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Evaluasi Kualitas Fisik Lingkungan Tempat Kerja dan Insiden CVS pada Pekerja PT PELINDO III (Persero)

Evaluation of Environment Physical Quality of Workplace and the CVS Incidents on Staff of PT PELINDO III (Persero)

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ABSTRAK

Latar Belakang: *Computer Vision Syndrome (CVS) merupakan salah satu insiden yang telah banyak dikeluhkan dan dialami oleh pekerja yang menggunakan komputer. Pekerja Teknologi Informasi dan Komunikasi di PT Pelabuhan Indonesia III merupakan salah satu yang memiliki risiko tinggi terhadap insiden CVS.*
Tujuan: *Penelitian ini bertujuan untuk mengevaluasi lingkungan fisik tempat kerja dan insiden Computer Vision Syndrome (CVS) pada staf di Kantor Pusat PT Pelabuhan Indonesia III (Persero) dengan peraturan berlaku.*
Metode: *Penelitian ini menggunakaan data primer dengan metode kualitatif observasional dengan rancang bangun cross sectional study. Penelitian ini menggunakan dua kelompok responden, yakni terpapar sebanyak 30 orang pekerja TIK dan kontrol sebanyak 30 orang pekerja HSSE dan Teknik Peralatan Pelabuhan. Variabel dependen penelitian ini adalah insiden CVS yang dialami pekerja. Variabel independen penelitian ini adalah kualitas fisik lingkungan tempat kerja (intensitas penerangan, suhu dan kelembaban).*
Hasil: *Hasil penelitian ini menunjukan bahwa intensitas penerangan dan suhu ruangan kelompok terpapar tidak sesuai standar dan pekerja mengalami CVS. Sedangkan pada kelompok kontrol intensitas penerangan ruangan tidak sesuai standar dan pekerja mengalami CVS, serta kelembaban tidak sesuai standar namun pekerja tidak mengalami CVS dan suhu ruangan kelompok kontrol telah memenuhi standar dan pekerja tidak mengalami CVS.*
Kesimpulan: *Kesimpulan dari penelitian ini terdapat ketidaksesuaian pada variabel lingkungan fisik tempat kerja dengan peraturan yang berlaku maupun berdasarkan studi literature penelitian terdahulu.*

Kata kunci: Computer vision syndrome, *Kualitas fisik lingkungan tempat kerja, Intensitas penerangan, Suhu, Kelembaban*

ABSTRACT

Background: Computer Vision Syndrome (CVS) is an incident commonly reported and experienced by workers using computers. The Information and Communication Technology staff of PT Pelabuhan Indonesia III are one of those having a high risk of CVS incidents.
Objectives: The study aimed to evaluate the workplace's physical environment and the Computer Vision Syndrome (CVS) incidents on staff at the head office of PT Pelabuhan Indonesia III (Persero) under the applicable regulations.
Methods: This study employed primary data with the qualitative observational method with a cross-sectional study design. The study utilized two respondent groups, i.e., exposed, comprising 30 ICT staff, and control, comprising 30 HSSE and Port Equipment Engineering staff. The dependent variable of the study was the

number of CVS incidents experienced by staff. The independent variable of the study was the workplace physical quality (lighting intensity, temperature, and humidity).
Results: The study result demonstrated that the lighting intensity and room temperature of the exposed group did not follow the standard, exposing staff to CVS. In the control group, lighting intensity did not follow the standard, and staff had CVS, the humidity did not follow the standard, and staff did not have CVS, and room temperature followed the standard, and staff did not have CVS.
Conclusions: The study concluded non-conformity in the physical environment variable of the workplace under the applicable regulations and is based on predecessor literature studies.

Keywords: Computer vision syndrome, Humidity, Lighting intensity, Temperature, Workplace environment physical quality

INTRODUCTION

Health is a human right, one of which is the health of the workforce. All workers from both the formal and informal sectors are entitled to health care. Health efforts for the workforce aim to protect work so as not to interfere with productivity at work. Nowadays, technology is developing rapidly which makes it easier for us to get information. One of the technologies that are currently developing is the computer. Over time, the use of computers and gadgets has become a natural thing among people in the era of technological development. In the Ministry of Communication and Informastics (2017) report, what is meant by computers are personal computers (PCs), laptops and tablets .

According to Ministry of Communication and Informastics statistics for 2017, 13.70% of Indonesians use computers, 22.52% use laptops, 6.52% use tablets, and 52.85% use mobile phones (Kominfo, 2017). Most people use gadgets for working, either from home or the office. Locations using computers at home as much as 61.92% and at the office as much as 42.08%. In general, 80% of office work is completed using computers. Over time, technology advances and increasing usage intensity can trigger adverse effects. Computer or gadget utilization often causes several disorders, such as computer vision syndrome, musculoskeletal disorders, and mental disorders. They can affect the life quality, productivity, and health degrees of people.

Research by Loh and Reddy (2008) states that Computer Vision Syndrome (CVS) is one of the disorders being highlighted and posing the greatest risk to global public health as a result of technology use in the twenty-first century. According to the P2PTM of the Indonesian Ministry of Health (2020), computer vision syndrome (CVS) is excessive use of computers with symptoms in the eyes and neck. Symptoms include blurry eyes, red eyes, dry eyes, double vision, eye strain, eye irritation, and headaches. The American Optometric Association (AOA) defines CVS as a collection of eye and visual symptoms that are associated with activities that impair near vision and persist during or after use of computers, tablets, e-readers, and cell phones (AOA, 2022). According to the findings of the study published in the Academic Journal, CVS prevalence among computer users ranged between 64 and 90%. It is estimated that nearly 60 million people have CVS globally, and approximately one million new cases occur annually (Akinbinu and Mashalla, 2014). This is supported by the incidence of CVS in various countries such as South Asia 67.4% in workers who use computers and 19.7% in children in Australia, India and Sweden from the results of a systematic review. From there it can be seen, a worker with a primary computer job, such as computer experts and administration staff in the office, has a high risk of experiencing CVS (Vilela *et al.*, 2015; Ranasinghe *et al.*, 2016).

Complaints of computer vision syndrome (CVS) occur in employees who work with a duration of > 4 hours using a computer (Fradisha, Wulandari and Sari, 2017). The United States National Institute for Occupational Safety and Health said there are about 90% of people who work > 3 hours a day using computers which can lead to Computer Vision Syndrome (CVS) (Anggrainy, Lubis and Ashar, 2020). The percentage of employees who work > 4 hours and experience CVS is greater (82.6%) than those who do not experience CVS (Pratiwi *et al.*, 2020). Workers who use computers > 3 hours per day are at risk of causing eye complaints (Rathore, 2017). Duration of computer use >4 hours has a significant relationship with CVS complaints (Asnifatima, Prakoso and Fatimah, 2017). Another study showed that using a computer more than five hours per day was 1.52 times more likely to experience three complaints of eye fatigue (Al Tawil *et al.*, 2020).

There are external factors related to CVS incidents, i.e., lighting intensity, room humidity, room design, and psychosocial factors (Anggrainy, Ashar and Rahmawati Lubis, 2018). Low humidity and temperature can reduce the frequency of blinking so that it can cause CVS complaints (Sari and Himayani, 2018). The risk factors for CVS incidents are divided into 3 namely individual

factors, environmental factors, and computer factors. Humidity and air temperature factors can affect the occurrence of CVS incidents (Sari and Himayani, 2018). In the research of Insani and Nurmulia (2018), it was stated that there was a relationship between light intensity and the incidence of CVS. The computer emits high-energy blue light that allows the energy to compress the ciliary muscles of the eye (Dessie *et al.*, 2018). According to the Regulation of the standard of Permenkes RI No.48 of 2016 on Office Occupational Safety and Health Standards, i.e., the workplace lighting condition must be between 300-500 lux (Indonesian Ministry of Health, 2016).

In this case, PT Pelabuhan Indonesia III (Persero) is a State-Owned Enterprise in Indonesia. PT Pelabuhan Indonesia III (Persero) has many staff using computers who are inseparable from the risk of CVS. All workers in the Sub-Directorate of Information and Communication Technology in their daily dealings with devices/computers in carrying out their work. It can be a health risk for workers, namely CVS Incidence. From the results of distributing a CVS questionnaire in the form of a google form to PT Pelabuhan Indonesia III staff randomly, it was found that 21 people (60%) experienced CVS incidents and 14 people (40%) did not experience CVS. Based on the initial measurements of the physical quality of the workplace environment in the ICT room, HSSE and techniques on the variables of lighting intensity and temperature have not met the standards of PERMENKES RI No. 48 of 2016. Based on this consideration, the researchers conducted a study on the evaluation of the physical environment and CVS incidents on the staff of PT Pelabuhan Indonesia III (Persero).

METHOD

The study was qualitative, comparing variables observed to the applicable standards. The study type was observational since it did not provide interventions or treatments for the study subjects or respondents. Instead, it observed or investigated the occurrence. The study design was cross-sectional, i.e., a study on exposure estimation, target measurement, and effect that was carried out at a particular period.

The study population was the staff of the Information and Communication Technology (ICT) Sub-Directorate of PT Pelabuhan Indonesia III (Persero), amounting to 30 people as the exposed group and 30 people at the Health Safety Security and Environment (HSSE) and Port Equipment Engineering departments as the control group.

The study samples were staff of the Information and Communication Technology (ICT), HSSE, and Engineering Sub-Directorates of PT Pelabuhan Indonesia III (Persero), who fulfilled the inclusion criteria. The sample respondents meeting the inclusion criteria were 30 people from the exposed group in the Information and Communication Technology (ICT) unit and 30 people from the control group in the HSSE and Port Equipment Engineering units. Sampling in this study was conducted by looking at the list of staff who attended the work form office (WFO) which were then randomly selected according to the inclusion and exclusion criteria.

Data collection was performed from April to June 2021. The independent variables of the study included the physical environment quality (lighting intensity, temperature, humidity) in the room. The dependent variable was Computer Vision Syndrome (CVS) incidents on staff. Symptoms using a questionnaire consisting of 16 items, namely burning sensation in the eyes, itchy eyes, feeling a foreign body in the eye, watery eyes, excessive blinking, sore eyes, heavy eyelids, dry eyes, blurred vision, double vision, difficulty focusing near vision, increased sensitivity to light, seeing colored halos around objects, feeling a worsening of vision, and headaches. Individuals who suffer from CVS are those who get a score of 6 from the results of the calculation of the frequency and intensity of symptoms felt by the respondent. Data on computer vision syndrome incidents was acquired from questionnaires filled out by respondents by answering the predetermined question list. Direct measurements of physical environment parameters such as lighting intensity, temperature, and humidity were obtained using a calibrated lux meter to measure lighting intensity and a thermohygrometer to measure room temperature and humidity. Determination of the measurement point for general lighting can be seen in table 1.

The room lighting intensity, temperature, and humidity measurements were tripled in the morning (09.00 – 10.00), midday (13.00 – 10.00), and afternoon (15.00 – 16.00). The study has obtained an ethical feasibility test from the Ethics Committee of Dentistry Faculty Universitas Airlangga with an issuance number: 252/HRECC.FODM/V/2021.

Table 1. Determination of the Measurement Point for General Lighting

No	Measurement Point for General Lighting		
	Room <10 m^2	**Room10-100 m^2**	**Room >100 m^2**
1	Create a plan that describes the original length and width of the room	Create a plan that describes the original length and width of the room	Create a floor plan that describes the original length and width of the room
2	Make a point of intersection of the long and wide horizontal lines at a distance of every 1 (one) meter	Create a point of intersection of the horizontal line of length and width at a distance of every 3 (three) meters	Create a point of intersection of the horizontal line of length and width on distance every 6 (six) meters
3	Write and draw a floor plan on a sheet	Write and draw a floor plan on a sheet	Write and draw a floor plan on a sheet

RESULT AND DISCUSSION

Physical Environment Quality

The Study Examined Lighting Intensity, Temperature, and Humidity

Based on the study result in Table 1, it was discovered that all respondents at the head office of PT Pelabuhan Indonesia III (ICT, HSSE, and Engineering Sub-Directorates) worked under a room lighting intensity condition that did not follow the standard of Permenkes RI No.48 of 2016 on Office Occupational Safety and Health Standards, i.e., the workplace lighting condition must be between 300-500 lux.

Based on the study results in Table 2, it was revealed that all staff in the exposed group at the head office of PT Pelabuhan Indonesia III worked under non-standard room temperature conditions (100%). Meanwhile, 22 people (73.3%) in the control group did not work at the appropriate room temperature. Based on Table 2, all staff in the exposed group at the head office of PT Pelabuhan Indonesia III worked under standard room humidity (100%). Twenty-three (76.6%) staff in the control group worked under a non-standard room humidity condition.

Computer Vision Syndrome (CVS) Incident

The study results in Table 3 demonstrate that most staff experienced CVS incidents. In the exposed group, 27 people (90%) experienced CVS incidents, while 16 people (53.3%) in the control group experienced CVS incidents.

Table 3. Distribution of CVS Incidents on Staff at the Head Office of PT Pelabuhan Indonesia III

CVS Incidents	Exposed		Control	
	n	**%**	**n**	**%**
No CVS	3	10.0	3	46.7
CVS	27	90.0	16	53.3
Total	30	100	30	100

CVS Incident Based on the Quality of the Workplace Physical Environment (Lighting Intensity, temperature, and humidity)

Table 4 revealed that all staff in the exposed group at the head office of PT Pelabuhan Indonesia III worked under non-standard lighting intensity, where the majority experienced CVS incidents, amounting to 27 people (90%). In the control group, all staff worked under non-standard lighting intensity, and 16 people (53.3%) experienced CVS incidents.

Table 2. Distribution of Room Lighting Intensity, Temperature, and Humidity of PT. Pelindo III

Variable		Exposure		Control	
		n	**%**	**n**	**%**
Lighting Intensity	<300 lux or >500 lux	30	100	30	100
	300-500 lux	0	0.0	0	0.0
Tempe-rature	<23ºC or >26ºC	30	10	8	26.7
	23ºC-26ºC	0	0.0	22	73.3
Humidity	<40% or >60%	0	0.0	23	76.7
	40% - 60%	30	100	7	23.3
Total		30	100	30	100

Table 4. Distribution of CVS Incidents Based on Workplace Physical Quality on Staff at the Head Office of PT. Pelabuhan Indonesia III

Variable		CVS				Total		*P-value*
		No		Yes				
		n	**%**	**n**	**%**	**N**	**%**	
Room Lighting Intensity								
Exposed	<300 lux or >500 lux	3	10.0	27	90.0	30	100	0,000
	300-500 lux	0	0.0	0	0.0	0	0.0	

Variable		CVS				Total		*P-value*
		No		Yes				
		n	%	n	%	N	%	
Control	<300 lux or >500 lux	14	46.7	16	53.3	30	100	
	300-500 lux	0	0.0	0	0.0	0	0.0	
Room Temperature								
Exposure	<23ºC or >26ºC	3	10.0	27	90.0	30	100	
	23ºC-26ºC	0	0.0	0	0.0	0	0.0	0,000
Control	<23ºC or >26ºC	1	12.5	7	87.5	8	100	
	23ºC-26ºC	13	59.1	9	40.9	22	100	
Room Humidity								
Exposure	<40% or >60%	0	0.0	0	0.0	0	100	
	40% - 60%	3	10.0	27	90.0	30	100	0,000
Control	<40% or > 60%	13	56.5	10	43.5	23	100	
	40% - 60%	1	14.3	6	85.7	7	100	

For the room temperature variable, staff in the exposed group worked under non-standard temperatures, where 27 people (90%) experienced CVS incidents. In the control group, staff worked under standard temperature, and 13 people (59.1%) experienced CVS incidents.

For the room humidity variable, all staff in the exposed group worked under standard humidity, although 27 people (90%) experienced CVS incidents. In the control group, most staff worked under non-standard room humidity conditions. However, most did not experience CVS incidents, amounting to 13 people (56.5%).

Physical Environment Quality

The Study Examined Lighting Intensity, Temperature, and Humidity

The quality of the physical environment in the workplace consists of light intensity, temperature and humidity. Light intensity is the amount of light in the workspace where the computer user is performing the activity effectively. Based on the results of the study, it was shown that the staff at the head office of PT Pelabuhan Indonesia III (Sub-Directorate of ICT, HSSE, and Equipment Engineering) worked with room light intensity of < 300 lux or > 500 lux. Based on the Decree of the Minister of Health of the Republic of Indonesia No. 48 of 2016 concerning Standards for Occupational Safety and Health in Offices, the lighting conditions for workspaces are 300-500 lux, so that the workspace at the head office of PT Pelabuhan Indonesia III (Sub-Directorate of ICT, HSSE, and Equipment Engineering) is not in accordance with applicable regulations. The room temperature in the work space of the ICT sub-directorate staff is <23ºC or > 26ºC, while the HSSE room and equipment engineering mostly work at a room temperature of 23ºC-26ºC. Based on the Minister of Health Regulation No. 48 of 2016, the staff room for the ICT sub-directorate has not been in accordance with applicable regulations, while the HSSE staff workspace and equipment engineering have complied with the regulations. Humidity in the workspace of the ICT sub-directorate staff is 40% - 60% while the HSSE room and equipment engineering mostly work at room temperature of <23ºC or > 26ºC. Based on the Minister of Health Regulation No. 48 of 2016, the ICT sub-directorate staff room has complied with the applicable regulations, while the HSSE staff workspace and equipment engineering have not been in accordance with the regulations.

Computer Vision Syndrome (CVS) Incident

Computer vision syndrome (CVS) is a collection of symptoms in the eye and vision associated with activities that impair near vision and last a long time or after using computers, tablets, e-readers, and cell phones. Symptoms of CVS include eye strain, eye discomfort, headache, dry eyes, blurred vision at close range, and double vision (Pratiwi *et al.*, 2020).

Based on the results of data analysis, it is known that the ICT sub-directorate staff who have CVS symptoms are 27 staff and 16 HSEE staff and equipment engineering staff have CVS symptoms. Symptoms experienced by PT Pelabuhan Indonesia III staff are headache, watery eyes, sore eyes, blurred vision, and itchy eyes. Research by Canto-Sancho *et al.* found that the most experienced symptoms were headache (78.7%) and itchy eyes (73%) (Cantó-Sancho *et al.*, 2021). A cross-sectional study by Agbonlahor O. also reported headache (48.8%) as the most common symptom (Agbonlahor, 2019). Febrianti and Bahri's research showed that the dominant symptom on the ocular surface was watery eyes (47%). This symptom occurs due to light reflection, duration of laptop use, room temperature and shadows formed on the monitor (Febrianti and Bahri, 2018). In addition, using a computer for more than three hours continuously can reduce the frequency of blinking which results in excessive evaporation of tears and a decrease in the distribution of tears, causing dry eyes. As a result, it facilitates the accumulation of dust and fine dirt on the surface of the eye, this results in irritation of the surface of

the eye, thus making vision blurry and impaired (Mowatt *et al.*, 2018).

Analysis of CVS incidents based on room lighting intensity at the head office of PT Pelabuhan Indonesia III

The descriptive analysis result showed that staff in the exposed group at the head office of PT Pelabuhan Indonesia III mostly worked under non-standard room lighting intensity, where the majority had CVS incidents by 27 people, or 90.0%. In the control group, most staff worked under non-standard room lighting intensity and had CVS incidents. Based on the observation findings, there were two lighting sources, i.e., sunlight and lamps. Lamps in HSSE and Engineering rooms have 18-watt power and emit light for 1,800 lumens. Meanwhile, the HSSE room, with an area of 236 m^2, requires 70,800 lumens, or equal to 52 18-watt lamps. Likewise, the Engineering room, with an area of 267 m^2, requires approximately 80,100 lumens, or equal to 58 18-watt lamps. Conversely, the ICT room has 32-watt power and emits light a brightness of 3,200 lumens. Meanwhile, with an area of 293 m^2, it requires 87,900 lumens, which is equal to 53 32-watt lamps. It causes most rooms to have lighting intensity under the standard of PERMENAKES No.48 of 2016.

The study result of Rozanna and Mulyono showed that several office rooms at PT PAL Surabaya have inappropriate lighting, with an average of <300 lux, which has an insignificant relationship with CVS symptoms (Nadhiva and Mulyono, 2020). Nopriadi *et al.* (2019) asserted a relationship between inappropriate workplace lighting (<280 lux) and CVS incidents on employees of Bank RK Pekanbaru. The results of this study are in accordance with research conducted by Shantakumari, mentioning that an overly bright room causes headaches and an overly dark room causes dry eyes. Computer lighting and its contrast should balance the room lighting. Permana *et al.* (2015) revealed a relationship between lighting intensity and computer vision syndrome (CVS) complaints among computer rent workers at the UNNES campus area.

According to the OSHA Theory, good lighting allows employees to examine their jobs carefully, quickly, and without unnecessary effort. It also helps to create a comfortable working environment. Lighting must be sufficient for computer users to see text on the computer screen. It should not be too bright, causing glare or discomfort in the eyes. Poor lighting conditions in the computer area have a negative impact on computer users' eyes (OSHA, 1997). In addition, efforts to improve the intensity of lighting can be carried out by designing work spaces and desks used by workers and paying attention to natural lighting sources such as windows and other lighting sources. There are other efforts, namely adding the number of lamps for general and local lighting and maintaining lamps which is carried out every six months (Arcasiatectura Antartika *et al.*, 2019).

Analysis of CVS incidents based on room temperature and humidity at the head office of PT Pelabuhan Indonesia III

For the room temperature variable, staff in the exposed group mostly worked under non-standard room temperatures and experienced CVS incidents. In the control group, most staff worked at standard room temperature and did not experience CVS incidents.

For the room humidity variable, staff in the exposed group mostly worked under standard room humidity. However, most experienced CVS incidents. In the control group, most staff worked under non-standard room humidity and did not experience CVS incidents.

Temperature and humidity are risk factors in the workplace for CVS incidents (Sánchez-Brau *et al.*, 2020). (Sánchez-Brau *et al.*, 2020). Besides individual comfort, room temperature and humidity also affect the tear film layer and humans during the production process and tear stabilization process (evaporation rate) (Abusharha, Pearce and Fagehi, 2016). Room temperature and humidity requirements are regulated in PERMENAKES RI No.48 of 2016 on Office Occupational Safety and Health Standards, i.e., room temperature must range between 23ºC – 26ºC and humidity must range between 40%-60%. If room temperature and humidity do not follow the requirements, it may affect CVS incidents by OR = 1.23 and OR = 1.22 (Sánchez-Brau *et al.*, 2020). Low humidity and temperature can reduce the frequency of blinking so that it can cause CVS complaints (Sari and Himayani, 2018). Other factors that may influence or exacerbate ocular symptoms in the workplace include dust, pollen, aerosol, combustion products, or chemical substances that irritate, such as the oxidation mixture formed by interactions between ozone and alkenes at relatively low humidity (Parihar *et al.*, 2016).

CONCLUSION

The conclusion of this study is that there is a discrepancy between the physical environment variables, namely the intensity of lighting and room temperature on the ICT staff of PT Pelabuhan Indonesia III (Persero) with applicable regulations and based on literature studies and workers experiencing CVS. In the HSSE, and Engineering Sub-Directorates staff there is a discrepancy of the lighting intensity variable with applicable regulations and workers experience CVS, on the humidity variable there is a discrepancy with

applicable regulations and workers do not experience CVS.

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