarette smoke

N	Cigarette	Exposure	Total	Percentage (%)
o.	History			
1	Exposed		58	86,6
2	Not Exposed		9	13,4
Total			67	100

Based on table 4, it shows that as many as 58 people (86.6%) were exposed to cigarette smoke and as many as 9 people (13.4%) were not exposed to cigarette smoke.

Table 5. Drinking Water Sources

No.	Source of Drinking Water	Total	Percentage (%)
1.	Well	37	55,2
2.	Bottled water	2	3,0
3.	Refill Water	25	37,3
4.	Regional Drinking Water Company Water	3	4,5
Total		67	100,0



Based on table 5, it shows that as many as 37 people (55.2%) consumed well water for their drinking water needs, 2 people (3%) consumed bottled water, 25 people (37.3) consumed refill water, and 3 people (4, 5%) drinking water from the Regional Drinking Water Company.

Analysis of Lead Levels in Blood and Body Mass Index

Table 6. Results of Examination of Blood Lead Levels and Body Mass Index

No.	Variable	n	Mean	SD	Median	Min	Max	<i>p</i> (normalitas)	NAB/ Normal levels
1.	Blood lead levels	67	74,84	12,49	75,3	45,5	99,7	0,2	5 $\mu\text{g/dL}$
2.	Body mass index	67	25,13	4,473	24,95	17,64	40,5 2	0,2	

Table 7. Frequency Distribution of Blood Lead Levels and Body Mass Index

No	Variable	frequency	(%)
1.	Lead Levels in Blood		
	High ($\geq 74,84 \mu\text{g/dL}$)	34	50,7
	low ($< 74,84 \mu\text{g/dL}$)	33	49,3
2.	Body mass index		
	Skinny	3	4,5
	Normal	32	47,8
	Fat	13	19,4
	Obesity	19	28,4

Levels of Lead in the Blood

The results of the examination of lead levels in the blood had an average of $74.84 \mu\text{g/dL}$ with a range of $45.5-99.7 \text{ g/dL}$. These results indicate that most respondents have blood lead levels that exceed the limit set by the Center for Diseases Control and Prevention (CDC), which is 5 g/dL . To make it easier for researchers, the researchers categorized the results of lead levels in the blood between high ($\geq 74.84 \text{ g/dL}$) and low ($< 74.84 \text{ g/dL}$), based on table 7, it was found



that there were 34 women of childbearing age (50 , 7%) had high lead levels, and 33 women of childbearing age (49.3%) had low lead levels.

Nutritional Status

The nutritional status category of respondents can be seen based on the respondent's Body Mass Index (BMI). The category of respondent's nutritional status is seen based on the respondent's Body Mass Index which consists of very thin (Body Mass Index <17), thin (Body Mass Index 17.0-18.4), normal (Body Mass Index 18.5-25.0), fat (Body Mass Index 25.1-27.0) and obesity (Body Mass Index > 25.0). The results of the Body Mass Index examination in women of childbearing age had an average of 25.13 with a range of 17.64-40.52. Based on table 7, it is found that as many as 3 people (4.5%) with the category of underweight nutritional status, as many as 32 people (47.8%) with the category of normal nutritional status, as many as 13 people (19.4%) with the category of fat nutritional status. , and as many as 19 people (28.4%) with the category of obesity nutritional status. Furthermore, to make it easier for researchers, the researchers categorized the nutritional status into normal and abnormal (very thin, thin, obese, and obese).

Data Normality Test

The data normality test was carried out to determine the mean difference test used in comparing the value of lead levels in the blood in each group. The data normality test used the Kolmogorov Smirnov because the number of respondents was more than 50.

Table 8 Normality test

Variable	Nilai- <i>p</i>	Information
Source of drinking water consumed		
Non-Bottled Drinking Water	0,019	Data distribution is not normal
Bottled Drinking Water	0,200	Normal data distribution
Body Mass Index (Nutritional Status)		
Abnormal	0,200	Normal data distribution
Normal	0,200	Normal data distribution
Cigarette Smoke Exposure History		
Yes	0,200	Normal data distribution
No	0,200	Normal data distribution
Lead Levels in Blood	0,200	Normal data distribution



Bivariate Analysis

Nutritional Status of Fertile Age Women

a. Mean Difference Test

Table 9 Results of the mean difference test results in blood lead levels based on the nutritional status of Women of childbearing age

Nutritional status	Lead content (μg) mean $\pm$ SD	<i>p</i>
Abnormal (n=35)	76,26 $\pm$ 12,74-2,15	0,333
Normal (n=32)	72,28 $\pm$ 12,21-2,1	

* Independent Sample T-Test

The mean difference test used is the parametric statistical test Independent Sample T-Test, because the data for groups that have abnormal nutritional status and normal groups have normal data distribution. Based on the statistical test, it was found that the value of $p = 0.333$, which means that there was no significant difference in the mean level of lead in the blood between groups with abnormal nutritional status and those with normal nutritional status.

b. Correlation Test

Table 10 The results of the correlation test between nutritional status and blood lead levels

Variable	Correlation coefficient (<i>r</i>)	<i>p-value</i>
Nutritional status and lead levels	-0,072	0,561

* Pearson Product Moment Correlation Test

Correlation test used is the pearson product moment parametric statistical test because the data is normally distributed. Based on the results of the Pearson product moment test, the value of $r = -0.072$; $p = 0.561$ ($p \text{ value} > 0.05$) which indicates there is no correlation between nutritional status and blood lead levels in women of childbearing age. The Pearson product moment correlation value of -0.072 indicates a very weak correlation and the direction of the relationship is negative.



Cigarette Smoke Exposure History

a. Mean difference test

Table 11 Test Results for Differences in the Proportion of Lead Levels based on Exposure to Cigarette Smoke

Body mass index	Lead content (μg) mean $\pm$ SD	<i>p</i>
Abnormal (n=58)	75,25 $\pm$ 12,26	0,5
Normal (n=9)	72,2 $\pm$ 14,38	

* Independent Sample T-Test

The mean difference test used is the parametric statistical test Independent Sample T-Test, because the data for the groups exposed to cigarette smoke and the groups not exposed to cigarette smoke have normal data distribution. Based on the statistical test, it was found that the value of $p = 0.5$, which means that there was no significant difference in the mean level of lead in the blood between the groups exposed to cigarette smoke and those who were not exposed to cigarette smoke.

b. Proportion difference test

Table 12 Results of the Difference Test for the Proportion of Lead Levels based on Exposure to Cigarette Smoke

Cigarette Smoke Exposure History	Lead Levels in Blood (μg)		PR (CI)	<i>p</i>
	High	Low		
Yes (n=58)	31 (53,4%)	27 (46,6%)	2,296	0,305
No (n=9)	3 (33,3%)	6 (66,7%)	(0,523-10,076)	

* Chi Square test

Based on table 12, it is found that the proportion of high lead levels in the blood is more in respondents who have a history of exposure to cigarette smoke (53.4%) than respondents who do not have a history of exposure to cigarette smoke (33.3%). The statistical test results obtained $p = 0.305$, which means there is no difference in the proportion of lead levels in the blood who have a history of exposure to cigarette smoke and those who do not have a history of exposure to cigarette smoke in women of childbearing age (PR 2.296; 95% CI = 0.523-10.076).



Source of Drinking Water

Table 13 Results of the Average Difference Test for Lead Levels based on Drinking Water Sources

Source of Drinking Water	Mean Rank	<i>p value</i>
Non Packaging (n=40)	36,83	0,149
Packaging (n=27)	29,81	

* Mann-Whitney U test

The mean difference test used is the non-parametric statistical test (Mann-Whitney test) because the data for the group of non-bottled drinking water sources has an abnormal data distribution and the group of bottled drinking water sources has a normal data distribution. Based on the results of statistical tests, it was found that the mean rank of non-bottled drinking water sources was 36.83, while for bottled water sources was 29.81. Obtained *p value* = 0.149, which means that at 5% alpha there is no significant difference between lead levels in women of childbearing age who use non-bottled drinking water and bottled water.

a. Proportion difference test

Table 14 Results of Different Tests for the Proportion of Lead Levels based on Drinking Water Sources

Source of Drinking Water	Lead Levels in Blood (μ g)		PR (CI)	<i>p</i>
	High	Low		
Non Packaging (n=40)	23 (57,5%)	17 (42,5%)	1,968 (0,730-5,302)	0,273
Packaging (n=27)	11 (40,7%)	16 (59,3%)		

* Chi Square test

Based on table 14, the results show that the proportion of high lead levels in the blood was more in respondents who consumed non-bottled drinking water (57.5%) compared to those who consumed bottled water (40.7%). The statistical test results obtained *p* = 0.273, which means there is no difference in the proportion of lead levels in the blood who consume non-bottled drinking water and those who consume bottled water in women of childbearing age (PR 1.968; 95% CI = 0.730-5.302).



DISCUSSION

Lead Levels in Blood

Lead levels in the blood are often used as an indicator of lead exposure and are the best indicator of current exposure. This only applies to the steady state condition, namely when a person is continuously exposed to lead. To achieve the steady state condition, 2 months of continuous exposure are required. After the exposure has stopped, the lead level will slowly drop. The half-life of lead in the blood is approximately 25-30 days (NHMRC, 2015).

Lead exposure can be obtained from the act of consuming food and drinks containing lead, inhalation of air and dust contaminated with lead, contact through skin, contact through eyes and through parental. However, not all Pb (lead) compounds that enter the body can be absorbed, but only 5-10% of the amount of lead that enters through food and or 30% of the amount of lead that enters through respiration. The lead that is inhaled during exhalation will enter the blood vessels of the lungs and then flow to all body tissues, while the lead that enters through food and drink will be carried out in the body's metabolic process. Of the amount of lead that is absorbed, only 15% will settle in the body's tissues and the rest will be excreted through urine 75-80%, feces 15% and others through bile, sweat, nails and hair. In general, this very slow excretion of lead causes lead to accumulate easily in the body, both on occupational and non-occupational exposures (Palar, 2004) (Stellman, 2014)

Based on the results of laboratory examinations using the AAS (Atomic Absorption Spectrophotometry) method, it can be seen that the respondents in this study had detected lead levels in their blood, all lead levels in the blood of women of childbearing age were above the threshold set by the CDC (Central for Disease Control and Prevention). in the ATSDR that the limit for blood lead levels is 10 µg / dL.

Researchers argued that the high levels of lead in the respondents' blood were due to the accumulative nature of lead, so that if air, water, and foods containing both small amounts of lead were exposed to it continuously it could cause high levels of lead in the blood. Lead that enters the bloodstream can directly affect the circulatory system because it affects the synthesis of hemoglobin by inhibiting the main enzymes involved in the process of heme synthesis. Lead can slow down the normal maturation of red blood cells in the spinal cord, which can lead to anemia.

The level of lead in the blood is an indicator to determine the level of ongoing exposure because lead in the blood can reflect a dynamic balance between exposure, absorption, distribution and excretion. The effects of lead on the human body can be acute and chronic. Acute toxicity can include nausea, stomach cramps, headaches, impaired kidney function and oliguria. Meanwhile,



the chronic effects of lead appear after exposure in a span of days, weeks, months and years. Chronic effects due to lead toxicity include fatigue, reproductive disorders, kidney problems, and in pregnant women it can cause miscarriage and premature birth. The toxicity of lead in the blood has multi-target properties, which means that it can interfere with several body systems at the same time, namely the cardiovascular, nervous, reproductive, heme system, digestive system and excretory system. Women of childbearing age, pregnant women, and children are the groups most vulnerable to lead exposure. In women of childbearing age, lead exposure greatly affects the reproductive system. In women who have blood lead levels of 10 $\mu\text{g} / \text{dL}$ it can cause fetal growth problems. When pregnant, 30 $\mu\text{g} / \text{dL}$ of lead in the blood can cause premature birth, and 60 $\mu\text{g} / \text{dL}$ in the blood can cause pregnancy complications such as hypertension during pregnancy. (Dreisbach, 1983)

Nutritional Status of Women of childbearing age

Nutritional status can be seen through the Body Mass Index, which is obtained from the division of weight and height. Body weight is a measure that provides an overview of tissue mass, including body fluids. Body weight is very sensitive to sudden changes, either due to infectious diseases or decreased food consumption. While the height provides an overview of the growth function seen from the thin and short stature. Body weight and height are important parameters for determining health status (Ministry of Health of the Republic of Indonesia, 2017)

Based on the correlation test obtained $r = -0.072$; $p = 0.561$ ($p \text{ value} > 0.05$) which indicates that the correlation between nutritional status variables and blood lead levels is not significant. The person product moment correlation value shows a very weak correlation. This study is in line with research conducted by Dewi in 2015 regarding factors related to blood plumbum levels in traffic police in Kokta Kendari, which concluded that the $p \text{ value} = 0.328$ with a very weak relationship strength, so it said there was no relationship between status. nutrition with lead levels in the blood (Dewi, Sabilu, Pratiwi, 2015)

Nutritional status is a factor affecting lead absorption by the body. The better a person's nutritional status, the more positive it will be in terms of preventing lead exposure. In a state of malnutrition, it will increase the level of lead in the blood. Absorption through the digestive tract is influenced by solubility, particle shape and size. Nutritional status, and type of diet. In adults, about 10% of lead contamination that enters the digestive tract will be absorbed by the body.



Cigarette Smoke Exposure History

Cigarettes are a market product that comes from tobacco leaves. The results of research in several countries show that cigarette tobacco and its sap contain various elements, one of which is lead. Based on the research conducted, it was found that there was no significant difference between the group of women of childbearing age who had a history of exposure to cigarette smoke and those who did not have a history of exposure to cigarette smoke, the results of the proportion test also showed that there was no difference in the proportion of lead levels in the blood between those who had cigarette smoke exposure. history of exposure and no history. This may be because exposure to cigarette smoke every day in women of childbearing age has a short duration. Research on smoking habits with blood lead levels was conducted by Wirsa in 2013 to find a significant difference between the blood lead levels of smoker respondents compared to nonsmokers. Tobacco leaves are a material for making cigarettes that contain lead as the receipt of the planting, fertilizing or lead from agricultural land (Hasan, Matondang, Syahrin, Wahyuni, 2013)

In another study in New York residents, the highest blood lead levels were found in heavy smokers (2.49 $\mu\text{g} / \text{dL}$). Former smokers had blood lead levels 8% higher than samples who had never smoked. (McKelvey, 2007) Smokers were 4.5 times more likely to have higher blood lead levels, because in every 20 cigarettes, smokers inhaled. 1.5 grams of lead. (Lee, Chun, Song, 2005)

Source of drinking water consumed

Heavy metal pollution in the working area of the Bandarharjo Community Health Center, North Semarang District will affect the quality and quantity of water sources originating from these waters. Based on the results of previous examinations, that the concentration of lead was found in clean water sources from seawater, dug well water, and also deep groundwater with an average value of 0.285 mg / L, a maximum value of 0.446 mg / L, and a value minimum 0.080 mg / L where the water is used as daily needs. Water that contains lead and exceeds the quality standard is not suitable for consumption, but people still consume it frequently.



CONCLUSION

1. The average blood lead level in women of childbearing age in the working area of the Bandarharjo Community Health Center, Semarang District, North Semarang City is 74.84 g / dL (already exceeding TLV, which is 10 g / dL).
2. There was no significant difference in the mean level of lead in the blood between groups with abnormal nutritional status and those with normal nutritional status with $p = 0.333$.
3. There is no correlation between nutritional status and blood lead levels in women of childbearing age in the work area of the Bandarharjo Community Health Center, Semarang District, North Semarang City, which is 74.84 g / dL with $p = 0.561$ and $r = -0.072$.
4. There was no significant difference in the mean level of lead in the blood between the group exposed to aspiration [cigarettes and those not exposed to cigarette smoke with $p = 0.5$.
5. There was no difference in the proportion of lead levels in the blood who had a history of exposure to cigarette smoke and those who did not have a history of cigarette smoke exposure in women of childbearing age ($p = 0.305$, PR 2.296; 95% CI = 0.523-10.076).
6. There was no significant difference between lead levels in women of childbearing age who used non-packaged drinking water sources and bottled drinking water sources with $p = 0.149$.
7. There was no difference in the proportion of lead levels in the blood who consumed non-packaged drinking water and those who consumed bottled water among women of childbearing age ($p = 0.273$, PR 1.968; 95% CI = 0.730-5.302).



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