Survey of knowledge and practice related health risks of mercury exposure among gold craft workers in Rappocini area, Makassar city

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Abstract. Mercury (Hg) can cause acute and chronic intoxications in humans, such as damage to the central nervous system, lungs, and kidneys. Goldsmiths pose the risk of exposure to Hg through direct skin contact or inhalation of Hg vapor during the amalgam burning process. This study aims to assess the level of workers' knowledge regarding the risk of exposure to Hg and investigate the practice of preventing health risks from exposure to Hg in household-level gold-crafting activities. The study used a descriptive observational approach. The population of the study was 110 gold craftsmen in the Rapokkaling Village, Makassar City. The number of samples was 52 people determined by the purposive sampling technique. The data collection instruments included a structured questionnaire, camera, recorder, and field note. The results of the data analysis showed that the proportion of respondents with a sufficient level of knowledge was greater than that with a low level of knowledge (65.4% and 34.6%, respectively). On the other hand, the results of the observation showed that 100% of gold craft workers had unsecure work practices. Sufficient knowledge about the risks of exposure to Hg does not guarantee the discipline of implementing secure work practices including using personal protective equipment.

1. Introduction
Indonesia is wide and stretches from Sabang to Merauke. The wealth of mining products is also abundant from the island of Sumatra to Papua[1]. Among all available natural resources, the most promising wealth to be managed is in the mining sector, considering that it only needs to take existing treasures from the earth, absorb a large number of labor, excite so many supporting sectors, and the selling value of the products taken are valuable [1]

Since the case of the mercury accident in Minamata Japan in 1953 which was intensively reported [2], the issue of heavy metal pollution has increased in line with the development of various studies which have begun to be directed at various technological applications to deal with environmental pollution caused by heavy metals at very low concentrations directly and accumulates in the food chain therefore there is a concern of having an impact on human health [3]. As with other sources of environmental pollution, these heavy metals can be transferred in a very far range in the environment, then have the potential to disrupt the life of environmental biota and ultimately affect human health even in the long term and far from the main pollution source [4]
Mercury (Hg) is one of the metals that is included in the teratogenic material [5]. Hg is a dangerous heavy metal, which in even small concentrations can be toxic[6], [7]. In Indonesia, there have been cases of Hg poisoning in several places, such as the case of pollution in Buyat Bay as a result of pollution from gold mining company Perseroan Terbatas Newmont and the activities of Unlicensed Gold Miners (PETI) polluting rivers in Central Kalimantan [8]. Hg levels in the fish body reached 0.257 mg/l in the Rungan river and 0.676 mg/l in the Kahayan River. Meanwhile, Hg levels at the bottom of the Rungan river are 0.554 mg/l and at the bottom of the Kahayan River are 0.789 mg/l even though the threshold for sediment is only 0.005 mg/l [9]. Meanwhile, in West Kalimantan, Hg pollution cases were found in the Menyuke and Kapuas rivers. The Hg content in the two rivers has exceeded the threshold of 199.27 ppm [10]. In a study on Hg levels in gold miners in Renggas Tujuh Village, Titi District, Ketapang Regency, West Kalimantan, 44.4% of gold mining workers had Hg poisoning in their urine with an average content of 7.6 g/l [11].

Research that has been conducted in Sulawesi, one of which was in Palu, Central Sulawesi, regarding the use of Hg in the gold processing process at the Poboya People's Mining has affected the land around the people's mining [12]. The level of Hg in the air was between 20 m³ and 40,000 m³ which threaten the health of the population residing in the region [13]. Meanwhile, research conducted in Bombana showed that the Hg content in the gold processing plant reached 0.0315 mg/l, far exceeding the quality standard at the processing site and at the mining site, which is only 0.005 mg/l [14].

Research that has been conducted in Makassar on the impact of Hg on marine sediments shows that the highest Hg concentration is in Cambayya Village at 1.871 mg/kg and the lowest Hg concentration is in Pulau Lae-Lae Village at 1.550 mg/kg [15]. In general, the heavy metal content of Hg in marine sediments in the coastal area of Makassar City has exceeded the threshold of 0.13 mg/kg which can pose a high risk to human health in the vicinity [15].

A preliminary study in Rappokalling Village, Makassar City through interviews with one of the gold craftsmen workers in Rappokalling Village found that the gold craftsmen had been around for a long time without wearing the masks. Based on these data, this study aimed to determine the knowledge about health risks related to Hg contamination of the gold craft industry workers in Rappokalling Village, Makassar City. Due to the fact that the knowledge of gold industry workers related to the occupational security and health is a factor that can reduce work accidents, it can be interpreted that the knowledge of gold industry workers is an important part for workers as a form of response to occupational security and health which is influenced by the knowledge of each worker.

2. Methodology
This study uses an observational survey design that aims to measure the level of knowledge, and practice of gold industry workers on health risks related to mercury exposure, especially for household-scale gold craftsmen in Rappokalling village, Makassar City. This research was conducted in Rappokalling Village in 2019, Makassar City with the descriptive observational approach which aims to identify the knowledge and practice related Hg exposure of the gold craftsmen in household scale. Data was obtained from the direct interviews through questionnaires with the total samples of 52 respondents. The data is processed using the SPSS application and applies the stages of editing, coding, scoring, processing and cleaning [16].

3. Result
This research was conducted in one area as a gold processing center in Makassar City since 1924. Rappokalling District supplies gold handicrafts to Sulawesi and Java islands. This research is a descriptive observational research method with the aim of knowing the knowledge of workers, and the practice of preventing health risks related to mercury contamination in household scale gold craftsmen in Rappokalling Village, Makassar City. Based on Table 1, data obtained in the highest age group is 26-35 years accounting for 29 respondents (55.8%). The number of respondents who had the elementary education as the highest education was 24 respondents (46.2%). The higher number of the respondents worked as the gold craftsmen making
accessories which accounts for 34 respondents (65.4%). The data on the highest length of the workgroup is the group of 6-10 years of work as many as 17 respondents (32.7%).

Table 1. Characteristics of respondents in Rappokalling Village, Makassar City.

| Characteristics of Respondents | n=52 | %  |
|-------------------------------|------|----|
| **Age (Years old)**          |      |    |
| 16-25                        | 7    | 13.5|
| 26-35                        | 29   | 55.8|
| 36-45                        | 16   | 30.7|
| **Education**                |      |    |
| Elementary School            | 24   | 46.2|
| Junior High School           | 23   | 44.2|
| Senior High School           | 5    | 9.60|
| **Occupation**               |      |    |
| Accessories maker            | 34   | 65.4|
| Grinder                      | 18   | 34.6|
| **Working duration (year)**  |      |    |
| 1-5                          | 5    | 9.60|
| 6-10                         | 17   | 32.7|
| 11-15                        | 12   | 23.1|
| 16-20                        | 9    | 17.3|
| 21-25                        | 9    | 17.3|

Table 2. Frequency distribution of respondents based on worker knowledge regarding Hg contamination in Rappokalling Village, Makassar City in 2019.

| Workers’ Knowledge | n   | %   |
|--------------------|-----|-----|
| Enough             | 34  | 65.4|
| Less               | 18  | 34.6|
| **Total**          | 52  | 100 |

Table 2 indicates that 34 of 52 respondents (65.4%) have sufficient knowledge and the 18 respondents (34.6%) have less knowledge.

Table 3. Overview of the Frequency Distribution of Worker Risk Prevention Practices in Rappokalling Village, Makassar City, 2019.

| Workers’ Practice | n   | %   |
|-------------------|-----|-----|
| Secure            | 0   | 0   |
| Unsecure          | 52  | 100 |
| **Total**         | 52  | 100 |

Based on Table 3, the data obtained from 52 respondents indicated that risk prevention practices employed workers Rappokaling goldsmiths at all insecure as many as 52 respondents (100%), since it is not using PPE.

Table 4. Overview of the knowledge of the workers with risk prevention practices in Rappokalling Village, Makassar City, 2019.

| Workers’ knowledge | Workers’ Risk Prevention Practices | Total |
|--------------------|-----------------------------------|-------|
|                    | Secure                            |       |
|                    | Unsecure                          |       |
|                    | **Total**                         |       |
|        | n  | %    | n  | %    | n  | %    |
|--------|----|------|----|------|----|------|
| Enough | 0  | 0    | 34 | 65.4 | 52 | 100  |
| Less   | 0  | 0    | 18 | 34.6 | 52 | 100  |
| Total  | 0  | 0    | 52 | 100  | 52 | 100  |

Table 4 shows that unsecure work practices were performed by 34 respondents (65.4%) who are knowledgeable enough and they had the practice of preventing worker risks. Another 18 respondents (34.6%) had less knowledge and also engaged in unsecure worker risk prevention practices.

4. Discussion

4.1. Knowledge Level
The results showed that from 52 respondents there were 34 (65.4%) respondents who belonged to the category of sufficient knowledge and 18 (34.6%) of respondents who belonged to the category of insufficient knowledge. This shows that a person's knowledge not only be seen from the level of education but can also be obtained or is influenced by several factors among which are the external factors including the environmental factor or factors of habit [17].

According to the researcher, although many of the respondents have low education, they are used to working as gold craftsmen. It can be seen from the results of interviews with respondents as many as 17 (32.7%) of respondents who had been working for 6-10 years even 9 (17.3%) of respondents who worked for 21-25 years. Although many are quite knowledgeable, due to the habits or environmental factors, they do not care about the dangers of mercury or they think everything is normal [18].

In addition, respondents with the highest recent education were Elementary School as many as 24 (46.2%) respondents who were in the early phase before adolescence where they began to get to know the environment around them. So, this can trigger their curiosity about the work that is being done around them that will benefit them. Without thinking about the risks that will occur so that they do not use PPE at work [19].

4.2. Risk Preventing Practices
The results showed that from 52 respondents there were 52 (100%) respondents who were not secure. This is because many gold craftsmen do not use PPE. Therefore, according to researchers with no use of PPE, respondents or goldsmith workers in the village Rappokkaling Makasar city can easily be directly contaminated with Hg.

The results also showed that of the 52 respondents, 34 respondents (100%) worked as accessories makers and the lowest was respondents who worked as grinders as many as 18 (34.6%) respondents. According to researchers, the types of work that are at risk of unsecure with Hg are those who work as grinders or those that separate gold from soil because they use Hg to separate gold from soil. Meanwhile, those who only work as accessories makers do not use Hg in their work because they only process gold into accessories such as rings, etc., although there is a possibility that they will also be contaminated with mercury if the environment around them is at risk, especially the craftsmen who do not use PPE [20].

Most miners who have work activities in the form of mixing Hg have the highest percentage of receiving mercury poisoning [21]. Workers are at risk for direct exposure to Hg. Such exposure can occur at the stage of mixing Hg and squeezing [22]. Furthermore, exposure can also occur in the combustion process where the Hg vapor from the combustion can be inhaled directly by the workers [23].

5. Conclusion
This study assessed the knowledge level of goldsmith workers as well as the practices of PPE used in work place to prevent the Hg contamination. According to the results of workers' knowledge and worker practices, all workers who have sufficient knowledge are lack of occupational security in their daily
works. However, unsecure work practices can cause the gold craftsmen to be exposed to or contaminated with Hg, especially most of the gold craftsmen who do the milling can be directly contaminated with mercury during gold separation. This is caused by habits or environmental factors. Respondents with sufficient knowledge do not guarantee that workers are safe from mercury craftsmen but must also be seen from the understanding of work practices or the use of personal protective equipment while working.

**Recommendation**

The results of this study recommend to the government to help goldsmiths to create a household gold craft industry model that is environmentally friendly and does not endanger public health. Goldsmiths should pay more attention to occupational health and safety aspects in the gold processing process, discipline to use personal protective equipment to minimize Hg exposure. In addition, people living around the household-scale gold processing industry participate in reducing the impact of mercury exposure by adopting a clean, healthy and safe lifestyle.

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