Complaints of Computer Vision Syndrome in Telemarketing Workers at Bank X in Jakarta

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ABSTRACT

Introduction: Computer Vision Syndrome (CVS) or digital eye strain is a collection of eye problems related to vision. The telemarketing division in Bank X has 10 hours working time per day and 60 hours per week. This study aimed to determine CVS complaints among telemarketing workers and analyze the factors that caused CVS complaints in workers. **Methods:** The study used a cross-sectional study design, with a total sample of 53 workers. The variables studied were lighting intensity, monitor distance, age, refractive disorders, eye rest, and eye protection. The study used a lux meter to measure the light intensity and the Snellen chart to see eye refraction abnormalities. **Results:** The results determined that 77.4% of computer workers in Bank X Telemarketing division experienced CVS complaints while 22.6% did not experience CVS. The results of statistical tests showed that light intensity, monitor distance, refractive disorders, and eye rest were associated with CVS complaints, while age and eye protection equipment were not related to CVS complaints. **Conclusion:** Most telemarketing workers experienced CVS complaints caused by lighting intensity, monitor distance, refractive disorders, and eye rest.

Keywords: computer vision syndrome complaints, eye rest, lighting intensity, snellen chart

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INTRODUCTION

Science and technology are growing rapidly in this globalization era, marked by the increasing number of technologies created to facilitate human activities. Today, electronic devices have become a necessity in various work sectors and cannot be separated from everyday life. Computers are one of the electronic devices used by multiple institutions to make work easier. There are around 100 million of people using computers in their daily work. Starting from 2010, computer users worldwide have increased by 1.6 billion annually (Ulpah, Denny and Jayanti, 2015).

The many benefits of using a computer include a faster and easier way to complete daily tasks. Computers can process large amounts of data in addition to having large capacity and storage media. However, among the many benefits, computers can also threaten their users (Putri and Mulyono, 2018). One of the threats is that computers can interfere with our optical health.

Computers emit ultraviolet rays and X-rays. The use of computers for a long time can cause eye and vision problem called Computer Vision Syndrome (CVS) or digital eye strain. CVS is an eye and vision problem related to various types of electronic displays like smartphones and computer displays (Rosenfield, 2016). The American Optometric Association (AOA) defines CVS as a group of optical-related symptoms associated with activities that use near vision and occur during and after using computers, mobile phones, and tablets (Pratiwi, Safitri and Lisnawaty, 2020). Eye strain/fatigue, eye irritation (sore, dry, and red eyes), sensitivity to light, blurred vision, eye focus which changes slowly, headaches, pain in the neck or shoulder, and back pain are CVS symptoms experienced by computer users (Ranasinghe *et al*., 2016; Rosenfield, 2016; Shahid *et al*., 2017; Dessie *et al*., 2018; Radmilo and Cvijanović, 2021).

WHO stated that in 2014, there were 40% to 90% of cases of eye fatigue among computer users. Based on world data, the prevalence of computer users in the world was 88% in 2013, 72% in 2014, 68% in 2015, and 60% in 2016 (Irma, Lestari and Kurniawan, 2019). CVS is one of the hazards caused by work affecting nearly 70% of all computer users

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in the 21st century. CVS is one of the major global public health issues which reduce productivity and job satisfaction, increase rates of error and impair vision abilities (Randolph, 2017; Dessie *et al*., 2018). According to Rosenfield, 80% of computer and other electronic display users reported having experienced CVS symptoms during and immediately after viewing electronic screens (Rosenfield, 2016).

A number of studies have shown that computer users in Sri Lanka had a high CVS prevalence with a percentage of 67.4%, and computer users in Debre Tabor Town, Northwest Ethiopia had a high CVS prevalence with a percentage of 73.0% (Ranasinghe *et al*., 2016; Dessie *et al*., 2018). The same thing was found in the research of Permana, Koesyanto and Mardiana (2015), in which they examined CVS complaints on computer rental workers in the UNNES area and found that as many as 83% of respondents experienced CVS complaints. Research by Iqbal *et al*. (2018) showed that the prevalence of CVS in medical students who used computers for more than 2 hours was recorded at 89%.

Pawar *et al*. (2015) stated that 75-80% of workers who sit in front of computers for more than 3 hours per day would experience eye and vision problems, from headache, eye strain , blurred vision, to neck or shoulder pain. Dessie *et al*. (2018) also revealed in their research that workers who use computers for more than 4 hours daily are more at risk of experiencing CVS than workers who use them for less than 4 hours per day.

CVS can be caused by a lack of a blink reflex when looking at a computer screen, causing eye fatigue. The longer a person opens his eyes without blinking, the more his eyes will experience heat and the cornea will become dehydrated, causing a heavy feeling in the eyes as if there is dust on the eyelids (Priliandita, 2015). A computer user in maintaining image sharpness tries hard to focus his eyes on the monitor screen. This process results in repeated stress on the eye muscles. If this syndrome is not resolved immediately, it can hinder daily activities, cause discomfort, increase work errors, reduce worker productivity, and decrease job satisfaction. The effect of eye damage tends to increase as exposure length per day and duration per year increases with the risk of permanent damage and takes years to appear (Mussa, 2016). However, not everyone considers CVS to have serious negative effects, primarily on eye health, due to the long time for CVS severity to take form. Moreover, it has not been fully proven that computers cause irreversible damage to the eye.

Telemarketing workers at Bank X are tasked with offering services and products such as credit cards or insurance to customers, inn addition to making a recapitulation of records of customers who have opened credit cards. In carrying out their duties, these workers cannot be separated from the use of computers with a total usage of 10 hours daily and 60 hours weekly. The work they do requires them to use computers for a long time so that these workers are at risk of experiencing CVS complaints. From the descriptions above, this study was conducted to determine CVS complaints' prevalence in telemarketing workers and analyze the factors that cause CVS complaints.

METHODS

This study was a quantitative study using a cross-sectional approach. The study was conducted in the telemarketing section of a bank in Tangerang in 2019. This research has received ethical approval from the Health Research Ethics Commission, Faculty of Public Health Universitas Sriwijaya No: 332/UN9.1.10/KKE/2019), on 12 November 2019.

The Sampling technique used in this study was total sampling because the total population was less than 100. Samples were taken from a total of 53 computer-using workers. The research variables were CVS complaints, lighting intensity, monitor distance, age, refractive disorders, eye rest, and eye protection. Data were collected through interviews and questionnaires on CVS complaints, age, eye rest, and eye protection.

The intensity of lighting was obtained from direct measurement using a Lux Meter, which refers to SNI 16-7062-2004. Measurements were made on the work object, namely the computer screen, by placing the sensor parallel to the computer screen's position and pointing to the light source. Another measuring instrument used was the Snellen chart to determine the workers' refractive disorders, by placing the Snellen chart six meters away from the workers. Workers with normal eye conditions will be able to read the seventh line clearly on the Snellen chart. Meanwhile, this research also used tape measures to determine distance between the monitor and worker's eyes.

The analysis in this study was univariate and bivariate analysis. The univariate analysis aimed to determine the description or frequency distribution of each research variable. Meanwhile, bivariate analysis using the chi-square test was carried out to analyze the relationship between the independent

variables (lighting intensity, monitor distance, age, refractive disorders, eye rest, and eye protection) and the dependent variable (CVS complaints).

RESULTS

The graph in Figure 1 shows that computer use of >3 hours per day caused telemarketing workers to complain of fatigue and eye strain the most (30%), pain in the neck and shoulders (28%), and back pain (27%) Thus, complaints that workers experienced were not only in the eyes, but there were also complaints on the neck, shoulders, and back

This study showed that CVS complaints on telemarketing workers were 77.4%, with 62.3% workers having non-standard lighting intensity. A large percentage of workers worked with non-ideal monitor-eye distance (75.5%), 32.1% were in a high risk age category (≥40 years), and most workers had refractive disorders at 75.5%. Furthermore, there were 52.8% who did not get enough eye rest (≤10 minutes), and 49.1% did not use eye protection (Table 1).

Bivariate analysis showed that lighting intensity (p-value 0.03), monitor distance (p-value 0.001), refractive disorders (p-value 0.007), and eye rest (p-value 0.01) had a statistical correlation with CVS complaints, while age (p-value 0.09) and eye protection (p-value 0.11) were not associated with CVS complaints (Table 2).

The statistical test showed that telemarketing workers with non-standard lighting intensity were 1.465 times riskier to have CVS complaints than workers with standard lighting intensity. Telemarketing workers with the non-ideal monitor-eye distance were 4.117 times riskier to develop CVS complaints than those with ideal monitor distance. In addition, workers with a refractive disorder could experience risk of CVS 1.896 times greater than workers who did not have a refractive disorder. Workers who had insufficient eye rest had a 1.548 times greater risk of experiencing CVS complaints than workers who had adequate eye rest.

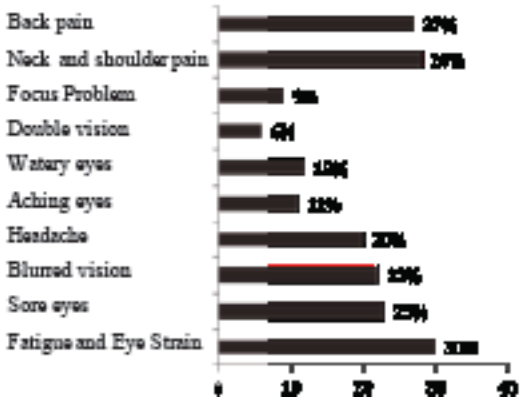

Figure 1. CVS Complaints on Telemarketing Workers at Bank X

DISCUSSION

This study showed that 77.4% of telemarketing workers who experienced CVS complaints worked for 10 hours per day. The symptoms experienced the most by these workers included fatigue and eye strain (30%), neck and shoulder pain (28%), and back pain (27%). Agarwal, Goel and Sharma (2013) showed that 56.8% of participants experienced neck pain, 48.9% experienced shoulder pain, and 43.3% experienced low back pain. Moreover, reduced vision, dryness and irritation of the eye were the most common eye complaints found in their study, with the most working duration of more than six hours per day (Cheng *et al*., 2019).

Table 1. Research Variable Frequency Distribution

Variable	n=53	%
CVS Complaint		
Yes	41	77.4
No	12	22.6
Lighting Intensity		
Not Standard (<315/>315 lux)	33	62.3
Standard (315 – 385 lux)	20	37.7
Monitor Distance		
Not Ideal (< 50 cm)	40	75.5
Ideal (≥ 50 cm)	13	24.5
Age		
Risky (≥ 40 years)	17	32.1
Not Risky (< 40 years)	36	67.9
Refractive Disorders		
Yes	40	75.5
No	13	24.5
Eye Rest		
Not enough (≤ 10 minutes)	28	52.8
Enough (10 minutes	25	47.2
Eye Protection		
Not Use	26	49.1
Use	27	50.9

Table 2. Factors Associated with CVS Complaints

Variable	CVS Complaints				p-value	PR (95% CI)
	Yes		No			
	n	%	n	%		
Lighting Intensity						
Not Standard (<315/>315 lux)	29	87.9	4	12.1	0.03*	1.465 (1.002 – 2.141)
Standard (315 – 385 lux)	12	60.0	8	40.0		
Monitor Distance						
Not Ideal (< 50 cm)	38	95.0	2	5.0	0.001*	4.117 (1.522 – 11.135)
Ideal (≥ 50 cm)	3	23.1	10	76.9		
Age						
Risky (≥ 40 years)	16	94.1	1	5.9	0.07	1.355 (1.059 – 1.1735)
Not Risky (< 40 years)	25	69.4	11	30.6		
Refractive Disorders						
Yes	35	87.5	5	12.5	0.005*	1.896 (1.042 – 3.450)
No	6	46.2	7	53.8		
Eye Rest						
Not enough (≤ 10 minutes)	26	92.9	2	7.1	0.01*	1.548 (1.106 – 2.166)
Enough (10 minutes	15	77.4	10	22.6		
Eye Protection						
Not Use	23	88.5	3	11.5	0.11	1.327 (0.982 – 1.792)
Use	18	66.7	9	33.3		

* : Significant (p-value < α (0.05))

The use of computers can cause eye fatigue from electromagnetic radiation emitted by the computer screen (Priliandita, 2015). CVS complaints due to computer use can be classified into asthenopic, ocular surface-related, visual, and extra-ocular symptoms (Dhar-Munshi, Amed and Munshi, 2019). Asthenopic symptoms commonly include eye strain, ache in and around the eyes, eye fatigue, double vision, light sensitivity, itches, and foreign-body sensation (Rosenfield, 2016; Dhar-Munshi, Amed and Munshi, 2019). Ocular surface-related symptoms are caused by infrequent blinking, causing dry and watery eyes, eye irritation, and contact lens problems (Dhar-Munshi, Amed and Munshi, 2019).

Visual symptoms reported in several studies are blurry vision, diplopia, presbyopia, slow focus change and transient blindness (Bogdănici, Săndulache and Nechita, 2017; Kaiti *et al*., 2020). Besides, computer users often experience musculoskeletal symptoms (extra-ocular symptoms) after prolonged work at the computer. Symptoms in extra-ocular are pains found in back, shoulders, wrists, and fingers (Chawla *et al*., 2019).

Eye fatigue is caused by the compulsion to the eye's ability to translate two-dimensional objects that appear on the monitor screen into three-dimensional objects because the visual effort of the eyes is greater when looking at objects on the computer screen compared to when looking at the paper (Putri and Mulyono, 2018). Light is a part of various long electromagnetic waves emitting a specific frequency in different values from other light energy in the electromagnetic spectrum (Jasna and Dahlan, 2019). A collection of pixels emitted by computer light emits bright light in the center of the screen and gradually darkens at the edges, causing normal eyes to focus on a single point behind the screen or a resting point of accommodation (dark focus). Besides, another cause of eye fatigue is when looking at the monitor for too long and too close, causing muscles and nerves tension in the eyes (Firdani, 2020).

The accommodation power of the eye involves sensory and extraocular muscles, which causes pupil contraction, point-of-view approach, and eyeball convergence. Long contraction period in the eyes can trigger spasms in the sensory and extraocular muscles, causing pain (Insani and Ngkolu, 2018). Eye muscles and nerves strain after working too long with computers can cause headaches. In more severe conditions, muscle and nerve tension in the

eyes can block blood flow, which causes oxygen deprivation and then stimulate nerves to send pain signals (Haeny, 2015). Eye fatigue is only temporary and will disappear if rested, but the discomfort can interfere with work activities and reduce work productivity. According to Evans and Allen (2016), diagnosing patients with visual impairment due to the exposure to computer screens is difficult, but the pain it causes can be cured with appropriate treatment procedures.

This study indicates that lighting intensity is one of the factors that cause telemarketing workers to experience CVS complaints. There were as many as 87.9% of workers with non-standard lighting intensity who experienced CVS issues. The mismatch of the lighting intensity used can cause eye fatigue. It is because the eyes will work harder to see objects. The lighting in the telemarketing room at Bank X in South Tangerang was still not well distributed because the number of lights available was not proportional to the room's area. As obtained from the research results, only 37.7% of workers had standard lighting intensity. Based on the observations, it was determined that workers had standard for lighting intensity because the workbenches they used were located near lights and windows.

The results showed that there was a correlation between lighting levels and CVS complaints among telemarketing workers. Insani and Ngkolu (2018) study also stated a correlation between lighting intensity and CVS incidence. The lighting intensity influences comfort while working. Meanwhile, the improper lighting conditions, such as glare from overhead lamps or windows and reflections from walls, ceilings, and computer screens can cause visual discomfort (Gowrisankaran and Sheedy, 2015). Adequate lighting is a requirement for good visual perception. Each type of work and room, however, has different standards of light intensity levels. A room used as a workspace where the task uses visual ability for a long time requires a lighting level of 2000-5000 lux. The light intensity standard for a computer room or visual display terminal according to the AOA is between 200 and 700 lux (Ulpah, Denny and Jayanti, 2015).

Besides, if the lighting far exceeds the Threshold Limit Value (TLV), it can cause glare. Eyes that receive excessive light can force the pupil to shrink because it adjusts to the light intensity that the eye should receive. This condition causes the eyes to tire quickly (Mappalotteng and Syahrul, 2015). The insufficient light intensity can cause eyestrain and impaired visual, while excessive lighting can cause glare, reflections, and excessive shadows which may cause eye strain (Putri and Mulyono, 2018; Alfitriana, 2019).

Visual fatigue will impact the efficiency of workers, and cause complaints of soreness in the eye area, headaches, and mental fatigue. It can also result in a decrease of the effectivity and quality of work, loss of productivity, and an increase in work accidents.

Monitor distance is one of the factors that affect comfort when someone is working on a computer. In this study, there were 95.0% of workers with a non-ideal distance who experienced CVS complaints. Based on the recommendations by the Occupational Safety and Health Association (OSHA), the best distance between the eyes and the computer screen is 45 and 60 cm (Gowrisankaran and Sheedy, 2015). The monitor should also be positioned, so the upper part of the screen is at eye level. Telemarketing workers had CVS complaints due to the long duration of computer use, which was 10 hours per day, while the frequency of eye break was short (with only 47.2% of workers had adequate eye rest).

The results of the study indicate that there was a correlation between monitor distance and CVS complaints among telemarketing workers. The result of study is in line with research of Permana, Koesyanto and Mardiana (2015) and Nopriadi *et al*. (2019), but it is not in line with the study of Putri and Mulyono (2018) and Alfitriana (2019) which stated that there was no correlation between monitor distance and eyestrain and other CVS complaints.

Reading from a computer screen is different from reading books especially because working with the computer screen's proximity will require accommodation, convergence, and eye miosis (Chawla *et al*., 2019). Sitting posture while staring at a computer screen also needs to be considered to not cause muscle and ocular stress after doing work. The ideal distance between the user's eyes and the monitor can be adjusted based on the diameter and the depth of the screen. Inadequate eye-monitor distance forces the eyes to see from a reasonably close distance for a long time, while the human sense of sight is not created to see from a close distance specifically (Pratiwi, Safitri and Lisnawaty, 2020) . Therefore, companies and workers must ensure that the work position is not <50 cm apart when workers are working using a computer to prevent eye health hazards.

Old age and young age are natural phases of life experienced by every human being. Physiologically, someone aged <40 years old has a better physical condition than someone aged> 40 years old (at risk). The statistical test results showed no significant correlation between age and CVS complaints among telemarketing workers (Nopriadi *et al*., 2019; Sánchez-Brau *et al*., 2020).

In this study, 94.1% of workers aged ≥ 40 years old (at risk) experienced CVS complaints. However, univariately, there were only 32.1% of workers aged ≥ 40 years old (at risk). Although this study indicated no correlation between age and CVS complaints, there was a high prevalence of workers aged ≥ 40 years old experiencing CVS complaints (94.1%). If this variable is not intervened, it will be a risk factor in the future.

At the age of 40, the need for light to see becomes four times greater than in younger ages. At the age of over 40 years old, humans experience old eyes or presbyopia where the eye lens almost loses its ability to accommodate. During the aging process, the eye distortion increases, and the ocular lens produces light diffusion that becomes less transparent, causing a deterioration in the retina's quality. Besides, the pupil diameter's size depends on age because it affects vision ability and visual quality. The risk will increase, especially for workers who are heavy smokers. This is because these workers can experience an early degenerative process due to an increase in free radicals that enter the body, which can affect the eye lens (Nopriadi *et al*., 2019; Sánchez-Brau *et al*., 2020). According to the National Aging Safety Database, increasing human age will reduce their ability to see around their environment, which can cause a high risk of accidents at work (Jasna and Dahlan, 2019).

A refraction disorder is the primary determinant of eye disorders when the eyes cannot focus on a point until the vision becomes blurry. To determine whether there are refractive disorders on telemarketing workers, the tool used in this study was a Snellen chart. The results of statistical tests showed that there was a correlation between refractive disorders and CVS complaints.

This study showed that 87.5% of telemarketing workers who had refraction disorders experiencing CVS complaints. The refractive disorders cause blurry vision, slow focus change, and diplopia (Dhar-Munshi, Amed and Munshi, 2019). Assefa *et al*. (2017) indicated that among the total bank workers who used computer in Gondar City, Northwest Ethiopia, 42.4 % experienced blurred vision.

The classifications of refraction disorders are myopia, hypermetropia, astigmatism, and presbyopia. Workers with myopia conditions will have blur vision of distant objects. Usually, people with myopia narrow their eyes to get a pinhole effect or to prevent spherical aberration (Huang *et al*., 2016). Computer users with moderate myopic refractive disorders often make adjustments to view a computer screen clearly, causing musculoskeletal symptoms in some individuals (Gowrisankaran and Sheedy, 2015).

Hypermetropia or farsightedness is a condition of the eye's refractive power where far parallel rays are not refracted sufficiently and the focus lies behind the retina (Schiefer *et al*., 2016). Likewise, computer users with hypermetropia will tire quickly, especially after focusing on close objects, such as reading or using a computer. Meanwhile, astigmatism is known as a refractive error where the incoming light is not focused on one point but at two points of perpendicular lines so that there is a curvature of the eye's cornea (Staningrum, 2019).

Eye fatigue occurs more quickly in an individual with astigmatism. People with uncorrected astigmatism will often complain of strain and ache in the eye, and headache (Gowrisankaran and Sheedy, 2015). Workers who often work for a long time in front of a computer are advised to avoid using contact lenses. When using a computer, a person's blinking duration will also decrease, which causes dry eyes and friction between the contact lens and the worker's eyelids (Maharani, Pemayun and Handayani, 2020).

Human blinking frequency under normal circumstances is 16 to 20 times per minute. In workers dealing directly with computers, the frequency of blinking decreases by 6 to 8 times. The ciliary muscle is the eye muscle that plays a role in accommodation when using a computer and when this muscle is overworked, tension and stiffness occur. Eye rest is, therefore, needed when someone is working at the computer for a long time. This study showed that 92.9% of telemarketing workers did not get enough eye rest and experienced CVS complaints. The statistical test result indicated a correlation between eye rest and CVS complaints. From the interview results through questionnaires, it was found that telemarketing workers only had time to rest their eyes for about 5 minutes and then

resumed their work on the computer because of the large amount of work that had to be completed immediately. Job demands include inputting and recapitulating customer data, and this work requires accuracy.

Pratiwi, Safitri and Lisnawaty (2020) also indicated a correlation between the length of rest and occurrence of CVS (p-value = 0.004), by stating that those r using a computer with only <10 minutes of rest had a 13.5-fold risk of suffering from CVS compared to those who rested for ≥ 10 minutes. However, the result is different from Sugarindra and Allamsyah's (2017) study, which stated that there was no correlation between the length of rest and CVS complaints (p-value = 0.67).

There are three types of rest breaks that workers who use computers can take. Eye break is done by stop looking at the screen and looking as far as 6 meters so that the eye muscles relax. It can be done for 10 to 20 minutes. Meanwhile, general rest break can be done by standing, moving, and doing other things besides using the computer. This movement will make the muscles rest and increase the blood circulation of workers. General rest break can be done for 30 minutes to 60 minutes while working. Lastly, exercise break is a break done by stretching the muscles to reduce the load and muscle fatigue for 1 to 2 hours while using the computer (Anshel, 2015). Taking a break after using a computer can increase comfort and relax the eye's accommodation power. Taking small breaks of 5-10 minutes is more effective than taking breaks every 2-3 hours from looking at computer screen. The rule most widely used today is the 20/20/20 rule, where after working for 20 minutes, people are advised to look at a distant object at about 20 feet (6 meters) away from computer screen for 20 seconds (Sari *et al*., 2018; Zulaiha, Rachman and Marisdayana, 2018; Pratiwi, Safitri and Lisnawaty, 2020).

Eye protection is used as a tool to protect the eyes from computer light radiation. The use of eye protection in the form of glasses is done to correct refractive errors in workers. The univariate results showed that there were only 49.1% of workers who abandoned the use of eye protection. Meanwhile, 88.5% of workers without eye protection experienced CVS. The statistical test results indicated that there was no correlation between the use of eye protection and CVS complaints. This result is in line with Arianti's (2017) study, which stated that there was no significant correlation between the use of eye protection and CVS complaints, especially eye fatigue (p-value = 0.467).

The diagnosis of CVS is achieved from a comprehensive eye examination. Treatment for CVS patients varies but is usually carried out by doing regular eye care and avoiding risk factors that can cause CVS (Dotulong, Rares and Najoan, 2021). Workers who work with computers are advised to use eye protection to avoid CVS complaints. Eye protection that can be used are anti-radiation glasses or regular glasses, preventing large amount of blue light from entering the eye. Workers should also avoid using refractive glasses and contact lenses because they do not support the eye function while working in front of the computer (Le, 2016; Damiri Valentina *et al*., 2020). In addition to using glasses, workers can also install screen filters and anti-glare filters on the computer screen to minimize radiation and glare generated by the monitor screen.

CONCLUSION

This study indicates that there were as many as 77.4% of telemarketing workers who experienced CVS complaints. The statistical test results showed a correlation between CVS complaints with lighting intensity, monitor distance, eye refraction abnormalities, and eye rest, while age and eye protection were not related to CVS complaints.

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