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Literature study: Comparative analysis of lead content in blood between spot workers, Caroseries industry workers, and metal smelting industry workers

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Abstract

Introduction: This study aims to analyze the comparison of lead content in blood between gas station attendants, bodywork industry workers, and metal smelting industry workers. Lead (Pb) is a heavy metal that can have dangerous effects on human health. Lead exposure can occur through various sources, including the work environment**.**

Method: The research used is a literature study by collecting articles published between 2013-2023. After selection, there were 18 articles that were relevant to the research topic.

Results and Discussion: The average lead content in the blood of gas station attendants ranges from 2.75 µg/dL to 35,317 µg/dL, bodywork industry workers range from 14.4 µg/dL to 35 µg/dL, and metal smelting industry workers range from 14.4 µg/dL. dL up to 50.83 µg/dL. Differences in levels of lead exposure between these three professions can be caused by differences in type of work, activities and work environment.

Conclusion: Based on the results of this research, it can be concluded that gas station officers, bodywork industry workers, and metal smelting industry workers have different levels of exposure to lead. Therefore, appropriate health protection, such as the use of PPE and safe work practices, needs to be implemented to reduce the risk of lead exposure.

Keywords: Lead; Blood; Human; Profession

1. Introduction

Lead (Pb) is a heavy metal which is known to have dangerous effects on human health, although lead poisoning is rare, but if left for a long time it can cause various damage to the body [10]. Lead exposure can occur through various sources, including the work environment. Several occupational groups that are frequently exposed to lead are public fuel station (SPBU) officers, bodywork industry workers, and the metal smelting industry. In this literature study, a comparative analysis will be carried out on the lead content in the blood of humans who work in these professions.

The importance of this research lies in understanding the impact of lead exposure on the health of workers working in various work environments with different potential for lead exposure. As urbanization and industrial development increase, understanding lead exposure levels and their impact on human health is critical to developing more effective health protection strategies.

This literature study will discuss previous findings related to lead exposure in various professions, the health effects associated with such exposure, and possible differences in exposure levels and health impacts between gas station

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attendants, auto body industry workers, and parking attendants. By exploring these differences, it is hoped that this research will provide deeper insight into how lead exposure can impact different groups of workers, thereby supporting the development of more effective health protection policies.

Exposure to lead in the work environment can occur through air, water, and direct contact with materials containing lead. Gas station attendants, car body industry workers, and lead smelting industries are some of the groups of workers who are at high risk of exposure to lead. Gas station attendants are exposed through the fuel they handle, such as gasoline and diesel which contain lead. Bodywork industry workers are exposed through the painting process, this happens because the paint used contains lead and when the painting process is carried out, lead will be in the air. The greater the concentration of lead in the air, the greater the potential for lead to enter the blood [11]. Metal smelting workers who use materials containing lead. Lead smelting activities have the potential to release micron-sized heavy metal particles into the air [7].

Lead exposure can have a negative impact on human health. Some of the health effects associated with lead exposure include damage to the nervous system, kidneys, and reproductive system. Lead can also cause developmental disorders in children, especially in their nervous systems. In addition, lead is also associated with an increased risk of cardiovascular disease, hypertension and impaired liver function. Almost 90% of the lead that enters the body has an impact on blood cells and disrupts the hemoglobin synthesis process [8].

The differences in levels of lead exposure and health impacts between gas station attendants, car body industry workers, and metal smelting industry workers can be caused by several factors. One of them is the difference in the type of work and activities carried out. Gas station attendants are primarily exposed through direct contact with fuel containing lead, such as when refueling vehicles or when cleaning fuel tanks. Bodywork industry workers are exposed to metal painting and smelting processes that use materials containing lead. They can also be exposed to air contaminated with lead particles during the production process. Metal smelting industry workers can be contaminated with lead when metal containing lead is melted and produces lead-containing vapors.

Apart from differences in type of work, other factors that can influence the level of lead exposure and health impacts between these three professions are the use of personal protective equipment (PPE) and adherence to safe work practices. Using proper PPE, such as masks and gloves, can help reduce lead exposure. Additionally, adherence to safe work practices, such as the use of adequate ventilation and dust control, can also reduce the risk of lead exposure.

Previous literature studies have identified differences in blood lead content between gas station attendants, bodywork industry workers, and metal smelting industry workers. For example, a study in Serang City found that the average lead content in the blood of gas station attendants was 30,517 μg/dL, with 2 out of 7 samples showing lead levels that exceeded normal limits [17]. On the other hand, a study on brass craftsmen found that the average lead content in the blood of metal smelting workers was 50.83 μg/dL, with 16 of 31 samples showing lead levels that exceeded normal limits [7].

Differences in lead exposure levels between these three professions may be caused by differences in types of work, activities and work environments. Gas station attendants are exposed through direct contact with fuel containing lead, while car body industry workers are exposed through the painting and metal melting processes. Parking attendants are exposed to vehicle emissions that contain lead. Additionally, factors such as use of PPE and adherence to safe work practices can also influence lead exposure levels.

The purpose of a comparative analysis of blood lead content between gas station officers, car body industry workers, and metal smelting industry workers is to understand the differences in levels of lead exposure and the health impacts that may occur in these three professions. By comparing these differences, this study aims to provide deeper insight into how exposure to lead in the environment may impact the health of different groups of workers. Apart from that, it is hoped that this research can become a recommendation for industry, society and government. Data on lead exposure in worker groups was taken from articles published in 2013-2023.

2. Material and methods

This research uses a literature study method sourced from *Google Schoolar*. In the initial search stage, 1,516 articles were found, then selection was carried out using the publication year 2013-2023 to obtain 1,295 articles. After that, further selection was carried out by looking at the article titles until there were 188 articles. And in the final stage, before writing the full article, a selection was made based on the abstract and the availability of articles for download, up to 18 articles. The following is the flow of the research method in this article.

3. Results and discussion

Human exposure to lead has enormous health impacts. So that groups of workers who are vulnerable to lead exposure must be handled well. One effort that can be made is to find out what factors cause lead exposure to enter the worker's body. Factors that influence workers' blood lead exposure can vary depending on the type of job and work environment.

For example, gas station attendants are exposed through direct contact with fuel containing lead. Bodywork industry workers are exposed through the painting and metal smelting processes, while parking attendants are exposed through vehicle emissions containing lead. In addition, factors such as the use of personal protective equipment (PPE) and compliance with safe work practices can also influence the level of lead exposure. The process of lead entering a worker's blood can occur through several pathways. One way is through inhalation, namely when workers inhale lead particles in the air.Lead can also enter the body through direct contact with the skin or through consuming food or drinks contaminated with lead. The threshold for lead levels in blood according to WHO is 10 µg/dL.

Table 1 Lead Contaminants to Gas Station Workers, Bodywork Industry Workers and Metal Smelting Industry Workers

Author and Year	**Title**	**Average Lead Content (µg/dL)**	**Sample**	**Profession**	**Information (threshold = 10 µg/dL.)**	
					Normal	Abnormal
Stamara, G., Diana R., dan Barlian, B. 2020	Identification of Lead (Pb) Levels in the Blood of Gas Station Operators 34-42115 Serang City	30,517	7	Gas Station Workers	2	5
Laila, N.N. dan Iting, S. 2013	Blood Lead Levels and Health Complaints in Female Gas Station Operators	8.662	34	Gas Station Workers	24	10
Sumba, I.H. 2019	Analysis of Lead Metal (Pb) Levels in the Blood of Public Gasoline Filling Station (SPBU) Officers, Oesapa Village, Kupang City	19,23	13	Gas Station Workers	-	13
Sari, M.P., Onny, S., dan Tri, J. 2016	The Relationship between Individual Characteristics and Use of Personal Protective Equipment (PPE) with Blood Lead (Pb) Levels in Body Painting Industry Workers	35	34	Pekerja Industri Karoseri	4	28
Cahyani, C. C., Setiani, O., & Darundiati, Y. H. (2016)	Differences in Lead (Pb) Levels in the Blood Before and After Giving Green Coconut Water (Cocos nucifera L) to Painting Workers in the Semarang Bodywork Industry.	29,3	10	Pekerja Industri Karoseri	3	7
Selviastuti, R., Darundiati, Y. H., & Setiani, O. (2016)	Health Risk Analysis of Lead (Pb) Exposure to 'X' Bus Bodywork Workers in Semarang City.	35,317	34	Pekerja Industri Karoseri	21	13
Fidiyatun, F., Setiani, O., & Suhartono, S. (2013)	Correlation of Lead Levels in the Blood with Liver Function Disorders in Lead Smelting Workers in Tegal Regency	30,66	55	Metal Smelting Industry Workers	41	14
Setyabudi, S., Setiani, O., & Wahyuningsih, N. E. (2014	The Relationship between Pb Levels in the Blood and the Incident of Hypertension in Lead Smelting Workers in Small Industrial	26,8	45	Metal Smelting Industry Workers	8	37

	Villages (PIK) Kebasen, Tegal Regency					
Ambarwanto, S. T., Nurjazuli, N., & Raharjo, M. (2016)	The relationship between exposure of lead in the blood and the incidence of hypertension in metal casting industry workers in Ceper Klaten in 2015	14,4	33	Metal Smelting Industry Workers	16	17
Lestari, V. D., Setiani, O., & Dewanti, N. A. Y. (2017)	Differences in Lead (Pb) Levels in Blood Based on Type of Work in Metal Casting Industry Workers at CV. Bonjor Jaya, Ceper, Klaten	14,87	31	Metal Smelting Industry Workers	-	31
Minarti, F. A., Setiani, O., & Joko, T. (2015)	The relationship between lead exposure and the incidence of liver function disorders in metal foundry workers in CV. Shining Baja Rays, Bakalan Village, Ceper, Klaten Regency	24,39	33	Metal Smelting Industry Workers	-	33
Susiani, S., & Lestari, M. W. (2022)	Relationship between Blood Lead Levels and Hemoglobin Levels in Gombel Semarang Gas Station Operators	2,83	18	Gas Station Workers	18	-
Surip, S., Setiani, O., & Rahfiludin, M. Z. (2013)	The Relationship Between Blood Lead Levels and Hemoglobin Levels in Women of Childbearing Age in the Metal Smelting Industrial Environment, Adiwerna District, Tegal Regency	28,33	32	Metal Smelting Industry Workers	20	12
Khairunisa, K., Yustina, Y., & Darmadi, D (2016)	Analysis of Lead (Pb) and Hemoglobin (Hb) Levels in Gas Station Operators in Pekanbaru City and Their Potential as Handout Design in Biology Learning in High School	29,3	25	Gas Station Workers	10	15
Wijayanti, O. R., & Purwati, P. (2022)	Relationship between Blood Lead Levels and Gamma GT (Gamma-Glutamyl Tranferase) Levels in Gombel Semarang Gas Station Operators)	2,75	20	Gas Station Workers	20	-
Susiani, S., & Lestari, M. W. (2022)	The Correlation of Lead Level in the Blood with Hemoglobin Level on the Operator of Public Refueling Station in Gombel Semarang.	2,83	18	Gas Station Workers	18	-
Sinaga, L. R. V., Munthe, S. A., Siregar, R. N., & Zamili, M. (2020)	Relationship between Lead Levels (Pb) in the Air of the Work Environment and the Incident of Hypertension in Public Fuel Filling Station Operators (SPBU Karya 14.)	4,6	31	Gas Station Workers	31	-
Marianti, A., Anies, A., & Abdurachim, H. R. S. (2015)	Increased Blood Lead Levels and the Emergence of Antisocial Behavior in Brass Craftsmen	50,83	31	Pekerja peleburan logam	16	15

Based on data from literature studies, it can be seen that differences in lead content in the blood between gas station attendants, bodywork industry workers, and metal smelting industry workers indicate differences in levels of lead exposure. Based on the results of research conducted by several authors, it was found that the average lead content in the blood of gas station attendants ranged from 2.75 μg/dL to 35.317 μg/dL. Automobile industry workers have an average blood lead content of between 14.4 μg/dL to 35 μg/dL. Meanwhile, in metal smelting industry workers, the average blood lead content ranges from 14.4 μg/dL to 50.83 μg/dL.

Differences in lead exposure levels between these three professions may be due by differences in types of work, activities, and work environments. In addition, factors such as use of PPE and adherence to safe work practices can also influence lead exposure levels. Previous studies have identified several negative effects associated with lead exposure in workers. For example, several studies have found a relationship between blood lead levels and liver dysfunction, hypertension, and hematological disorders such as decreased hemoglobin levels.

3.1. Exposure to Lead in the Blood of Gas Station Attendants

Lead exposure to gas station attendants can occur through inhalation of air contaminated by gasoline vapor containing lead or through direct contact with fuel containing lead. Lead (Pb) is a heavy metal that is known to have harmful effects on human health. Therefore, it is important to understand the level of lead exposure and its impact on the health of gas station attendants.

A literature study has been carried out to analyze the comparison of lead content in blood between gas station attendants and metal smelting industry workers. Several studies show that the average level of lead in the blood of gas station attendants varies, but there are still some samples that have lead levels above the normal limit. For example, a study found that the average blood lead level of gas station attendants in Serang City was 30.517 μg/dL [17].

Lead exposure in gas station attendants can have significant health impacts. Several studies show a relationship between blood lead levels and various health conditions, such as liver dysfunction and hypertension. For example, a study found a relationship between blood lead levels and the incidence of hypertension in gas station attendants in Yogyakarta City. The results of this study show that gas station attendants with high levels of lead have a higher risk of developing hypertension [12].

To protect the health of gas station attendants from lead exposure, several health protection recommendations can be implemented. One of them is the use of appropriate Personal Protective Equipment (PPE). Gas station attendants need to use masks, gloves and protective clothing to reduce the risk of lead exposure through inhalation and skin contact. Apart from that, training and education regarding the dangers of lead and ways to protect yourself also need to be provided to gas station officers. This can be done through occupational health and safety training programs organized by companies or related agencies.

3.2. Exposure to Lead in the Blood of Bodywork Industry Workers

Bodywork industry workers are also one of the groups of workers who are potentially exposed to lead in their work environment. Several studies show that auto body industry workers also have varying blood lead levels. For example, a study found that the average level of lead in the blood of auto body industry workers was 35 μg/dL [13].

Lead exposure in auto body industry workers can have significant health impacts. Several studies show a relationship between blood lead levels and various health conditions, such as liver dysfunction and hypertension. For example, a study found that there is the relationship between blood lead levels and the incidence of liver function disorders in bodywork industry workers in Semarang [2].

To protect the health of auto body industry workers from lead exposure, several health protection recommendations can be made. One of them is the use of appropriate Personal Protective Equipment (PPE). Automobile industry workers need to use masks, gloves and protective clothing to reduce the risk of lead exposure through inhalation and skin contact. Apart from that, the use of a good ventilation system in the work area also needs to be considered to reduce lead exposure.

3.3. Exposure to Lead in the Blood of Metal Smelting Industry Workers

The metal smelting industry is one of the industrial sectors that has a high potential for exposure to lead. In this industry, lead can be found in the form of metal or lead compounds which are used in the metal smelting process. Several studies show that metal smelting industry workers have blood lead levels that tend to be higher than other groups of workers.

For example, a study found that the average level of lead in the blood of lead smelting workers in Tegal Regency was 30.66μg/dL [3]. There are also several samples that have lead levels above the normal limits set by WHO.

Lead exposure in metal smelting industry workers can have serious health impacts. Several studies show a relationship between blood lead levels and various health conditions, such as liver function disorders, hypertension, and kidney function disorders. For example, a study found a relationship between blood lead levels and the incidence of hypertension in lead smelting workers in the Kebasen Small Industry Village (PIK), Tegal Regency [15].

To protect the health of metal smelting industry workers from exposure to lead, several health protection recommendations can be implemented. One of them is the use of appropriate Personal Protective Equipment (PPE). Metal smelting workers need to use masks, gloves and protective clothing to reduce the risk of lead exposure through inhalation and skin contact. Apart from that, the use of a good ventilation system in the work area also needs to be considered to reduce lead exposure.

4. Conclusion

Metal smelting industry workers have a higher potential for exposure to lead compared to gas station attendants. Lead levels in the blood of metal smelting industry workers tend to be higher and there are several cases that exceed the normal limits set by WHO. Lead exposure in metal smelting industry workers can have serious health impacts, such as impaired liver function, hypertension, and impaired kidney function.

Companies or related agencies need to increase the use of Personal Protective Equipment (PPE), ventilation systems in work areas need to be improved in order to reduce lead exposure, training and education regarding the dangers of lead and ways to protect themselves need to be provided to workers. Companies or related agencies need to regularly supervise and monitor lead levels in workers' blood. This can help identify workers who have lead levels above normal limits and take necessary action to protect their health.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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