

Blood Lead Levels and Disturbances of Liver Function of Pregnant Woman In Grinting Bulakamba Sub District Brebes District.

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Abstract

Lead is a highly toxic metal and can affect every organ and system in the human body. The tugs that enter into the body will be distributed into the blood and 95% of lead in the blood is bound by red blood cells only 5% in the blood plasma. The use of lead in large or repeated quantities and will be stored cumulatively on the liver. This is because About 90% of lead gets into the blood circulation, 25% is deposited in the liver. The result of the research on the workers in lead smelting was found there is significant correlation of Pb level in blood with the disruption of liver function. The purpose of the research wanted to know the disruption of liver function and analyze the blood lead level in pregnant women group in Grinting, Bulakamba Sub-district of Brebes district. This research uses observational analytic method with cross-sectional design with 49 respondents. The test result showed that all respondents had lead level (Pb) above NAB 5 µg / dL with mean ± SD: 19,74 ± 9,214, median 19,70, minimum 6,33 and maximum 36,60. Although all respondents with Pb levels exceeded NAB but SGOT levels and SGPT levels pregnant women in agricultural areas showed normal results. By using cut off point median value (19,70) respondents with Lead (Pb) level in "high blood" equal to (51%). The results of the correlation test and test of different levels of lead (Pb) "high" and "low" on SGOT and SGPT levels showed no significant relationship. all respondents had Pb levels exceeding NAB 5 µg / dLL; there was no relationship and difference between lead level (Pb) in blood with examination of SGOT and SGPT levels.

Keywords: Blood Lead Level; Pregnant Women; Disturbances Of Liver Function

Introduction

Environmental pollution by lead can pose a threat to human health. Sources of lead pollution in the environment include exposure to industrial waste, unregistered alcoholic beverages, air pollution, and cosmetic ingredients. The main problems of lead poisoning come from mining, contaminated food and drink, paint in old houses, and lead smelting.

The World Health Organization (WHO) estimates that lead poisoning causes 143,000 deaths and 600,000 cases of intellectual disability in children each year. Lead is a highly toxic metal that can affect every organ and system in the human body. Lead poisoning, also known as plumbism, colica pictorum, Saturnism, Devonian colic, or painter's

colic, is a type of metal poisoning that is dangerous to humans and vertebrates because it can affect the heart, bones, stomach, kidneys, reproductive system, and central nervous system.

Lead can enter the environment and the human body from various sources such as petrol, food, recycling or disposal of car batteries, toys, paint, pipes, soil, some types of cosmetics and traditional medicines and various other sources.

Lead can enter the human body through inhalation, ingestion, and skin contact. Tetraethyl lead is absorbed through the skin, but most of it enters red blood cells and circulates throughout the body, eventually concentrating in the liver and kidneys, and then spreading to the bones, teeth, and brain. Lead poisoning can affect people of all ages. However, young children, pregnant women, and workers in certain industries are at greater risk than other groups.

Lead poisoning in Indonesia is thought to originate from various sources, including leaded gasoline, paint, vegetables, fertilizers, pesticides, and seafood. The sea is one source of water bodies susceptible to heavy metal toxicity, one of which is lead, which has been identified in Indonesia. Based on research conducted by Angraini D. in 2007, the concentration of lead in seawater was around 1.8 ppm and in sediment around 64.2 ppm, which is higher than the threshold value.

Grinting Village is highly susceptible to lead contamination. This is because Grinting Village is located in Bulakamba District, Brebes Regency, Central Java. The northern border of Bulakamba District is the sea. The sea is another identified source of lead poisoning in Indonesia. A 2006 study by Yulianto, which covered 13 regencies/cities from Brebes Regency to Pati Regency, revealed that most heavy metals, particularly lead, exceeded the established quality standard threshold.

Research conducted by Agus Suyanto in 2010 on heavy metal residues in fish from polluted waters on the North Coast of Central Java, specifically in the waters of Pati Regency, Semarang City, and Tegal Regency, revealed that the lead content in water samples from laboratory tests exceeded the established quality standard threshold. The average lead concentration in the laboratory tests in the waters was found to be 0.03 mg/L. This average lead concentration is 10 times greater than the threshold value set by the Ministry of Environment.

High concentrations of heavy metals, especially lead, can cause biomagnification, or bioconcentration, in the marine food chain. Biomagnification, or bioconcentration, is a process that can result in dangerous concentrations of toxic substances in the food we eat. Lead enters the body through food and drink, enters the digestive tract, and is involved in the body's metabolic processes. Lead is distributed into the bloodstream. Approximately 95% of lead in the blood is bound by red blood cells, and 5% is in the blood plasma.

Materials And Methods

This study was an observational analytical study with a cross-sectional design. The population was all pregnant women in Grinting Village, Bulakamba District, Brebes Regency who met the inclusion criteria. The criteria used to determine the study subjects were: willingness to participate as respondents and have their blood drawn and tested, residing in Grinting Village, healthy pregnant women, and no history of liver disease. The sample size for this study

was 49 pregnant women, who underwent blood lead and liver function tests, including SGOT and SGPT levels. Blood lead levels and liver function parameters (SGOT and SGPT) were measured using laboratory tests, while factors contributing to lead exposure (nutritional status, history of pesticide exposure, and history of drug use) were assessed through interviews using a structured questionnaire.

Large or repeated exposure to lead causes cumulative effects in the liver, which can lead to liver toxicity. Approximately 90% of lead enters the bloodstream, and 25% is deposited in the liver. Residents of Grinting Village are likely at risk of lead contamination, especially those who consume seafood caught by the local community. Heavy metal contamination in seawater in Grinting Village, Bulakamba District, Brebes Regency is suspected to originate from industrial waste, oil residue from ships passing through Indonesian waters, and pesticide residue flowing in rivers due to agricultural activities.

Agricultural activities involving human activities are not only carried out by farmers but also by pregnant women, parents and children who are involved in agricultural activities. This activity has the potential to expose agricultural workers to pesticides and lead chemicals.

One of the toxic properties of lead is its impact on liver function. Some of the liver's functions include serving as the center of protein, fat, and carbohydrate metabolism, producing bile, producing heparin (a blood anticoagulant), producing plasma proteins, clearing bilirubin from the blood, detoxifying toxic substances in the body, forming red blood cells (erythrocytes) during fetal life, and others. Liver disorders or damage can disrupt the liver's important functions in metabolism and detoxification. Liver dysfunction in women of childbearing age (WUS) not only impacts the woman's own health but also affects her fetus during pregnancy. Liver dysfunction can disrupt food metabolism and detoxification in the mother's body, thus affecting the amount of nutrients and other substances entering the fetus's circulatory system.

Results and Discussion

Based on Table 1, the median blood lead levels of pregnant women in Grinting Village, Bulakamba District, Brebes Regency were 19.70 µg/dL. The median SGOT level was 17.00 U/L. The median SGPT level was 12.00 U/L. The median nutritional status was 27.00.

Based on Table 2, it can be seen that 25 respondents (51%) had Pb levels in their blood in the 'high' category and 24 respondents (49%) had 'low' categories. The SGOT variable shows that 1 respondent (2%) had SGOT levels in the 'abnormal' category, and 48 respondents (98%) had SGOT levels in the 'normal' category.

The SGPT level variable shows that 1 respondent (2%) had an "abnormal" SGPT level, while 48 respondents (98%) had a normal SGPT level. The nutritional status variable shows that 25 respondents (51%) had a "normal" nutritional status, while 24 respondents (49%) had an "abnormal/severe" nutritional status. The pesticide exposure history variable shows that 15 respondents (30.6%) were "exposed" to pesticides, while 34 respondents (69.4%) were "not exposed." The medication consumption history variable shows that 24 respondents (49%) consumed drugs, while 25 respondents (51%) did not consume drugs.

Based on table 3, the results of the Spearman's rho correlation test between the parameters of Pb levels in the blood and SGOT levels showed no relationship (correlation) ($r = 0.282$; $p\text{-value} = 0.050$). Meanwhile, Pb levels in the blood with SGPT levels ($r = 0.275$; $p\text{-value} = 0.056$) did not have a significant relationship (correlation). The results of the Spearman's rho correlation test between the nutritional status parameters (LILA) and SGOT levels proved that there was no positive correlation ($r = -0.185$; $p\text{-value} = 0.202$). Nutritional Status (LILA) and SGOT levels also proved that there was no positive correlation ($r = -0.099$; $p\text{-value} = 0.498$).

Based on table 4, it is known that the median value of SGOT levels in the group of pregnant women with 'high' blood Lead (Pb) levels is 17.00 with a maximum value of 27 and a minimum value of 13. Meanwhile, the median value of SGOT levels in the group of pregnant women with 'low' blood Lead (Pb) levels is 16.00 with a maximum value of 33 and a minimum value of 12. The results of the Mann Whitney test obtained a $p\text{-value} = 0.094$, indicating that there is no difference in SGOT levels between pregnant women with 'high' blood Lead levels and pregnant women with 'low' blood Lead levels.

Based on table 5, it is known that the median value of SGPT levels in the group of pregnant women with 'high' blood Lead (Pb) levels is 12.00 with a maximum value of 38 and a minimum value of 7. The results of the Mann Whitney test obtained a $p\text{-value}$ of 0.063, indicating that there is no difference in SGPT levels in pregnant women with 'high' blood Lead levels and pregnant women with 'low' blood Lead levels.

Table 1. Distribution of Pb levels, SGOT levels, and SGPT levels in the blood, as well as LILA

Variable	Min	Max	Mean	Median	SD
Pb level	6,33	36,60	19,74	19,70	9,412
SGOT level (U/L)	12	33	17,65	17,00	3,998
SGPT level (U/L)	5	38	14,24	12,00	7,401
Nutritional status/LILA (cm)	20	38	26,57	27,00	4,082

Table 2. Frequency distribution of categorical variables

Variable	N=49	%
Blood lead levels		
High	25	51,0
Low	24	49,0
SGOT levels		
Abnormal	1	2,0
Normal	48	98,0
SGPT levels		
Abnormal	1	2,0
Normal	48	98,0

Nutritional status		
Abnormal/malnourished	24	49,0
Normal	25	51,0
History of pesticide exposure		
Exposed	15	30,6
Not exposed	34	69,4
History of medication use		
Taking medication	24	49,0
Not taking medication	25	51,0

Table 3. Results of the correlation test of research variables (n=49)

Correlated	Correlation Coefficient	Value-p
Blood Pb levels with SGOT levels	0,282	0,050 ^a
Blood Pb levels with SGPT levels	0,275	0,056 ^a
Nutritional status (LILA) with SGOT	-0,185	0,202 ^a
Nutritional status (LILA) with SGPT levels	-0,099	0,498 ^a

Table 4. The difference in mean SGOT levels with dependent and confounding variables

Variable	SGOT level (U/L)	p-value
	Mean ± SD, median min-max	
Blood lead levels		
'High' (n=25)	18,32 ± 3,727, 17,00, 13-27	0,094 ^b
'Low' (n=24)	16,96 ± 4,227, 16,00, 12-33	
Nutritional status		
Normal (n=25)	16,72 ± 3,943, 16,00, 12-33	0,083 ^b
Abnormal (n=24)	18,63 ± 3,899, 17,50, 13-27	
Pesticide exposure		
Exposed (n=15)	16,47 ± 3,399, 16,00, 12-26	0,162 ^b
Not exposed (n=34)	18,18 ± 4,174, 17,00, 13-33	
Medication consumption		
Consuming (n=24)	17,38 ± 3,854, 16,00, 13-27	0,456 ^b
Not consuming (n=25)	17,92 ± 4,192, 17,00, 12-33	

Table 5. The difference in mean SGPT levels with dependent variables and confounding variables

Variable	SGPT level (U/L)	P-Value
	Mean ± SD, median min-max	
Blood lead levels		
'High' (n=25)	15,92 ± 8,124, 12,00, 7-38	0,063 ^b
'Low' (n=24)	12,50 ± 6,262, 10,50, 5-31	
Nutritional status		
Normal (n=25)	12,04 ± 5,20, 11,00, 5-31	0,151
Abnormal (n=24)	16,54 ± 8,678, 14,00, 7-38	
Pesticide exposure		
Exposed (n=15)	12,07± 3,731, 10,00, 5-18	0,402
Not exposed (n=34)	15,21 ± 8,406, 12,00, 5-38	
Medication consumption		
Consuming (n=24)	13,71 ± 6,577, 12,50, 5-38	0,872
Not consuming (n=25)	14,76 ± 8,217, 11,00, 5-33	

Blood Lead Levels

Public exposure to lead can have negative health effects, including on the central and peripheral nervous systems, cardiovascular system, hematopoietic system, kidneys, liver, digestive system, and reproductive system, and is carcinogenic.

The highest accumulation of lead in soft tissues occurs in the kidneys, followed by the liver, brain, lungs, heart, muscles, and testicles. One organ affected by excessive lead (Pb) exposure is the liver. The liver is the largest and most complex metabolic organ in the body. This organ is involved in the metabolism of nutrients, as well as most drugs and toxicants. The mechanism of liver damage caused by lead (Pb) is that certain levels of lead (Pb) can induce the formation of free radicals and reduce the body's antioxidant capacity, thereby automatically causing oxidative stress.

The Centers for Disease Control and Prevention (CDC) in its ATSDR set the threshold limit for lead levels in the blood of pregnant women at 5 µg/dL. The study results showed that 49 (100%) pregnant women had abnormal blood lead levels. This is in line with a study conducted by Osmel La-Liave Leon et al. in Durango, Mexico in 2016, which found lead levels 3.82 times higher than the threshold set by the CDC for lead levels in pregnant women, which is 5 µg/dL.

The results of the study on pregnant women showed that 25 respondents (49%) had blood lead levels that exceeded the average, with an average value of 19.74 µg/dL with the lowest Pb level being 6.33 µg/dL and the highest being 36.60 µg/dL.

Based on the observation results, the high lead levels in pregnant women at the research location are likely caused by the following: First, lead comes from seafood consumed by pregnant women. Quantitative examination of seafood at the research location found that the lead levels in fish were (0.39 mg/kg), while the Threshold Limit Value set by SNI for fish is (0.3 mg/kg). In shrimp it was (0.61 mg/kg), the NAB set by SNI for shrimp was (0.5 mg/kg). In squid it was (0.41 mg/kg), the NAB set for squid was (0.5 mg/kg). In shellfish it was (0.72 mg/kg) while the NAB set by SNI for shellfish was (1.5 mg/kg). This means that fish, shrimp and squid exceed the Threshold Limit Value set by SNI. Seafood containing lead even though the levels are still below the threshold are not suitable for consumption because of the accumulative nature of lead which can be harmful to health.

People, especially pregnant women in Grinting Village, Bulakamba District, Brebes Regency, frequently consume seafood such as fish, shrimp, shellfish, and squid. This high seafood consumption increases the risk of lead contamination through daily food consumption.

Second, lead comes from a history of pesticide exposure. Theoretically, pesticides contain lead chemicals. Thakur's research in India in 2014 found Pb content in Methyl Parathion pesticides with a concentration of 13 ppm. The presence of Pb content in pesticides was confirmed by Karyadi's 2005 research on the accumulation of Pb heavy metals as residues in agricultural land, a case study on shallot farming land in Gemuh District, Kendal Regency, Central Java, where based on the results of an examination by the Semarang Industrial Research and Development Center, it was found that several pesticides contained Pb heavy metals. Some pesticides used by the community that were found to contain lead were Antracol 70 WP, Dithane M 45 80 WP, Furadan 3G, Goal 240 EC, Bulldog 25 EC, Hostathion 200 EC and Profile 430 EC. The lowest Pb content was found in Goal 240 EC at 0.87 mg/kg and the highest Pb content was found in Dithane at 19.37 mg/kg.

The involvement of pregnant women in agricultural activities allows them to be in an environment contaminated with lead. The results of the examination of vegetables taken at the research location cumulatively showed that the lead levels in mustard greens were (0.36 mg/kg), kale was (0.37 mg/kg), corn was (0.35 mg/kg), long beans were (0.28 mg/kg), cabbage was (0.36 mg/kg) potatoes were (<0.10 mg/kg), eggplant was (0.25 mg/kg) carrots were (0.17 mg/kg), spinach was (0.61 mg/kg), tomatoes were (0.34 mg/kg), shallots were (<0.10 mg/kg), chilies were (0.22 mg/kg).

Spinach, cabbage, kale and mustard greens have lead levels that exceed the threshold limit set by SNI (0.3 mg/kg), as well as eggplant, corn, long beans, carrots and chilies which also exceed the threshold limit set by SNI, namely (0.1).

Furthermore, pregnant women frequently consume fruit. Results of lead tests on fruit collected at the research site showed that papayas were 0.34 mg/kg and bananas were 0.17 mg/kg. Both papayas and bananas also exceeded the National Standard of Lead (TLV) for lead, which is 0.1 mg/kg.

Meanwhile, the concentration of lead in drinking water frequently consumed by the community, especially pregnant women in Grinting Village, is also a cause of high lead levels in the blood. The results of water examinations taken from several points at the research location are: sample 1 of (<0.002 mg/L), sample 2 of (0.0024 mg/L), sample

3 of (<0.002 mg/L), sample 4 of (0.0026 mg/L), sample 5 of (0.002 mg/L), sample 6 of (<0.002 mg/L), sample 7 of (<0.002 mg/L), sample 8 of (<0.002 mg/L), sample 9 of (<0.002 mg/L), sample 10 of (<0.002 mg/L). Based on the examination results, all water samples have lead levels below the Threshold Limit Value set by the Indonesian Minister of Health Regulation No. 492 of 2010 of 0.01 mg/L.

This can lead to accumulated lead exposure in pregnant women. Lead can be absorbed into the body in three ways: through the skin, the respiratory tract, and the digestive tract. Activities such as removing onions from their stems while pregnant, when handling onions containing lead residue, directly cause initial exposure. Indirect exposure occurs through soil, air, and water. Pregnant women who handle onions still mixed with soil are also at risk of lead exposure due to the presence of lead residue in the soil.

Liver Function Test Results

Liver function is a composite variable of SGOT and SGPT levels. Liver function is categorized as abnormal if any of the laboratory results exceed the specified standards. This is because the liver must perform various biochemical functions, including synthesis and excretion, so no single biochemical test can fully detect liver function. The liver's filtering processes circulate in the blood throughout the body. Liver cells contain proteins called enzymes that drive chemical reactions. When liver cells are damaged or destroyed, the enzymes within the cells leak into the blood, where they can be measured with a blood test. If SGOT and SGPT are found together in high levels in the blood, liver damage is suspected.

SGOT is an enzyme with high metabolic activity, found in the heart, liver, skeletal muscle, kidneys, brain, spleen, pancreas, and lungs. Diseases that cause changes, damage, or death of cells in these tissues will result in the release of this enzyme into the circulation. Abnormal or elevated SGOT levels do not necessarily indicate cell damage in the liver parenchyma, as it is still possible that the damage originates from other organs. Furthermore, SGPT is more sensitive as an indicator of liver disorders because SGPT originates from the cytoplasm of liver cells, while SGOT originates from the mitochondria and cytoplasm of hepatocytes or liver cells.

The study found that the proportion of abnormal SGOT levels was 4.1%. The proportion of abnormal SGPT levels was 4.1%. Liver function in this study was lower than that of Fidiyatun's 2013 study. Fidiyatun found that the proportion of liver dysfunction among lead smelter workers in Tegal Regency was 67.3%.

The Relationship between Blood Lead Levels and Liver Function Disorders

To examine the trend of blood lead levels in relation to SGOT and SGPT values, a correlation test was conducted. The Spearman Rho correlation test between blood lead levels and SGOT levels demonstrated no significant correlation, with a p-value of 0.05 and a correlation strength of 0.282. This finding contradicts Fidiyatun's 2013 study, which showed a correlation between blood lead levels and SGOT levels with a p-value of -0.002 and a weak correlation strength ($r=0.294$). However, Fafemanesh's 2015 study on chemical hazards and liver function in rubber industry workers in Iran showed no difference between chemical exposure and SGOT values, with a p-value of -0.1.

Meanwhile, the parameters of lead levels in the blood with SGPT levels prove that there is no significant relationship (correlation) between lead levels in the blood with SGPT levels (p -value = 0.056 with a correlation strength of 0.275). The results of this study are in line with Fitra Ayu Minarti's 2015 study that there is no relationship between lead levels in the blood and SGPT levels (p -value 0.169) with a weak correlation strength r : 0.347).

Based on the research results and discussion, it can be assumed that liver dysfunction in pregnant women may be caused by factors other than lead (Pb) exposure. Research by Santosa in 2012 showed that the chemical compound formalin can increase hepatic metabolic activity. Formalin, when exposed to cells, coagulates proteins found in the cell's protoplasm and nucleus, thus altering the mucosal structure, resulting in functional changes that can cause cell damage.

Besides formaldehyde, other factors that can cause liver dysfunction include the use of bulk cooking oil and repeated use of used cooking oil. Research conducted by Aisyah et al. in 2015 and Sutejo in 2012 on white mice demonstrated that the administration of used cooking oil resulted in liver cell damage. The use of used cooking oil can increase liver damage at moderate to severe levels, while the use of bulk oil causes changes in the liver at a mild level. The mechanism of liver cell damage caused by used cooking oil containing free radicals is related to O₂ in the body forming peroxy (peroxy radical). Peroxy absorbs hydrogen atoms from unsaturated lipid molecules, resulting in a prolonged reaction that produces other peroxides, namely peroxy, and peroxy. This peroxide is lipophilic which causes lipid peroxide in the membrane and in this cell the mitochondria are attacked, then release ribose and endoplasmic reticulum, so that the energy supply needed to maintain the function and structure of the endoplasmic reticulum is hampered and protein synthesis decreases so that cells lose the power to release triglycerides and liver cell damage occurs. Based on the results of respondent interviews, it is known that most of the mothers at the research location use bulk cooking oil (retail) with repeated use of cooking oil.

The second assumption is that there may be a chemical interaction between lead and protective chemicals. Research conducted by Saraswati in 2015 on 15 quails demonstrated that administering turmeric powder improved the quail's liver function. Turmeric powder contains curcumin, which can play a role in improving liver function, allowing the liver to function optimally. The results showed that the curcumin content in turmeric powder was 7.97%. Curcumin has pharmacological effects including improving blood flow, anti-inflammatory, antioxidant, and hepatoprotective properties. Curcumin has the property of inhibiting lipid peroxidation in cell membranes. As an antioxidant, curcumin can clean up free radicals, increase antioxidant enzymes, prevent the formation of inflammatory chemicals, namely cyclooxygenase-2 (COX-2), and induce the liver detoxification enzyme, glutathione-s-transferase.

Research conducted by Anindita et al. in 2012 demonstrated that administering green tea at a dose of 0.015 g/bw/day can repair hepatocyte damage. This is due to green tea's high polyphenol content. Mousa's 2014 study demonstrated that administering cinnamic acid to mice (30 mg/kg) can be used to treat hepatocytes from acute first-degree liver damage. Cinnamic acid is commonly found in galangal, cloves, ginger, galangal, and other fruits and vegetables. Based on the results of food recalls of children, it was discovered that ingredients such as turmeric, tea, ginger, garlic, and cinnamic acid are found in foods and drinks frequently consumed by pregnant women.

Conclusion

The research results and discussion can be concluded as follows: 49 respondents (100%) had blood lead levels exceeding the CDC threshold of 5µg/dL. Blood lead (Pb) levels in the "high" category among pregnant women in Grinting Village, Bulakamba District, Brebes Regency were 51%. There was no correlation between Pb levels and SGOT levels in pregnant women ($p=0.050$). There was no correlation between Pb levels and SGPT levels in pregnant women ($p=0.056$). There was no difference in SGOT levels between pregnant women with "high" Pb levels and those with "low" Pb levels ($p=0.094$). There was no difference in SGPT levels between pregnant women with "high" Pb levels and those with "low" Pb levels ($p=0.063$).

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