TRANSPUBLIKA INTERNATIONAL RESEARCH IN EXACT SCIENCES (TIRES)

IDENTIFICATION OF DISEASE SYMPTOMS OF ARTISANAL GOLD MINERS IN TERMS OF LENGTH OF TIME WORKED (0-5 YEARS) IN THE WORKING AREA OF UPTD PUSKESMAS UJUNG PADANG RASIAN

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Abstract

According to WHO, mercury is a naturally occurring metallic element and is divided into three groups: liquid and gaseous mercury, inorganic mercury, and organic mercury. Mercury is the only metal that is liquid under standard conditions and vaporizes on contact with air. This study aims to identify symptoms of illness due to mercury exposure in gold mine workers at the UPTD Puskesmas Ujung Padang Rasian, South Aceh District. The study involving 24 respondents was conducted in June 2023 using a questionnaire. The results showed that the most frequent acute clinical symptoms were headache (14 respondents), cough (11 respondents), pain during urination and nausea (10 respondents each), pelvic pain (9 respondents), vomiting and bloody urine (7 respondents), cloudy urine (5 respondents), abdominal pain and numbness in the mouth (3 respondents), loose teeth and swollen gums (2 respondents), and diarrhea and dark gums (1 respondent each). Symptoms of chronic toxicity included headache (6 respondents), muscle cramps (9 respondents), irritability (2 respondents), erythema, weight loss, anorexia, anxiety, depression, insomnia and memory loss (1 respondent each). In conclusion, the majority of respondents experienced symptoms due to mercury exposure such as headache (20 respondents), pelvic pain and painful urination (14 respondents), cough (13 respondents), and nausea (12 respondents).

Keywords: *Mercury, Gold Mine, Disease Symptoms, Workers, Acute, Chronic*

1. INTRODUCTION

According to WHO, mercury is a naturally occurring metallic element and is classified into 3 main groups: liquid and gaseous, inorganic mercury such as mercuric chloride, mercuric acetate, mercuric sulfide, and organic mercury. Mercury is also the only metal that exists in a liquid aggregate state under standard conditions and vaporizes on contact with air. Mercury is a chemical element with a silver-gray color. According to the official European Union directive, mercury is categorized as a threat to aquatic ecosystems, toxic by inhalation and hazardous to human health (Debora et al., 2023)

Mercury is a heavy metal that can cause various health problems and can cause death to living things. This metal is in the environment in various forms and HgCl2 is a form that is easily bound in the human body which can cause loss of metabolic functions in the body. In addition to HgCl2, organic mercury compounds, especially methyl mercury and phenyl mercury, are also very dangerous to human health and have a very high level of mobility compared to Hg0 and HgCl2 (Dewanti et al., 2013). In Indonesia, the mercury problem is currently growing with the increase in illegal gold mining activities carried out by communities or small industries, especially those in Sumatra and

Kalimantan. Disposal of mercury waste is done illegally in rivers or land around the gold mining site, causing pollution to the environment. In addition to the gold mining industry, several other industries also use mercury materials such as lamps, measuring instruments such as thermometers, and dental amalgam (Dewanti et al., 2013).

Beras et al (2014) stated that mercury exists naturally in the environment and as a contaminant due to human activities. The re-release of mercury into the environment can lead to a progressive increase in the amount of natural mercury, which can enter the air, soil, and water distribution cycles, where mercury can remain in the environment for many years. The main route of human exposure to methylmercury (MeHg) is mostly through the consumption of mercury-contaminated fish, seafood, and wildlife through the consumption of low-level contaminated organisms (Adlim et al., 2023).

Mercury (Hg) is one type of metal that is widely found in nature such as in mountains and is distributed in rocks, mining grains, soil and air as organic and inorganic compounds. Generally, the levels in soil, water and air are relatively low. Various types of human activities can increase these levels, such as mining activities that can produce as much as 10,000 tons/year of mercury (Suryani, 2021). Hg can naturally come from volcanic gases and evaporation from sea water. The metal casting industry and all industries that use Hg as a raw or auxiliary material, its waste is a source of Hg pollution. Examples include the chlor alkali industry, gold mines, electrical appliances, paints, thermometers, tensimeters, agricultural industries, and detonator factories. Another activity that is a source of Hg pollution is dental practices that use amalgam as a tooth filling material. In addition, fossil fuels are also a source of Hg (Putranto, 2011).

The entry of mercury into the human body can occur through direct skin contact, inhalation of mercury vapor, or eating mercury-contaminated fish (Grishela & Tamba, 2017). It is known that about 80% of mercury vapor enters the body through inhalation, and only a small amount of elemental mercury (Hgo) enters the human body through skin and mouth contact. When amalgam is heated, anyone in the vicinity of the burning site can be exposed to mercury vapor from the burning. Several studies in Indonesia have examined river degradation and potential health risks associated with mining activities (Adlim et al., 2023).

Mercury is found in food, the environment, and fish. Fish in rivers and lakes will be exposed to mercury. Fish that have been exposed to mercury will be consumed by humans so that humans accumulate mercury in their bodies. Factors of mercury levels in fish are age, fish weight, and environment. The maximum limit of mercury allowed by SNI in fish is 0.5 mg/kg (Silalahi et al., 2021). Mercury as a toxic material that enters the body will follow the blood circulation and undergo the process of absorption, distribution, metabolism and excretion. The kidney is the main excretory organ that is important for excreting toxic substances that enter the body (Veronika & Hartono, 2019).

Mercury enters the body mainly through the lungs in the form of vapor or dust. About 80% of inhaled mercury vapor will be absorbed. Absorption of ingested metallic mercury from the gastrointestinal tract is only in negligible amounts, while water-soluble mercury compounds are easily absorbed. Some organic and inorganic mercury compounds can be absorbed through the skin. Biotransformation of absorbed elemental mercury is rapidly oxidized to Hg2+ ions that have the affinity to bind to substrates rich in these groups. Mercury is found in the kidneys (bound to metallothioneers) and liver.

Methyl mercury has a strong affinity for the brain (Herix Sonata et al., 2021). Mercury in the urine occurs because it has undergone an absorption process and continued with the excretion process. Elemental mercury and its inorganic compounds are eliminated more through the urine than feces, because the excretion process is strongly influenced by time. The time required for excretion is almost half of the levels present in the body. The half-life of mercury is about 60 days, and the excretion of mercury in the form of urine has a half-life of 40-60 days (Herix Sonata et al., 2021).

Mercury poisoning due to mercury exposure can have a variety of toxic effects, depending on the chemical form and route of exposure (Adlim et al., 2023). Mercury can cause serious health problems in the community when exposed to the heavy metal. In this case, the most dangerous is methyl mercury (MeHg). The production of MeHg comes from the amalgamation process which is released into the environment in the form of metal and vapor. The release can harm residents or workers and communities living around the mining site and can penetrate the nervous system as the main target, causing acute or chronic nervous disorders (Kamil & Karma, 2022).

Mercury-related cases that have occurred include "Minamata disease" in Japan. Based on the results of the study, it was found that residents around the area regularly consume fish from the sea around Minamata Bay and it turned out that the fish had been contaminated with metal mercury from plastic industry waste. Symptoms of mental abnormalities, and neurological defects began to appear especially in children 25 years later (Grishela & Tamba, 2017). Chronic toxicity cases that have occurred are poisoning cases in Iraq, Minamata and Niigata Japan. The first case of chronic toxicity in Japan was reported in May 1956 in the area around Minamata Bay. By the end of 1956, the number of patients increased to 52, including 17 deaths.

In 1957, this unknown disease was called Minamata disease. In Iraq, in the early 1970s, more than 6000 people were hospitalized and 459 died from eating bread made from flour contaminated with methylmercury from fungicides. Mercury levels in flour at that time ranged from 4.8-14.6 µg/g (Yanuar 2000). Similar cases have also occurred in various regions in Indonesia, for example since 1996 the waters of Buyat Bay in North Sulawesi Province have been used as a waste disposal site by PT Newmont Minahasa Raya as a result of which people who consume fish around Buyat Bay experience health problems, especially skin diseases. This pollution is mainly airborne during the gold amalgamation process. The Hg content at the spawning site reached 15,499 µg/m (Grishela & Tamba, 2017).

According to research by Kamil & Karma (2022) shows that the most acute clinical symptoms experienced by gold mine worker respondents are coughing (8 respondents), and pelvic pain, diarrhea, abdominal pain, vomiting, nausea, and headaches experienced by 7 respondents. While chronic clinical symptoms of workers experienced headaches and insomnia (8 respondents), irritability (6 respondents), anxiety (6 respondents), cramps (5 respondents), and trembling (4 respondents).

2. LITERATURE REVIEW

From the results of observations, it is known that gold processing activities carried out in the Working Area of the UPTD Puskesmas Ujung Padang Rasian, South Aceh Regency still use the amalgamation technique, which uses mercury in the processing

process. Where the impact caused by mercury is very dangerous for health because mercury is toxic and toxic. For this reason, researchers want to see the identification of symptoms of diseases caused by gold mining workers caused by mercury.

3. RESEARCH METHODS

This study was conducted in the working area of the UPTD Puskesmas Ujung Padang Rasian, South Aceh District, Aceh Province, Indonesia. This location was chosen based on the consideration that gold processing has been running for more than 10 years. The workers still use amalgamation techniques in gold processing. Therefore, some of the mercury used in this technique is released directly into the environment. And some communities and workers complain a lot about health problems so this research is focused on analyzing the symptoms of diseases experienced by gold mining workers due to mercury exposure.

The study was conducted in June 2023 involving 37 gold mine worker respondents. All respondents were observed, interviewed, and checked for vital signs. Questionnaires were distributed and each participant completed a health outcome assessment questionnaire to identify symptoms of acute and chronic toxicity. The clinical symptoms measured were those of neurological disorders. Neurological disorders were categorized into acute and chronic neurological disorders. The protocol in this study has received ethical approval through letter No.076/KEP-UNISM/IX/2023 (dated September 9, 2023) from the Research Ethics Commission of Sari Mulia University Banjarmasin.

4. RESULTS AND DISCUSSION

4.1. Research Results

4.1.1. Respondent Characteristics

Worker respondents were categorized based on gender, age, education and length of working time.

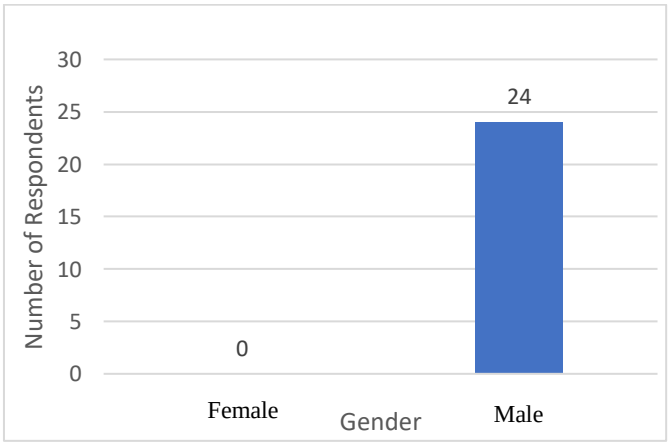

Figure 1. Gender of Respondents

Figure 1 shows that 24 respondents were mostly male.

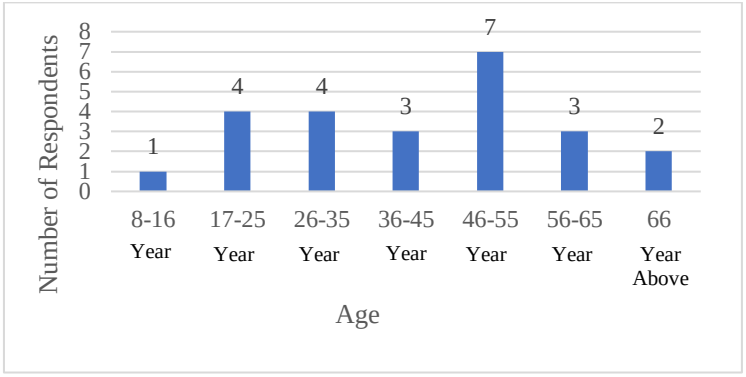

Figure 2. Age of Respondents

Figure 2 shows that most respondents were aged 46-55 years as many as 7 respondents, followed by ages 17-25 years and 26-35 years each as many as 4 respondents, then ages 36-45 years and 56-65 years each 3 respondents. Age 66 years and above as many as 2 respondents and the last 8-16 years as many as 1 respondent.

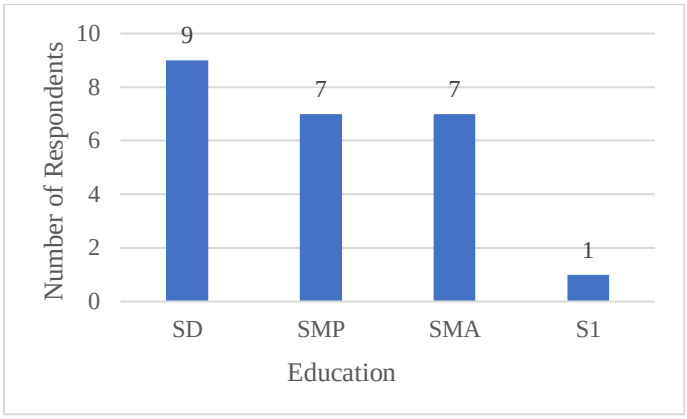

Figure 3. Respondents' Education

According to Figure 3, most respondents' education is elementary school as many as 9 respondents, followed by junior and senior high school education as many as 7 respondents each, and the last is S1 (Bachelor) as many as 1 respondent.

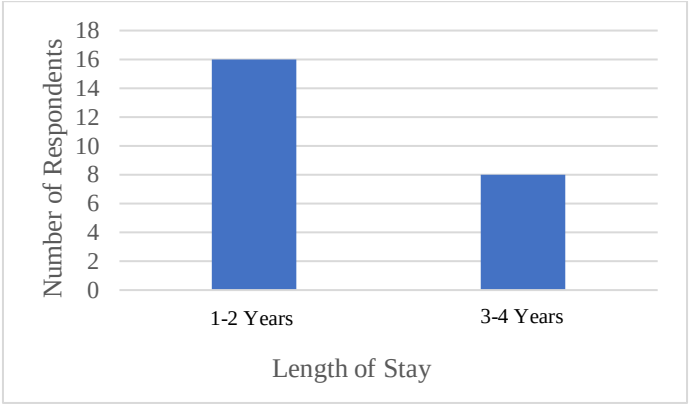

Figure 4. Length of Working Time

Figure 4 Most respondents worked for 1-2 years as many as 16 respondents and 3-4 years as many as 8 respondents.

4.1.2. Symptomatic Overview of Gold Mine Workers' Illness

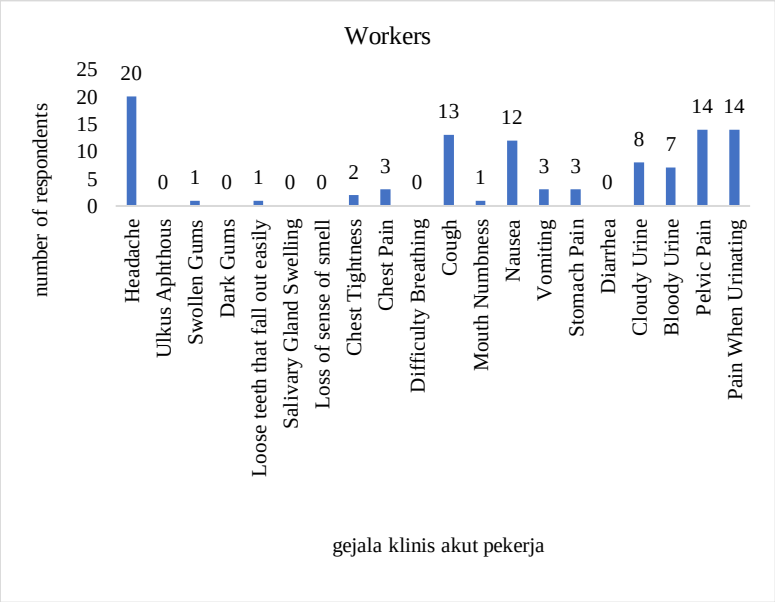

Figure 5. Acute Clinical Symptoms of Workers (n=24)

Based on Figure 5, it can be seen that the acute clinical symptoms of workers are the majority of respondents experiencing symptoms of headache (20 respondents), symptoms of pelvic pain and pain when urinating each 14 respondents, symptoms of cough (13 respondents), nausea (12 respondents), cloudy urine (8 respondents), bloody urine (7 respondents). Chest pain, vomiting and abdominal pain each (3 respondents), chest tightness (2 respondents), and finally swollen gums, loose teeth that fall out easily and numbness in the mouth each (1 respondent).

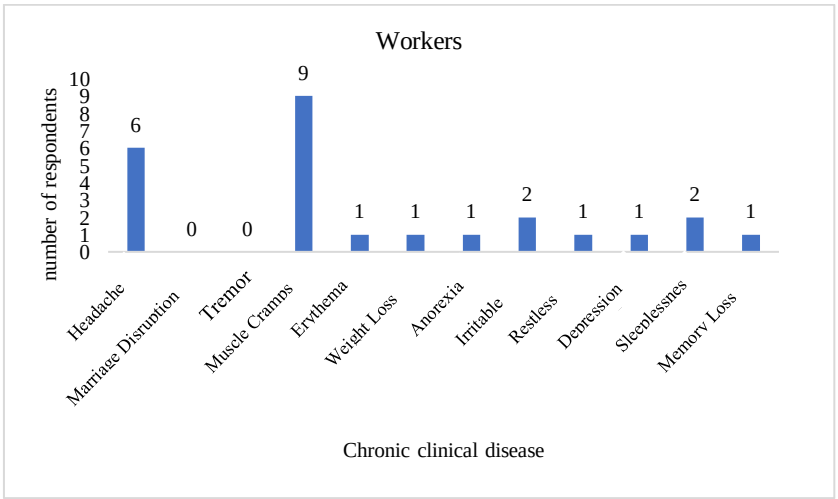

Figure 6. Chronic Clinical Symptoms of Workers (n=24)

Figure 6 shows an overview of the analysis results. Symptoms of chronic toxicity recorded include somatosensory disturbances in gold processing workers. The majority of workers experienced muscle cramps (9 respondents), headaches (6 respondents), irritability and insomnia each (2 respondents), and finally erythema, weight loss, anorexia, anxiety, depression and memory loss each (1 respondent).

4.2. Discussion (Sub-chapter)

Figure 1 shows that most respondents are male as many as 24 respondents. Figure 2 shows that most respondents are 46-55 years old as many as 7 respondents, followed by ages 17-25 years and 26-35 years each as many as 4 respondents, then ages 36-45 years and 56-65 years each 3 respondents. Age 66 years and over as many as 2 respondents and the last 8-16 years as many as 1 respondent. According to Figure 3, most respondents' education is elementary school as many as 9 respondents, followed by junior and senior high school education as many as 7 respondents each, and the last is S1 as many as 1 respondent. Figure 4 most respondents worked for 1-2 years as many as 16 respondents and 3-4 years as many as 8 respondents. Based on Figure 5, it can be seen that the acute clinical symptoms of workers are the majority of respondents experiencing symptoms of headache (20 respondents), symptoms of pelvic pain and pain when urinating each 14 respondents, cough symptoms (13 respondents), nausea (12 respondents), cloudy urine (8 respondents), bloody urine (7 respondents).

Chest pain, vomiting and abdominal pain each (3 respondents), chest tightness (2 respondents), and finally swollen gums, loose teeth that fall out easily and numbness in the mouth each (1 respondent). Figure 6 shows an overview of the analysis results. Symptoms of chronic toxicity recorded include somatosensory disturbances in gold processing workers. The majority of workers experienced muscle cramps (9 respondents), headaches (6 respondents), irritability and insomnia each (2 respondents), and finally erythema, weight loss, anorexia, anxiety, depression and memory loss each (1 respondent).

The results of previous research related to disease symptoms experienced by amalgamation gold processing workers have also been reported previously by other researchers. The results stated that gold milling operations carried out by the community had an impact on the health of workers. Mercury poisoning reported in communities around mining sites is usually chronic. The toxic effects of mercury depend on the form of mercury, the route of exposure, and the duration of development (Adlim et al., 2023). The results of the study stated that gold milling operations carried out by the community have an impact on the health of workers.

Da Silva-Junior et al. (2018) examined the symptoms of illness due to mercury exposure in communities around the Amazon river and found that visual impairment had the highest prevalence (43.3%) among health problems and symptoms of Hg poisoning, followed by complaints/symptoms of memory loss (42.9%), weakness (35.1%), fatigue (34.3%), mood swings (28.7%) and concentration difficulties (27.2%) (Adlim et al., 2023). Several studies have shown symptoms of neurological disorders as an effect of mercury exposure such as acute neurological disorders in the form of headaches 38(48.7%), emotional lability 7(9.0%), hearing loss 3(3.8%). While chronic neurological disorders experienced were insomnia 29(37.2%) respondents, tremor 8(10.3%), memory loss 7(9.0%), and somatosensory disorders 3(3.8%) (Bagia et al., 2023).

Other neurological symptoms experienced by miners were tremor, visual disturbances, slow reflexes, unbalanced rigidity and ataxia. 3 Gum discoloration is 34% of 68%.6% The highest neurological disorder is the presence of gum discoloration as much as 34% of 68.6% of goldsmiths (Bagia et al., 2023). Neurological disorders found based on examination results vary. One of the highest is colored gums and tremors (Suhelmi et al., 2020). The results of this study are in line with research conducted in Chile showing 71% of goldsmiths who have also experienced neurological disorders (Corral et al., 2013).

According to Bagia et al (2023), based on observations of traditional gold miners in Mantikulore District, Palu City using The German Q18 Questionnaire with a cut-off point of 5 symptoms, it was found that respondents who experienced neurological symptoms amounted to 60.98% more dominant than respondents who did not experience neurological symptoms which amounted to 39.02%. Symptoms of neurological disorders ≥50% experienced by respondents are headaches 27 (66%), forgetfulness 25 (61%) and often feel unusually tired 21 (51%). Other symptoms experienced by respondents included tremors 15(37%), difficulty understanding what was read 14(34%), numbness of hands or feet (numbness) 12(29%), difficulty in concentrating 11(27%), feeling heart palpitations without stress or activity 7(22%), reduced sexuality 7(17%), arms or legs feeling weak 6(15%), often feeling emotional for no apparent reason 4(10%), often feeling tightness or pain as if being pressed 1(2%).

Sofia et al (2016), showed symptoms of neurological disorders as an effect of mercury exposure such as acute neurological disorders in the form of headaches 38(48.7%), emotional lability 7(9.0%), hearing loss 3(3.8%). While chronic neurological disorders experienced are insomnia 29(37.2%) respondents, tremor 8(10.3%), memory loss 7(9.0%), and somatosensory disorders 3(3.8%) (Sofia et al., 2016).

5. CONCLUSION

Based on the results of the research conducted, the majority of acute clinical symptoms experienced by workers are headache symptoms (14 respondents), cough symptoms (11 respondents), pain when urinating and nausea each experienced by (10 respondents), pelvic pain (9 respondents), vomiting and bloody urine (7 respondents), cloudy urine (5 respondents), abdominal pain and numbness in the mouth (3 respondents), loose teeth that fall out easily and swollen gums (2 respondents) and finally diarrhea and dark gums each (1 respondent). Meanwhile, symptoms of chronic toxicity recorded include somatosensory disturbances in gold processing workers. The majority of workers experienced headaches (6 respondents), muscle cramps (9 respondents), irritability (2 respondents), erythema (1 respondent), weight loss (1 respondent), anorexia (1 respondent), anxiety (1 respondent), depression (1 respondent), insomnia (2 respondents), and memory loss (1 respondent). From the study, it can be concluded that the majority of respondents experienced many symptoms of illness due to exposure to mercury, including headache (20 respondents), pelvic pain and pain during urination (14 respondents each), cough (13 respondents), and nausea (12 respondents).

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