ORIGINAL RESEARCH

# ANALYSIS OF METAL CONTAMINATION IN PUBLIC TRANSPORT DRIVER'S HAIR MR.X IN MEDAN LOCATION 2024

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**Abstract**

*Lead is often referred to as lead or plumbum. Lead (Pb) is a heavy metal that can cause poisoning until it can accumulate in the human body. The process of entering Pb into the body can go through several pathways, namely through food and drink, air and penetration or penetration of the membranes or layers of the skin. Hair is one of the bioindicators of heavy metal pollution because in the hair there is a sulfhydryl group that can bind lead. This research aims to determine the lead metal content in the hair of the Mr X public transportation driver on the Medan Amplas - Medan Helvetia route in 2024. A wet destruction method validation test has been carried out for the determination of lead (Pb) levels in the hair. Wet destruction using HNO3 and HCl. The analysis of the lead content of the destruction was carried out with an Atomic Absorption Spectrophotometer (SSA). The research results show that the highest Pb Lead level in hair is 24,000 ppm with a service life of 27 years, and the lowest Pb Lead level in hair is 0,400 ppm with a working period of 3 years.*

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## 1. Introduction

As a heavy metal, lead has a toxic potential and tends to be difficult to degrade, causing environmental accumulation. Moreover, it can accumulate in living organisms and spread through the food chain, eventually reaching humans as the ultimate consumers (Miranda et al., 2018). Plumbum can enter the body through food, drink, and air. The cause of lead contamination not contamination of soil through various sources, including the use of fertilizers and pesticides, emissions from motor vehicles, industrial activities, mining, and other activities (Irianti et al., 2017).

Transportation is often a major source of pollution, especially in urban areas. Every vehicle that ($SO_2$), and other particulates. The combustion of fuel in a vehicle engine to produce energy is a major cause of air pollution. If the combustion of fuel is incomplete, it produces many unwanted substances and worsens air pollution.

Air pollution is closely linked to the dispersion of metals in the atmosphere. Hazardous and toxic heavy metals, such as lead (Pb), are a major cause of pollution. According to the Environment Project Agency cited by Dessy (2012), about 25% of lead (Pb) from fuel remains in the vehicle engine, while the other 75% pollutes the air through exhaust fumes. These lead emissions can cause air pollution wherever the vehicle is located, and the particles can stick to parts of the human body, such as hair. Humans are exposed to lead (Pb) in normal amounts or within tolerance limits, namely in hair of 0.007 - 1.117 mg Pb/100g (Putri Syalma Wijatma, et al, 2023).

The release of lead into the earth's atmosphere can occur in the form of gas or particles. Lead released in gaseous form mainly comes from motor vehicle emissions. These emissions are a by-product of the combustion process in vehicle engines. Lead in gaseous form comes from tetramethyl-Pb and tetraethyl-Pb compounds that are added to vehicle fuel to prevent anti-knock in the engine (Palar Heryando, 2008).

Both tetramethyl-Pb and tetraethyl-Pb compounds can be absorbed by the skin as they are soluble in oils and fats. In the atmosphere, tetraethyl-Pb decomposes quickly due to exposure to sunlight, forming derivative compounds such as triethyl-Pb, diethyl-Pb, and monoethyl-Pb, diethyl-Pb, and monoethyl-Pb. These decomposed compounds have a distinctive garlic-like odor, are difficult to dissolve in oil, but are very soluble in water. These Pb compounds can be dispersed in the air in a dry state, so they can be inhaled when breathing, accumulate in the skin, or absorbed by plants (Palar Heryando, 2008).

Lead heavy metal is highly toxic and can cause both acute and chronic poisoning effects. These effects affect various body systems, such as the digestive system with the appearance of intestinal colic accompanied by severe constipation. Lead also affects the hematopoietic system by inhibiting the activity of the enzyme aminolevulinate dehydratase (ALAD) in bone marrow erythroblasts and erythrocytes, resulting in a shorter lifespan of red blood cells. In addition, lead poisoning can cause loss of appetite, and affects the nervous system with symptoms such as epilepsy, hallucinations, delirium, and major brain damage. In addition, lead exposure to the kidneys can trigger kidney failure and kidney organ damage, reduce reproductive ability, cause heart function abnormalities in children, and result in iodine deficiency in the endocrine system. Lead is also known as a weak carcinogen that can trigger lung cancer, stomach cancer, and glioma cancer (Adhani et al., 2017).

According to the Big Indonesian Dictionary (KBBI), hair is hair that grows on human skin, especially on the head. Hair is one of the organs of the body that is formed like strands of thread and grows on skin that is rich in keratin. Hair comes from the epidermis layer, which is the outermost layer of the skin.

Lead that accumulates in the body can be detected through hair. In hair, lead can bind to sulfhydryl groups, so lead levels in hair can be used as an indicator of lead pollution (Marianti Aditya, 2013).

Analysis of heavy metal content in blood or urine tends to be less accurate because heavy metals in blood or urine do not last long and are immediately excreted through the body's metabolic processes. In contrast, heavy metal analysis lasts longer in hair. The amount of metal in hair is related to the amount of metal absorbed by the body, so hair is used as biopsy material (Lawrance D. Wilson, 2003).

Atomic Absorption Spectrophotometer is a scientific instrument utilized in the quantitative determination of the presence and concentration of certain chemical elements in a sample.

## 2. Methodolody

This research method uses quantitative descriptive research using an Atomic Absorption Spectrophotometer (SSA), this study aims to measure heavy metal lead (Pb) in the hair of Mr. X public transportation drivers on the Medan Amplas - Medan Helvetia route in 2024.

Sampling was carried out in the area around Medan Amplas, then continued with laboratory analysis at the UPT Regional Health Laboratory of North Sumatra Province located on Williem Iskandar Pasar V Barat 1 No. 4, Medan.

The population in this study were 20 drivers of Mr. X Public Transportation on the Medan Amplas-Medan Helvetia route and the number of samples in this study were 10 people as samples.

**Table 1. Tools Used**

| No | Tool Name | Specifications |
|---|---|---|
| 1 | Atomic Absorption Spectrophotometer | Wavelength 283.3 nm |
| 2 | Measuring flask | 50 - 100 ml |
| 3 | Volume pipette | 10 ml |
| 4 | Erlenmeyer | 100 ml |
| 5 | Hot plate | 95ºC |
| 6 | Analytical balance | - |
| 7 | Beaker | 100 ml |
| 8 | Water bath | - |
| 9 | Watch glass | - |
| 10 | Whatman filter paper | 10 Pieces |
| 11 | Funnel | 10 Pieces |

**Table 2: Materials used**

| No | Material Name | Weight |
|---|---|---|
| 1 | Hair | 0,2g |

**Table 3. Reagents Used**

| No | Reagent Name | Chemical Formulas | Concentration |
|---|---|---|---|
| 1 | Nitric Acid | $HNO_3$ | 65% |
| 2 | Aquadest | $H_2O$ | - |
| 3 | Hydrochloric Acid | HCl | - |

**PROCEDURE**

1. Weigh a sample of 0.2 accurately using an analytical balance.
2. Then add ±15 ml of HCl and 5 ml of HNO3 and cover using a watch glass.
3. The solution is heated to boiling for approximately 30 minutes on a hot plate.
4. The watch glass cover is opened and the solution is evaporated in a water bath, then filtered.
5. Then add another 12.5 ml of nitric acid, the solution is heated until all dissolved and cooled again in a water bath.
6. The solution was transferred into a 50 ml volumetric flask while rinsed with distilled water and adjusted to the limit mark.
7. After this process runs, the sample is ready to be measured with an atomic absorption spectrophotometer with a wavelength of 283.3.

## 3. Results And Discussion

The results of the examination of 10 hair samples of public transportation drivers at the UPTD Regional Health Laboratory on May 16, 2024, showed the following results:

**Table 4. Data of Quantitative Test Results of Pb (Lead) Level Examination in the Hair of Mr. X Public Transport Driver Route Medan Amplas - Medan Helvetia**

| Sample Code | Age (Year) | Duration of Work | Pb concentration from SSA (mg/L) | Calculated Pb Concentration (ppm) | Pb Pollution Level Based on WHO Year 1995 |
|---|---|---|---|---|---|
| A1 | 62 Years | 27 Years | 0,0941 | 24,000 | High Pb Pollution Level |
| A2 | 42 Years | 7 Years | 0,0313 | 7,800 | Low Pb Pollution Level |
| A3 | 34 Years | 6 Years | 0,0108 | 2,700 | Low Pb Pollution Level |
| A4 | 30 Years | 5 Years | 0,00975 | 2,400 | Low Pb Pollution Level |
| A5 | 30 Years | 5 Years | 0,0017 | 2,100 | Low Pb Pollution Level |
| A6 | 26 Years | 3 Years | 0,00866 | 0,400 | Low Pb Pollution Level |
| A7 | 58 Years | 20 Years | 0,0464 | 11,600 | Med Pb Pollution Level |
| A8 | 32 Years | 3 Years | 0,00722 | 1,800 | Low Pb Pollution Level |

| | | | | | |
|---|---|---|---|---|---|
| A9 | 46 Years | 11 Years | 0,0208 | 5,200 | Low Pb Pollution Level |
| A10 | 52 Years | 13 Years | 0,0276 | 6,900 | Low Pb Pollution Level |

Description:
Low Pb Pollution Level: <10 ppm
Medium Pb Pollution Level : 10-20 ppm
High Pb Pollution Level : >20 ppm

The results of the research data table indicate Pb levels in 10 (ten) hair samples of Mr. X public transport drivers on the Medan Amplas - Medan Helvetia 2024 route with a variable length of work of 3 years - 13 years declared a low level of Pb pollution, namely <7,800 ppm, and a length of work of 20 years declared a moderate level of pollution, namely 11,600 ppm, while a length of work of 27 years declared a high level of lead pollution, namely 24,000 ppm. categories based on work duration are done to facilitate the evaluation of the effect of work duration on lead levels contained in the hair of public transport drivers.

The causes of positive Pb levels in public transportation drivers include duration of work or length of employment, age, and not using personal protective equipment (PPE) such as masks and hats. Therefore, constant exposure to exhaust gases from vehicles with leaded fuel inhaled daily outdoors can lead to increased lead concentrations in the body.

## 4. Conclusion

Research conducted at the UPTD Regional Health Laboratory of Sumatra Province Atomic Absorption with a wavelength of 283.3 nm resulted in the highest lead level in hair of 24,000 ppm (sample A1), while the lowest lead level in hair was 0.400 ppm (sample A6).

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