



FACTORS RELATED TO MERCURY (Hg) POISONING IN UNLIMITED GOLD MINING (CATE) KAYELI VILLAGE, BURU REGENCY, MALUKU PROVINCE

Rajid Fariz Rasako¹, Tri Joko², Yusniar Hanani D³

Master in Environmental Health, Faculty of Public Health, Diponegoro University

Email : rajidrasako46@gmail.com

Article details:

Published: 27 May 2022



ABSTRACT

The gold mining activity without a permit (PETI) in Kayeli Village, Buru Regency is an activity that has been carried out since early 2011 by the surrounding community. PETI activities in Kayeli Village, Buru Regency are generally carried out between 2 rivers, namely the Masarete and Anahoni rivers. The purpose of this study was to determine the factors associated with mercury (Hg) poisoning in unlicensed gold miners (PETI) in Kayeli Village, Buru Regency, Maluku Province. This study is an observational study with a cross sectional approach. The

technique used in sample collection is proportional random sampling. The number of samples in this study was 45 people. The factors studied in this study were the type of miner's activity, length of work/day, working period/year, continuity of use of PPE, completeness of PPE, and amount of mercury use/day. The results showed that the use of mercury in mining was relatively high, ranging from between 0.25 ounces to 1 ounce. This can reduce the quality of the environment, especially rivers that are used as a dumping ground for mercury. In addition to having an impact on the environment, it also has an impact on the health of the miners and the surrounding community. The characteristics of the gold miners who were sampled in this study were mercury levels in river water at 3 sample points from 0.0004 to 0.0005 mg/l, which has exceeded the threshold value according to Permenkes No. 416/menkes/ Per/IX/1990, regarding river water. The mercury levels found in the miners' hair ranged from 0.0001 to 512.8651 with a toxicity level of 88.9%. The results of the chi-square analysis showed that 2 independent variables, namely length of work/day ($p=0.003$), and continuity of use of PPE (0.000) had a significant relationship with mercury poisoning in illegal gold miners (PETI).

Keywords: Mercury poisoning, PETI, Buru Regency

To cite this article :

Rajid Fariz Rasako, Tri Joko, Y. H. D. (2022). FACTORS RELATED TO MERCURY (Hg) POISONING IN UNLIMITED GOLD MINING (CATE) KAYELI VILLAGE, BURU REGENCY, MALUKU PROVINCE. *International Journal of Health, Education and Social (IJHES)*, 5(5), 40–47.



Introduction

In Indonesia, heavy metal pollution tends to increase in line with the increasing industrialization process. Since the era of industrialization, mercury has become a pollutant in excavations because mercury can be utilized as much as possible. One of the causes of environmental pollution by mercury is the disposal of amalgamated gold processing tailings.¹

Regions in Indonesia are currently the barns of people's gold miners who cause a lot of losses. The loss of state losses and foreign exchange due to this activity poses a threat to ecosystem damage and a decrease in the carrying capacity and capacity of the environment. IFTN (Indonesia Free Toxic Network) states that in the last five years, the number of vulnerable points for ASGM (Small-Scale Gold Miners) in Indonesia is quite rapid. by 2010, the number of traditional miners was 900 miner locations, with the number of miners working around 250,000 miners. This number includes women and children who are still underage. The total number of working miners is more than 1 million people, with an average income of Rp. 20,000 – Rp. 100,000 every day, this work is done without thinking about the negative impact on health.²

The traditional gold amalgamation process carried out by the community, at the washing and roasting stages will directly release mercury into the environment. Mercury compounds are carried in the waste/tailings during washing because the mercury decomposes into smaller particles or fine grains which are not easily separated in the milling process which is treated together with the amalgamation process. Discharge of waste containing mercury to the ground and water bodies in large quantities occurs in the washing process.³

Tailings that are dumped into rivers cause river water to be contaminated with mercury. Likewise, if they are dumped on the ground. The absorption of mercury into the soil will be carried away by water currents below the ground surface. In water or in soil, mercury compounds will be converted into organic mercury, namely methyl mercury due to the decomposition process by bacteria known as mercury methylation process. Then the microorganisms will absorb these organic elements and enter the food chain. The movement of mercury in the food chain involves the processes of bioaccumulation and biomagnification. Humans as the top predator in the food chain are at the greatest risk because of this process.³

In November 2011 gold was discovered at Mount Botak, Buru Island, Maluku Province, Indonesia. Since 2012 mercury has been used to extract gold requiring large volumes of water and resulting in mercury deposition into the Masarete and Anahoni Rivers. The amount of mercury in the sewage pond is over 680 mg/kg. In sediments at local river mouths and small river feeders > 3.00 mg/kg and > 7.66 mg/kg respectively. River and bay sediments are proportionally higher in available mercury than elemental mercury and more bound to mercury sulfide compared to drum waste. This initial investigation raised concerns about the long-term distribution and speciation of mercury. The floodplain is an important agricultural resource, and the Maluku Province is recognized internationally. nationally as Indonesia's center of fish stocks. Challenges for management include communicating potential future risks to communities and leaders and identifying mechanisms to reduce mercury waste.⁴

Kayeli Village is located in Buru Regency, Teluk Kayeli District, Maluku Province. Community gold mining activities have been carrying out mining activities since 2011 until now



(2020). Gold mining activities are carried out by the community, without permission from the local government. This activity is called PETI (Unlicensed Gold Mining), The number of newcomer miners (mostly from Java, Sulawesi and Kalimantan) currently amounts to approximately 350 miners in 2020 So that data collection on workers cannot be carried out properly. Kayeli Village is located in Buru Regency, Teluk Kayeli District, Maluku Province. The number of locations for amalgam processing in Kayeli Village is 45 units. Traditional amalgamation activities are managed by local indigenous peoples. The positive impact of amalgamation activities is very large, from a social and economic perspective, namely opening up new jobs for the population, but the negative impact caused is also getting bigger, namely environmental quality damage due to the impact of the amalgamation. pollution of waste, dust and steam from the gold processing process using amalgamation techniques that use large amounts of mercury.

METHOD

This research is an analytic observational study, namely research that explains the relationship between variables through hypothesis testing. Meanwhile, the research is carried out using survey methods and laboratory examinations. Based on the research time, this research design is a cross sectional study.

RESEARCH RESULT

1. Univariate Analysis Results.

The research subject is an Unlicensed Gold Miner (PETI) in Kayeli Village, Buru Regency. The number of research subjects used in this study were 45 miners.

a. Characteristics of respondents

The characteristics of the respondents in this study were gold miners in the PETI area of Kayeli Village. Characteristics based on age, gender, and level of education obtained from interviews using a questionnaire to 45 respondents.

Tabel Characteristic distribution of gold miners in the PETI area of Kayeli Village.

No	Characteristics of Respondents	Unit	Percentage (%)
Age			
1	a. 25 – 34	18	40
	b. 35 – 49	27	60
Education			
2	1) No School	8	17,8
	2) Middle School	15	33,3
	3) High School	22	48,9
Gender			
3	a. Man	37	82,2
	b. Woman	8	17,8



- b. Water sampling was carried out at a predetermined location. Mercury (Hg) levels in river water at the PETI location in Kayeli Village.

Table of results of examination of mercury (Hg) levels in river water at the PETI location in Kayeli Village.

No	No. Lab	Code Sample	Unit	Mercury (Hg)
1	22004415	Point 1	mg/L	0,0005
2	22004416	Point 2	mg/L	0,0005
3	22004417	Point 3	mg/L	< 0,0005

From the results of laboratory examinations, it was found that the mercury concentration in river water in Kayeli Village, from three measurement points it was known that the mercury concentration was 0.0004 mg/l – 0.0005 mg/l while the maximum allowed limit was 0.0001 mg/l.

- c. Mercury levels in miners' hair at the PETI location in Kayeli Village.

Miners' hair samples were taken about ± 2 grams for laboratory analysis, the analysis used to determine mercury levels in hair was wet destruction ASS analysis. From the analysis of 45 samples of miners' hair, the highest mercury level was 512.8651 g/g and the lowest was 0.0001 g/g. (can be seen in the appendix), with the level of poisoning in 88.9% miners experiencing mercury poisoning.

- d. Length of work/day of miners at PETI Kayeli Village.

The length of work of gold miners in Kayeli Village generally ranges from 07.00 to 18.30, with a rest time of about 1-2 hours, which is around 13.00-14.00. However, this time is uncertain, sometimes the length of work between miners differs from one another depending on the work and difficulty when mining. The results of the univariate analysis showed that there were 34 miners with a length of work > 8 hours/day with a percentage of 75.6% while miners with a length of work/day < 8 hours/day were 11 with a percentage of 24.4%.

- e. Continuity of use of personal protective equipment (PPE) at PETI Kayeli Village.

The continuity of the use of personal protective equipment (PPE) by Unlicensed Gold Miners (PETI) in Kayeli Village is still relatively low. This is related to the knowledge of miners about the importance of continuous use of personal protective equipment when mining gold. Due to lack of information, miners often ignore its use, this is related to the work pattern of traditional miners so they are accustomed to using makeshift equipment. In the variable of continuity of use of personal protective equipment (PPE), respondents were grouped into 2 groups, namely the discontinuous group and the continuous group. From 45 cases of continuity of personal protective equipment (PPE), data showed that the discontinuous group was higher (64.4%) when compared to the continuous group (35.6%).



2. Results of Bivariate Analysis

Bivariate analysis was conducted to determine the relationship between the factors (independent variable) and the incidence of mercury poisoning (dependent variable), with a significance level of 95%. To analyze with Chi-square test. The existence of a relationship of factors with mercury poisoning is indicated by the value of $p < 0.05$. The results of bivariate analysis of six variables, namely length of work/day, continuity of use of PPE. The following are the results of the analysis of each variable, namely :

a. The relationship between length of work/day with the incidence of mercury poisoning.

Length of work/day	Mercury Poisoning					Total
	Poisoning		Not Poisoning			
	f	%	f	%	f	%
>8 working hours/day	29	85,3	5	14,7	34	100
<8 working hours/day	4	36,4	7	63,6	11	100
Total	33		12		45	
X ² =10.175		p=0.003	RP=2.346		(95%CI=1.060-5.190)	

It can be seen that the Chi-square test results in $X^2 = 10.175$ $p = 0.003$. The p value < 0.05 means that there is a significant relationship between length of work/day with mercury poisoning. Most of the unlicensed gold miners in Gunung Botak, Kayeli Village, have been poisoned (85.3%).

b. The relationship between the continuity of the use of personal protective equipment (PPE) with the incidence of mercury poisoning.

Continuity of use of PPE	Mercury Poisoning				Total	
	Poisoning		Not Poisoning			
	f	%	f	%	f	%
Discontinuous	27	93,1	2	6,9	29	100
Continouos	6	37,5	10	62,5	16	100
Total	33		12		45	
X ² =16.302	p=0.000	RP=2.483		(95%CI=1.309-4.710)		

In this variable the continuity of the use of personal protective equipment (PPE), respondents are grouped into 2 groups, namely the discontinuous group and the continuous group. Based on table 4.6. it can be seen that the Chi-square test results in $X^2 = 16.302$ $p = 0.000$. The p value < 0.05 means that there is a significant relationship between the continuity of the use of personal protective equipment and mercury poisoning.



3. Multivariate Analysis Results

- a. The results of a multivariate test of mercury poisoning on unlicensed gold miners (PETI) in Kayeli Village, Buru Regency.

Variable	B	p-value	RP	CI 95%
Continuity of use of PPE	3.114	0.001	35.725	0.896-12.062
Constant	-2.603			

It is known that the variable continuity of the use of personal protective equipment (PPE) p value <0.05 means that this variable is a risk factor that can be used to predict the magnitude of the influence of risk factors on the incidence of mercury.

DISCUSSION

The gold mining activity without a permit (PETI) in Kayeli Village, Buru Regency is an activity that has been carried out from 2011 until now by the surrounding community. The equipment and technology used in mining in Kayeli Village, Buru district is low-tech equipment and technology. PETI activities are generally carried out with a suction system, namely the extraction of sedimentary material (alluvial) both below the soil surface on embankments or riverbanks or at the bottom of rivers and river cliffs, PETI activities in Kayeli Village, Buru Regency are generally carried out near two rivers, namely the Masarete River and the Anahoni River. Since 2011 from research conducted by the government, it is known that PETI causes water pollution by heavy metals, namely mercury. Mercury is carried out both during the mining process and post-mining. The significant increase in mercury levels in the waters around Kayeli Village, Buru Regency is the result of gold purification either by miners directly or by gold buyers, the mercury is directly discharged into the river without any processing. However, the government still has not found effective solutions and efforts to reduce the level of pollution of the aquatic environment. Efforts have been made to close mining without a permit, but this is still a conflict between the government and the community.

The results of the examination of mercury levels in river water around the gold mining location showed that the mercury level was 0.0005 (mg/l), while the lowest was 0.0004 (mg/l). The highest levels are in the river in Kayeli Village because it is a place to drain waste from illegal gold mining (PETI). Indicates that the mercury level has exceeded the threshold value (NAV) in accordance with Permenkes No. 416/Menkes/Per/IX/1990: mercury levels in river water that the permissible level of mercury is 0.0001 (mg/l). This can have a negative impact on the health of the miners and the surrounding community because the river around the mining site has an important role, especially for the needs of daily life such as bathing, washing, fishing, and others.

Based on descriptive data, it shows that the mercury content in the hair of gold mining workers in Kayeli Village, Buru Regency, with mercury levels ranging from 0.0001 to 512.8651 mg/kg. The results of the examination of 45 workers, there are 33 (73.3%) gold miner workers whose mercury poisoning content has exceeded the Threshold Limit Value (NAV) according to



the provisions set by the World Health Organization (WHO) stating that mercury levels in hair range from 1- 2 mg/kg.⁵

The results of the bivariate analysis between miners' length of work/day with the incidence of mercury poisoning were obtained from 34 miners with working hours > 8 hours, 29 (85.3%) miners experienced mercury poisoning, and 5 (14.7%) miners did not experience mercury poisoning. While miners with working hours < 8 hours out of 11 miners, 4 (36.4%) miners experienced mercury poisoning and 7 (63.6%) did not experience mercury poisoning. The results of Chi-square analysis, value ($p=0.003$), which means that there is a significant relationship between length of work/day with mercury poisoning. The longer gold miners work, the longer they are exposed to mercury elements and compounds, thus allowing the greater absorption of mercury by the body either through inhalation or absorption and the greater the accumulation of mercury poisoning by gold mining workers.⁶

From the results of the bivariate analysis for the continuity of the use of personal protective equipment (PPE) with the incidence of mercury poisoning, it shows that gold miners who use personal protective equipment discontinuously with 29 miners have a percentage of 93.1% experiencing mercury poisoning, and only 6.9% who did not experience mercury poisoning. There were 16 miners with continuous PPE, the percentage of miners who experienced mercury poisoning was 37.5% and 62.5% did not experience mercury poisoning. The results of the Chi-square statistical test obtained p value = 0.000, this indicates that there is a significant relationship between the use of personal protective equipment (PPE) and the incidence of mercury poisoning. The use of PPE that is not continuous can increase the high exposure to mercury that enters the body so that it has the potential for mercury bioaccumulation in the body. This has the potential to cause mercury poisoning in gold miners.

CONCLUSION

Mercury levels found in river water in Kayeli Village, Buru Regency are 0.0004-0.0005 (mg/l). The value exceeds the threshold value (NAV) based on Permenkes No. 416/Menkes/Per/IX/1990, the mercury level in river water that the permissible level of mercury is 0.0001 (mg/l). Gold miners in Kayeli Village, Buru Regency were poisoned by 33 people (73.3%) gold miner workers whose mercury poisoning content had exceeded the Threshold Limit Value (NAV) according to the provisions set by the World Health Organization (WHO) which stated that mercury levels in hair ranged from 1-2 mg/kg. There is a significant relationship between length of work/day and the incidence of mercury poisoning in illegal gold miners (PETI) in Kayeli Village, Buru Regency, with a p value = 0.003. there is a significant relationship between the continuity of the use of personal protective equipment with the incidence of mercury poisoning in gold miners without a permit (PETI) in Kayeli Village, Buru Regency, with a p value = 0.000.

SUGGESTION

It is hoped that the participation of the community in efforts to reduce the impact of exposure that causes mercury poisoning so as not to endanger health, especially mercury and mercury waste used during mining. It is hoped that the awareness of miners in an effort to reduce the



impact of mercury hazards is by paying more attention to occupational health and safety aspects in the gold mining process, namely by using complete and adequate personal protective equipment to minimize the level of mercury exposure.

REFERENCES

1. International Agency for research on cancer World Health Organization. Monographs on the evaluation of carcinogenic risk to humans. Vol. 58. Berrullium, Cadmium, Mercury, and exposures in the glass manufacturing. 1993.
2. ITFN (Indonesia Toxic-Free Network), 2012.
3. Widhiyatna, D. Data Collection on the Distribution of Mercury Due to Gold Mining in the Tasikmalaya Region, West Java Province. Field Results Colloquium-DIM; 2005.
4. Male YT, Reichelt-Brushett AJ, Pocock M, Nanlohy A. Recent mercury contamination from artisanal gold mining on Buru Island, Indonesia – Potential future risks to environmental health and food safety. Marine Pollution Bulletin; 2013, 77(1-2) : 428–433.
5. Palar H. Heavy Metal Pollution and Toxicology. Jakarta : PT. Rineka Cipta; 2008.
6. International Labor Office, Geneva. Accident prevention, Manual. Gramedia Jakarta.