

LEAD CONTRETATION ARE ASSOCIATED TO ANEMIA IN INDONESIAN PREGNANT WOMEN



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Abstract

A low hemoglobin level indicates anemia, which has a variety of causes, including age, gender, smoking, poor nutrition, and lead exposure. Materials and method: This research design is observational, quantitative, and cross-sectional in nature. A study of 50 pregnant women. This study's variable was lead in the blood as determined by ICP-MS; hemoglobin was measured using the chyanmeth method, and cigarette smoke exposure was measured using a questionnaire. Result: 20 subjects out of a total of 50 had blood lead levels that were less than 5 g/dL. The Chi-square test and Fisher's exact test found no connection between iron consumption ($p = 0.047$) and lead concentration. In contrast, there is a significant association between lead level ($p = 0.004$) and tobacco exposure ($p = 0.000$) with anemia in pregnant women. Conclusions: Lead concentrations and exposure to tobacco both affect anemia in pregnant women. We advise monitoring high-risk women based on their social, occupational, environmental, and personal characteristics for serum lead levels during pregnancy. All governmental and private efforts must be made to limit lead exposure and consumption during pregnancy.

Keywords: Lead Level, Anemia, Cigarette Exposure, Pregnant

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1. Introduction

Lead (Pb) is one of the most hazardous and toxic heavy metals that harms the global environment (Faizi, & Kazmi, 2017). Pb contamination can be found in the environment, in the air, and at work sites where people mix metals or solder. However, tainted food and drinks are the most common way that people get exposed at work (Ardillah, 2016). Heavy metals then used to increase combustion in motor vehicles can produce lead oxide in the form of particulate dust, which humans inhale (Barry & Steenland, 2019). The most well-known occupational disease is lead poisoning. Lead can migrate to the heart, bones, intestines, kidneys, reproductive, and nervous systems after being inhaled or ingested, causing specific adverse

effects on tissues (Baranowska et al., 2019;Ruslan et al., 2022).

Humans are exposed to lead through their respiratory tract, gastrointestinal organs, and skin. Lead poisoning can happen to people of all ages if Pb is always in the body (Perkins et al., 2014). The developing fetus is especially sensitive to outside stressors, which makes pregnancy a vulnerable time. Pregnancy is also vulnerable because lead that was stored in the mother's bones can move with calcium stores and become an internal source of exposure. However, pregnant women, children and employees in certain industries that use Pb-based raw materials or additives are at the greatest risk. Pb exposure during pregnancy has been linked to the development of anemia in pregnant women (Fu & Xi, 2020).

Anemia is intimately correlated with maternal and infant mortality and morbidity, including the risk of miscarriage, stillbirth, premature birth, and low birth weight in pregnant women. Anemia in women can be caused by things other than a lack of iron, like known hemoglobinopathies, chronic disease anemia, iron deficiency anemia, not taking iron therapy as prescribed, or factors that make iron deficiency hard to diagnose. Women with anemia caused by factors other than iron deficiency, such as known hemoglobinopathies, chronic disease anemia, iron deficiency anemia, non adherence to iron therapy, or confounding factors causing iron deficiency.

Anemia symptoms are characterized a decrease in hemoglobin levels. Gender, age, smoking habits, food intake, lead poisoning and other factors have a direct impact on hemoglobin levels (Perkins et al., 2014b). Anemia in pregnant women also increases the risk of bleeding during the delivery process and additionally reduces the oxygen supply to the fetus, resulting in impaired fetal growth and development, which is characterized, among other things, by the occurrence of low birth weight babies (Wells et al., 2011). A study in India found that 11.11% of pregnant women with a history of iron deficiency anemia had higher blood lead levels than pregnant women without a history of iron deficiency anemia (Slota et al., 2022). Pb levels in the blood can indicate ongoing exposure as well as Pb stores in the bones that can be transferred to the blood. Because Pb elimination in the blood is faster than in the bones, blood Pb levels reflect the history of exposure in the last few months. The negative effects of Pb in humans are increasingly being recognized as a potential problem, but the mechanism of action and genetic aspects of susceptibility to lead toxicity are unknown. Generally, high-risk groups such as industrial and factory workers are the priority of Pb concentration research. The effect of Pb on the incidence of anemia in pregnant women was investigated in this study. Since not much is known about how lead affects anemia in pregnant women in Indonesia, more research is needed.

Subjects And Methods

This research is quantitative and employs a cross-sectional design. This study's sample consisted of fifty pregnant women from Makassar City who met the third trimester pregnancy inclusion criteria. After receiving informed consent, pregnant women who accepted to participate in the study completed identity data questionnaires, cigarette smoke exposure questionnaires, and lead exposure questionnaires. Up to 3 cc of venous blood was extracted from pregnant women and then placed in the EDTA tube. At the Center for the Environment, the concentration of lead and hemoglobin in the blood is measured. According to education, occupation, age of pregnant women, iron intake, tobacco exposure, and lead concentrations, sample characteristics were categorized.

Blood Lead Analysis

A blood samples as possible collected 3 cc from the Nessler tube, 10 ml of HNO₃ solution (Merck, Germany) was added. To break the bonds in complex organometallic compounds, nitric acid is used. The sample was heated to 95 oC above the water bath (Memmert WNB14) until it dissolved, at which point the brown steam turned white. This heating process takes 48 hours to finish. The standard 1,000 ppm lead solution was prepared (Merck, Germany).

To make 50 ml of lead standard, combine 10 ppm lead standard solution (diluted with 200 ml and 500 ml) and 1 ppm lead standard solution (diluted with 10 ml, 50 ml, and 100 ml). Then, make a working series with a blank containing 0.2% nitric acid diluted with aquadest. The sample is diluted with 50 ml of aquadest at the end of the preparation phase. The solution was then filtered using Whatman 42 paper with pore 2.5 microns in diameter. The samples were then filtered and analyzed for thirty seconds per sample using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) (Thermoscientific iCAP RQ). The laboratory results were then analyzed using independent variables. The method acceptance limits for quality control performance have been defined as 18.2-23.6 g/L using an ERA certificate reference material (CRM).

Hemoglobin Analysis

The goal of measuring hemoglobin levels is to find out how bad anemia is, how well anemia treatment is working, or if diseases linked to anemia are getting worse. Prepare two test containers: one plain and one sample. Fill each container with 5 mL of the Drabkin's leftover solution. A blood sample of 20 microliters should be introduced. After thoroughly mixing the contents of the container, put it aside at room temperature for 10 minutes. Insert resistance. tube B (with a wavelength of 546 mm) and adjust it until the absorbance reading equals 0. Remove tube B from the photometer and insert tube T; read the absorbency and convert to g/dl using the previously generated standard curve.

Statistical analysis

The chi-square test was used to determine the effects of lead concentration, cigarette smoke exposure, and anemia in pregnant women.

Ethic

The study was conducted in accordance with the Health Ethics Committee of the Faculty of Public Health at Hasanuddin University. The approval number is 9068/UN4.14.1/TP.02.02/2022. All participants provided written, informed consent.

Result

The respondents' average age is included in the reproductive age of women, which is the young age during pregnancy. The older a person is, the more likely it is that he or she will get iron deficiency anemia. This is because, in general, when people reach an age when they are no longer productive, they get different diseases that try to put the body at risk for iron deficiency anemia. As for aging, it brings degenerative changes in body function, making the presence of Pb pollutants in the body more difficult to tolerate.

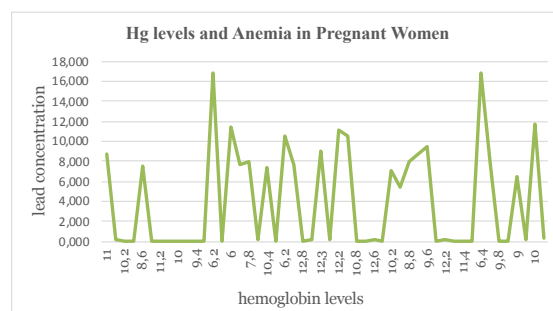
This is also consistent with how pregnant women are employed; only about a third of pregnant women are unemployed. Pregnant women who keep their bodies in shape during early pregnancy will have more energy and be stronger when giving birth. Working pregnant women must earn money to support their husbands' daily needs. Pregnant women who make enough money to support their families have a better chance of learning about anemia.

Table 1. Characteristics of Respondents

Charasteristic	n
Age	
≥ 35 years	6
< 35 years	44
Education	
≤ 12 years	43
> 12 years	7
Occupation	
Working	8
Not Working	42

The graph displays a high blood lead level of 16,00 µg/dL and a low blood lead level of 0,06 µg/dL Hb levels in many pregnant women are below normal. The Hb levels range from 6 g/dL at the lowest to 16 g/dL at the maximum.

Chart 1. Hg levels and Anemia in Pregnant Women



* Reference value of blood Pb 5 µg/dL

Tobacco exposed has an important association with the incidence of anemia (p> 0.05). Table 3 demonstrates that smoking has an effect on anemic women. There is also a linkbetween high Pb levels and the occurrence of anemia. Pregnant women with high Pb levels are more likely to develop anemia than pregnant women with low Pb levels.

Table 3. Relationship between exposure to cigarettes and lead concentrations in the blood with the incidence of anemia

Independen Variables	Anemia Inciden
	Anemia

	n	%	food. If a pregnant woman has anemia, it is important to make sure that any iron lost through urination is replaced by iron eaten through food.	p-value
Tobacco Exposure				
Exposed	25	75,8	8	24,2
Not Exposed	2	11,8	15	88,2
Pb levels			Lead relationship with the incidence of Anemia	
High (≥ 5 $\mu\text{g/dL}$)	16	80,0	The environmental heavy metal lead is toxic, and it has a number of negative health effects. When absorbed by the body, the potentially toxic element pb builds up in the blood, bones, and various organs, including the liver, kidneys, brain and skin (García et al., 2019). Out of a total of 50 participants in this study, 20 participants had blood lead concentrations that were less than 5 g/dL.	0,004
Low (< 5 $\mu\text{g/dL}$)	11	36,4	63,3	
Iron Intake				
Enough	14	60,9	39,1	0,407
not enough	13	48,1	51,9	

Lead Concentration

Blood can be taken at any time during pregnancy, so it can be used to predict the results of heavy metal tests (Li et al., 2019). According to the study's findings, 16 (80.0%) of 50 (100%) pregnant women had blood lead concentrations over the acceptable level (5 g/dL). According to studies, over 99% of the lead in blood is bound to red blood cells, making it impossible for it to cross the placenta. Just 1% of the lead in blood plasma is linked to lead exposure in fetuses (Charkiewicz & Backstrand, 2020). The most polluting things are cars and motorcycle gas, factories, power plants, and things people do around the house and the fact that combustion produces air pollutants that can either take the form of gases or particles, it may result in a decline in air quality.

Anemia In Pregnant Women

If a pregnant woman's Hb level is below 11 g/dL, she is said to have anemia. This is a condition in which the number of red blood cells and their ability to carry oxygen are not enough to meet the body's physiological needs. According to the research findings, out of 50 respondents, there were still a significant number of pregnant women in Makassar City who suffered anemia, with 27 respondents (54%) versus 23 respondents (46%), which is the percentage of pregnant women who did not. Due to the high iron needs during pregnancy, it is important to keep an eye on the balance of iron in the mother's body and make sure that any iron lost through urination is replaced by iron eaten through

Pregnant women may be exposed to lead through industrial, mining, and agricultural processes that can spread through the air, soil, water, and lead-containing foods (Flora et al., 2008). Anemia has been linked to the amount of lead in the blood of pregnant women. Anemia caused by lead exposure is of particular concern to the population because its effects can disrupt the integrity of red blood cell membranes, making them more fragile (Rehaman et al., 2018). Another study's findings included up to 16 participants who had a history of anemia. By preventing the synthesis of protoporirin and obstructing iron absorption, elevated blood lead levels can affect erythropoiesis and raise the risk of anemia (Njati & Maguta, 2019).

This is also in keeping with how pregnant women are employed; only about a third of pregnant women are unemployed. Pregnant women who keep their bodies in shape during early pregnancy will have more energy and be stronger when giving birth. Working pregnant women must earn money to support their husbands' daily needs. Pregnant women who make enough money to support their families have a better chance of learning about anemia. No appreciable difference was discovered between pregnant women's BPb levels and their level of hemoglobin or Fe levels in a cross-sectional study conducted by (Hamadne et al., 2018). However, the authors pointed out that women with lower socioeconomic status and those who took multivitamins had higher BPb levels.

The Association Between Smoking Exposure and the Risk of Anemia

This is also consistent with how pregnant women are employed; only about a third of pregnant women are unemployed. Pregnant women who keep their bodies in shape during early pregnancy will have more energy and be stronger when giving birth. Working pregnant women must earn money to support their husbands' daily needs. Pregnant women who make enough money to support their families have a better chance of learning about anemia. This is also consistent with how pregnant women are employed; only about a third of pregnant women are unemployed. Pregnant women who keep their bodies in shape during early pregnancy will have more energy and be stronger when giving birth. Working pregnant women must earn money to support their husbands' daily needs. Pregnant women who make enough money to support their families have a better chance of learning about anemia (Leifert, 2008).

In relation to this study, pregnant women who are exposed to cigarette smoke run the risk of developing anemia. Theoretically, both nonsmokers and active smokers are affected by exposure to cigarette smoke, which is all the chemicals produced when cigarettes are burned. Mainstream cigarette smoke is the smoke that the smoker inhales into their lungs, whereas sidestream smoke is the smoke that emanates from the burning end of the cigarette. Environmental cigarette smoke is the term used to describe the smoke that smokers exhale that causes air pollution. Passive smokers are those who are forced to inhale cigarette smoke from their surroundings despite not smoking, and it is not even likely that they will develop any diseases related to smoking even though they do not smoke (Safitri & Syahrul, 2015).

However, research indicates that smokers have low Hb levels. In a study of pregnant women, there was a significant correlation between the case group's exposure to cigarette smoke during pregnancy (61.1%) and the control group's exposure to cigarette smoke during pregnancy (27.8%). The analysis revealed that the odds ratio (OR) of exposure to cigarette smoke was 4.09 (95% confidence interval [CI]: 1.07 OR 16.26), indicating that pregnant women who were

exposed to cigarette smoke had a 4.09-fold increased risk of developing anemia compared to mothers who were not exposed to cigarette smoke. Compared to pregnant women who are exposed to smoke detectors, pregnant women who are exposed to cigarette smoke are 2.67 times more likely to get anemia (Sulaiman et al., 2022).

Relationship Between Iron Intake And Anemia

The evidence implies that frequent iron supplementation during pregnancy improves maternal hematological indices, but its clinical effect on pregnant women is untested (Brannon & Taylor, 2017; Cantor et al., 2015; Demuth & Weissenbor, 2018). Despite this, the World Health Organization (WHO) recommends 15–20 mg/day of iron during pregnancy (World, 2016). The results showed that there was no link between how much Fe pregnant women ate and how often they had anemia ($p = 0.407 > 0.05$).

According to Martínez et al (2019) In addition to iron intake from food, pregnant women need to take iron tablets in the amount of at least 90 tablets during pregnancy. There's no association between iron intake and anemia, according to reports. Dietary intake of iron (mg/day) was not associated with the risk of anemia. Iron supplementation > 40 mg/day showed a protective association with SGA in both the crude analysis (OR=0.55, 95% CI: 0.39, 0.77) and the adjusted analysis (OR =0.64, 95% CI: 0.42,0.99).

2. Conclusion

There is a strong link between Pb levels, tobacco exposure, and pregnant women with anemia. To avoid exposure to lead in the air, it is advised to stay away from cigarette smoke and to use a mask when moving outside. To aid in the body's heavy metal detoxification, eat enough vitamin C-rich and leafy green vegetables. It is intended that more research be done, such as looking at additional symptoms that pregnant women can experience and analyzing how they relate to Pb concentrations.

References

- Ardillah, Y. (2016). Risk factors of blood lead level. *Jurnal Ilmu Kesehatan Masyarakat*, 7(3), 58019.

- Baranowska-Bosiacka, I., Korbecki, J., & Marchlewicz, M. (2019). Lead, Pb. Mammals and Birds as Bioindicators of Trace Element Contaminations in Terrestrial Environments: *An Ecotoxicological Assessment of the Northern Hemisphere*, 563-592.
- Barry, V., & Steenland, K. (2019). Lead exposure and mortality among US workers in a surveillance program: Results from 10 additional years of follow-up. *Environmental research*, 177, 108625.
- Brannon, P. M., & Taylor, C. L. (2017). Iron supplementation during pregnancy and infancy: uncertainties and implications for research and policy. *Nutrients*, 9(12), 1327
- Charkiewicz, A. E., & Backstrand, J. R. (2020). Lead toxicity and pollution in Poland. *International journal of environmental research and public health*, 17(12), 4385.
- Cantor, A. G., Bougatsos, C., Dana, T., Blazina, I., & McDonagh, M. (2015). Routine iron supplementation and screening for iron deficiency anemia in pregnancy: a systematic review for the US Preventive Services Task Force. *Annals of internal medicine*, 162(8), 566-576
- Faizi, N., & Kazmi, S. (2017). Universal health coverage-There is more to it than meets the eye. *Journal of family medicine and primary care*, 6(1), 169.
- Flora, S. J. S., Mittal, M., & Mehta, A. (2008). Heavy metal induced oxidative stress & its possible reversal by chelation therapy. *Indian Journal of Medical Research*, 128(4), 501-523.
- Fu, Z., & Xi, S. (2020). The effects of heavy metals on human metabolism. *Toxicology mechanisms and methods*, 30(3), 167-176.
- García-Montalvo, I. A., Martínez-Gutiérrez, C., Sánchez-Medina, M. A., Pérez-Santiago, A. D., & de Jesús Ramírez-Altamirano, M. (2019). Afecciones neurodegenerativas: toxicidad por acumulación de metales. *Journal of Negative and No Positive Results*, 4(4), 456-465.
- Hamadneh, J., Massadeh, A., Hamadneh, S., Kassab, M., Al-bayyari, N. S., Khader, Y., & Sbuihat, W. (2018). Blood lead level and correlation with pregnancy-associated anaemia. *Australasian Medical Journal*, 11(4).
- Leifert, J. A. (2008). Anaemia and cigarette smoking. *International journal of laboratory hematology*, 30(3), 177-184.
- Njati, S. Y., & Maguta, M. M. (2019). Lead-based paints and children's PVC toys are potential sources of domestic lead poisoning—A review. *Environmental pollution*, 249, 1091-1105.
- Perkins, M., Wright, R. O., Amarasiriwardena, C. J., Jayawardene, I., Rifas-Shiman, S. L., & Oken, E. (2014). Very low maternal lead level in pregnancy and birth outcomes in an eastern Massachusetts population. *Annals of epidemiology*, 24(12), 915-919.
- Rehman, K., Fatima, F., Waheed, I., & Akash, M. S. H. (2018). Prevalence of exposure of heavy metals and their impact on health consequences. *Journal of cellular biochemistry*, 119(1), 157-184.
- Ruslan, R., Amqam, H., Yusuf, W. M., Nani, T., Arsy, N. I., & Ramadhani, A. R. (2022). Serum Lead Level and Academic Performance of Elementary School Children in Makassar City. *Jurnal Ilmu*

- Kesehatan Masyarakat*, 13(3), 350-361.
- Słota, M., Wąsik, M., Stołtny, T., Machoń-Grecka, A., & Kasperczyk, S. (2022). Effects of environmental and occupational lead toxicity and its association with iron metabolism. *Toxicology and Applied Pharmacology*, 434, 115794.
- Wells, E. M., Navas-Acien, A., Herbstman, J. B., Apelberg, B. J., Silbergeld, E. K., Caldwell, K. L., ... & Goldman, L. R. (2011). Low-level lead exposure and elevations in blood pressure during pregnancy. *Environmental health perspectives*, 119(5), 664-669.
- Safitri, R. N., & Syahrul, F. (2015). The Risk of Exposure to Cigarette Smoke in Anemia During Pregnancy. *Jurnal Berkala Epidemiologi*, 3(3), 327-339.
- Mehsen, J. T., Madhi, Z. S., & Madhi, I. S. (2020). Spinal stenosis: What outcome should be expected? Review the latest evidence using the assessment of multiple systematic reviews appraisal tool (AMSTAR). *Medical Journal of Babylon*, 17(2), 118.
- Sulaiman, M. H., Flora, R., Zulkarnain, M., Yuliana, I., & Tanjung, R. (2022). Defisiensi Zat Besi dengan Kejadian Anemia pada Ibu Hamil. *Journal of Telenursing (JOTING)*, 4(1), 11-19.”.
- Demuth, I. R., Martin, A., & Weissenborn, A. (2018). Iron supplementation during pregnancy—a cross-sectional study undertaken in four German states. *BMC pregnancy and childbirth*, 18(1), 1-10.
- World Health Organization. (2016). *World Health Organization recommendations on antenatal care for a positive pregnancy experience*. Geneva: WHO.
- Martínez- Galiano, J. M., Amezcua-Prieto, C., Cano- Ibañez, N., Salcedo- Bellido, I., Bueno-Cavanillas, A., & Delgado-Rodríguez, M. (2019). Maternal iron intake during pregnancy and the risk of small for gestational age. *Maternal & child nutrition*, 15(3), e12814.
- Manyullei S. (2022). *Environmental Pollution: A Public Health Perspective*.
- Li, A., Zhuang, T., Shi, J., Liang, Y., & Song, M. (2019). Heavy metals in maternal and cord blood in Beijing and their efficiency of placental transfer. *Journal of environmental sciences*, 80, 99-106.