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Health Risk Assessment of Workers at the Mining Company PT. HIJ Site in South Kalimantan: An Overview

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Abstract

There are many hazards in the mining sector that have potential risks to the health and well-being of workers. The environment where mining processing takes place can cause health problems such as silicosis, pneumoconiosis, noise-induced hearing loss, musculoskeletal disorders and other health complications that can cause accidents. Identifying the health hazards and their sources in the workplace is required to manage the health risks. Based on MCU data in 2016, the top five diseases, such as dyslipidemia, refraction disorder, BMI > 25, abnormal audiometry, and abnormal liver enzymes were found. This study was conducted to get a comprehensive overview of health risks in the workplace. A cross-sectional design was used to conduct occupational health and safety risk assessments and classify them as health risk in mining, hauling road and port area. This study also considers the MCU results and clinic visits in 2016. Based on hazard identification and risk control (HIRADC) mining, hauling road, and port, there were two categories of risk value: medium and low. From the MCU results, dyslipidemia at 85.9 percent, BMI > 25 at 46.15 percent, refraction disorder at 16.67 percent, abnormal audiometry at 15.38 percent and abnormal liver enzymes at 13.92 percent were found. Based on the clinic visits data in 2016, the five diseases found were the common cold at 14.04 percent, acute pharyngitis at 10.03 percent, rhinitis at 10.32 percent, myalgia and muscle aches at 7.45 percent and coughing at 7.16 percent. From the research results, it can be concluded that the health risk assessment (HRA) has been implemented well, but it only assessed the risk factors of the work environment. Seen in MCU and clinic visits, the illnesses are diagnosed not only from the work environment but also from the patterns of work and lifestyle.

Keywords: occupational health, health risk assessment, and health risks of mine workers

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1. Introduction

PT. HIJ is a coal mining company with an open pit mining system, which is done by backfill or cut and fill methods. The main process includes exploration, land clearing, topsoil removal, overburden removal, coal getting, coal hauling, coal processing and coal barging. There are many hazards in the mining sector that have potential risks to the health and well-being of workers. The environment where mining processes take place can cause health problems, such as silicosis, pneumoconiosis, noise-induced hearing loss, musculoskeletal disorders and other health complications that can cause accidents. Identifying the health hazards and risks and the sources of them in the workplace is required to manage the health risks successfully.

According to statistics from MSHA, there were 151 occupational disease cases in American mines in 2008. These diseases included one case of dermatitis, 24 cases of hearing loss or impairment, one case of heat stroke, 60 cases of joint, tendon, or muscle inflammation or irritation, 40 cases of black lung disease (coal workers' pneumoconiosis) and 25 cases of other diseases [1]. One of the studies with an objective to assess morbidity among the workers from an opencast iron ore mine revealed 3.2 percent abnormal spirometry, 5.1 percent diabetes, 8.3 percent hypertension and 37.5 percent dyslipidemia [2].

Based on medical check-up data at PT. HIJ in 2016, the top five diseases, such as dyslipidemia at 97.5 percent, refraction disorder at 47.8 percent, BMI > 25 at 45.2 percent, abnormal audiometry at 17 percent and abnormal liver enzymes at 12.7 percent were found. In addition, the common cold 14.04 percent, acute pharyngitis at 10,03 percent, rhinitis at 10.32 percent, myalgia and muscle aches at 7.45 percent and coughing at 7.16 percent were the most common diseases found.

An occupational HRA is a structured and systematic identification and analysis of workplace hazards. The aim is to reduce the risks of exposure to hazardous materials through the development and implementation of measures that prevent their release and mitigate the effects of exposure should it occur [3].

From there HRA, there are outcomes about the health status of workers individually and in groups. The outcomes include the form of workers' health status, certain health risk profiles, identification of health problems that need immediate control, identification of health conditions, which are contraindications of subsequent examination and need follow-up. Outcomes also include participant behaviors and reaction to the Work Health Program, physical activity, nutritional status, and hazard and risk identification in work environment [4].

One of the steps in the HRA is identifying the health hazards and the sources of these health hazards in the workplace, and the harmful health effects associated with the identified hazards. This step can be done by doing desktop analysis where records of previous risk assessment and other employment records are available to get a comprehensive overview of health hazards and risks in the workplace.

2. Methods

The HRA was conducted in July 2017 using desktop analysis by analyzing the risk assessment data on HIRADC In three main working areas: the mining area, hauling road and port. Risk analysis was done by sorting the hazards and risks included in the health sector. Sorting was based on potential hazards and risk values, and data was placed into high, medium, and low-risk categories by considering the controls that have been implemented. From the results of the assessment, the existing risk value of each activity mining area, hauling road and port was obtained. Risk assessment uses a matrix that has been established by the company as seen in Tables 1, 2 and 3.

The health risk assessment was also conducted by analysouring the top five diseases based on the results of the medical check-ups and clinic visits in 2016. The analysis was also based on the five diseases occurring in employees in the mine production, technical services and port departments who were in the mining area, hauling road and port.

TABLE 1: Matrix Risk Assessment

Probability x Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

3. Results

Based on the HIRADC conducted by the company, the identified hazards had medium and low-risk value. Mining activities, hauling roads and ports are included in medium and low-risk categories as detailed in Tables 4 – 6.

TABLE 2: Probability.

Rating	Probability (P)	Parameter
1	Very unlikely to happen	Can happen 1x in more than a year
2	The possibility is small	Can happen 1x in a year
3	The chances are average	Can happen 1x in a month
4	Often occur	Can happen 1x a week
5	Almost certainly happened	Occurs almost every day

TABLE 3: Severity.

Rating	Severity (S)
1	Medium health problems can work normally
2	Sick and leave work
3	Pain and decreased organ function
4	Acute/chronic/PAK
5	Died

Based on the results of MCU conducted by the company in 2016, the top five diseases, such as dyslipidemia, refraction disorder, BMI > 25, abnormal audiometry, and abnormal liver enzymes on employees working in the technical services, mine production and port were found. Details are in Table 7.

The results from the clinic visits of technical services workers in 2016 showed the most commonly complained of diseases were the common cold, rhinitis, cough, acute pharyngitis, and myalgia. See Table 8.

The results from the clinic visits of mine production workers in 2016 showed the most commonly complained of diseases were the common cold, rhinitis, cough, cephalgia and eye irritation. See Table 9.

From the results of the 2016 clinic visit to Port Workers, the most commonly complained of diseases were the common cold, myalgia, acute pharyngitis, dyspepsia, and dermatitis. See Table 10.

TABLE 4: Risk value of activities in the mining area.

Type of Hazard	Risk Value	Source of Hazard/Activity
Noise	Medium	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Material Overburden with Bulldozer, Supervision Coal Getting, Measurement topography/survey in mining

Coal Dust	Medium	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Material Overburden with Bulldozer, Supervision Coal Getting, Measurement topography/survey in mining, Channel sampling geologist
Radiation of sunlight	Medium	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Material Overburden with Bulldozer, Supervision Coal Getting, Test Pit Geologist
Radiation of sunlight (solar heat)	Low	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Top Soil with Bulldozer, Supervision Loading/hauling/dumping Overburden, Supervision Coal Getting, Measurement topography/survey in mining, Channel Sampling Geologist, Test Pit Geologist
Coal Dust	Low	Making stake control, Test Pit Geologist, Monitoring coal seam Geologist
Dust	Low	Supervision Clearing with Bulldozer
Noise	Low	Supervision Loading/Hauling/Dumping topsoil
Radiation of sunlight	Low	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Top Soil with Bulldozer, Supervision Loading/hauling/dumping Overburden, Supervision Coal Getting, Measurement topography/survey in mining, Channel Sampling Geologist, Test Pit Geologist
Low Lighting	Low	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Top Soil with Bulldozer, Supervision Loading/hauling/dumping Overburden, Supervision Spreading Material Overburden with Bulldozer, Supervision Coal Getting
Long-Standing Position	Low	Supervision Loading/Hauling/Dumping topsoil, Supervision Loading/hauling/dumping Overburden, Supervision Coal Getting, Measurement topography/survey in mining
Excessive Lift Load	Low	Preparation of survey equipment, Making stake control, Installation of IPPKH stakes, Measurement topography/survey in mining
Forceful Exertion	Low	Channel Sampling Geologist
Vehicle gas emission	Low	Supervision Spreading Top Soil with Bulldozer, Supervision Loading/hauling/dumping Overburden, Supervision Coal Getting, Measurement topography/survey in mining, Channel Sampling Geologist, Test Pit Geologist
Fatigue	Low	Supervision Loading/Hauling/Dumping topsoil, Supervision Spreading Top Soil with Bulldozer, Supervision Loading/hauling/dumping Overburden, Supervision Coal Getting, Measurement topography/survey in mining

TABLE 5: Risk value of activities in hauling road.

Type of Hazard	Risk Value	Source of Hazard/Activity
Noise	Medium	Supervision hauling truck, Supervision hauling road maintenance
Coal Dust	Medium	Supervision hauling truck, Supervision hauling road maintenance
Radiation of sunlight	Low	Supervision hauling truck, Supervision hauling road maintenance, hauling road material inspection on Dump Truck
Long-Standing Position	Low	Supervision hauling road maintenance
Low Lighting	Low	Installation Aramco
Fatigue	Low	Supervision hauling truck, Supervision hauling road maintenance
Vehicle gas emission	Low	Supervision hauling truck, Supervision hauling road maintenance
Base coarse dust	Low	Hauling road material inspection on Dump Truck
Excessive Lift Load	Low	Installation Aramco
Forceful Exertion	Low	Installation Aramco
Coal Dust	Low	Installation Aramco

4. Discussion

Based on the result of the summary of health risk assessment with HIRADC tools, there were three hazards with medium risk and 11 hazards with low risk. Hazards assessed with medium risk were coal dust, noise, and sun heat. In the hauling road area, there are 11 health risks from the four activities, i.e., two hazards with medium risk and nine hazards with low risk. Hazards assessed with medium risk were coal dust and noise. In the port area, the health risk assessment obtained three health risks with medium value and seven health risks with low value. Hazards with identified medium risk included coal dust, noise and solar radiation.

Based on the results of the medical check-ups, it can be seen in Table 2 that the top five diseases are diagnosed in workers in mines, hauling roads and ports. The diseases include dyslipidemia in 67 workers (85.90%), obesity in 36 workers who had BMI > 25 (46.15%), refraction disorders in 13 workers (16.67%), abnormal audiometry or hearing loss in 12 workers (15.38%) and abnormal liver enzymes in 11 workers (13.92%).

The results of the medical check-ups of workers in all three departments were analyzed. There were 41 out of 42 (97.62%) in the mine production department and 15

TABLE 6: Risk value of activities in port.

Type of Hazard	Risk Value	Source of Hazard/Activity
Noise	Medium	Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile and Feeder Breaker areas, Fine Coal Cleaning under Feeder Breaker Area
Coal Dust	Medium	Weight Bridge Cleaning, Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile and Feeder Breaker areas, Fine Coal Cleaning under Feeder Breaker Area
Radiation of sunlight	Medium	Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile and Feeder Breaker areas, Fine Coal Cleaning under Feeder Breaker Area
Radiation of sunlight (solar heat)	Low	Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile and Feeder Breaker areas, Fine Coal Cleaning under Feeder Breaker Area
Low Lighting	Low	Maintenance Stockpile, Supervision and directing of unit movement and DT in Stockpile and Feeder Breaker areas
Awkward Posture	Low	Input data tonnage DT at Weight Bridge, Weight Bridge Cleaning, Fine Coal Cleaning on conveyor/roller or hopper, Fine Coal Cleaning under Feeder Breaker Area
Vehicle gas emission	Low	Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile
Fatigue	Low	Input data tonnage DT at Weight Bridge, Weight Bridge Cleaning, Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile, Fine Coal Cleaning on conveyor/roller or hopper, Fine Coal Cleaning under Feeder Breaker Area
Computer Radiation	Low	Input data tonnage DT at Weight Bridge, Weight Bridge Cleaning, Maintenance Stockpile, Temperature Measurements in Stockpile, Supervision and directing of unit movement and DT in Stockpile, Fine Coal Cleaning on conveyor/roller or hopper, Fine Coal Cleaning under Feeder Breaker Area
Chemical/oil	Low	Weight Bridge Cleaning

out of 16 (93.75%) workers who had dyslipidemia. In the overweight/obesity category, workers whose BMI exceeded 25 were 22 of 42 (52.38%) in the port department, and

TABLE 7: Health risk in mine workers based on MCU.

Diseases	Technical Services			Mine Production			Port			Total		
	Case	Total	%	Case	Total	%	Case	Total	%	Case	Worker	%
dyslipidemia	11	20	55	15	16	93.75	41	42	97.6	67	78	85.90
BMI > 25	6	20	30	8	16	50	22	42	52.38	36	78	46.15
Refraction disorders	2	20	10	3	16	18.75	8	42	19.05	13	78	16.67
Abnormal audiometry	3	20	15	2	16	12.5	7	42	16.67	12	78	15.38
Abnormal liver enzymes	2	20	10	2	16	12.5	7	43	16.28	11	79	13.92

TABLE 8: Clinic visit diseases on technical services department.

Diseases	Total Visit	Total Worker	Percentage
Common cold	19	124	15.32%
Acute pharyngitis	13	124	10.48%
Rhinitis	13	124	10.48%
Cough	10	124	8.06%
Myalgia	7	124	5.65%
Total	**62**	124	**50.00%**

TABLE 9: Clinic visit diseases on mine production department.

Diseases	Total Visit	Total Worker	Percentage
Common cold	9	51	17.65%
Rhinitis	7	51	13.73%
Cough	5	51	9.80%
Cephalgia	4	51	7.84%
Eye Irritation	3	51	5.88%
Total	**28**	51	**54.90%**

8 out of 16 (50%) in the mine production departments. The results of this study are consistent with previous studies showing that the prevalence of dyslipidemia in miners increases with increasing BMI (5). Increased liver enzymes were suffered by workers in the port department in 7 out of 42 workers (16.28%). These three diagnosed diseases in the workers are the effects of an unhealthy lifestyle. Awareness about prevention of health hazards in mining must be considered by management by conducting training programs and education of healthy lifestyle for workers.

TABLE 10: Clinic visit diseases on port department.

Diseases	Total Visit	Total Worker	Percentage
Common Cold	21	202	10.40%
Myalgia	17	202	8.42%
Acute pharyngitis	15	202	7.43%
Dyspepsia	14	202	6.93%
Dermatitis	12	202	5.94%
Total	**79**	**202**	**39.11%**

The results of the audiometric examination showed abnormal results suffered by workers in the port department by 7 out of 42 workers (16.67%). In the technical services department, abnormal results were shown in 3 out of 20 workers (15%) and in the mine production department, results were shown in 2 of 16 workers (12.5%). In line with the HIRADC results that the identified noise may cause, there was a decrease in hearing function. Donoghue in 2004 evaluated several previous studies showing how noise control in mining proved difficult to do so hearing loss remained [6]. Further examination of workers who are diagnosed with abnormal audiometry and noise level analysis in the workplace should be of special concern.

In addition to analyzing the medical check-up data, an analysis based on clinical visits was also done, where the results of occupational illnesses related to myalgia or muscle pain. This myalgia and muscle pain was found in the technical services department in seven visits and in 17 visits in the port department. In line with the HIRADC results, ergonomic hazards to workers in both departments were identified. Operationally, ergonomic hazards exposure can be caused by physical overload, posture and body movement [7]. In the United States, 39 percent of a total of 26 percent of workers who experience had inflammation or irritation of muscles, joints and tendons [1]. In a study conducted with the Standardized Nordic Questionnaire by Nurmianto in 2015 shows that mine supervisors are at risk of musculoskeletal disorders due to manual handling [8]. Compared with HIRADC results, ergonomic hazards are identified with low-risk values, but in actual conditions, muscle pain is much complained of by workers.

5. Conclusions

The HRA performed is the result of the analysis done by reviewing the HIRADC, the results of medical check-ups and clinic visits. The work environment and work activities undertaken by the assessment are accepted as they are controlled by continuous improvement, monitoring and measurement of the work environment. While the HIRADC assessed the risk based on work environment and activity factors, the work behavior factors and diet patterns of workers have not been identified. By looking more detail on the medical check-up results and clinical visits of employees working in the mining, hauling road, and port diagnosed and complained diseases that are not only related to the work environment but related to healthy work behaviors and healthy lifestyles.

Conflict of Interest

The authors declare no competing interest.

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