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Analysis of Lead (Pb) Levels in The Blood of Gasoline Filling Officers in Kedungrejo Village, Banyuwangi Regency

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ABSTRACT

Introduction: *Lead pollution in the air is a potential cause of increased lead accumulation in the blood, which harms health. Lead exposure can be found in various places, such as petrol stations, toll road workers, public transport drivers, and mining processes. The intensity of exposure will be higher for those who, due to professional demands, are always in places at risk of being exposed to lead.*
Objectives and Methods: *The type of research used is descriptive analysis, using 13 research subjects at the Kedungrejo Village Gas Station, Banyuwangi Regency. Data was collected by interview, and blood lead levels were measured using an Atomic Absorption Spectrophotometer (AAS)*
Results *showed that lead levels in the blood of gas station attendants were still within normal limits (25 µg/dL) with an average of 19.23 µg/dL. The average service life for gas station attendants in Kedungrejo Village is 4.6 years.*
Conclusions: *The results of a study conducted on 13 gas station staff at Kedungrejo Village, Myncar District, Banyuwangi Regency, it can be concluded that the average lead level in the blood of gas station attendants is 19.23 µg/dL and is still within normal limits according to the Decree of the Minister of Health of the Republic of Indonesia, namely 10-25 µg/dL. Based on years of service, the highest lead content was in sample I, with a service period of 7 years, namely 25 µg/dL, and the lowest in samples D and M, with a service period of 6 and 3 years, namely 15 µg/dL.*

Introduction

The developments in technology and industry are progressing very rapidly (Kusumastuti et al., 2020). The development is an effort to provide facilities and infrastructure support for human well-being (Qomariyah, 2022). One of them is increment motor vehicle transportation. Improved means of transportation indeed have a positive impact, but can also have a negative impact because reduce the quality of the environment, one of which is the emission of exhaust gases from fueled vehicles containing the heavy metal lead (Pb) (Qomariyah & Hidayah, 2022).

Lead heavy metal pollution is a serious problem in both developed and developing countries like Indonesia (Raharjo et al., 2018). Lead pollution is closely related to mining processes, motor vehicle fumes and industries that use Pb as raw material (Susanti et al., 2014). This can be seen from the parameters of ambient air pollution in certain locations indicating that motorized vehicles are the main source of lead pollution, namely 100% (Mayaserli et al., 2018).

Lead (Pb) poisoning often occurs in groups of people who are at high risk, such as workshop workers, toll road workers, public transport drivers, and fuel fillers at public petrol filling stations

(SPBU) (Budiman et al., 2010). Gas station attendants are a group of people who are vulnerable to exposure to lead (Pb). It is estimated that exhaust emissions released from motorized vehicles can cause contamination of the bodies of gas station attendants who refuel vehicles (Kawatu, 2009). This is supported by the length of time worked per day, years of service per year, gender, age, use of personal protective equipment such as masks to reduce or eliminate the effects of exposure to vapors or gases produced by fuel oil (Nasir, 2023). The location of the gas station which is on the side of the main road makes it easy for officers to be exposed to lead pollutants from the fumes of vehicles driving on the highway or vehicles queuing to carry out the refueling process (Amriami et al., 2012;Fibrianti & Azizah, 2016;Nurjannah, 2017). The presence of chemicals in the work environment creates an additional workload for workers, causing occupational health problems (Kustiningsih et al., 2017;Hidayati, 2014;Hamzah, 2015).

Currently the use of fuel oil (BBM) is still dominated by leaded gasoline, so the greater the consumption of fuel, the greater the pollution of lead in the air (Yaqin, 2015). This is caused by 70% of the lead in gasoline fuel emitted into the air along with other gases released by motorized vehicles. Particles of lead released together with other exhaust emissions will remain in the air before finally settling. Fine lead particles can be directly inhaled into the deepest parts of the lungs and absorbed into the blood with almost 100% efficiency causing systemic poisoning (Rosita, 2018).

According to research published by IOP Publishing Journal Environmental Research Letters in July 2013, estimates that around 470 thousand people die every year due to vehicle emissions that react with oxygen. Based on research that was conducted by Klopfleisch, et al., (2017) the average lead level in the blood of gas station attendants at Jln. Adisucipto, gas station Jln. Monjali, and the Jln. Magelang gas station, which is 62.174 µg/dL, research conducted by Ayu, et al., (2016) namely the average blood lead level of gas station attendants, Tamalanrea District, Makassar city, which is> 25 µg/dL, as well as research conducted by Endah, et al., (2007) namely the average lead level in the blood of gas station operators in East Semarang City, namely 13.35 µg/dL.

Based on the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES /SK/XI/2002 concerning the standard for examining Lead levels in human biomarker specimens, namely the value in normal adults is 10-25 µg/dL. Lead levels in the blood that exceed 25 µL/dL indicate the possibility of lead poisoning which is a serious health condition and requires further treatment.

In this article, an analysis of levels of lead (Pb) metal in the blood of petrol filling officers in Kedungrejo Village, Muncar District, Banyuwangi Regency is presented.

Material and Methods

1. Material

The equipments used in this study were glassware, disposable syringe, tourniquet, dry cotton, 70% alcohol, EDTA vacuum tube, hot plate, Atomic Absorption Spectrophotometer (Shimadzu, A 7000). The materials used in this research were aquadest, HCl hydrochloric acid solution (Merck), nitric acid HNO_3 solution (Merck), Whatman paper No.41 (Merck) and blood samples

2. Methods

a. Solution Making

1) Pb Solution 1000 ppm

A 1000 ppm lead solution was prepared by dissolving 1000 grams of $Pb(NO_3)_2$ in a 100 mL beaker glass, then the solution was transferred to a 100 mL volumetric flask and added distilled water up to the mark.

2) 100 ppm Pb Standard Solution

5 mL of 1000 ppm mother liquor was pipetted into a 50 mL volumetric flask, diluted with distilled water up to the mark and homogenized until completely mixed.

3) Standard Pb Solution 10 ppm

Standard solution was pipetted into a 50 mL volumetric flask, 12.5 mL each; 25mL; 50mL; 75mL; 100 mL was diluted with distilled water up to the mark and homogenized until completely mixed, so that this Pb solution has a concentration of 2.50 ppm; 5.00 ppm; 10.00 ppm; 15.00 ppm; 20.00 ppm.

b. Analysis of lead results in samples

A total of 2 mL of blood sample was put into a porcelain cup which had been weighed beforehand, then 1 mL of HClO4 and 5 mL of HNO3 p.a were added, then heated on a hot plate until smoking, then the porcelain cup was removed and cooled. Then filtered with Whatman paper No. 41 then the solution was transferred to a 50 mL volumetric flask, after which distilled water was added until the volume was exactly 50 mL. The absorbance of the sample solution was read using AAS at a wavelength of 283.53 nm.

c. Data Analysis

Data obtained from measurements using tools Atomic Absorption Spectrophotometer (AAS) in the form of sample solution concentration and the standard solution was then converted to µg/dL units to obtain Pb levels. Furthermore, the data obtained was described and presented in tabular form.

Results and Discussion

1. Overview of the Kedungrejo Village Public Gasoline Filling Station

Kedungrejo Village is one of the villages that is part of the Muncar District, Banyuwangi Regency, East Java Province. Kedungrejo village is one of the busiest villages. This is due to the location of shops, public transportation routes, and also gas stations. The more the number of vehicles, the more places to refuel. There are 2 Public Gasoline Filling Stations operating in Kedungrejo Village, which are located on Jalan Raya Tembokrejo and Jalan Raya Sumberayu. The Public Gasoline Filling Station has employees or female employees who have worked for a long time or who are new to work. The gas station operates from 08.00 to 22.00 and its employees work using a shift distribution system.

2. Results of Determination of Pb Levels in the Blood

In this study, measurements of lead Pb levels in the blood of officers at the General Gasoline Filling Station in Kedungrejo Village, Muncar District, Banyuwangi Regency were carried out. This study aims to determine the levels of Pb metal in the blood based on years of service. The measurement of Pb metal levels in blood uses the atomic absorption spectrophotometry method by means of wet destruction using $HClO_4$ and HNO_3.

The purpose of the destruction is to separate the organic compounds and other metals present in the sample so that only lead metal is present in the sample. The function of $HClO_4$ and HNO_3 in the destruction process is as an oxidizing agent to separate lead metal from other organic compounds contained in the sample. The test solution resulting from the destruction was then measured for its concentration with an atomic absorption spectrophotometer at a wavelength of 283.53 nm. The results of the analysis showed that there were differences in the levels of metals contained in each blood sample (can be seen in Table 1).

Table 1: Results of Measurement of Lead Levels in Samples

Sample Code	Concentration		Working time/ year	Age
	(mg/L)	(µg/dL)		
A	0.16	16	5	21
B	0.20	19	3	22
C	0.19	17	8	36
D	0.15	15	6	21
E	0.18	18	5	39
F	0.17	17	9	30
G	0.24	21	1	22

H	0.21	20	3	21
I	0.25	25	7	25
J	0.24	24	4	26
K	0.19	19	2	23
L	0.17	17	9	33
M	0.15	15	3	30

The results of the analysis showed that the highest lead concentration was in sample I, which was 25 µg/dL and the lowest was found in samples D and M, which was 15 µg/dL. The average lead level in the blood of gas station staff at Kedungrejo Village, Muncar District, is 19.23 µg/dL. These results are still within the normal limits for blood lead levels based on the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES /IX/2002, namely 10-25 µg/dL or 0.1-0.25 mg/L.

Palar (2008) states that lead that enters the human body even in small amounts can be dangerous, because it accumulates in the body and eventually causes poisoning effects on various organ functions. The first effect of chronic lead poisoning before it reaches the target organ is interference with hemoglobin biosynthesis. If this is not addressed immediately, the toxic effects of lead metal will continue, including human organs, especially the nervous system, human blood formation system, kidneys, heart system, and reproductive system. Lead can also cause high blood pressure and anemia. Accumulation of lead in the blood which is relatively high will cause gastrointestinal syndrome, consciousness, anemia, kidney damage, hypertension, neuromuscular, and pathophysiological consequences as well as damage to the central nervous system and changes in behavior.

3. Description of Lead Levels in Blood Based on Working Period

One of the factors that affect blood lead levels depending on the length of a person's working life will affect the high exposure to lead (Sutomo, 2001). One of the factors that affect high blood lead levels with a lower length of service is the use of personal protective equipment (PPE) when working, for example masks. Muzakkir (2009) in Rosmiarti and Amalia (2014) said that the use of personal protective equipment such as masks can reduce the effects of exposure to vapors or gases produced by fuel oil. Another factor that also influences high levels of lead in the blood of gas station staff at Kedungrejo Village, Muncar Subdistrict, is vehicle exhaust coming from vehicles queuing to carry out the refueling process as well as vehicles passing through the road around the gas station because the gas station is located on the edge of the highway so make it easier for officers to be exposed to lead pollutants. The results of research conducted on gas station attendants in Kedungrejo Village, Muncar District, Banyuwangi Regency with different years of service can be seen in Table 2.

Table 2: Comparison of Working Period (Years) with Average Grades Lead in The Blood of Gas Station Officers

Working Period (Years)	Average Grades Lead (µg/dL)	N
9	17.5	2
8	19.0	1
7	25.0	3
6	15.0	1
5	17.0	1
4	24.0	1
3	17.3	1
2	19.0	1
1	22.0	2

The data in Table 2 shows that gas station attendants with 7 years of service have the highest lead levels of 25.0 µg/dL, while 6 years of service have the lowest lead levels of 15.0 µg/dL. If we look at and observe in table 2, it appears that the blood lead level of gas station attendants

with a working age of 1-9 years is contrary to the theory which states that length of service will affect a person's blood lead level. Gas station attendants in Kedungrejo Village, Banyuwangi Regency with 1 year of service have an average blood lead level higher than the average blood lead level of gas station workers with 9 years of service. In addition, several factors can also affect high lead levels in the blood, namely work before becoming a gas station attendant. Some of the respondents work as motorcycle taxi drivers. This is because ojek drivers who work every day are always exposed to lead-contaminated air, especially if they do not use personal protective equipment. Several respondents complained of having difficulty sleeping at night, often feeling dizzy, tired quickly, often feeling tense in the neck, having a history of hypertension and anemia, this is due to the presence of Pb metal which is absorbed in the blood. Pb metal levels in the blood can inhibit the biosynthesis of hemoglobin, if not treated and high levels can cause toxic effects such as hypertension, anemia.

Conclusion

The results of a study conducted on 13 gas station staff at Kedungrejo Village, Myncar District, Banyuwangi Regency, it can be concluded that the average lead level in the blood of gas station attendants is 19.23 µg/dL and is still within normal limits according to the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES/ SK/XI/2002, namely 10-25 µg/dL. Based on years of service, the highest lead content was in sample I with a service period of 7 years, namely 25 µg/dL and the lowest in samples D and M with a service period of 6 and 3 years, namely 15 µg/dL.

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