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Analysis of Lead (Pb) In Street Vendors' Urine at Antang Market, Makassar

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ABSTRACT

Lead is a pollutant originating from motor vehicles. As a heavy metal, it is harmful to living organisms and may cause serious health problems. This study aimed to determine the levels of lead (Pb) in the urine of street vendors around the Antang market, Makassar. This study used an atomic absorption spectrophotometer (AAS) to analyze lead levels in the urine of 10 street vendors who met the study criteria. The results of this study showed that of 10 respondents, 4 had lead levels below the standard threshold, and 6 exceeded it. The highest level was 0.28 mg/L. This suggests that prolonged exposure is associated with higher urinary lead levels.

Keywords: Lead, street vendors, urine

1. Introduction

Air pollution is the entry of substances, energy, or other components into the air that exceeds air quality standards. The problem of air pollution is a problem that occurs every year due to technological developments [1]. The increasing number of motorized vehicles every day means an increase in pollution, which can result in air pollution [2]. Population growth, followed by growth in transportation, can contribute to air pollution. Air pollution can make clean air dirty. One of the human activities that can be exposed to air pollution is street vendors, because street vendors are in locations that are polluted with air for an extended period every day [3].

Street vendors are informal-sector traders without a business license who operate on roads or sidewalks not designated for commerce. Where they run their business by selling on roads or sidewalks that are not designated as business premises [4]. The length of contact of street vendors with air that has been polluted by the heavy metal lead (Pb) can cause street vendors to be included in the group of people at high risk of being exposed to lead (Pb) [3].

Lead is one of the pollutants emitted by motor vehicles. Lead is a heavy metal that can harm organisms and cause serious health problems if the body is exposed to it [5]. Lead enters the body through food, water, and air. If the human body has absorbed lead (Pb), it will inhibit the activity of the enzyme Aminolaevulinic acid dehydrase (ALAD), which plays a role in the formation of hemoglobin [6][7]. Lead enters the body through the respiratory tract into the lungs. After that, it enters the blood vessels. In the blood, lead will mix with or bind to oxygen, which is then circulated to other organs. After that, it is excreted by different organs into the kidneys. In the kidneys, it is excreted in urine. Where the lead content in urine is higher, and the volume is also greater [4].

Urine is the residual excretion processed by the kidneys and expelled from the body. Urine is also a metabolic product that the body no longer needs, such as nitrogen, urea, and ammonia [8]. The presence of substances still required by the body indicates an error in the kidneys' filtration. One substance often present in urine and still needed by the body is protein [9]. Previous research on street vendors at the Kampung Rambutan terminal using an atomic absorption spectrophotometer showed that 18 respondents had an average blood lead (Pb) level exceeding the threshold (20 µg/dL or 0.20 ppm) of 22.03 µg/dL, with some exceeding 65 µg/dL [3]. In an examination of street vendors at the 45 Manado market using the SSA method, 31 respondents had the lowest urine lead (Pb) level of 0.23 mg/L and the highest of 3.01 mg/L, with

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an average of 0.8461 mg/L [4]. Analysis of lead in children's gums using the atomic absorption spectrophotometer method among 22 respondents showed 6 with high lead levels and 16 with normal levels [10]. Based on the background above, it is necessary to analyze urine lead levels of street vendors in the Antang market area, Makassar, using the Atomic Absorption Spectrophotometer (AAS) method.

2. Methods

2.1. Instrument and Materials

The tools used in this study included a Varian Atomic Absorption Spectrophotometer (AAS) model AA24OFS, a sample pot, a hot plate, a stirrer, a bulb, and glassware commonly used in the laboratory. The materials used in this study were dry cotton, HNO_3 solution, and a lead stock solution at 1000 ppm.

2.2. Sample collection

The population in this study was 10 street vendors around Antang market. All of them were used as research samples, meeting the criteria of being willing to serve as respondents, being street vendors within $\leqslant$ 5 meters of the main road, having a work length of $\geqslant$ 2 years, being 25-50 years old, and working $\geq$ 8 hours. An interview was conducted first with the respondents to fill out the questionnaire. Respondents who met the criteria were asked to collect their urine into the prepared urine pot.

2.3. Sample destruction

The urine sample was put into a 10 ml Erlenmeyer flask, 90 ml of water (H_2O) was added, and 5 ml of HNO_3 solution was added [11]. Then, the sample was heated to 20 mL in a fume hood, removed, and cooled. After cooling, it was placed into a 100 ml measuring flask, and distilled water was added to the limit mark. Furthermore, measurements were carried out on an atomic absorption spectrophotometer (AAS).

2.4. Preparation of standard lead solution (ppm)

A 10-ppm stock solution was made from a 1000-ppm stock solution by pipetting 0.5 ml of the 1000-ppm solution into a 50 ml measuring flask and adding distilled water to the boundary mark. Subsequently, standard solutions of 0.1, 0.2, 0.3, 0.5, and 1 ppm were prepared by pipetting 0.5, 1, 1.5, 2.5, and 5 ml of the 10-ppm stock solution into a 50 ml measuring flask and adding distilled water to the boundary mark.

2.5. Preparation of a calibration curve

The standard solution was measured using an Atomic Absorption Spectrophotometer (AAS) at 283 nm, and the absorbance was recorded. The standard lead (Pb) calibration curve is made by entering the concentration value of the standard lead solution on the X axis and the absorbance value on the Y axis to obtain a linear equation from the calibration curve [12].

3. Results and Discussion

The blank was added to the AAS, then the destroyed sample was added, and its absorbance was recorded. After the absorbance was obtained, the data were entered into the equation Y = a + bX to determine the lead content. In this study, observations of street vendors around the Antang market in Makassar were conducted, and respondent samples were collected for analysis at the Chemistry, Science and Technology Laboratory of UIN Alauddin Makassar.

Analysis of lead levels in the urine of street vendors around the Antang market in Makassar was conducted using an atomic absorption spectrophotometer with a maximum wavelength of 283 nm. Based on the standard solution calibration data, a calibration curve can be generated. The standard calibration curve is based on a standard solution, where Y is absorbance, and X is concentration.

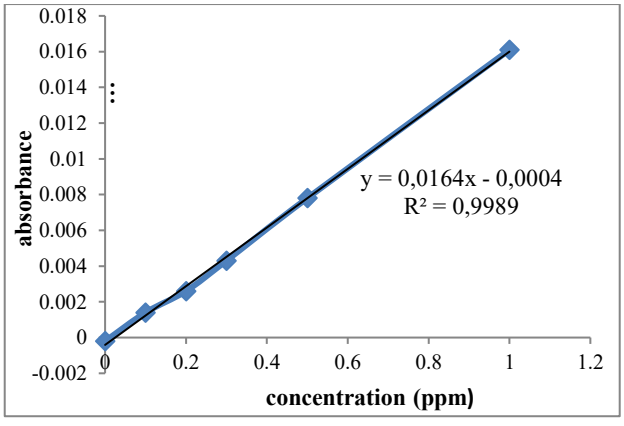

Figure 1. Standard calibration curve

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Based on the standard calibration curve in Figure 1, the R^2 value was 0.9989. The correlation coefficient indicates that the standard solution used is good, as the value obtained is within the acceptable range ($r < 0.99$). The results of measuring lead levels in urine are determined based on the equation of the line from the calibration curve of the standard solution. Data on the analysis of lead levels in urine are shown in Table 1.

Table 1. Lead levels of street vendors

Respondent Name	Lead content (mg/L)	Normal Standard (mg/L)	Information
SI	0,18	0,15	Abnormal
WD	0,21	0,15	Abnormal
SR	0,06	0,15	Normal
RI	0,15	0,15	Normal
AL	0,18	0,15	Abnormal
RA	0,09	0,15	Normal
DA	0,27	0,15	Abnormal
DI	0.24	0,15	Abnormal
AN	0,03	0,15	Normal
RL	0,27	0,15	Abnormal

Table 1 shows that four respondents had urine lead levels below the threshold, and 6 had levels exceeding it. The highest urine lead level was 0.27 mg/L, and the lowest was 0.03 mg/L; urine lead levels by respondent age are shown in Table 2.

Table 2. Lead levels in urine based on respondent age

No.	Respondent	Age	Lead levels in urine (mg/L)
1	RI	25	0,15
2	RA	27	0,09
3	DI	31	0,24
4	WD	36	0,21
5	DA	37	0,27
6	SI	38	0,18
7	RL	40	0,27
8	AN	45	0,03
9	SR	45	0,06
10	AL	46	0,18

Table 2 indicates that respondents aged 37 and 43 years exhibited elevated urine lead (Pb) concentrations of 0.27 mg/L and 0.03 mg/L, respectively. These findings suggest potential age-related or exposure-related differences in lead accumulation among the respondents. Data on respondents' lead levels by the distance from the place of sale to the highway are shown in Table 3.

Table 3. Distance of sales location from the main road

Respondent	Distance of the place of sale to the main road	Amount	Lead levels in urine (mg/L)
AL	1 m	1	0,18
DA; RI & RL	2 m	3	0,27; 0,15 & 0,27
DI & WD	3 m	2	0,24 & 0,21
RA & SI	4 m	2	0,09 & 0,18
SR & AN	5 m	2	0,06 & 0,03

Table 3 shows that respondents who have high levels of lead in urine come from sellers with a distance of 3 meters from the highway, with a lead level of 0.27 mg/L, and the lowest lead levels are from sellers with a distance of 5 meters from the highway, with a lead level of 0.03 mg/L. Data on respondents' lead levels by the length of their selling each day are shown in Table 4.

Table 4. Duration of selling each day

Respondent	Selling time per day	Amount	Lead levels in urine (mg/L)
AN & SR	8 hours	2	0,03 & 0,06
RA	10 hours	1	0,09
RI	11 hours	1	0,15
SI; AL & WD	12 hours	3	0,18; 0,18 & 0,21
DI	14 hours	1	0,24
DA & RL	15 hours	2	0,27 & 0,27

Table 4 shows that vendors selling for 15 hours per day had the highest urine lead level of 0.27 mg/L, while those selling for 8 hours per day had the lowest, 0.03 mg/L.

Lead level examination is conducted in the laboratory by comparing the threshold value for lead in the human body, as outlined in Decree of the Minister of Health number 1406/MENKES/SK/XI/2002. The limit of lead levels in urine is 0.15 ppm (mg/L) [13].

High levels of lead in the human body are caused by exposure to excessive lead, which can be seen in age, length of service, and duration of exposure [14][15].

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According to Table 1, the highest lead level in street vendors' urine is 0.27 mg/L. This is due to a 10-year work period, exposure for 15 hours per day, and the toxic effects of lead on the body, which can cause anemia. Based on the qualitative test for lead in urine samples from workshop workers using color reagents, 15 samples showed no sediment. Three samples showed a cloudy color, and quantitative lead analysis using SSA showed results that did not exceed the lead content threshold [16].

Table 2 explains that age does not affect lead levels in the body. The age of 37 years has a lead level of 0.27 mg/L, and at the age of 43 years has a lead level below the threshold for street vendors because respondents who sell for about 8 hours per day, work for a period of 2 years, and the distance between their place of sale and the highway is about 5 meters. This study is consistent with previous findings reporting elevated urine lead levels among street vendors with more extended working periods (>3 years), indicating that prolonged occupational exposure may contribute to increased lead accumulation [4].

The distance from the street vendor's location to the highway can affect urine lead levels. This can be seen in Table 3: the highest lead level of 0.27 mg/L is due to the sales location being 2 meters from the highway; the closer someone lives to the highway, the higher the body's lead levels can be. This is due to activities on the road, which cause one of the sources of lead levels to come from motor vehicles, so that the exposure to lead that enters the respondents is increasing [17]. The findings of this study are consistent with previous research, indicating that closer proximity of vending locations to highways is associated with higher urine lead concentrations among street vendors, with measured levels exceeding the recommended threshold value of 0.20 ppm [3].

The duration of exposure to lead affects the levels of lead in urine [18][19]. Table 4 shows that the highest lead levels are in respondents who work 15 hours per day. This is because respondents are exposed to lead for a long time. The longer a street vendor works (> 8 hours per day), the more they are indirectly exposed to lead. This is because the extended work period reduces the body's immune function due to insufficient rest hours. This study is consistent with earlier findings showing that urine lead concentrations among street vendors were highest in individuals with more than three years of work experience, suggesting the influence of prolonged occupational exposure [4]. Lead content in hair, urine, and blood specimens of TPS 3R Sutorejo waste officers using Atomic Absorption Spectrophotometry. From 10 research samples, the lead concentrations ranged from 0.108 to 0.239 µg/g in hair samples, from 0.000095 to 0.00121 mg/L in urine samples, and from 1.665 to 4.785 µg/dL in blood samples. All respondents (100%) had lead levels in hair, urine, and blood specimens in the normal category [20].

4. Conclusion

Based on this study's results, the highest lead concentration in the urine of street vendors at the Antang Market was 0.27 mg/L, while the lowest was 0.03 mg/L. Notably, 60% of the urine samples analyzed showed lead levels exceeding the recommended health-based threshold, indicating that a substantial proportion of vendors may be exposed to lead at concentrations that may pose adverse health risks. These findings suggest significant occupational and environmental exposure to lead among street vendors in this area, particularly due to prolonged daily exposure to traffic-related emissions and surrounding environmental conditions.

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