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Identification of Mercury Content in Children Stunting Patients Aged 0–24 Months in the Regions Small Scale Gold Mine in Krueng Sabee District, Aceh Jaya Regency

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Abstract: Mercury is a type of heavy metal that is included in the category of Hazardous and Toxic Materials (B3) waste because it can harm living things and pollute the environment. Community mining activities are generally known to be the largest contributor of mercury to the environment. In addition, people's mining activities can indirectly result in the destruction of the landscape and vegetation on it. Mercury exposure can have a negative impact on the health of children living in ASGM areas. A reduced immune response or immune system in children living in ASGM areas with a high risk of exposure to mercury and exacerbated by concomitant malnutrition is very at risk of stunting. this study aims to identify mercury content in children stunting patients aged 0–24 months in the region's small-scale gold mine in Krueng Sabee district, Aceh Jaya Regency. The AAS instrument is used to analyze urine mercury levels. Three of the 11 urine samples did not show mercury, while the remaining 08 samples were found to contain mercury, each of the 08 urine samples was found to have mercury levels exceeding the acceptable threshold (7µg/L) Human Biomonitoring (HBM), while three twenty-nine samples had urine mercury levels below the threshold. This study concluded that 88% of stunted toddlers were found to contain mercury that exceeded the threshold. Meanwhile, 03 urine samples did not contain mercury.

Keywords: Gold; Mercury; Mine; Stunting; Urine

Introduction

Mercury is a type of heavy metal that is included in the category of Hazardous and Toxic Materials (B3) waste because it can harm living things and pollute the environment (Kusumawaty et al., 2022). Wastewater containing mercury must be treated first so that it has the same quality as environmental water quality which is not toxic to living things (Lensoni, 2021). Mercury pollutant sources are divided into two major categories, namely those originating from nature and those originating from mining (Al-Sulaiti et al., 2022). Community mining activities are generally known to be the largest contributor of mercury to the environment. In addition, people's mining activities can indirectly result in the destruction of the landscape and vegetation on it. The management of gold ore in community mining activities is broadly divided into two processes, namely physical processes and chemical processes (Sea, 2022).

Mercury is a very dangerous heavy metal because it can accumulate in the body (Mitra et al., 2022). Mercury (Hg) is widely used in the beauty industry as a chemical used in beauty products today (Abbas et al., 2020). But in fact it is known that the impact of continuous exposure to mercury has an effect on metabolic disorders in the body (Roy et al., 2017). Mercury (Hg) is a dangerous heavy metal which in small concentrations can be toxic (Zaynab et al., 2022). The use of mercury in whitening creams can cause various things, ranging from skin allergies, skin irritation, and

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dark spots (Juliano, 2022). With high doses can cause permanent damage to the brain, causing vomiting, headaches. Mercury toxicity levels range from 50-100 µg% and symptoms of poisoning will be seen (Rama Jyothi et al., 2020). Mercury generally enters the body through air, water or food which is absorbed in varying amounts. Meanwhile, the human body cannot process forms of methyl mercury so that mercury remains in the body for a relatively long time and can cause health problems (Nogara et al., 2019). Short term exposure to high levels of mercury can cause lung damage, vomiting, increased blood pressure and heart rate (Briffa et al., 2020).

Mercury enters the body through the food chain and water if it has exceeded the tolerance limit it will cause poisoning (Lensoni et al., 2020). Based on Law Number 32 of 2009 concerning Environmental Protection and Management in article 69 it is clearly stated that everyone is prohibited from disposing of B3 waste into environmental media including river bodies (Yuan et al., 2022). If B3 waste is disposed of into river bodies, it will certainly contaminate river water and be hazardous to the health of the people who use the river water as drinking water and necessities of life (Soprima et al., 2018).

Mercury exposure can have a negative impact on the health of children living in ASGM areas (Vergara-Murillo et al., 2022). A reduced immune response or immune system in children living in ASGM areas with a high risk of exposure to mercury and exacerbated by concomitant malnutrition is very at risk of stunting (Serafini et al., 2022). Apart from malnutrition and infectious diseases, people living in ASGM areas are also at risk of diarrhea (Puspita et al., 2020). Stunted toddlers with a high prevalence of diarrhea will have lower levels of immunity (Budge et al., 2019). A reduced immune response or immune system in children living in ASGM areas with a high risk of exposure to mercury and exacerbated by malnutrition that occurs simultaneously is very at risk of stunting (Puspita et al., 2020), this study aims to identify mercury content in children stunting patients aged 0–24 months in the regions small scale gold mine in krueng sabee district, Aceh Jaya Regency.

Method

The type of research used is the experimental test method. Where, this method uses a urine sample of stunted children aged 0-24 months to see the mercury content in the urine. Collect samples from certain populations as a tool to identify mercury content in stunted children aged 0 to 24 months in small-scale gold mining areas. The population in this study used 25 toddlers with stunting as respondents. The sample in this study used a total sampling method of 25 people. However, the research samples that we were able to take were 11 toddlers with stunting.

Inclusion and Exclusion Criteria

The first is inclusion There are families who allow urine collection for their toddlers, communicate well, have no mental disabilities, and are not in a contagious disease. Second, there are exceptions some families do not allow their children to collect urine, some children with stunting experience infectious diseases, and some families closed themselves during the survey. Time and location This research was conducted in the vicinity of small-scale gold mining areas. Conducted on Monday 7 March to Friday 18 March 2022 for sampling. To test the mercury content of urine in stunted children, it is carried out in the laboratory.

This study used secondary data, the population in this study were all stunted children aged 0-24 months in small-scale gold mining areas. The sampling technique in this study was a saturated sample, which is a sampling technique when all members of the population are used as samples. This is often done when the population is relatively small. Sample analysis uses several methods, namely Atomic Absorption Spectrometry (AAS), and Atomic Fluorescence Spectroscopy or inductively coupled plasma mass spectrometry (ICP-MS). In this work, the optimal conditions for determination of mercury by graphite furnace atomic absorption spectrometry, (drying temperature and time, ashing temperature and time, atomization temperature and time) in pharmaceutical products (thimerosal and products with thimerosal) are investigated. A method has been proposed for the determination of mercury in pharmaceutical samples with palladium chloride as a chemical modifier (Yang et al., 2002).

Result and Discussion

The results of this study show Table 1. characteristics of respondents by gender. Based on Table 1, it can be seen that the male respondents are larger than the female respondents, namely 64%, while the female respondents are 36% of 11.

Table 1. Characteristics of Respondents by Gender

Gender	F	(%)
Man	7	64
Woman	4	36
Total	11	100

Based on Table 2 , it is known that the age of the respondents is 14 months and 21 months more with a frequency of 2 people and a percentage of 18.50%. The

age of the respondents 5 months, 6 months, 7 months, 9 months, 16 months, 19 months, and 23 months was 1 person with a percentage of 9%.

Table 2. Characteristics of Respondents by Age (Monthly)

Gender	F	(%)
5	1	9
6	1	9
7	1	9
9	1	9
14	2	18.50
16	1	9
19	1	9
21	2	18.50
23	1	9
Total	11	100

Table 3. Urine Test Results for Children Aged 0-24 Months

Test Sample Code	Unit	Quality standards	Analysis results	Information
1	ug/l	-	35.28	
2	ug/l	-	39.22	
3	ug/l	-	62.20	
4	ug/l	-	TD	lih. (1)
5	ug/l	-	TD	lih. (1)
6	ug/l	-	27.54	
7	ug/l	-	12.48	
8	ug/l	-	11.46	
9	ug/l	-	TD	lih. (1)
10	ug/l	-	61.57	
11	ug/l	-	30.37	

TD: not detectable because the concentration is below the detection limit of the device (<0.001 ug/l).

Based on Table 3 above, it is known that there were 8 children who were identified as mercury and 3 children who were not identified as mercury. Children with test sample code 3 are declared to have the highest mercury identification based on the analysis results (62.20). The results of this study showed that all urine samples taken contained mercury, as many as eight urine samples contained mercury above the threshold set by Human Biomonitoring (HBM), 7 µg/L (Lensoni, et al., 2023), while three In the urine sample there is a mercury content below a predetermined threshold. This shows that as many as 88% of stunting toddlers contain mercury in the urine while 12% contain mercury below a predetermined threshold. The AAS instrument is used to analyze urine mercury levels (Debora et al., 2023). Three of the 11 urine samples did not show mercury, while the remaining 08 samples were found to contain mercury that exceeded the acceptable threshold (7 µg/L) for Human Biomonitoring (HBM), while thirty-nine samples had urine mercury levels below the threshold. Limit (Khaled et al., 2023).

This study is in line with research Sofia et al. (2017) which reported that the concentration of mercury in hair was highest in Paya Seumantok Village (48.1 µg/g), followed by Panton Makmur Village (42.1 µg/g), and Panggong Village. (35.2 µg/g) and Gampong Curek (11.3 µg/g). The highest concentration of mercury in Gampong Paya Seumantok is due to the large number of artisanal gold processing industries in the area. Lensoni (2023) reported concentrations in the urine of the Seumantok Gampong Paya community. Sixteen of 91 urine samples did not show mercury, while the remaining 75 samples were found to contain mercury. The average urine mercury level among local residents near the site was 8.392 µg/L (SD: 6.721 g/L), while the minimum and maximum urine mercury levels in this study were 0.19 µg/L and. 28.31 µg/L, respectively. Accumulation of mercury in these organisms was significantly greater in shellfish than in fish where the average concentrations were 2.882 ± 148 and 0.321 ± 18.7 mg/kg dry weight, respectively. The highest mercury content is indicated by the Meureubo River. The minimum bioaccumulation of mercury by fish was found in the head (197.8 ± 10.2 µg/kg dry weight), while the maximum bioaccumulation in fish was found in the eyes (382 ± 1.3 µg/kg dry weight). The concentration of mercury varies greatly in the following order: Eyes, Muscles, Fins, Bones, and Head (Suhendrayatna, 2012).

Conclusion

Eight samples of urine for children with stunting aged 0-24 months contained mercury above the threshold set by Human Biomonitoring (HBM), 7 µg/L, while three urine samples contained mercury below a predetermined threshold. This shows that as many as 88% of stunting toddlers contain mercury in the urine while 12% contain mercury below a predetermined threshold.

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Author Contributions
Conceptualization, L, A. N, I.; methodology, L.; validation, A. N and I.; formal analysis, L.; investigation, A. N and I.; formal analysis, L.; investigation, A. N and I.; resources, L and A. N.; data curation, I.: writing—original draft preparation, L and A. N.; writing—review and editing, I.: visualization, L and A. N.; supervision, I.; project administration, L.; funding acquisition, A. N and I. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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