CHARACTERISTICS OF DISEASE SYMPTOMS EXPERIENCED BY COMMUNITIES AROUND MINE SITES AND GEOTHERMAL MANIFESTATION AREAS IN DRIEN MANGKO VILLAGE, WOYLA DISTRICT, ACEH BARAT DISTRICT

Srie Wahyuni[1*], Lensoni[2], Rima Meilisa[3]
[1,3]Department of Public Health, Faculty of Health Sciences,
Universitas Abulyatama, Aceh Besar
[2]Occupational Safety and Health Study Program, Universitas Abulyatama Aceh Besar
E-mail: [1)] sriewahyuni3139@gmail.com

Abstract

According to WHO, mercury is a metallic element that occurs naturally and is classified into 3 main groups, namely liquid and gas, inorganic mercury such as mercury chloride, mercury acetate, mercury sulfide, and organic mercury. The research was conducted in November involving 32 respondents from gold mining communities and the research location was in Drien Mangko Village, Woyla District, West Aceh Regency. Samples were taken from communities around gold mining in the gold mining area and around the mine. Sample measurement by providing a prepared questionnaire. The results of the research showed that the acute clinical symptoms of the community were that the majority of respondents experienced symptoms of headache and swelling of the salivary glands (18 respondents), vomiting (14 respondents), chest tightness and bloody urine (12 respondents), numbness in the mouth (10 respondents), loose teeth. easy to fall out (9 respondents), difficulty breathing (8 respondents), pelvic pain (6 respondents), nausea (5 respondents), loss of sense of smell (2 respondents) and dark gums (1 respondent). Meanwhile, chronic toxicity symptoms recorded include somatosensory disorders in gold processing workers. The majority of workers experience hearing loss (18 respondents), irritability (5 respondents), and headaches (3 respondents).

Keywords: *Mercury, Geothermal, Gold Mine, Community, Disease*

1. INTRODUCTION

According to WHO, mercury is a naturally occurring metallic element and is classified into 3 main groups: liquid and gas, inorganic mercury such as mercuric chloride, mercuric acetate, mercuric sulfide, and organic mercury. According to the official European Union directive, mercury is categorized as a threat to aquatic ecosystems, toxic by inhalation and harmful to human health (Debora et al., 2023). The United States Government's Agency for Toxic Substances and Disease Registry ranks mercury as the third most toxic element or substance that enters waterways and soil, spills into the atmosphere, and contaminates food and water (Sofia et al., 2016). Mercury (Hg) is one of the chemical elements classified as heavy metals with a high level of toxicity, this is because the organisms in the environment cannot destroy mercury (Hg), causing it to accumulate or precipitate mercury (Hg) in the environment. Therefore, mercury (Hg) contamination of humans can occur through the respiratory tract, food and drink, and direct skin contact (Hidayat, 2020). Mercury (Hg) is a toxic material that can have

harmful effects on humans and the environment. It is widely used in the gold mining process which serves to purify precious metals. Gold processing with amalgamation techniques is known to damage the environment and pose human health risks (Kamil & Karma, 2022). Mercury problems to the environment in Indonesia mostly come from artisanal small-scale gold mining, also known as PETI (unlicensed gold mining). This mining activity uses mercury to separate gold from rock using a process that produces amalgam. There are several hot spots scattered across Indonesia. This activity can cause mercury exposure in waters, sediments, biota and even humans (Bagia et al., 2023).

Geothermal is a source of heat energy contained in heat, steam, and rocks stored in the earth. The use of geothermal energy means utilizing heat from within the earth through these materials. (Christina E. Mediastika, 2013: 38). Geothermal energy is a renewable energy source in the form of thermal energy (heat) produced and stored in the earth's core. The term geothermal comes from the Greek language where the word, "geo", means earth and, "thermos", means heat. This energy is widely used to produce electricity, warm buildings and melt snow on the roads.

Mercury (Hg) is one of the heavy metal contaminants and is a natural element that often pollutes the environment and is highly accumulative toxic. In the environment, this element is bound to other chemical elements that are distributed in corals, soil, air, water and even in living organisms. Mercury is rarely found in its free form. The distribution of mercury is influenced by complex geological, physical, chemical and biological factors (Bouty et al., 2022). Geological and biological processes are one of the activities that can be a source of mercury pollution, but not as much as pollution from human activities such as: coal combustion, types of petroleum products, the use of fungicides, mercury catalysts and gold mining that uses mercury as a gold extraction material (Hidayat, 2020). Mercury re-release to 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 (Adlim et al., 2023).

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 combustion site may be exposed to mercury vapor from the combustion (Adlim et al., 2023). Regarding the route of exposure, 80% of elemental mercury enters the human body through inhalation during the amalgam burning process, and less than 3% enters through the skin. If taken orally, only a small amount is toxic. In the blood, elemental mercury is distributed throughout the body, as it easily passes through most cell membranes, the blood-brain barrier, and the placenta. In the bloodstream, elemental mercury can bind to many tissues, proteins, and erythrocytes. In red blood cells, elemental mercury is partially oxidized to mercury through the role of the enzyme catalase, which when crossing the blood-brain barrier, allows the release of neurotoxic properties. The uptake of elemental mercury by the brain is reduced if the activity of the catalase enzyme in the brain is inhibited. Mercury uptake in the brain also depends on the glutathione (GSH) levels in the brain. If GSH levels in the brain are reduced by 20%, it will cause mercury levels in the brain to increase by 66%. Elemental mercury can remain in the brain for a long time after exposure. The half-life of elemental mercury in adults is about 60 days. Elemental

mercury can also be converted to Hg2+ and CH3 Hg1+ in the gut through microbial activity (Adlim et al., 2023).

The impact that occurs when exposed to methyl mercury / mercury (Hg) caused by geothermal heat can cause fetal abnormalities and death at birth and can cause Fetal Minamata Disease. In addition, exposure to mercury (Hg) can cause brain damage, cerebral palsy, motor nerves and mental retardation. Then generally if men are exposed to mercury (Hg), especially inorganic mercury (Hg) can cause impotence and impaired libido while for women it can interfere with the menstrual process (Hidayat, 2020). Prolonged exposure to mercury from geothermal causes acute and chronic toxicity. Acute toxicity includes mood changes, headaches, hearing loss, speech impairment (dysarthria) while chronic toxicity is detected in the form of tremors, cerebral ataxia, decreased hearing and vision, tingling in the mouth to hands, memory impairment, impaired sensation and insomnia. Cases related to mercury toxicity have been reported, such as Minamata Disease in Japan in 1932 and 1968 which resulted in epidemics affecting 50,000 poisoned people and more than 2,000 people. (Sofia et al., 2017). The most dangerous type of mercury is methyl mercury (organic mercury). About 90% of the levels of methyl mercury that are ingested or enter the body will be absorbed into the blood. This figure is very large when compared to other types of mercury which are only absorbed 2-10% into the blood and will cause neurological, cardiac, motor, reproductive, genetic, renal, and immunological conditions and other health problems in traditional gold miners (Bagia et al., 2022). Globally, health problems related to mercury exposure impose an estimated disease burden of 1.22 to 2.29 million. Gold workers who have been exposed to mercury will have an impact on their health. Mercury exposure in the human body can affect the central nervous system, kidneys and heart (Suhelmi et al., 2020). Long-term exposure to mercury is known to cause health problems, especially in individuals living in mercury-contaminated environments. 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. The health effects of mercury are usually evident after 5 to 10 years of exposure, and mercury toxicity is reported to affect various organs and metabolic functions. The most commonly reported complications of mercury poisoning in ASGM workers are neurological effects, including tremors, ataxia, memory problems, and visual disturbances (Adlim et al., 2023).

Geothermal area or geothermal field is an area that has geothermal energy in a certain hydrological-rock condition or called a geothermal system. Geothermal areas are areas that have a source of heat energy contained and formed in the earth's crust. Geothermal areas have higher soil temperatures and pH levels compared to ordinary areas. Geothermal is one of the natural resources that has enormous potential to be utilized as an alternative energy source. The appearance of geothermal heat below the ground surface can be seen through the appearance of geothermal manifestations such as hot springs and hot mud puddles. Geothermal manifestations in the form of hot water are formed through water on the surface that seeps into groundwater or springs that are in the ground and come into contact with magma or hot igneous rocks and return to the surface through fracture fields in the earth's crust to form geothermal manifestations (Ziharsya, 2019).

One of the implications of the enactment of the 2004 Regional Autonomy Law (Otda) is the discretion of local governments to open opportunities for investors to invest

in the geothermal energy mining sector. One of the objectives of opening the opportunity is to increase local revenue (PAD) which can be sourced from revenue sharing funds with investors, as stipulated in the provisions of Article 11 of Law No. 33/2004 on Autonomy. However, often efforts to maximize the potential of geothermal is considered to override the negative impact of exploration on people's lives in the location of exploration takes place. Bosman Batubara in his research report states that there are at least three negative impacts that threaten people's lives due to geothermal exploration, including minor earthquakes, water pollution, and subsidence (Putra et al., 2021).

According to research (Lensoni et al., 2022) in his research showed that the most acute clinical symptoms experienced by respondents in the gold mining area were coughing (8 respondents), and pelvic pain, diarrhea, abdominal pain, vomiting, nausea, and headaches experienced by 7 respondents. While chronic clinical symptoms workers experience headaches and insomnia (8 respondents), irritability (6 respondents), anxiety (6 respondents), cramps (5 respondents), and trembling (4 respondents) (Kamil & Karma, 2022)

2. RESEARCH METHOD

2.1. Research Location

This research uses a questionnaire method that is carried out by collecting and synthesizing research results. This research was conducted in Drien Mangko Village, Woyla District, West Aceh Regency. The study analyzed the mercury content in geothermal heat in the community around gold miners tested using the questionnaire method. This location was chosen based on the consideration that gold processing using geothermal has been running for more than 5 years. This study focused on analyzing the clinical symptoms experienced by the community around gold mining due to exposure to mercury from geothermal energy.

2.2. Health Impact Survey

The research was conducted in November involving 32 respondents of gold mine workers and the research location was in Drien Mangko Village, Woyla Subdistrict and Samples were taken from the community around the gold mine Sample measurement by providing a prepared questionnaire. Respondents from the selected community are people who live around the gold mine. The questionnaire was distributed. Each participant completed a health outcome assessment questionnaire to identify symptoms of acute and chronic toxicity according to WHO provisions. The clinical symptoms measured were those of neurological disorders. The questionnaire contained a list of symptoms commonly associated with mercury exposure due to geothermal. The study showed that the most acute clinical symptoms experienced by respondents living around the gold mine were cough and pelvic pain, diarrhea, abdominal pain, vomiting, nausea, and headache experienced by the community. While chronic clinical symptoms of headache and insomnia, irritability, anxiety, cramps, and trembling, ARI, skin diseases.

3. RESULT AND DISCUSSION

3.1. Respondent Characteristics

Worker respondents were categorized by gender, age, education, and occupation.

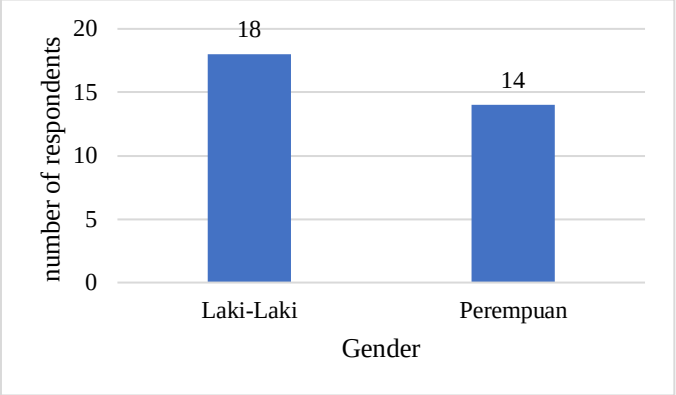

Figure 1. Gender (n = 32)

Figure 1 shows the results of the majority of worker respondents are male with 18 respondents and female with 14 respondents.

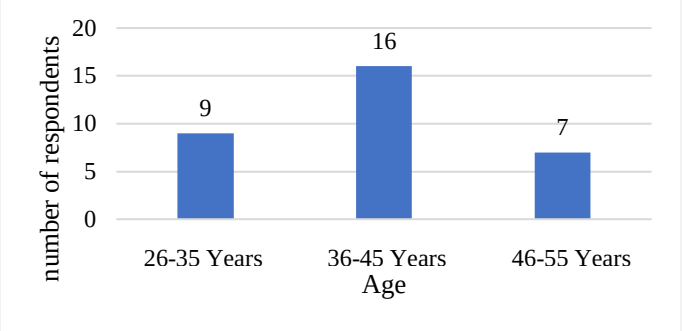

Figure 2. Age of workers (n = 32)

Figure 2 shows the results of the majority of respondents aged 36-45 years (16 respondents), followed by respondents aged 26-35 years (9 respondents), and respondents aged 46-55 years (7 respondents). Next, the education graph will be explained.

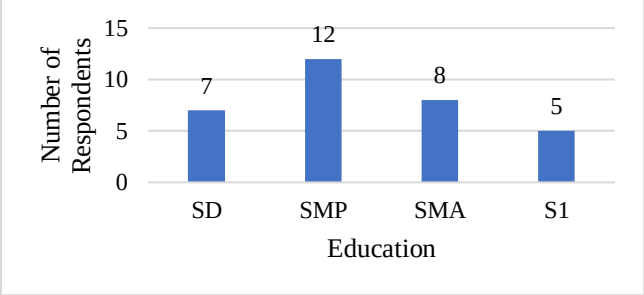

Figure 3. Education (n = 34)

Based on Figure 3, the results show that the majority of respondents' education is junior high school (12 respondents), followed by high school (8 respondents), then respondents with junior high school education (7 respondents) and finally S1 education (5 respondents). Next, a graph of the length of time worked will be explained.

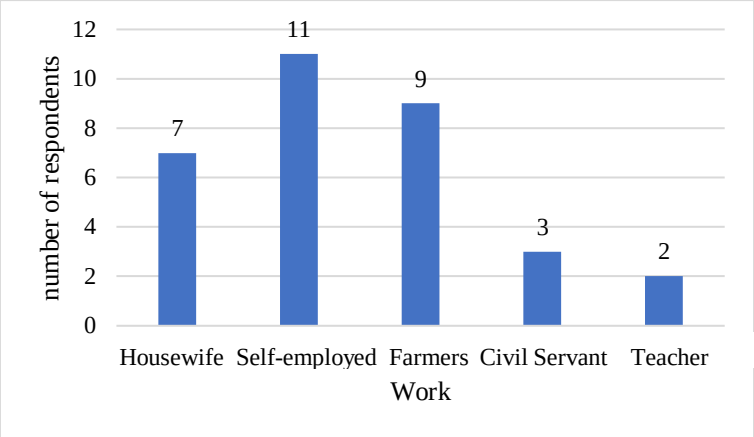

Figure 4. Work (n = 32)

Based on Figure 4, the results show that the majority of respondents' occupations are self-employed (11 respondents), farmers (9 respondents), housewives (7 respondents), civil servants (3 respondents), and teachers (2 respondents).

3.2. Symptoms of Community Disease

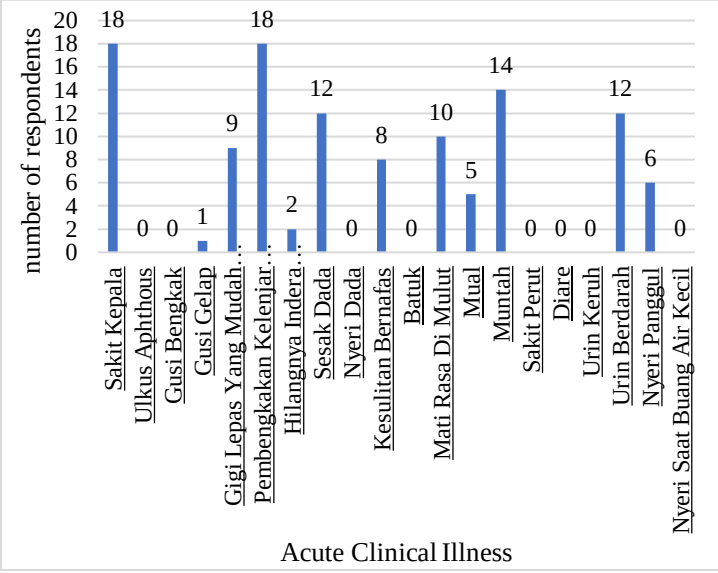

Figure 5. Acute Clinical Symptoms of Workers (n = 32)

Based on Figure 5, the majority of respondents experienced symptoms of headache and swollen salivary glands (18 respondents), vomiting (14 respondents), chest tightness

and bloody urine (12 respondents), numbness in the mouth (10 respondents), loose teeth that fall out easily (9 respondents), difficulty breathing (8 respondents), pelvic pain (6 respondents), nausea (5 respondents), loss of sense of smell (2 respondents) and dark gums (1 respondent).

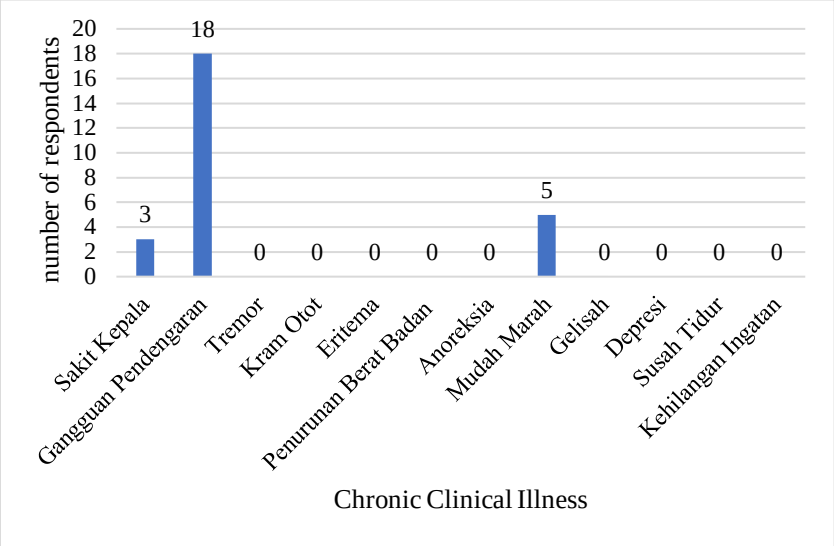

Figure 6. Chronic Clinical Symptoms of Workers (n = 32)

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 hearing loss (18 respondents), irritability (5 respondents) and headaches (3 respondents).

3.3. Discussion

Figure 1 shows the results of the majority of worker respondents are male with 18 respondents and female with 14 respondents. Figure 2 shows the results of the majority of respondents aged 36-45 years (16 respondents), followed by respondents aged 26-35 years (9 respondents), and respondents aged 46-55 years (7 respondents). Next, the education graph will be explained. Based on Figure 3, the results show that the majority of respondents' education is junior high school (12 respondents), followed by high school (8 respondents), then respondents with junior high school education (7 respondents) and the last is S1 education (5 respondents). Next, a graph of the length of time worked will be explained. Based on Figure 4, the results show that the majority of respondents' occupations are self-employed (11 respondents), farmers (9 respondents), housewives (7 respondents), civil servants (3 respondents), and teachers (2 respondents). Based on Figure 5, it can be seen that the majority of respondents experienced symptoms of headache and swelling of the salivary glands (18 respondents), vomiting (14 respondents), chest tightness and bloody urine (12 respondents), numbness in the mouth (10 respondents), loose teeth that fall out easily (9 respondents), difficulty breathing (8 respondents), pelvic pain (6 respondents), nausea (5 respondents), loss of sense of smell (2 respondents) and dark gums (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 hearing loss (18 respondents), irritability (5 respondents) and headaches (3 respondents).

The results of previous studies related to disease symptoms experienced by amalgamation gold processing workers have also been reported previously by other researchers. The results of the study state that gold milling operations carried out by the community have an impact on the health of workers. According to research (Lensoni et al., 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). while Symptoms of chronic toxicity recorded include somatosensory disorders in gold processing workers. The majority of workers experienced headaches and insomnia (8 respondents), irritability (6 respondents), anxiety (6 respondents), muscle cramps (5 respondents), and trembling (4 respondents). (Lensoni et al., 2022). Respondents who experienced health problems in the last 1 month, namely, respondents who experienced itching as many as 34 people (50.74%), eye irritation symptoms as many as 16 respondents (23.88%), who experienced tingling as many as 11 people (16.41%), and respondents who experienced stiff joints as many as 7 people (10.44%) (Lain B, et al., 2016).

According to research by S.D. Gundo, it was found that there were symptoms of Hg exposure in miners such as easy fatigue, headaches, reduced hearing, difficulty moving legs, and tremors (S.D. Gundo I, et al., 2020). Research by Sofia et al (2016) showed the 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%) (Sofia et al., 2016). Neurological assessments were conducted on some residents and gold miners. 12 symptoms ((1) Signs of bluish discoloration of the gums; (2) Rigidity and ataxia (walking or standing), (3) Alternating movements or dysdiadokokinesia, (4) Irregular eye movements or nystagmus, (5) Field of vision, (6) Knee jerk reflex, (7) Biceps reflex, (8) Babinski reflex, (9) Labial reflex, (10) Salivation and dysarthria, (11) Sensory examination and (12) Tremor.) are used to describe neurological disorders that may be associated with mercury exposure (Arifin et al., 2020). Respondents who experienced neurological symptoms totaled 27 respondents. Among the 27 respondents, there were 16 (84%) respondents who had a working time of >8 hours/day and 11 (50%) respondents who had a working time of ≤8 hours/day. While respondents who were not symptomatic amounted to 14 respondents, among the 14 respondents there were 3 (15.8%) respondents who had a working time > 8 hours / day and 11 (50%) respondents had a working time ≤ 8 hours / day so that the resulting p-value = 0.48, this shows that the working period is significantly related to neurological symptoms. Miners who work more than normal working hours (>8 hours/day) are miners whose type of work is as a drum worker and gold miners who also process their own rocks and gold buyers in the gold mine in Mantikulore District, Palu City (Bagia et al., 2022)

4. CONCLUSION

Based on the results of the study, the majority of respondents experienced symptoms of headache and swelling of the salivary glands (18 respondents), vomiting (14 respondents), chest tightness and bloody urine (12 respondents), numbness in the mouth (10 respondents), loose teeth that fall out easily (9 respondents), difficulty breathing (8 respondents), pelvic pain (6 respondents), nausea (5 respondents), loss of sense of smell (2 respondents) and dark gums (1 respondent). Meanwhile, symptoms of chronic toxicity recorded include somatosensory disorders in gold processing workers. The majority of workers experienced hearing loss (18 respondents), irritability (5 respondents), and headaches (3 respondents).

So, the conclusion of this study is that the majority of respondents experiencing symptoms of disease due to exposure to mercury are symptoms of headache and swelling of the salivary glands (18 respondents), hearing loss (18 respondents) and vomiting (14 respondents).

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