

# File Comparison Report

Produced by WCopyfind.4.1.4 with These Settings:

Shortest Phrase to Match: 3  
 Fewest Matches to Report: 2  
 Ignore Punctuation: No  
 Ignore Outer Punctuation: No  
 Ignore Numbers: No  
 Ignore Letter Case: No  
 Skip Non-Words: No  
 Skip Long Words: No  
 Most Imperfections to Allow: 4  
 Minimum % of Matching Words: 85

Perfect Match	Overall Match	View Both Files	File L	File R
730 (17% L, 9% R)	753 (17%) L; 755 (10%) R	<a href="#">Side-by-Side</a>	<a href="#">02. The Influence of Illegal Gold Mining Activities.docx</a>	<a href="#">01. Solution on Handling of Illegal Gold Mining.docx</a>
1083 (18% L, 14% R)	1127 (19%) L; 1139 (15%) R	<a href="#">Side-by-Side</a>	<a href="#">03. Impact of Illegal Gold Mining Activities Toward.docx</a>	<a href="#">01. Solution on Handling of Illegal Gold Mining.docx</a>
585 (9% L, 13% R)	611 (10%) L; 601 (14%) R	<a href="#">Side-by-Side</a>	<a href="#">03. Impact of Illegal Gold Mining Activities Toward.docx</a>	<a href="#">02. The Influence of Illegal Gold Mining Activities.docx</a>
1513 (37% L, 20% R)	1563 (38%) L; 1572 (20%) R	<a href="#">Side-by-Side</a>	<a href="#">04. Effect of Illegal Gold Mining Activities on Social.docx</a>	<a href="#">01. Solution on Handling of Illegal Gold Mining.docx</a>
586 (14% L, 13% R)	611 (15%) L; 608 (14%) R	<a href="#">Side-by-Side</a>	<a href="#">04. Effect of Illegal Gold Mining Activities on Social.docx</a>	<a href="#">02. The Influence of Illegal Gold Mining Activities.docx</a>
999 (24% L, 16% R)	1046 (25%) L; 1029 (17%) R	<a href="#">Side-by-Side</a>	<a href="#">04. Effect of Illegal Gold Mining Activities on Social.docx</a>	<a href="#">03. Impact of Illegal Gold Mining Activities Toward.docx</a>

WCopyfind.4.1.4 found 6 matching pairs of documents.

The Influence of Illegal Gold Mining Activities toward Health of Workers in Kuantan Singingi, Indonesia

## 1. Introduction

Rapid industrial and technological development is very rapid today have a positive impact in the form of industrial products and technologies that can be utilized in improving the quality of life, but also has negative impact of environmental pollution, such as industrial waste and technology. Environmental pollution should be controlled so as not to interfere human health [1].

One of the industry and technology developments that can pollute the environment and give impact on human health is the use of mercury in gold mining activities. Gold mining activity is often referred to as a folk gold mining, traditional, small scale and without permission, because it is done by people, not by a company, using simple equipment, small- scale production, and its existence does not get permission from the local government [2,3].

Illegal gold mining activity are found in various regions in Indonesia, among others; The Pongkor, Bogor, West Java, Kulo North Sulawesi, Landak West Kalimantan, Central Kalimantan Gunung Mas, Jambi, West Sumatra Sijunjung. In Riau Province are also found in Kampar, Indragiri Hulu, and the most numerous in Kuantan Singingi, which flows along

the Kuantan River, Singingi River, irrigation dams, creeks and plantation area.

Kuansing area is known contain of gold (alluvial) which is quite a lot, both in the base flow of the river or in the fields, thus attracting the interest of small-scale illegal gold miners who come from outside of the area. Illegal gold miners activity is carried out since 2006, initially by migrants and followed by local villagers. The number of illegal gold miners increased very rapidly from year to year and spread almost in every district and village close to the river flow. In January 2014 there were approximately 2.103 units and in January 2015 is estimated at more than 3.000 units a raft of illegal gold miners and machinery (Dongfeng) equipped with vacuum and run by 3-4 workers. So now estimated that there are 9.000 to 12.000 gold miners are active in operation every day.

There are even some illegal gold miners who use heavy equipment (excavator) to dredge the land optimally.

Illegal gold miners activities in Kuansing is thought to have resulted in water pollution Singingi River & Kuantan River, and also tributaries where the water flows into the residential, irrigation dams (fields) of concern.

According to the Head of the Environment Agency (BLH) Kabupaten Kuansing, Indra Suandy (2012), now Singingi Kuantan River are not suitable for human consumption due to the condition

of the water is very muddy and suspected contaminated waste mercury (Hg) used by the perpetrators of illegal gold miners and directly discharged into rivers or the irrigation dam without being processed first.

Environmental pollution caused by mercury is very harmful to human health, animals, plants and the continuity of life in the surrounding environment [4]. At low concentrations, the effects of mercury has direct effect and accumulate in the food chain, the environmental biota so disturbing impact on human health despite relatively long and far from pollution sources [5].

Illegal Gold mining activities (illegal gold miners) at risk for health problems and safety of workers, because the use of mercury as an ingredient for mixing and combustion processes amalgam (mercury and gold). The impact will be seen the next years.

Research on the effects of mercury have been carried out in Indonesia, among others [6], which examines the variable consumption of marine fish, mercury levels in the hair, and health symptoms Kenjeran Turkish citizens in Surabaya. The study indicates symptoms of the disease that occurs in those who consume fish include kidney pain, dizziness, tumors, bleeding gums, and sight problems. Rudolf [7], also investigated complaints of health problems in the offender illegal gold miners and communities in relation to mercury exposure around the Kapuas River Sintang district, West Kalimantan. The results showed no difference in disease due Hg levels between groups of miners and non-miners group. Lestaris research results [5], in the district. Gunung Mas Central Kalimantan, indicates that the variable working time/day and the continuity of the use of personal protective equipment (PPE) has a significant relationship with mercury poisoning in illegal gold miners. they was Found disease symptoms arising from gold miners are easily tired, headache, shaking/shivering and stiff joints.

The use of mercury in illegal gold miners activity in the District Kuansing relatively high, ranging between 0.25 ounces until 0.5 ounces per day. It has lowered the quality of the environment and also have an impact on the health status of the workers themselves. The health status of workers is a health condition before and after working in gold mining. The health status of workers can be said to be good if the worker is not experiencing symptoms or health problems caused by work, poisoned by mercury (Hg), and is said to illness if the worker is experiencing symptoms or disorders as below;

1) Erethism, such as mood changes, sleep disturbances, depression, memory loss, irritability, reduced hearing and eyesight, tingling around the mouth, fingers and toes.

2) Tremor, such as impaired coordination, impaired balance, ataxia, hand writing becomes chaotic. 3) Stomatitis, increased salivation, pneumonitis followed by fever, dyspnea. 4) Chronic gingivitis, 5) weight loss (anorexia), 6) Headache continuously, 7) Anemia and frequent urination [5,9].

The purpose of this study was to determine the effect the activity of illegal gold miners which include length of service, the amount of Hg are used, contact with Hg and use of PPE against health problems in workers illegal gold miners in the district of Kuansing.

## 2. Method

This research is an observational analytic "Cross Sectional Study". Design of this study was conducted in seven districts of the 15 districts in Kuantan Singingi regency the are Singingi Hilir, Singingi, Kuantan Mudik, Gunung Toar, Kuantan Hulu, Kuantan Tengah, and Sentajo Raya. The population in this study were all workers illegal gold miners were scattered in Kuantan Singingi, around 8.412 up to

12.000 people. The amount is obtained based on the number of rafts (illegal gold miners) of about 2.103 up to 3.000 units scattered along the Kuantan River, Singingi River and other tributaries and irrigation dams. One unit of a raft of illegal gold miners 3-4 run by the workers. Sampling (respondents) in this study is based cluster performed by quota and accidental sampling [10]. Determination of the sample using the method of Rapid Assessment Procedure (RAP) which has become the jurisprudence by the World Health Organization (WHO), as many as 30 respondents for each district, so the sample size is  $30 \times 7 = 210$  gold miners. The data analysis use univariate analysis, bivariate analysis with chi-square test and multivariate analysis with multiple logistic regression prediction model.

## 3. Result

Univariate analysis results from table 1 it is known that

100% of respondents say (always, often and sometimes) feel the symptoms of itching on the hands, feet and skin disorders. Many respondents complained about and feel easily tired, skin of the hands and soles of the feet was thickened and numbness, sleeplessness, muscle stiffness, numbness accompanied by pain in the hands and feet, trembling, anxious, stiff joints, hearing reduced and more. Results of the questionnaire showed there is no indication of some workers illegal gold miners feel some of the symptoms of health problems as a description of the symptoms of mercury poisoning and activities of illegal gold miners.

Table 1: The Frequency Distribution Disease Symptoms Field by Illegal Gold Miners in Kuantan Singingi, 2014  
In picture 1 we can see that the symptoms of the disease which is always, often and sometimes perceived by respondents categorized as by symptoms of health problems, while the symptoms of the disease are rare and have never felt the respondents categorized as there are no health problems. So that it can be seen from picture 1, 66% of respondents who experienced symptoms of health problems and the remaining 34% did not experience symptoms of health problems.

### Bivariate Analysis Results

Based on table 2 found a statistically significant relationship between the independent variables workers who perform the activity gold mining activity includes: length of service, the amount of mercury (Hg), contact with Hg and use of PPE with the dependent variable of workers health disorder symptoms because all p values  $< 0.05$ . Respondents with a long service life of  $> 2$  years of experience symptoms of health problems as many as 102 people (73.4%),  $p = 0.001$ , meaning there is a significant correlation between the length of employment with workers health disorder symptoms. Value of prevalence odds ratio (POR) = 3.0 which means that respondents with a long service life of  $> 2$  years 3 times the risk of having symptoms of health problems than respondents worked 1-2 years, with confident interval (95% CI = 1.649 to 5.459).

Respondents who use the amount of mercury (hg)  $> 0.25$  ounces per day experiencing symptoms of health problems as many as 17 people (12.2%) and who have no symptoms of health disorder 1 (1.4%),  $p = 0.017$ , mean there is a significant correlation between the number of doses of mercury were used with health disorder symptoms perceived by Gold Miners. POR value = 9.754, which means that respondents were using the amount of mercury (hg)  $> 0.25$  ounces per day of 9.7 times the risk of having symptoms of health problems than respondents who use the number of mercury (hg)  $\leq 0.25$  ounces per day, with a value of CI 95% = 1.271 to 74.871.

Table 2: The Influence of Illegal Gold Miners Towards Occupational Health Disorder Symptom in Kuansing, 2014

Respondents were in contact with mercury in gold mining activity experiencing symptoms of health problems as many as 127 people (91.4%).  $P = 0.001$ , which means there is a significant relationship between direct contact

with mercury with symptoms of health problems perceived Gold Miners. POR value = 6.494, which means that respondents who have direct contact with mercury 6.5 times the risk of experiencing health problems than respondents who are not in direct contact with mercury (hg), with a value of 95% CI = 3.032 to 13.908.

Respondents who did not use PPE in performing gold mining activity have symptoms of health problems as many as 132 people (95%). P = 0.001, which means there is a significant association between the use of PPE in Gold mining activity with symptoms of health problems perceived by Gold Miners. POR value = 14.614, which means that respondents who do not use PPE 14.6 times the risk of having symptoms of health problems than respondents who use PPE in gold mining activity, with a value of 95% CI = 5.982 to 35.702.

#### Multivariate Analysis Results

Based on the results of multivariate analysis showed that length of service variables (P1) and a variable number of doses of Hg (P2) is not a risk factor for symptoms of illness (p values > 0.05). Variable contact with Hg (P3) is a confounding variable PPE usage because at the time there is a change excluded from modeling POR > 10% on the variable use of APD. Variable use of PPE (P4) is a risk factor for health problems in workers symptoms (p < 0,05). Illegal gold miners are not using PPE 15.4 times more at risk to suffer from symptoms of health disorders compared to illegal Gold Miners who use PPE (CI, 95%: POR = 3.9 to 60.7).

#### Variabel Independen

P

Value

POR

(95% CI)

P1 (Long worker)

-

-

-

P2 (Total dosis Hg)

-

-

-

P3 (Contact with Hg)

0,920

0,934

0,245-3,554

P4 (Used PPE)

0,001

15,411

3,915-60,663

Table 3: Multivariate Analysis (Last Model)

#### 4. Discussion

Health Problem Symptom on Illegal Gold Miners.

Results of this study showed that of the 28 symptoms of health problems (symptoms) were asked to the respondents, there are some symptoms of the disease are quite often perceived by illegal gold miners, 1) irritation on the hands, feet and skin disorders, 2 ) feel easily tired, 3) skin of the hands and soles of the feet feels thick and numb, 4) insomnia, 5) muscles feel stiff, 6) hearing loss, 7) numbness accompanied by pain in the hands and feet, 8) stiff joints, 9) headaches and dizziness, 10) shaking or shivering (such as freezing), 11) reduced memory or forgetfulness, 12)

irritation of the eyes, 13) decreases concentration, 14), appetite decreased and down weight, 15) abdominal pain.

Results of this study indicate that there are 66% of illegal gold miners were experiencing symptoms of health problems and 34% who do not have symptoms of health problems. There are indications that the health disorder symptoms perceived by the must workers associated with or effect of illegal gold mining activities and symptoms of mercury poisoning.

Results of this research that there are some similarities with the research [5], which states that the symptoms of



the disease found [in illegal gold](#) miners in Kurun Gunung Mas Regency of Central Kalimantan, that is tiredness, headache, shaking or chills, and stiff joints. But according to the researchers, these symptoms are not yet represent symptoms of mercury poisoning in after workers, either acute symptom or chronic. So that there is a difference with this study is the number and type of symptoms experienced [by illegal gold](#) miners, [as well as](#) the number of samples and coverage area of research.

The results also there are similarities with the research Subanri [9], associated with symptoms of mercury poisoning in 60 gold miners in Menyuke Porcupine District of West Kalimantan. Complaints of health problems found by the questionnaire are: muscle pain, stiff joints, feet and hands tingling, arthritis and rheumatism, aches, fatigue, chills/shivering, skin infections (red), allergies and fungal, back pain, chest pain, ulcers, headaches, dizziness, insomnia, abdominal pain, diarrhea, fever, flu, colds, and sore eyes). While the disease based on medical records of doctors in the health center is obtained an overview of the complaints [of gold miners](#) health problems [and surrounding communities](#) are complaints on the muscular system and connective tissue (bones diseases, including rheumatoid arthritis), skin infections, skin allergies, and fungi. [The difference with this study](#) [is not](#) taking secondary data from medical records public health centers [because it was feared would](#) happen a bias data with people who are not gold miners.

The length of Work Period towards Health Problems

Respondents who has over 2 years of work , has symptoms of health problems [as much as](#) 102 people (73.4%) and the value of  $p = 0.001$ . it Means there is a significant correlation between the length of employment with workers health disorder symptoms. with the value of prevalence odds ratio (POR) = 3.0. This means that respondents with a long service life of > 2 years at risk 3 times experiencing symptoms of health problems than respondents who work for less than 2 years.

This results are consistent with the results of Ruyani et al research [11], who conducted the analysis of the level of toxicity of mercury [in illegal gold miners in](#) Kerinci National Park area (TNKS) Bengkulu, which states there is a link between health problems of workers with higher levels of Hg and longer operational. However, these results are different from the results of Lestarisa [5], in the district of Gunung Mas Central Kalimantan, which states that the chi-square test results has no significant correlation between the length of service with the symptoms of mercury poisoning ( $p$  value = 0.070 or > 0.05). Mercury poisoning in gold miners with a service life of > 10 years shows a high percentage value that is 90.9% of miners were poisoned, only 9.1% of miners with a service life of > 10 years who did not experience toxicity.

The results also differ from the results of Petasule [12], at Huwala Village, East Sumalata, North Gorontalo District, which states that the results of statistical tests fisher exact ( $p$  value = 0.169 > 0.05), illustrates there is no relationship between long service life (10 years) with mercury poisoning in miners.

[According to investigators](#), the categorization of tenure (new and old) with a limit of 10 years less suitable, given the way in (intake) of mercury into the body can be directly through the pores of the skin, inhaled, swallowed, liquid contact, via the eyes, [as well as](#) through the fish, shellfish or food. Various symptoms (health problems) that arise due to the gold miners activity and mercury poisoning, there are acute and chronic. Symptoms of acute illness, of course, does not take up to 10 years, even less than 2 years. Long service life of miners indeed need to watch out, because extremely long service life allowing [illegal gold miners](#) experience more and longer exposure to mercury and mercury bioaccumulation potential to occur in the body so that it affects their health.

Total Mercury (Hg) to Health Problems

Respondents who use the amount of mercury (hg) > 0.25 ounces per day is also experiencing symptoms of health disorders with a value of  $p = 0.017$ . it Means that there is also a significant relationship between the number of doses of mercury were used with health disorder symptoms perceived by Gold Miners, with a value of 9.754 POR. This means that respondents were using the amount of mercury (hg) > 0.25 ounces per day of 9.7 times the risk of having symptoms of health disorders than respondents who use the number of mercury (hg)  $\leq$  0.25 ounces per day.

These results differ from the results Lestarisa [5], which states that the results of the chi square test that there is no significant correlation between the amount of the mercury / day with symptoms of mercury poisoning in Gold Mining ( $p$  value = 0.543 or > 0, 05). Use of the amount of mercury for Gold Miners without permission activity in these studies is relatively high between 0:25 ons s / d 1 ounce per day and of course [have an impact on](#) the environment of mercury pollution in the river.

The results also differ from the results of Petasule [12], which states that the results of statistical tests fisher

exact ( $\rho$  value = 0.283 > 0.05), there is no relationship between the amount of mercury per day with the incidence of mercury poisoning in miners. The high percentage of respondents who use mercury poisoning but only  $\leq 0.5$  kg / day in comparison with the use of mercury > 0.5 Kg / day is because the miners are collectively as with tenure > 5 years and are at risk of direct exposure to mercury through the inhaled air.

According to the researchers, the amount of mercury categorization used by Petasule is ( $\pm 0.5$  Kg / day) by the Gold Miners, considered less appropriate because they are too many and it is impossible used by folk in small-scale gold mining. The mercury can actually be used by gold miners in several times mixing process, as was done in Kuantan Singingi and Gunung Mas, Central Kalimantan. Total use of mercury by gold miners per day depending on the mixing frequency or stirring mercury and gold were obtained.

#### Mercury (Hg) Contiguity to Health Problems

Respondents were in contact with the mercury (Hg) in the illegal gold mining, experiencing symptoms of health problems 127 people (91.4%), with  $p = 0.001$ . Means there is a significant relationship between direct contact with mercury with symptoms of health problems perceived Gold Miners without permission POR value = 6.494. This means that respondents who have direct contact with mercury 6.5 times the risk of having symptoms of health disorders in

comparison with respondents who are not in direct contact with mercury (hg).

These results differ from the results of Lestaris [5], which states that the results of the chi square test has was no significant relationship between the type of activity miners (the contact of mercury) with mercury poisoning in Gold Miners ( $p$  value = 0.6987 or > 0.05). In this study, illegal gold miners who have direct contact with mercury (holding, inhaling), such as mixing, stirring, racking and burning mercury amalgam. While Gold Miners who doesn't have direct contact only work as mud cleaners, carpet washing equipment and parts.

Gold Mining activities in Kuansing, workers who initially served sucking mud and washing carpets, was also do mixing, stirring and squeeze mercury in buckets, trays and cloth. But to burn the amalgam need any special skills, so it is also often done by buyers of gold in the house or shop around location of Gold Miners.

The use of mercury even is a little even if it contact directly on with the skin, it will be absorbed through the skin pores, as well as the mercury evaporates when it will be inhaled into the lungs. Mercury enters the body not only through the pores of the skin or the respiratory tract but also through contact fluid, for example through the eyes and others [12].

#### The use of PPE for Occupational Health Disorders

Respondents who did not use PPE (masks, gloves, ear caps, hats and boots) in Gold mining activity experiencing symptoms of health problems 132 people (95%).  $P = 0.001$ , it means there is a significant association between the use of PPE in illegal activities with health disorder symptoms perceived by Gold Miners. Value POR = 14.614, which means respondents who do not use PPE 14.6 times the risk of having symptoms of health problems than respondents who use PPE in gold mining activity.

This results are consistent with the results of Lestaris research [5], which states that the results of the chi square test has a significant relationship between continuity of use of PPE with the symptoms of mercury poisoning ( $p$  value =

0.000 or <0.05). The unsustainable use of PPE may increase the risk of exposure to mercury taken into the body so the potential for bioaccumulation of mercury in the body. It has the potential to cause mercury poisoning in gold miners. Knowledge and awareness of Gold Miners needs to be improved for the importance of using PPE continuously to prevent or minimize the risk of mercury exposure to workers.

However Lestaris [5], split between variable continuity with the use of PPE completeness. While in this study combined into one variable use of PPE is complete and continuous. So the results of this study differ from the results of research which states that the results of the chi square test has no significant relationship between the completeness of PPE with the symptoms of mercury poisoning ( $p$  value = 0.217 or > 0.05).

The results are consistent with research Petasule [12], which states that the results of statistical tests fisher exact ( $\rho$  value

= 0.022 <0.05) and the value of Phi 0.48, has a relationship between the completeness of PPE with the incidence of mercury poisoning in miners. Phi value of 0.48 or belong to the category of moderate relationship which means that the

48% incidence of mercury poisoning affected by the completeness of the use of PPE.

The Completeness of PPE which is owned by the workers Gold Miners in Kuansing is still lacking. Due to lack of knowledge and awareness of illegal Gold Miners Without Permission of the importance of providing PPE.

Unlike the case with workers in a legal gold mining company, the company shall provide appropriate PPE

requirements and standards, because it is set by the Act (the Act) safety, health law and labour law.

Often found that the gold miners are not using PPE at the time of mine. Like not wearing shoes and gloves when mixing / stirring and squeeze mercury, there are still many who do not use a mask and goggles when burning amalgam. The workers just using only sandals and a long dress. They argued that it cause uncomfortable and hinder the movement while working, have become accustomed since the early work white out PPE so it's difficult to change, lack of information about the complete personal protective equipment and appropriate standards.

#### 5. Conclusion

Based on the results of multivariate analysis, we can conclude: Variable use of PPE (P4) influence the occurrence of health problems in workers. Gold Miners are not using PPE 15.4 times more at risk to suffer from symptoms of health disorders compared to who use PPE (CI, 95%: POR = 3.9 to 60.7). Old variable of work period (P1) and a variable amount of Hg were used (P2) does not influence against the occurrence of workers of health disorders symptoms. Variable Contact with Hg (P3) is a confounding variable PPE use.

#### 6. Suggestion

Workers should use complete personal protective equipment (PPE) is complete and in accordance with the standards in order to avoid the symptoms of health problems caused by Gold Mining activity and mercury poisoning, such as the use of gloves, masks, ear plug, hats, goggles and boots) at the time of the gold mine, stirring, racking and when burning amalgam mercury. The Health Department and Community Health Center should socialized more frequent socialization and do counseling about the danger of gold mining and health impacts for the surrounding community. To the police station for more serious to curb illegal gold miners and law enforcement, because Illegal Gold Mining has impact on environmental pollution of river water and biota. Suggestions for further research, because the cause of health problems in illegal Gold Miners is multi factor, it is necessary to do research by adding more independent variables and using different designs such as Cohort study.

## The Influence of Illegal Gold Mining Activities toward Health of Workers in Kuantan Singingi, Indonesia

### 1. Introduction

Rapid industrial and technological development is very rapid today have a positive impact in the form of industrial products and technologies that can be utilized in improving the quality of life, but also has negative impact of environmental pollution, such as industrial waste and technology. Environmental pollution should be controlled so as not to interfere human health [1].

One of the industry and technology developments that can pollute the environment and give impact on human health is the use of mercury in gold mining activities. Gold mining activity is often referred to as a folk gold mining, traditional, small scale and without permission, because it is done by people, not by a company, using simple equipment, small- scale production, and its existence does not get permission from the local government [2,3].

Illegal gold mining activity are found in various regions in Indonesia, among others: The Pongkor, Bogor, West Java, Kulo North Sulawesi, Landak West Kalimantan, Central Kalimantan Gunung Mas, Jambi, West Sumatra Sijunjung. In Riau Province are also found in Kampar, Indragiri Hulu, and the most numerous in Kuantan Singingi, which flows along the Kuantan River, Singingi River, irrigation dams, creeks and plantation area.

Kuansing area is known contain of gold (alluvial) which is quite a lot, both in the base flow of the river or in the fields, thus attracting the interest of small-scale illegal gold miners who come from outside of the area. Illegal gold miners activity is carried out since 2006, initially by migrants and followed by local villagers. The number of illegal gold miners increased very rapidly from year to year and spread almost in every district and village close to the river flow. In January 2014 there were approximately 2.103 units and in January 2015 is estimated at more than 3.000 units a raft of illegal gold miners and machinery (Dongfeng) equipped with vacuum and run by 3-4 workers. So now estimated that there are 9.000 to 12.000 gold miners are active in operation every day.

There are even some illegal gold miners who use heavy equipment (excavator) to dredge the land optimally. Illegal gold miners activities in Kuansing is thought to have resulted in water pollution Singingi River & Kuantan River, and also tributaries where the water flows into the residential, irrigation dams (fields) of concern. According to the Head of the Environment Agency (BLH) Kabupaten Kuansing, Indra Suandy (2012), now Singingi Kuantan River are not suitable for human consumption due to the condition of the water is very muddy and suspected contaminated waste mercury (Hg) used by the perpetrators of illegal gold miners and directly discharged into rivers or the irrigation dam without being processed first.

Environmental pollution caused by mercury is very harmful to human health, animals, plants and the continuity of life in the surrounding environment [4]. At low concentrations, the effects of mercury has direct effect and accumulate in the food chain, the environmental biota so disturbing impact on human health despite relatively long and far from pollution sources [5]. Illegal Gold mining activities (illegal gold miners) at risk for health problems and safety of workers, because the use of mercury as an ingredient for mixing and combustion processes amalgam (mercury and gold). The impact will be seen the next years.

Research on the effects of mercury have been carried out in Indonesia, among others [6], which examines the variable consumption of marine fish, mercury levels in the hair, and health symptoms Kenjeran Turkish citizens in Surabaya. The study indicates symptoms of the disease that occurs in those who consume fish include kidney pain, dizziness, tumors, bleeding gums, and sight problems. Rudolf [7], also investigated complaints of health problems in the offender illegal gold miners and communities in relation to mercury exposure around the Kapuas River Sintang district, West Kalimantan. The results showed no difference in disease due Hg levels between groups of miners and non-miners group. Lestaris research results [5], in the district. Gunung Mas Central Kalimantan, indicates that the variable working time/day and the continuity of the use of personal protective equipment (PPE) has a significant relationship with mercury poisoning in illegal gold miners. they was Found disease symptoms arising from gold miners are easily tired, headache, shaking/shivering and stiff joints.

The use of mercury in illegal gold miners activity in the District Kuansing relatively high, ranging between 0.25 ounces until 0.5 ounces per day. It has lowered the quality of the environment and also have an impact on the health status of the workers themselves. The health status of workers is a health condition before and after working in gold mining. The health status of workers can be said to be good if the worker is not experiencing symptoms or health problems caused by work, poisoned by mercury (Hg), and is said to illness if the worker is experiencing symptoms or disorders as below; 1) Erethism, such as mood changes, sleep disturbances, depression, memory loss, irritability, reduced hearing and eyesight, tingling around the mouth, fingers and toes.



2) Tremor, such as impaired coordination, impaired balance, ataxia, hand writing becomes chaotic. 3) Stomatitis, increased salivation, pneumonitis followed by fever, dyspnea. 4) Chronic gingivitis, 5) weight loss (anorexia), 6) Headache continuously, 7) Anemia and frequent urination [5,9].

The purpose of this study was to determine the effect the activity of illegal gold miners which include length of service, the amount of Hg are used, contact with Hg and use of PPE against health problems in workers illegal gold miners in the district of Kuansing.

## 2. Method

This research is an observational analytic "Cross Sectional Study". Design of this study was conducted in seven districts of the 15 districts in Kuantan Singingi regency the are Singingi Hilir, Singingi, Kuantan Mudik, Gunung Toar, Kuantan Hulu, Kuantan Tengah, and Sentajo Raya. The population in this study were all workers illegal gold miners were scattered in Kuantan Singingi, around 8.412 up to 12.000 people. The amount is obtained based on the number of rafts (illegal gold miners) of about 2.103 up to 3.000 units scattered along the Kuantan River, Singingi River and other tributaries and irrigation dams. One unit of a raft of illegal gold miners 3-4 run by the workers. Sampling (respondents) in this study is based cluster performed by quota and accidental sampling [10]. Determination of the sample using the method of Rapid Assessment Procedure (RAP) which has become the jurisprudence by the World Health Organization (WHO), as many as 30 respondents for each district, so the sample size is  $30 \times 7 = 210$  gold miners. The data analysis use univariate analysis, bivariate analysis with chi-square test and multivariate analysis with multiple logistic regression prediction model.

## 3. Result

Univariate analysis results from table 1 it is known that

100% of respondents say (always, often and sometimes) feel the symptoms of itching on the hands, feet and skin disorders. Many respondents complained about and feel easily tired, skin of the hands and soles of the feet was thickened and numbness, sleeplessness, muscle stiffness, numbness accompanied by pain in the hands and feet, trembling, anxious, stiff joints, hearing reduced and more. Results of the questionnaire showed there is no indication of some workers illegal gold miners feel some of the symptoms of health problems as a description of the symptoms of mercury poisoning and activities of illegal gold miners.

Table 1: The Frequency Distribution Disease Symptoms Field by Illegal Gold Miners in Kuantan Singingi, 2014  
In picture 1 we can see that the symptoms of the disease which is always, often and sometimes perceived by respondents categorized as by symptoms of health problems, while the symptoms of the disease are rare and have never felt the respondents categorized as there are no health problems. So that it can be seen from picture 1, 66% of respondents who experienced symptoms of health problems and the remaining 34% did not experience symptoms of health problems.

### Bivariate Analysis Results

Based on table 2 found a statistically significant relationship between the independent variables workers who perform the activity gold mining activity includes: length of service, the amount of mercury (Hg), contact with Hg and use of PPE with the dependent variable of workers health disorder symptoms because all p values  $< 0.05$ . Respondents with a long service life of  $> 2$  years of experience symptoms of health problems as many as 102 people (73.4%),  $p = 0.001$ , meaning there is a significant correlation between the length of employment with workers health disorder symptoms. Value of prevalence odds ratio (POR) = 3.0 which means that respondents with a long service life of  $> 2$  years 3 times the risk of having symptoms of health problems than respondents worked 1-2 years, with confident interval (95% CI = 1.649 to 5.459).

Respondents who use the amount of mercury (hg)  $> 0.25$  ounces per day experiencing symptoms of health problems as many as 17 people (12.2%) and who have no symptoms of health disorder 1 (1.4%),  $p = 0.017$ , mean there is a significant correlation between the number of doses of mercury were used with health disorder symptoms perceived by Gold Miners. POR value = 9.754, which means that respondents were using the amount of mercury (hg)  $> 0.25$  ounces per day of 9.7 times the risk of having symptoms of health problems than respondents who use the number of mercury (hg)  $\leq 0.25$  ounces per day, with a value of CI 95% = 1.271 to 74.871.

Table 2: The Influence of Illegal Gold Miners Towards Occupational Health Disorder Symptom in Kuansing, 2014

Respondents were in contact with mercury in gold mining activity experiencing symptoms of health problems as many as 127 people (91.4%).  $P = 0.001$ , which means there is a significant relationship between direct contact

with mercury with symptoms of health problems perceived Gold Miners. POR value = 6.494, which means that respondents who have direct contact with mercury 6.5 times the risk of experiencing health problems than respondents who are not in direct contact with mercury (hg), with a value of 95% CI = 3.032 to 13.908.

Respondents who did not use PPE in performing [gold mining activity](#) have symptoms of health problems as many as 132 people (95%).  $P = 0.001$ , which means there is a significant association between the use of PPE in Gold mining activity with symptoms of health problems perceived by Gold Miners. POR value = 14.614, which means that respondents who do not use PPE 14.6 times the risk of having symptoms of health problems than respondents who use PPE in gold mining activity, with a value of 95% CI = 5.982 to 35.702.

#### Multivariate Analysis Results

Based on the results of multivariate analysis showed that length of service variables (P1) and a variable number of doses of Hg (P2) is not a risk factor for symptoms of illness ( $p$  values  $> 0.05$ ). Variable contact with Hg (P3) is a confounding variable PPE usage because [at the time there is a change](#) excluded from modeling  $POR > 10\%$  on the variable use of APD. Variable use of PPE (P4) is a risk factor for health problems in workers symptoms ( $p < 0,05$ ). [Illegal gold miners](#) are not using PPE 15.4 times more at risk to suffer from symptoms of health disorders compared to illegal Gold Miners who use PPE (CI, 95%: POR = 3.9 to 60.7).

#### Variabel Independen

P

Value

POR

(95% CI)

P1 (Long worker)

-

-

-

P2 (Total dosis Hg)

-

-

-

P3 (Contact with Hg)

0,920

0,934

0,245-3,554

P4 (Used PPE)

0,001

15,411

3,915-60,663

Table 3: Multivariate Analysis (Last Model)

#### 4. Discussion

Health Problem Symptom on Illegal Gold Miners.

Results [of this study](#) showed that of the 28 symptoms of health problems (symptoms) were asked to the respondents, [there are some](#) symptoms of the disease are quite often perceived by illegal gold miners, 1) irritation on the hands, feet and skin disorders, 2) feel easily tired, 3) skin of the hands and soles of the feet feels thick and numb, 4) insomnia, 5) muscles feel stiff, 6) hearing loss, 7) numbness accompanied by pain in the hands and feet, 8) stiff joints, 9) headaches and dizziness, 10) shaking or shivering (such as freezing), 11) reduced memory or forgetfulness, 12)

irritation of the eyes, 13) decreases concentration, 14), appetite decreased and down weight, 15) abdominal pain.

Results [of this study indicate that](#) there are 66% [of illegal gold](#) miners were experiencing symptoms of health problems and 34% who do not have symptoms of health problems. There are indications that the health disorder symptoms perceived by the must workers associated with or effect of [illegal gold mining](#) activities and symptoms of mercury poisoning.

Results [of this research](#) that there are some similarities with the research [5], which states that the symptoms of

the disease found in illegal gold miners in Kurun Gunung Mas Regency of Central Kalimantan, that is tiredness, headache, shaking or chills, and stiff joints. But [according to the](#) researchers, these symptoms are not yet represent symptoms of mercury poisoning in after workers, either acute symptom or chronic. So that there is a difference with this study is [the number and](#) type of symptoms experienced by illegal gold miners, as well as the number of samples and coverage area of research.

The results also there are similarities with the research Subanri [9], associated with symptoms of mercury poisoning in 60 gold miners in Menyuke Porcupine District of West Kalimantan. Complaints of health problems found by the questionnaire are: muscle pain, stiff joints, feet and hands tingling, arthritis and rheumatism, aches, fatigue, chills/shivering, skin infections (red), allergies and fungal, back pain, chest pain, ulcers, headaches, dizziness, insomnia, abdominal pain, diarrhea, fever, flu, colds, and sore eyes). While the disease based on medical records of doctors in the health center is obtained an overview of the complaints of gold miners health problems [and surrounding communities](#) are complaints on the muscular system and connective tissue (bones diseases, including rheumatoid arthritis), skin infections, skin allergies, and fungi. The difference with this study is not taking [secondary data from](#) medical records public health centers because it was feared would happen a bias data with people who are not gold miners.

The length of Work Period towards Health Problems

Respondents who has over 2 years of work , has symptoms of health problems [as much as](#) 102 people (73.4%) and the value of  $p = 0.001$ . it Means there is a significant correlation between the length of employment with workers health disorder symptoms. with the value of prevalence odds ratio (POR) = 3.0. This means that respondents with a long service life of > 2 years at risk 3 times experiencing symptoms of health problems than respondents who work for less than 2 years.

This results are consistent with the results of Ruyani et al research [11], who conducted the analysis of the level of toxicity of mercury [in illegal gold](#) miners in Kerinci National Park area (TNKS) Bengkulu, which states there is a link between health problems of workers with [higher levels of](#) Hg and longer operational. However, these results are different from the results of Lestaris [5], in the district of Gunung Mas Central Kalimantan, which states that the chi-square test results has no significant correlation between the length of service with the symptoms of mercury poisoning ( $p$  value = 0.070 or > 0.05). Mercury poisoning in gold miners with a service life of > 10 years shows a high percentage value that is 90.9% of miners were poisoned, only 9.1% of miners with a service life of > 10 years who did not experience toxicity.

The results also differ from the results of Petasule [12], at Huwala Village, East Sumalata, North Gorontalo District, which states that the results of statistical tests fisher exact ( $p$  value = 0.169 > 0.05), illustrates there is no relationship between long service life (10 years) with mercury poisoning in miners.

According to investigators, the categorization of tenure (new and old) with a limit of 10 years less suitable, given the way in (intake) of mercury into the body can be directly through the pores of the skin, inhaled, swallowed, liquid contact, via the eyes, as well as through [the fish, shellfish](#) or food. Various symptoms (health problems) that arise due to the gold miners activity and mercury poisoning, there are acute and chronic. Symptoms of acute illness, of course, does not take up to 10 years, even less than 2 years. Long service life of miners indeed need to watch out, because extremely long service life allowing illegal gold miners experience more and longer exposure to mercury and mercury bioaccumulation potential [to occur in](#) the body [so that it](#) affects their health.

Total Mercury (Hg) to Health Problems

Respondents who use the amount of mercury (hg) > 0.25 ounces per day is also experiencing symptoms of health disorders with a value of  $p = 0.017$ . it Means that there is also a significant relationship between the number of doses of mercury were used with health disorder symptoms perceived by Gold Miners, with a value of 9.754 POR. [This means that](#) respondents were using the amount of mercury (hg) > 0.25 ounces per day of 9.7 times the risk of having symptoms of health disorders than respondents who use the number of mercury (hg)  $\leq 0.25$  ounces per day.

These results differ from the results Lestaris [5], which states that the results of the chi square test [that there is](#) no significant correlation between the amount of the mercury / day with symptoms of mercury poisoning in Gold Mining ( $p$  value = 0.543 or > 0 , 05). Use of the amount of mercury for Gold Miners without permission activity in these studies is relatively high between 0:25 ons s / d 1 ounce per day and of course [have an impact on the](#) environment [of mercury pollution in the river](#).

[The results](#) also differ from the results of Petasule [12], which states that the results of statistical tests fisher

exact ( $\rho$  value = 0.283 > 0.05), there is no relationship between [the amount of](#) mercury per day with the incidence of mercury poisoning in miners. The high percentage of respondents who use mercury poisoning but only  $\leq 0.5$  kg / day in comparison with the use of mercury > 0.5 Kg / day is because the miners are collectively as with tenure > 5 years and are at risk of direct exposure to mercury through the inhaled air.

According to the researchers, [the amount of](#) mercury categorization used by Petasule is ( $\pm 0.5$  Kg / day) by the Gold Miners, considered less appropriate because they are too many and it is impossible used by folk in small-scale gold mining. The [mercury can actually be](#) used by gold miners in several times mixing process, as was done [in Kuantan Singingi](#) and Gunung Mas, Central Kalimantan. Total use of mercury [by gold miners](#) per day depending on the mixing frequency or stirring mercury and gold were obtained.

#### Mercury (Hg) Contiguity to Health Problems

Respondents were in contact with the [mercury \(Hg\) in](#) the [illegal gold mining](#), experiencing symptoms of health problems 127 people (91.4%), with  $p = 0.001$ . Means there is a significant relationship between direct contact with mercury with symptoms of health problems perceived Gold Miners without permission POR value = 6.494.

[This means that](#) respondents who have direct contact with mercury 6.5 times the risk of having symptoms of health disorders in

comparison with respondents who are not in direct contact with mercury (hg).

These results [differ from the](#) results of Lestaris [5], [which states that](#) the results of the chi square test has was no significant relationship between the type of activity miners (the contact of mercury) with mercury poisoning in Gold Miners ( $p$  value = 0.6987 or > 0.05). In this study, illegal [gold miners who](#) have direct contact with mercury (holding, inhaling), such as mixing, stirring, racking and burning mercury amalgam. While Gold Miners who doesn't have direct contact only work as mud cleaners, carpet washing equipment and parts.

Gold Mining activities in Kuansing, workers who initially served sucking mud and washing carpets, was also do mixing, stirring and squeeze mercury in buckets, trays and cloth. But to burn the amalgam need any special skills, so it is also often done by buyers of gold in the house or shop around location of Gold Miners.

The use of mercury even is a little even if it contact directly on with the skin, it will be absorbed through the skin pores, as well as the mercury evaporates when it will be inhaled into the lungs. Mercury enters the body not only through the pores of the skin or the respiratory tract but also through contact fluid, for example through the eyes and others [12].

#### The use of PPE for Occupational Health Disorders

Respondents who did not use PPE (masks, gloves, ear caps, hats and boots) in Gold mining activity experiencing symptoms of health problems 132 people (95%).  $P = 0.001$ , it means there is a significant association between the use of PPE in illegal activities with health disorder symptoms perceived by Gold Miners. Value POR = 14.614, which means respondents who do not use PPE 14.6 times the risk of having symptoms of health problems than respondents who use PPE in gold mining activity.

This results are consistent with the results of Lestaris research [5], [which states that](#) the results of the chi square test has a significant relationship between continuity of use of PPE with the symptoms of mercury poisoning ( $p$  value =

0.000 or <0.05). The unsustainable use of PPE may increase the risk of exposure to mercury taken into the body so the potential for bioaccumulation [of mercury in](#) the body. It has the potential to cause [mercury poisoning in](#) [gold](#) miners. Knowledge and awareness of Gold Miners needs to be improved for the importance of using PPE continuously to prevent or minimize the risk [of mercury exposure to](#) workers.

However Lestaris [5], split between variable continuity with the use of PPE completeness. While in this study combined into one variable use of PPE is complete and continuous. So the [results of this](#) study differ from the [results of research which states that](#) the results of the chi square test has no significant relationship between the completeness of PPE with the symptoms of mercury poisoning ( $p$  value = 0.217 or > 0.05).

[The results are](#) consistent with research Petasule [12], [which states that the](#) results of statistical tests fisher exact ( $\rho$  value

= 0.022 <0.05) and the value of Phi 0.48, has [a relationship between](#) the completeness of PPE with the incidence [of mercury poisoning in](#) miners. Phi value of 0.48 or belong to the category of moderate relationship which means that the

48% incidence of mercury poisoning affected by the completeness of the use of PPE.

The Completeness of PPE which is owned by the workers Gold Miners in Kuansing is still lacking. Due to lack of knowledge and awareness of illegal Gold Miners Without Permission of the importance of providing PPE.

Unlike the case with workers in a legal gold mining company, the company shall provide appropriate PPE



requirements and standards, because it is set by the Act (the Act) safety, health law and labour law.

Often found that [the gold miners](#) are not using PPE [at the time of](#) mine. Like not wearing shoes and gloves when mixing / stirring and squeeze mercury, there are still many who do not use a mask and goggles when burning amalgam. The workers just using only sandals and a long dress. They argued that it cause uncomfortable and hinder the movement while working, have become accustomed since the early work white out PPE so it's difficult to change, lack of information about the complete personal protective equipment and appropriate standards.

#### 5. Conclusion

Based on the results of multivariate analysis, we can conclude: Variable use of PPE (P4) influence the occurrence of health problems in workers. Gold Miners are not using PPE 15.4 times more at risk to suffer from symptoms of health disorders compared to who use PPE (CI, 95%: POR = 3.9 to 60.7). Old variable of work period (P1) and a variable amount of Hg were used (P2) does not influence against [the occurrence of](#) workers of health disorders symptoms. Variable Contact with Hg (P3) is a confounding variable PPE use.

#### 6. Suggestion

Workers should use complete personal protective equipment (PPE) is complete and in accordance with the standards in order to avoid the symptoms of health problems caused by Gold Mining activity and mercury poisoning, such as the use of gloves, masks, ear plug, hats, goggles and boots) at the time of the gold mine, stirring, racking and when burning amalgam mercury. The Health Department and Community Health Center should socialized more frequent socialization and do counseling about the danger [of gold mining](#) and health impacts for the surrounding community. To the police station for more serious [to curb illegal gold](#) miners and law enforcement, because [Illegal Gold Mining has impact on](#) environmental pollution [of river water](#) and biota. Suggestions for further research, because the cause of health problems in illegal Gold Miners is multi factor, it is necessary to do research by adding more independent variables and using different designs such as Cohort study.

## The Influence of Illegal Gold Mining Activities toward Health of Workers in Kuantan Singingi, Indonesia

### 1. Introduction

Rapid industrial and technological development is very rapid today have a positive impact in the form of industrial products and technologies that can be utilized in improving the quality of life, but also has negative impact of environmental pollution, such as industrial waste and technology. Environmental pollution should be controlled so as not to interfere human health [1].

One of the industry and technology developments that can pollute the environment and give impact on human health is the use of mercury in gold mining activities. Gold mining activity is often referred to as a folk gold mining, traditional, small scale and without permission, because it is done by people, not by a company, using simple equipment, small- scale production, and its existence does not get permission from the local government [2,3].

Illegal gold mining activity are found in various regions in Indonesia, among others: The Pongkor, Bogor, West Java, Kulo North Sulawesi, Landak West Kalimantan, Central Kalimantan Gunung Mas, Jambi, West Sumatra Sijunjung. In Riau Province are also found in Kampar, Indragiri Hulu, and the most numerous in Kuantan Singingi, which flows along

the Kuantan River, Singingi River, irrigation dams, creeks and plantation area.

Kuansing area is known contain of gold (alluvial) which is quite a lot, both in the base flow of the river or in the fields, thus attracting the interest of small-scale illegal gold miners who come from outside of the area. Illegal gold miners activity is carried out since 2006, initially by migrants and followed by local villagers. The number of illegal gold miners increased very rapidly from year to year and spread almost in every district and village close to the river flow. In January 2014 there were approximately 2.103 units and in January 2015 is estimated at more than 3.000 units a raft of illegal gold miners and machinery (Dongfeng) equipped with vacuum and run by 3-4 workers. So now estimated that there are 9.000 to 12.000 gold miners are active in operation every day.

There are even some illegal gold miners who use heavy equipment (excavator) to dredge the land optimally. Illegal gold miners activities in Kuansing is thought to have resulted in water pollution Singingi River & Kuantan River, and also tributaries where the water flows into the residential, irrigation dams (fields) of concern. According to the Head of the Environment Agency (BLH) Kabupaten Kuansing, Indra Suandy (2012), now Singingi Kuantan River are not suitable for human consumption due to the condition of the water is very muddy and suspected contaminated waste mercury (Hg) used by the perpetrators of illegal gold miners and directly discharged into rivers or the irrigation dam without being processed first.

Environmental pollution caused by mercury is very harmful to human health, animals, plants and the continuity of life in the surrounding environment [4]. At low concentrations, the effects of mercury has direct effect and accumulate in the food chain, the environmental biota so disturbing impact on human health despite relatively long and far from pollution sources [5]. Illegal Gold mining activities (illegal gold miners) at risk for health problems and safety of workers, because the use of mercury as an ingredient for mixing and combustion processes amalgam (mercury and gold). The impact will be seen the next years.

Research on the effects of mercury have been carried out in Indonesia, among others [6], which examines the variable consumption of marine fish, mercury levels in the hair, and health symptoms Kenjeran Turkish citizens in Surabaya. The study indicates symptoms of the disease that occurs in those who consume fish include kidney pain, dizziness, tumors, bleeding gums, and sight problems. Rudolf [7], also investigated complaints of health problems in the offender illegal gold miners and communities in relation to mercury exposure around the Kapuas River Sintang district, West Kalimantan. The results showed no difference in disease due Hg levels between groups of miners and non-miners group. Lestaris research results [5], in the district. Gunung Mas Central Kalimantan, indicates that the variable working time/day and the continuity of the use of personal protective equipment (PPE) has a significant relationship with mercury poisoning in illegal gold miners. they was Found disease symptoms arising from gold miners are easily tired, headache, shaking/shivering and stiff joints.

The use of mercury in illegal gold miners activity in the District Kuansing relatively high, ranging between 0.25 ounces until 0.5 ounces per day. It has lowered the quality of the environment and also have an impact on the health status of the workers themselves. The health status of workers is a health condition before and after working in gold mining. The health status of workers can be said to be good if the worker is not experiencing symptoms or health problems caused by work, poisoned by mercury (Hg), and is said to illness if the worker is experiencing symptoms or disorders as below; 1) Erethism, such as mood changes, sleep disturbances, depression, memory loss, irritability, reduced hearing and eyesight, tingling around the mouth, fingers and toes.

2) Tremor, such as impaired coordination, impaired balance, ataxia, hand writing becomes chaotic. 3) Stomatitis, increased salivation, pneumonitis followed by fever, dyspnea. 4) Chronic gingivitis, 5) weight loss (anorexia), 6) Headache continuously, 7) Anemia and frequent urination [5,9].

The purpose of this study was to determine the effect the activity of illegal gold miners which include length of service, the amount of Hg are used, contact with Hg and use of PPE against health problems in workers illegal gold miners in the district of Kuansing.

## 2. Method

This research is an observational analytic "Cross Sectional Study". Design of this study was conducted in seven districts of the 15 districts in Kuantan Singingi regency the are Singingi Hilir, Singingi, Kuantan Mudik, Gunung Toar, Kuantan Hulu, Kuantan Tengah, and Sentajo Raya. The population in this study were all workers illegal gold miners were scattered in Kuantan Singingi, around 8.412 up to

12.000 people. The amount is obtained based on the number of rafts (illegal gold miners) of about 2.103 up to 3.000 units scattered along the Kuantan River, Singingi River and other tributaries and irrigation dams. One unit of a raft of illegal gold miners 3-4 run by the workers. Sampling (respondents) in this study is based cluster performed by quota and accidental sampling [10]. Determination of the sample using the method of Rapid Assessment Procedure (RAP) which has become the jurisprudence by the World Health Organization (WHO), as many as 30 respondents for each district, so the sample size is  $30 \times 7 = 210$  gold miners. The data analysis use univariate analysis, bivariate analysis with chi-square test and multivariate analysis with multiple logistic regression prediction model.

## 3. Result

Univariate analysis results from table 1 it is known that

100% of respondents say (always, often and sometimes) feel the symptoms of itching on the hands, feet and skin disorders. Many respondents complained about and feel easily tired, skin of the hands and soles of the feet was thickened and numbness, sleeplessness, muscle stiffness, numbness accompanied by pain in the hands and feet, trembling, anxious, stiff joints, hearing reduced and more. Results of the questionnaire showed there is no indication of some workers illegal gold miners feel some of the symptoms of health problems as a description of the symptoms of mercury poisoning and activities of illegal gold miners.

Table 1: The Frequency Distribution Disease Symptoms Field by Illegal Gold Miners in Kuantan Singingi, 2014  
In picture 1 we can see that the symptoms of the disease which is always, often and sometimes perceived by respondents categorized as by symptoms of health problems, while the symptoms of the disease are rare and have never felt the respondents categorized as there are no health problems. So that it can be seen from picture 1, 66% of respondents who experienced symptoms of health problems and the remaining 34% did not experience symptoms of health problems.

### Bivariate Analysis Results

Based on table 2 found a statistically significant relationship between the independent variables workers who perform the activity gold mining activity includes: length of service, the amount of mercury (Hg), contact with Hg and use of PPE with the dependent variable of workers health disorder symptoms because all p values  $< 0.05$ . Respondents with a long service life of  $> 2$  years of experience symptoms of health problems as many as 102 people (73.4%),  $p = 0.001$ , meaning there is a significant correlation between the length of employment with workers health disorder symptoms. Value of prevalence odds ratio (POR) = 3.0 which means that respondents with a long service life of  $> 2$  years 3 times the risk of having symptoms of health problems than respondents worked 1-2 years, with confident interval (95% CI = 1.649 to 5.459).

Respondents who use the amount of mercury (hg)  $> 0.25$  ounces per day experiencing symptoms of health problems as many as 17 people (12.2%) and who have no symptoms of health disorder 1 (1.4%),  $p = 0.017$ , mean there is a significant correlation between the number of doses of mercury were used with health disorder symptoms perceived by Gold Miners. POR value = 9.754, which means that respondents were using the amount of mercury (hg)  $> 0.25$  ounces per day of 9.7 times the risk of having symptoms of health problems than respondents who use the number of mercury (hg)  $\leq 0.25$  ounces per day, with a value of CI 95% = 1.271 to 74.871.

Table 2: The Influence of Illegal Gold Miners Towards Occupational Health Disorder Symptom in Kuansing, 2014

Respondents were in contact with mercury in gold mining activity experiencing symptoms of health problems as many as 127 people (91.4%).  $P = 0.001$ , which means there is a significant relationship between direct contact

with mercury with symptoms of health problems perceived Gold Miners. POR value = 6.494, which means that respondents who have direct contact with mercury 6.5 times the risk of experiencing health problems than respondents who are not in direct contact with mercury (hg), with a value of 95% CI = 3.032 to 13.908.

Respondents who did not use PPE in performing gold mining activity have symptoms of health problems as many as 132 people (95%). P = 0.001, which means there is a significant association between the use of PPE in Gold mining activity with symptoms of health problems perceived by Gold Miners. POR value = 14.614, which means that respondents who do not use PPE 14.6 times the risk of having symptoms of health problems than respondents who use PPE in gold mining activity, with a value of 95% CI = 5.982 to 35.702.

#### Multivariate Analysis Results

Based on the results of multivariate analysis showed that length of service variables (P1) and a variable number of doses of Hg (P2) is not a risk factor for symptoms of illness (p values > 0.05). Variable contact with Hg (P3) is a confounding variable PPE usage because at the time there is a change excluded from modeling POR > 10% on the variable use of APD. Variable use of PPE (P4) is a risk factor for health problems in workers symptoms (p < 0,05). Illegal gold miners are not using PPE 15.4 times more at risk to suffer from symptoms of health disorders compared to illegal Gold Miners who use PPE (CI, 95%: POR = 3.9 to 60.7).

#### Variabel Independen

P

Value

POR

(95% CI)

P1 (Long worker)

-

-

-

P2 (Total dosis Hg)

-

-

-

P3 (Contact with Hg)

0,920

0,934

0,245-3,554

P4 (Used PPE)

0,001

15,411

3,915-60,663

Table 3: Multivariate Analysis (Last Model)

#### 4. Discussion

Health Problem Symptom on Illegal Gold Miners.

Results of this study showed that of the 28 symptoms of health problems (symptoms) were asked to the respondents, there are some symptoms of the disease are quite often perceived by illegal gold miners, 1) irritation on the hands, feet and skin disorders, 2) feel easily tired, 3) skin of the hands and soles of the feet feels thick and numb, 4) insomnia, 5) muscles feel stiff, 6) hearing loss, 7) numbness accompanied by pain in the hands and feet, 8) stiff joints, 9) headaches and dizziness, 10) shaking or shivering (such as freezing), 11) reduced memory or forgetfulness, 12)

irritation of the eyes, 13) decreases concentration, 14), appetite decreased and down weight, 15) abdominal pain.

Results of this study indicate that there are 66% of illegal gold miners were experiencing symptoms of health problems and 34% who do not have symptoms of health problems. There are indications that the health disorder symptoms perceived by the must workers associated with or effect of illegal gold mining activities and symptoms of mercury poisoning.

Results of this research that there are some similarities with the research [5], which states that the symptoms of



the disease found in illegal gold miners in Kurun Gunung Mas Regency of Central Kalimantan, that is tiredness, headache, shaking or chills, and stiff joints. But according to the researchers, these symptoms are not yet represent symptoms of mercury poisoning in after workers, either acute symptom or chronic. So that there is a difference with this study is the number and type of symptoms experienced by illegal gold miners, as well as the number of samples and coverage area of research.

The results also there are similarities with the research Subanri [9], associated with symptoms of mercury poisoning in 60 gold miners in Menyuke Porcupine District of West Kalimantan. Complaints of health problems found by the questionnaire are: muscle pain, stiff joints, feet and hands tingling, arthritis and rheumatism, aches, fatigue, chills/shivering, skin infections (red), allergies and fungal, back pain, chest pain, ulcers, headaches, dizziness, insomnia, abdominal pain, diarrhea, fever, flu, colds, and sore eyes). While the disease based on medical records of doctors in the health center is obtained an overview of the complaints of gold miners health problems and surrounding communities are complaints on the muscular system and connective tissue (bones diseases, including rheumatoid arthritis), skin infections, skin allergies, and fungi. The difference with this study is not taking secondary data from medical records public health centers because it was feared would happen a bias data with people who are not gold miners.

The length of Work Period towards Health Problems

Respondents who has over 2 years of work , has symptoms of health problems as much as 102 people (73.4%) and the value of  $p = 0.001$ . it Means there is a significant correlation between the length of employment with workers health disorder symptoms. with the value of prevalence odds ratio (POR) = 3.0. This means that respondents with a long service life of > 2 years at risk 3 times experiencing symptoms of health problems than respondents who work for less than 2 years.

This results are consistent with the results of Ruyani et al research [11], who conducted the analysis of the level of toxicity of mercury in illegal gold miners in Kerinci National Park area (TNKS) Bengkulu, which states there is a link between health problems of workers with higher levels of Hg and longer operational. However, these results are different from the results of Lestarisa [5], in the district of Gunung Mas Central Kalimantan, which states that the chi-square test results has no significant correlation between the length of service with the symptoms of mercury poisoning ( $p$  value = 0.070 or > 0.05). Mercury poisoning in gold miners with a service life of > 10 years shows a high percentage value that is 90.9% of miners were poisoned, only 9.1% of miners with a service life of > 10 years who did not experience toxicity.

The results also differ from the results of Petasule [12], at Huwala Village, East Sumalata, North Gorontalo District, which states that the results of statistical tests fisher exact ( $p$  value = 0.169 > 0.05), illustrates there is no relationship between long service life (10 years) with mercury poisoning in miners.

According to investigators, the categorization of tenure (new and old) with a limit of 10 years less suitable, given the way in (intake) of mercury into the body can be directly through the pores of the skin, inhaled, swallowed, liquid contact, via the eyes, as well as through the fish, shellfish or food. Various symptoms (health problems) that arise due to the gold miners activity and mercury poisoning, there are acute and chronic. Symptoms of acute illness, of course, does not take up to 10 years, even less than 2 years. Long service life of miners indeed need to watch out, because extremely long service life allowing illegal gold miners experience more and longer exposure to mercury and mercury bioaccumulation potential to occur in the body so that it affects their health.

Total Mercury (Hg) to Health Problems

Respondents who use the amount of mercury (hg) > 0.25 ounces per day is also experiencing symptoms of health disorders with a value of  $p = 0.017$ . it Means that there is also a significant relationship between the number of doses of mercury were used with health disorder symptoms perceived by Gold Miners, with a value of 9.754 POR. This means that respondents were using the amount of mercury (hg) > 0.25 ounces per day of 9.7 times the risk of having symptoms of health disorders than respondents who use the number of mercury (hg)  $\leq$  0.25 ounces per day.

These results differ from the results Lestarisa [5], which states that the results of the chi square test that there is no significant correlation between the amount of the mercury / day with symptoms of mercury poisoning in Gold Mining ( $p$  value = 0.543 or > 0 , 05). Use of the amount of mercury for Gold Miners without permission activity in these studies is relatively high between 0:25 ons s / d 1 ounce per day and of course have an impact on the environment of mercury pollution in the river.

The results also differ from the results of Petasule [12], which states that the results of statistical tests fisher

exact ( $\rho$  value = 0.283 > 0.05), there is no relationship between the amount of mercury per day with the incidence of mercury poisoning in miners. The high percentage of respondents who use mercury poisoning but only  $\leq 0.5$  kg / day in comparison with the use of mercury > 0.5 Kg / day is because the miners are collectively as with tenure > 5 years and are at risk of direct exposure to mercury through the inhaled air.

According to the researchers, the amount of mercury categorization used by Petasule is ( $\pm 0.5$  Kg / day) by the Gold Miners, considered less appropriate because they are too many and it is impossible used by folk in small-scale gold mining. The mercury can actually be used by gold miners in several times mixing process, as was done in Kuantan Singingi and Gunung Mas, Central Kalimantan. Total use of mercury by gold miners per day depending on the mixing frequency or stirring mercury and gold were obtained.

#### Mercury (Hg) Contiguity to Health Problems

Respondents were in contact with the mercury (Hg) in the illegal gold mining, experiencing symptoms of health problems 127 people (91.4%), with  $p = 0.001$ . Means there is a significant relationship between direct contact with mercury with symptoms of health problems perceived Gold Miners without permission POR value = 6.494. This means that respondents who have direct contact with mercury 6.5 times the risk of having symptoms of health disorders in

comparison with respondents who are not in direct contact with mercury (hg).

These results differ from the results of Lestarisa [5], which states that the results of the chi square test has was no significant relationship between the type of activity miners (the contact of mercury) with mercury poisoning in Gold Miners ( $p$  value = 0.6987 or > 0.05). In this study, illegal gold miners who have direct contact with mercury (holding, inhaling), such as mixing, stirring, racking and burning mercury amalgam. While Gold Miners who doesn't have direct contact only work as mud cleaners, carpet washing equipment and parts.

Gold Mining activities in Kuansing, workers who initially served sucking mud and washing carpets, was also do mixing, stirring and squeeze mercury in buckets, trays and cloth. But to burn the amalgam need any special skills, so it is also often done by buyers of gold in the house or shop around location of Gold Miners.

The use of mercury even is a little even if it contact directly on with the skin, it will be absorbed through the skin pores, as well as the mercury evaporates when it will be inhaled into the lungs. Mercury enters the body not only through the pores of the skin or the respiratory tract but also through contact fluid, for example through the eyes and others [12].

#### The use of PPE for Occupational Health Disorders

Respondents who did not use PPE (masks, gloves, ear caps, hats and boots) in Gold mining activity experiencing symptoms of health problems 132 people (95%).  $P = 0.001$ , it means there is a significant association between the use of PPE in illegal activities with health disorder symptoms perceived by Gold Miners. Value POR = 14.614, which means respondents who do not use PPE 14.6 times the risk of having symptoms of health problems than respondents who use PPE in gold mining activity.

This results are consistent with the results of Lestarisa research [5], which states that the results of the chi square test has a significant relationship between continuity of use of PPE with the symptoms of mercury poisoning ( $p$  value =

0.000 or <0.05). The unsustainable use of PPE may increase the risk of exposure to mercury taken into the body so the potential for bioaccumulation of mercury in the body. It has the potential to cause mercury poisoning in gold miners. Knowledge and awareness of Gold Miners needs to be improved for the importance of using PPE continuously to prevent or minimize the risk of mercury exposure to workers.

However Lestarisa [5], split between variable continuity with the use of PPE completeness. While in this study combined into one variable use of PPE is complete and continuous. So the results of this study differ from the results of research which states that the results of the chi square test has no significant relationship between the completeness of PPE with the symptoms of mercury poisoning ( $p$  value = 0.217 or > 0.05).

The results are consistent with research Petasule [12], which states that the results of statistical tests fisher exact ( $\rho$  value

= 0.022 <0.05) and the value of Phi 0.48, has a relationship between the completeness of PPE with the incidence of mercury poisoning in miners. Phi value of 0.48 or belong to the category of moderate relationship which means that the

48% incidence of mercury poisoning affected by the completeness of the use of PPE.

The Completeness of PPE which is owned by the workers Gold Miners in Kuansing is still lacking. Due to lack of knowledge and awareness of illegal Gold Miners Without Permission of the importance of providing PPE.

Unlike the case with workers in a legal gold mining company, the company shall provide appropriate PPE

requirements and standards, because it is set by the Act (the Act) safety, health law and labour law.

Often found that [the gold miners](#) are not using PPE at the time of mine. Like not wearing shoes and gloves when mixing / stirring and squeeze mercury, there are still many who do not use a mask and goggles when burning amalgam. The workers just using only sandals and a long dress. They argued that it cause uncomfortable and hinder the movement while working, have become accustomed since the early work white out PPE so it's difficult to change, lack of information about the complete personal protective equipment and appropriate standards.

#### 5. Conclusion

Based on [the results of](#) multivariate analysis, we can conclude: Variable use of PPE (P4) influence the occurrence of health problems in workers. Gold Miners are not using PPE 15.4 times more at risk to suffer from symptoms of health disorders compared to who use PPE (CI, 95%: POR = 3.9 to 60.7). Old variable of work period (P1) and a variable amount of Hg were used (P2) does not influence against [the occurrence of](#) workers of health disorders symptoms. Variable Contact with Hg (P3) is a confounding variable PPE use.

#### 6. Suggestion

Workers should use complete personal protective equipment (PPE) is complete and in accordance with the standards in order to avoid the symptoms of health problems caused by Gold Mining activity and mercury poisoning, [such as the](#) use of gloves, masks, ear plug, hats, goggles and boots) at the time of the gold mine, stirring, racking and when burning amalgam mercury. The [Health Department and](#) Community Health Center should socialized more frequent socialization and do counseling about the danger [of gold mining](#) and health impacts for [the surrounding community](#). To the police station for more serious [to curb illegal gold miners and](#) law enforcement, because [Illegal Gold Mining](#) has impact on environmental [pollution of river water and](#) biota. Suggestions for further research, because the cause of health problems in illegal Gold Miners is multi factor, it is necessary to do research by adding more independent variables and using different designs such as Cohort study.