

# Evaluation of the Physical Work Environment of Miners in Kutai Kartanegara, East Kalimantan

Putri Pujianti<sup>1</sup>, Zulkifli Djunaidi<sup>2</sup>

<sup>1</sup>Occupational Health and Safety Graduate Program, Faculty of Public Health, Universitas Indonesia, Indonesia

<sup>2</sup>Department of Occupational Health and Safety, Faculty of Public Health, Universitas Indonesia, Indonesia Building C, 1st Floor Faculty of Public Health Universitas Indonesia, Depok, West Java 16424, Indonesia

## ABSTRACT

**Introduction:** Mining is a field of work that has a high potential of risk, both in terms of health risks and safety risks. In its business processes, environmental factors are one of the potential risks that cannot be avoided by every employee. Physical work environment factors are everything around the workplace that can affect workers, either directly or indirectly, and can cause health problems such as headaches, dizziness, nausea, shortness of breath, fatigue, and dehydration. This study aims to determine the physical environmental factors that greatly influence employee productivity. **Methods:** This study used quantitative methods and the secondary data. Measurement of physical factors applied the standard Threshold Limit Value (TLV) in accordance with the Regulation of the Minister of Manpower of the Republic of Indonesia Number 05 of 2018. Measurements were carried out in the workshop areas, ports, heavy equipment units, and office spaces of each department. In this study, measurements of physical climate include work climate, placement, and lighting. **Results:** The physical work environment is found to be good enough despite being below the standard in some areas, e.g., the lighting at the administration desk, the noise in the generator room, and some heavy equipment such as bulldozers and dump trucks. **Conclusions:** The physical work environment is still considered safe and will not cause health problems. However, the arrangement of lighting conditions, work climate, and noise can be improved to meet the overall OHS standards and the evaluation of other work environment factors. **Keywords:** literature review, metal industry, occupational contact dermatitis.

**Keywords:** lighting, noise, occupational health and safety, physical work environment, work climate

### Corresponding Author:

Putri Pujianti

Email: putri.pujianti25@gmail.com

Telephone: +6282149153543

## INTRODUCTION

Law No. 1 of 1970 of the Republic of Indonesia has defined workplace as each room or field, close or open, move or persistent, where the worker works, or is often joined by worker to do business. Meanwhile, according to OHSAS 18001:2007, workplace is any location related to work activities that are under the control of the organization (company). Work environment is a place where workers do their daily work. Indicators for physical environment include workplace buildings, adequate work equipment, facilities, and the availability of transportation facilities. According to Nurdinati and Santoso (2016), work environment is everything that is around workers and affects them in carrying out their tasks, such as lighting, air temperature, security,

cleanliness, space for movement, music, and others. In addition, physical work environment can affect health problems, either directly or indirectly, caused by physical factors and adverse effects. Physical hazard is one of the potential factors of danger that cannot affect the physical activity of workers through excessive exposure to the physical environment elements.

Based on the Regulation of the Minister of Manpower of the Republic of Indonesia Number 05 of 2018, factors for physical hazard include work climate, noise, vibration, radio waves or microwaves, ultraviolet light, static magnetic fields, air pressure, and lighting. These dangerous physical factors can cause health problems such as headaches or dizziness, nausea, and shortness of breath. Threshold Limit Value (TLV) is a standard level of exposure to hazard factors at workplace in a time-weighted average intensity that can be accepted by workers without causing illness or health problems in their daily working period, which does not exceed 8 hours

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a day or 40 hours a week. In this study, the measured physical factors include work climate, noise, and lighting.

According to Suma'mur (2004), work climate is a combination of air temperature, humidity, speed of air movement, and heat radiation. Hot temperature from heat energy transferred directly by intermediary has the impact of giving additional burdens to workers. Excessive exposure to heat can cause health problems, such as heat rash, heat cramp, heat syncope, heat exhaustion, heat stroke, malaria, dehydration, and hyperthermia. Comfortable temperature for each work area is around 24 -26°C. A hot working environment leads to various problems, compared to a cold one. This is because it is easier for humans to protect themselves against cold temperatures than heat. The American Conference of Governmental Industrial Hygienists (ACGIH) has set a benchmark in evaluating the work climate by using the Wet Bulb Globe Temperature (WBGT). In the Regulation of the Minister of Manpower Number 13 of 2011, WBGT is termed Indeks Suhu Basah dan Bola (ISBB). Exposure to hot temperatures that exceed the permitted Threshold Limit Value (TLV) can cause work-related illnesses or work accidents. Control of work climate hazards can be done by eliminating heat or cold sources from the workplace, replacing tools, materials, and work processes that cause heat or cold sources to appear, creating adequate ventilation systems, providing drinking water, regulating or limiting the time of exposure to heat or cold sources, and using appropriate Personal Protective Equipment (PPE) at work. Measurement of work climate can be done using the Heat Stress Check, Anemometer, or High Meter.

Noise is unwanted sound that comes from work equipment and/or production process which can cause noise-induced hearing loss, either temporarily and permanently, and can also be a source of stress, leading to increased alertness and psychological imbalance (Wandani, Sabilu, and Munandar, 2017). Hearing loss can occur due to continuous, intermittent, impulsive, compulsive, and repeated exposure to loud noises for a long time. Today, noise remains a serious environmental problem and can trigger various health problems, such as cardiovascular disease, sleep disorders, cognitive disorders, hearing loss, and psychological impairment (Nasution, 2019). Noise is one of the environmental stressors that can affect the endocrine system and autonomic nervous system if there is exposure of over 65 dBA per day for a long period

of time, or acute exposure at intensity of above 80-85 dBA. Noise accompanied by vibrations or low-frequency sounds is more likely to cause annoyance which in the long run may cause stress.

Physiological disorders can be in the form of increased blood pressure ( $\pm 10$  mmHg), increased heart rate, and constriction of peripheral blood vessels especially in the hands and feet, and can cause pallor and sensory disturbances. In addition, high intensity of noise can cause dizziness/headache. This is because noise can stimulate the situation of the vestibular receptors in the inner ear, which will trigger dizziness/vertigo effects. Nausea, insomnia, and shortness of breath are caused by noise stimulation to the nervous system, organ balance, endocrine glands, blood pressure, digestive system, and electrolyte balance. Noise-induced psychological disorders can be in the form of discomfort, lack of concentration, insomnia, and irritability. If the noise continues for a long time, it can cause psychosomatic diseases such as gastritis, heart disease, stress, fatigue, and others.

Communication disorders are usually caused by masking effects (sounds that cover poor hearing) or impaired voice clarity. In this case, communication must be done by shouting. Such disorder causes disruption of work and the possibility of errors as workers do not hear a signal or danger sign. Thus, communication disorders may indirectly endanger people's safety. Very high noise can cause the impression of walking in space or floating, which can lead to physiological disorders such as dizziness (vertigo) or nausea.

The main effect of noise on health is damage to the hearing, causing progressive deafness. At first, the effect of noise on hearing is temporary, and recovery occurs rapidly after leaving the noisy area. However, continuous exposure to noise may cause permanent deafness. The high intensity of noise usually starts at a 4000 Hz and then expands to the surrounding frequencies before finally hits the frequency normally used for conversation.

Temporary Threshold Shift (TTS) is temporary deafness caused by exposure to high-intensity noise. In this case, workers will experience a temporary decrease in hearing ability, and the exposure time is usually very short. If workers are given sufficient rest time, their hearing will recover. Meanwhile, permanent deafness or Permanent Threshold Shift (PTS) occurs due to long (chronic) exposure time. The severity of PTS is influenced by the following factors: high sound level, duration of exposure,

sound spectrum, temporal pattern (if the noise is continuous, the possibility of TTS will be greater), individual sensitivity, health conditions, and effect of some drugs that can worsen deafness (synergistic effect) when given together with sound contact, for example quinine, aspirin, and some other drugs.

Acoustic trauma is any injury that damages parts or all of the hearing sense caused by single or multiple exposures to noise with very high intensity, explosions, or very loud sounds, e.g., the sound of a cannon blast that can rupture the eardrum and damage the ossicles or the auditory sensory nerves. Decreased hearing in older age known as presbycusis (decreased hearing in high notes) is experienced by almost everyone. This must be taken into account when assessing hearing loss due to noise exposure in the workplace. Tinnitus, or the ringing in the ears, is an early symptom of hearing loss. People can experience tinnitus when the situation is quiet, such as when sleeping at night or in an audiometric examination room (International Labour Organization, 2013).

The levels of noise in decibels (dB) are as follows: (1) 30 dB: weak whispering voice; (2) 85 dB: safe limit, it is recommended to wear hearing protection; (3) 90 dB: can damage hearing within 8 hours, e.g., the sound of a lawn mower or a truck on a traffic jam; (4) 100 dB: damage hearing within 2 hours, e.g., the sound of a chainsaw or voice over the phone; (5) 105 dB: damage hearing within 1 hour, e.g., the sound of a helicopter or a stone crusher; (6) 115 dB: damage hearing within 15 minutes, e.g., crying baby or the noise in a football stadium; (7) 120 dB: damage hearing within 7.5 minutes, e.g., sound produced in a rock concert; (8) 125 dB: pain threshold in the inner ear, e.g., the sound of firecrackers and sirens; and (9) 140 dB: cause short-term hearing loss, e.g., gunshots and jet engines.

Measurement of noise can be done using a Sound Level Meter tool with a standard Threshold Limit Value (TLV), which is 85 dB for 8 hours of exposure per day. In addition, workers are not allowed to be exposed to noise of more than 140 dB. If the measurement results in the workplace exceed TLV, several controls must be implemented, such as eliminating sources of noise from the workplace, replacing tools, materials, and work processes that become sources of noise, installing retainers, silencers, or partial or complete closures of equipment, regulating or limiting noise exposure or working time, and using the appropriate PPE.

Light is needed by humans to see objects visually. With the light reflected by the object,

we can see it clearly. So, visual comfort can be obtained with sufficient lighting. Conversely, if there is too little or too much lighting, it will interfere with visual comfort which will impact on health, especially sense of sight (eyes). The amount of light needed for each job is different from one another. Work areas require a sufficient level of visual comfort so that workers can carry out their tasks and be productive. Visual comfort in a room is sourced from lighting determined by the number, size, and placement of windows Widiyantoro, Mulyadi, and Vidiyanti (2017). Natural lighting is influenced by several variables, namely the design of window openings, the shape and depth of space, visual comfort, and external factors. Good lighting helps workers see clearly and comfortably, thus enabling them to work optimally. This has an impact on improving productivity and work efficiency, as well as reducing work errors. Insufficient lighting can result in eye fatigue, weariness, headaches, stress, and accidents. Likewise, too much lighting can cause glare, headaches, and stress (Ulfah and Heriziana, 2018). Measurement of lighting can be done using Lux Meter tool.

Mining is a field of work that has high potential of safety and health risks. The potential health risk of mining workers is quite high due to the 12 hours of work per day and the use of machines or heavy equipment to support their activities, with the conditions of the physical work environment being unavoidable. Health risks of mining workers are non-communicable diseases, such as obesity, cholesterol, gout, visual impairment, impaired hearing, and respiratory disorders. Meanwhile, the health risk factors include unhealthy behavior or lifestyle of workers and environmental factors around the work area.

The objective of this study is to analyze the factors of physical work environment at PT. XYZ and determine which factors greatly affect employee productivity. In addition, several risk controls are proposed to be implemented in the work areas so that workers can work comfortably and health problems that can reduce work productivity as well as accidents can be avoided.

## METHODS

This study was carried out for one month in November 2021, applying quantitative descriptive method to analyze the secondary data. Measurements of physical factors were taken at PT XYZ with sampling locations in the workshop areas, ports,

heavy equipment units, and office rooms in each department which may have high potential for physical hazards.

The analysis of the physical work environment factors cover the measurement of work climate using Heat Stress Monitoring with Quest Temp 36 tool, the measurement of noise using Sound Level Meter tool, and the measurement of lighting using Lux Meter tool. The measurement results were then brought to Komite Akreditasi Nasional (KAN) LP-864-IDN- certified Balai K3 Samarinda to obtain the average values. The measured physical environment factors should be in accordance with the standard Threshold Limit Value stipulated in the Regulation of the Minister of Manpower Number 05 of 2018 on Measurement and Control of the Work Environment. The obtained assessment data were then analyzed to be submitted as an evaluation of the physical work environment of PT. XYZ.

The measurement of work climate covers 4 areas, 3 of which are the rooms of the Health, Safety, and Environment (HSE) Department, the Operations Department, and the Human Resource Development (HRD) Department. For these rooms, the workload is light and the threshold limit value is 31°C. Meanwhile, one measured area is the workshop, with moderate workload and the threshold limit value limit of 28°C.

The measurement of noise covers 15 measured points, namely 3 port areas, 4 generator areas, and 8 heavy equipment units. The measurement of lighting covers 8 points, consisting of 5 department rooms and 3 department administrative desks. The evaluated departments are HSE, HRD, FICO, Operation, and Mineplan.

## RESULTS

Physical work environment can affect the health of the workers due to several physical factors. In

this study, the physical factors measured at PT XYZ include work climate, noise, and lighting.

The measurement results of work climate at PT XYZ (Table 1) with working time setting of 75% - 100% each shift are as follows: (1) the HSE Dept. room with light workload obtained a value of 19.8°C (below TLV of 31°C), with a temperature of 23.3°C and Relative Humidity of 63%; (2) the Operations Dept. room with light workload had a value of 22.7°C (below TLV of 31°C), with a temperature of 24.5°C and Relative Humidity of 81%; (3) the HRD Dept. room with light workload got a value of 19.8°C (below TLV of 31°C), with a temperature of 23.7°C and Relative Humidity of 62%; and (4) the workshop with moderate workload achieved a value of 27.5°C (below TLV of 28°C), with a temperature of 30.3°C and Relative Humidity of 75%.

From the results of noise measurement at PT XYZ (Table 2) with the TLV of 85 dB / shift daily, some points were considered safe location (within or below TLV), while some others had a high noise hazard potential. Safe areas were the conveyor (75.4 dB), on ground feeder (71.1 dB), roof fixed crusher (79.9 dB), genset workshop room (70.5 dB), operator station of genset port (60.9 dB), and compressor units (83.5 dB and 85.0 dB), whereas the areas with high noise hazard potential were the dozer units (94.1 dB and 110.3 dB), dump truck units (86.7 dB and 100.9 dB), wheel loader units (76.4 dB and 80.2 dB), genset port (98.5 dB) and explosives warehouse generator room (86.2 dB).

The measurement results of lighting at PT XYZ (Table 3) found sufficient lighting for all department rooms (with TLV of 100 Lux) and insufficient lighting for all department administrative desks (with TLV of 300 Lux). The HSE Dept. room with natural and artificial lighting and rough and non-continuous work activities had sufficient lighting, with a value of 265 Lux. The HRD Dept. room with artificial lighting and rough and non-continuous

**Table 1.** Work Climate Measurement Results

Point Measured Area	Workload	Working Time Setting	Tem (o C)	R (%)	Test Results Work Climate / WBGT (o C)		
					Measured	TLV	Evaluation
HSE Dept. Room	Light	75% - 100%	23.3	63	19.8	31	< TLV
Operations Dept. Room	Light	75% - 100%	24.5	81	22.7	31	< TLV
HRD Dept. Room	Light	75% - 100%	23.7	62	19.8	31	< TLV
Workshop	Moderate	75% - 100%	30.3	75	27.5	28	< TLV

work activities had sufficient lighting, with a value of 183 Lux. The Finance and Controlling (FICO) Dept. room with artificial lighting and rough and non-continuous work activities had sufficient lighting, with a value of 247 Lux. The Mineplan Dept. room with natural and artificial lighting and rough and non-continuous work activities had sufficient lighting, with a value of 657 Lux. Meanwhile, the Operations Dept. room with natural

and artificial lighting and rough and non-continuous work activities had sufficient lighting, with a value of 262 Lux. Meanwhile, the admin desk in the HSE room with natural and artificial lighting and routine work activities had insufficient lighting, with a value of 261 Lux. The admin desk in the HRD room with artificial lighting and routine work activities had insufficient lighting, with a value of 151 Lux. Lastly, the admin desk in the FICO room with artificial lighting and routine work activities had insufficient lighting, with a value of 245 Lux.

**Table 2.** Noise Measurement Results

Measured Area	Test Results Noise Intensity	
	Measured	Evaluation
Dozer Units (1)	110.3 dB	> TLV
Dozer Units (2)	94.1 dB	> TLV
Dump Truck Units (1)	100.9 dB	> TLV
Dump Truck Units (2)	86.7 dB	> TLV
Wheel Loader Units (1)	76.4 dB	< TLV
Wheel Loader Units (2)	80.2 dB	< TLV
Compressor Unit (1)	85.0 dB	= TLV
Compressor Units (2)	83.5 dB	< TLV
Genset Port	98.5 dB	> TLV
Operator Station of Genset Port	60.9 dB	< TLV
Explosives Warehouse	86.2 dB	> TLV
Generator Room		
Genset Workshop Room	70.5 dB	< TLV
Roof Fixed Crusher	79.9 dB	< TLV
On Ground Feeder	71.1 dB	< TLV
Conveyor	75.4 dB	< TLV

**Table 3.** Lighting Measurement Results

Point / Measured Area	Lighting Intensity (LUX)			Source of Light
	Measured	TLV	Evaluation	
HSE Dept. Room	265	100	Sufficient	Natural & Artificial
HSE Room - Admin	261	300	Insufficient	Natural & Artificial
HRD Dept. Room	183	100	Sufficient	Artificial
HRD Room - Admin	151	300	Insufficient	Artificial
FICO Dept. Room	247	100	Sufficient	Artificial
FICO Room - Admin	245	300	Insufficient	Artificial
Mineplan Dept. Room	657	100	Sufficient	Natural & Artificial
Operations Dept. Room	262	100	Sufficient	Natural & Artificial

## DISCUSSION

### Work Climate

One of the physical hazards often found in work environment that can induce various health problems for workers and has the potential to cause work accidents and reduce work performance is exposure to heat (Pitaloka and Sididi, 2021). Hot work environment commonly creates more problems than cold one. Exposure to a hot environment during work can pose a hazard to occupational safety and health. In addition, hot temperatures may result in decreased work performance and way of thinking. According to Ikhssani (2019), Indonesian people are generally adaptive to a tropical temperature of 29–30°C and humidity of 85 - 95%, with comfortable temperature ranging between 24°C and 26°C.

Based on the measurement results, the work climate or Wet Bulb Globe Temperature (WBGT) at a coal mining company is found to be below the Threshold Limit Value. According to Sutrisno, Tirta, and Haryandi (2020) a healthy, comfortable, and safe work climate strongly supports the increase in labor productivity of workers as human resources. In addition, Sunaryo and Rhomadhoni (2020) argued that continuous exposure to heat can cause heat

rash, heat cramps, heat syncope, heat exhaustion, heat stroke, malaria, dehydration, and hyperthermia. A prior study by Haryani (2020) on 56 respondents found that 3.6% of workers experienced subjective complaints due to the hot temperature in the mines, with the most experienced complaints being sweating and thirst which make workers feel uncomfortable, dehydrated, and some workers experienced itching due to excessive sweating. Another previous study by Hijah, Setyaningsih, and Jayanti (2021) conducted at welding workshop with temperatures of 30.5°C – 33.8°C discovered that 18 of 40 workers (45%) experienced severe work fatigue when the temperature increased beyond the TLV, whereas the moderate to mild work fatigue (42.8%) was felt when the temperature reached the TLV. In a study by Sunaryo and Rhomadhoni (2020) on the candle industry which requires a workload of 750-2000 calories at work, 15 of 21 respondents in the production section and 10 of 17 respondents in the finishing section complained of being dehydrated, whereas 12 of 21 respondents in the production section and 9 of 17 respondents in the finishing section complained about experiencing heat rash. This proves that hot work climate can cause fatigue, excessive dehydration, and heat rash.

According to Sunaryo and Sahri (2019), the proper ways to control the work climate are by providing trainings for workers and controlling heat stress by maintaining cleanliness in the company or workplace, while the specific controls include reducing workload, lowering air temperature, reducing heat radiation, implementing administrative controls, and having personal protection.

## Noise

The mining industry is one of the high-risk industries; heavy equipment operators and generator operators are workers with high potential for hazards when working, with exposure coming from the sounds of heavy equipment machines, generators, tools, and other machines they use to support their works (Nasution, 2019). Daily and continuous exposure can lead to chronic exposure (Faritsy and Nugroho, 2017). Exposure can also interfere with hearing impairments, such as hearing loss and tinnitus. Noise can cause various disorders such as physiological disorders, psychological disorders, communication disorders, and deafness. The effects of noise are classified into two categories, namely auditory such as hearing loss and non-auditory such as communication disorders, threats to occupational

safety, decreased work performance, stress, and fatigue (Fathimah, Ramadhani, and Ginanjar, 2018).

Noise hazards are very often encountered in work areas that use machines or equipment to support work. At PT. XYZ, noise is very difficult to avoid, especially for heavy equipment operators. According to Nurdinati and Santoso (2016), there are three aspects that affect the quality of sound that enters our ears: duration, intensity, and frequency. Furthermore, Mentari, Imran, and Raharjo (2018) stated that the Threshold Limit Value of noise is 85 dB for 8 hours/day exposure. Workers are not allowed to be exposed to noise of more than 140 dB. Noise level of above the Threshold Limit Value will have an impact on the health of workers, leading to various problems such as communication disorders, paleness, increased blood pressure, poor communication ability, and psychosomatic disorders. This is proven by Ariestyajuni (2019) in her study which found that 70% of workers experienced communication problems, for example, they have to shout (speak in a high tone) when talking to their coworkers at work, they often ask their coworkers to repeat what they said, and they have been reprimanded by their coworkers for not understanding what they said. This disrupts productivity and can even lead to work accidents.

In a study by Setyaningrum, Widjasena, and Suroto (2014) at a fabrication work area, noise exposure has been shown to increase the risk of Noise Induce Hearing Loss (NIHL) 15 times higher, especially for workers who have worked for more than 10 years. In a study by Wuladani *et al.* (2015) conducted at a mining workshop area with the intensity of noise exceeding the TLV (> 85 dB), 24% of the 365 workers who underwent audiometry when having MCU showed hearing loss or commonly termed NIHL as an effect of exposure to the high intensity of noise in the study area. NIHL is a hearing loss or impairment in the form of decreased hearing ability due to exposure to excessive and continuous noise for a long time.

Noise can be controlled by various measures, such as by installing equipment and systems that have been engineered to operate quietly, covering or shielding noisy equipment, ensuring that equipment is in good condition, repaired and maintained properly with all worn or damaged parts replaced, mounting noisy equipment on special mounts to reduce vibration, and installing silencers, mufflers, or baffles (Lady and Wiyanto, 2019).

The measurement results of noise at a coal mining company indicated that some work areas had high intensity of noise. This can lead to hearing problems or occupational diseases if no further improvement is made. Work areas with noise intensity exceeding the Threshold Limit Value are genset ports, explosives warehouse generator room, and heavy equipment machines such as bulldozers, dump trucks, and wheel loaders. For these work areas, corrective actions must be taken, such as installing silencers on the unit and providing hearing protector such as earmuffs for bulldozer and dump truck operators. As for the generator room, control measures can be in the form of providing Noise Area signs, requiring the use of ear protection, maintaining sufficient distance from work activities, and providing ear plugs or ear muffs for generator operators so that they do not experience hearing loss which can interfere with their productivity.

### Lighting

Sufficient light which provides visual comfort is needed so that objects can be seen clearly. Insufficient or excessive lighting will interfere with the comfort of our vision, which will have an impact on the health of the sense of sight (eyes) (Ulfah and Heriziana, 2018). The required amount of light is different for each job. Work areas need an adequate level of visual comfort so that workers can carry out their activities smoothly and have good work productivity. Visual comfort in a room is provided by lighting and influenced by the number, size, and placement of openings/ windows (Widiyantoro, Mulyadi, and Vidiyanti, 2017). According to Hamdi (2013), natural lighting is influenced by several variables, namely the design of window openings, the shape and depth of space, visual comfort, and external factors.

Urianti and Simbolon (2021) argued that lighting in every workplace must meet the requirements so that workers can do their jobs properly. Proper lighting is very important to improve work quality and productivity. When lighting is insufficient, workers are forced to bend over to focus their eyes. This causes discomfort and slows them down. In the long term, it can lead to back and eye problems (International Labour Organization, 2013). According to Faritsy and Nugroho (2017), insufficient lighting makes workers' eyes quickly tired, causing work errors and lowering productivity. Therefore, it is necessary to increase lighting in dark workplaces.

The measurement results of lighting intensity in this study showed that all examined rooms had good lighting coming from natural and/or artificial sources, whereas the admin desks in all observed departments had insufficient lighting. If the lighting in the workplace is insufficient, workers can feel tired easily. This can trigger various health problems, such as eye fatigue, headaches, stress, and can reduce productivity at work (Ulfah and Heriziana, 2018). The corrective actions that can be taken for workplaces with insufficient lighting include adding more lamps, replacing the existing lamps with new and brighter ones, and/or changing the position of the workbenches or desks to get sufficient lighting.

According to Wahyuni, Kurniawan, and Ekawati (2014), there is a relationship between excessive lighting and eye fatigue. This study found that 6 of 8 respondents experienced eye fatigue due to too bright lighting at work, namely 481 Lux (higher than the standard TLV of 100 Lux). With insufficient lighting, i.e., 74.1 Lux (below the standard TLV of 100 Lux) found in a study by Extrada *et al.* (2021), workers in Mesra Hospital complained of having sore eyes, pain around the eyes, dizziness, and drowsiness when working in a room with poor lighting. Furthermore, Martian and Suri (2017) stated that the addition of lighting intensity has an effect on decreasing the level of physical and psychological factors that affect work stress. The impact of insufficient or excessive lighting has also been analyzed previously by Ulfah and Heriziana (2018).

### CONCLUSION

This study aims to evaluate the work environment that has a high potential to cause health problems for workers and to prevent occupational diseases caused by physical hazards at a coal mining company. Evaluation of the physical work environment were done by measuring areas with high potential for physical hazards which are dangerous for workers, with reference to the Regulation of the Minister of Manpower Number 05 of 2018 on the threshold limit value for each hazard. The physical hazards measured in this study were work climate, noise, and lighting. The results of the assessment found that the physical work environment is still considered safe, although some areas have not reached the threshold limit value. Therefore, control measures are highly recommended to be taken to secure the health of the workers against the possible risks.

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