# THE ASSOCIATION BETWEEN COMPUTER DURATION USE AND BREAK TIME WITH THE INCIDENCE OF COMPUTER VISION SYNDROME (CVS) DURING THE COVID-19 PANDEMIC LOCKDOWN AMONG MEDICAL STUDENTS AT MUHAMMADIYAH SURABAYA UNIVERSITY, INDONESIA

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## ABSTRACT

The use of digital devices was found to increase during the Covid-19 pandemic. In the context of medical education, a shift to distance learning has increased the use of digital devices and gadgets in student learning activities. A study of computer vision syndrome (CVS) related to the use of digital devices by medical students during study activities can be beneficial for educational programme policy development and promote awareness of better healthy lifestyles among stakeholders. To determine the association between computer duration use and break time with the incidence of CVS among medical students during the COVID 19 pandemic era. One hundred and ninety-four undergraduate and clerkship medical students of Muhammadiyah Surabaya University-Faculty of Medicine (MSU-FM) participated in an online survey using a re-validated CVS Questionnaire (CVS-Q) by Seguí et al. The data were analysed using SPSS version 25. One hundred and ninety-four students responded to the questionnaire, with the most frequently reported complaints being headaches (73%), a burning sensation in the eyes (69%) and increased sensitivity to light (67%). It was found that 67.4% of people who used the computer for more than three hours continuously ($p$ = .002) and 75.8% of those who took a break of less than 15 minutes ($p$ = .000) had CVS. A significant association exists between the duration of continuous computer use and break time and the incidence of CVS among undergraduate medical students. The prevalence of CVS was found 80.5% among medical students.

**Keywords:** COVID-19, computer vision syndrome, computer use, online activities, medical students

## INTRODUCTION

The new normal era established during the Covid-19 pandemic has altered several aspects of our lives, with nearly everyone relying on digital devices for information and entertainment, including teaching and learning activities inside the education systems. With the implementation of the Covid-19 pandemic lockdown by the Indonesian government and in most other countries, learning methods have become primarily digital. Increased use of digital media ranging from computers, laptops, tablets and smartphones are some examples of the visual display terminal (VDT) that has an impact on health problems associated with learning or working at home (Alemayehu & Alemayehu, 2019; Setyowati et al., 2021). Concerns have been raised about the Covid-19 lockdown policy because it could increase the prevalence of computer vision syndrome (CVS), particularly among students who must adapt their learning methods to become more extensive online (Wang, Wei, & Deng, 2021). CVS is defined as a complexity of eye and vision problems associated with computer-related activities that put an emphasis on near vision (Ranasinghe et al., 2016). The Covid-19 pandemic conditions have meant that VDT devices are widely used as distance learning medium, requiring practically all students to use devices such as PCs or laptops with a somewhat extended duration of exposure in their daily lives. Without specific guidelines, it is currently typical for medical students to spend 8-12 hours per day in front of digital devices for learning or entertainment purposes (Lakshmi, 2020).

Dry eyes, weary eyes, red eyes, a burning sensation in the eyes, blurred vision, double vision, headaches, glare and delays in changing focus are all possible symptoms

of CVS (Ranasinghe et al., 2016). A study found the prevalence of CVS was 69.5%, with the most common symptoms being blurred vision, eye fatigue and eye irritation (Dessie, Adane, Nega, Wami, & Chercos, 2018). CVS manifestations vary in severity according to the amount of time spent in front of a monitor screen. According to study conducted by Iqbal et al., the majority of participants spent three hours or more a day were complaining about CVS (Iqbal, El-Massry, Elagouz, & Elzembely, 2018). A study conducted in Malaysia found that 90% of students who spent more than two hours a day on computers exhibited symptoms associated with CVS. Although students currently rarely use computers and switch to laptops, the impact is comparable to that of using computers (Vikanaswari & Handayani, 2018). Computer users who do not take a break every 20 minutes are twice as likely to develop CVS as those who do (Assefa, Weldemichael, Alemu, & Anbesse, 2017). According to American Optometric Association (AOA) recommendations, every two hours of computer use should be followed by a 15-minute break to alleviate eye fatigue induced by continuous computer use and to provide users with additional comfort so the eye can readjust their focus (Pawar, Soni, & Bajpai, 2015).

In the meantime, the e-learning strategy has emerged as an alternative method of teaching adopted during the pandemic to continue the teaching-learning process in a virtual manner. Medical courses are now learned through distance learning from home using an online approach, and medical students at Muhammadiyah University Surabaya use learning platforms, such as Moodle-based e-learning, video conferencing and social networking (Utama, Levani, & Paramita, 2020). According to previous studies, medical

students' use of e-learning during the Covid-19 pandemic has had several negative consequences on their health scale. The most prevalent outcomes experienced by students are ocular and non-ocular symptoms associated with CVS, which raises concerns about health problems associated with excessive use of digital devices during the Covid-19 pandemic (Lakshmi, 2020). A survey of medical students' awareness of CVS revealed that 80% were unaware of the syndrome and the effects of long-term computer use on the eyes or the factors that influence it (Kumar, 2020).

The study of visual complaints related to CVS caused by medical students' use of digital devices during learning activities may benefit educational programme policies or institutions and raise awareness of healthy lifestyles among stakeholders. Institutional policies on this subject should be studied immediately to develop effective strategies for protecting the younger generation from the negative health consequences of excessive digitisation during a pandemic (Lakshmi, 2020). Considering the critical nature of eye health for educational performance, visual impairment caused by visual fatigue can lead to a decrease in learning efficiency and in a person's quality of life (Altalhi, Khayyat, Khojah, Alsalmi, & Almarzouki, 2020). This study determines the relationship between computer use and rest time with the incidence of CVS in medical students during the Covid-19 pandemic era.

## MATERIALS AND METHODS

The sample of this study is fourth-year cohort undergraduate medical students and clerkships medical students of Muhammadiyah Surabaya University-Faculty of Medicine

(MSU-FM), who participated in a three-week cross-sectional study from November to December 2020. This study included students who used a computer for at least one hour per day without a break or pause and were willing to participate as study subjects. Students who had historically used high myopia glasses with a prescription greater than -6.00 D, had congenital eye illness, were unable to finish the questionnaire or did not complete the questionnaire completely were excluded. Data were collected via an online survey link and a Google Form. Respondents were informed in advance about the objective, purpose and a brief description of how to fill out the questionnaire. Informed consent was obtained only if they agreed to participate in the survey. This study was approved by the Health Research Ethics Commission Faculty of Medicine, Muhammadiyah Surabaya University (No.030/KET/II.3/AU/F/2020).

The questionnaire used in this study was adapted from Segui et al. (2015) and was divided into four sections: (i) demographic details of the respondents, (ii) questions regarding the characteristics of computer use, (iii) questions regarding the duration of computer use and break time and (iv) questions regarding symptoms or complaints associated with CVS. The Indonesian translated questionnaire content was validated by a medical expert panel. Factor analysis was conducted using a pilot study with 150 participants. The results revealed that one of the questions in the questionnaire was invalid: The questions referred to coloured halos around objects. The Cronbach's Alpha score was .81 thus the questionnaire is reliable. The chi-square test was applied to categorical data to determine the association between variables. Using a confidence interval (CI) of 95%, the significance level was carried out with a significance limit ($\alpha <$

0.05). If the significance value is less than ($p$-value < α), a significant association exists between the independent and dependent variables, and vice versa.

## RESULTS

This study enrolled 194 (75%) medical students from Muhammadiyah Surabaya University-Faculty of Medicine as undergraduates and clerkship students who answered the questionnaire completely. Two of the respondents had used high myopia glasses with a prescription greater than -6.00 D. No respondent had congenital eye illness. Four respondents were unable to finish the questionnaire, and six respondents did not complete the questionnaire. Data for the excluded respondents were dropped from the analysis process.

The participants' ages ranged from 18 to 24 years. There were 134 females (69%) and 60 males (31%). Table 1 presents the respondents' characteristics.

**Table 1. Respondents' Characteristics**

| Variable | N (194) | % |
|---|---|---|
| **Device type** | | |
| Computer | 5 | 2.6% |
| Laptop | 189 | 97.4% |
| **Lighting in the room** | | |
| Natural light | 64 | 33% |
| Fluorescent light | 130 | 67% |
| **The use of antiglare filter** | | |
| Yes | 40 | 20.6% |

| | | |
|---|---|---|
| No | 154 | 79.4% |
| **Distance to the monitor** | | |
| ≥ 50 cm | 112 | 57.7% |
| < 50 cm | 82 | 42.3% |
| **Monitor level to the eye** | | |
| Eye level | 89 | 45.9% |
| Lower | 105 | 54.1% |
| **Daily use** | | |
| ≥ 4 hours | 156 | 80.4% |
| < 4 hours | 38 | 19.6% |
| **Spectacles use** | | |
| Yes | 92 | 47.4% |
| No | 102 | 52.6% |
| **Contact lenses use** | | |
| Yes | 8 | 4.1% |
| No | 186 | 95.9% |
| **History of the eye disease** | | |
| Yes | 51 | 26.3% |
| No | 143 | 73.7% |
| **Medication use** | | |
| Yes | 4 | 2.1% |
| No | 190 | 97.9% |

The majority of students in this study (189, or 97.4%) used laptops, and 130 (67%) used fluorescent bulbs to light the room. Of the respondents, 40 (20.6%) used an antiglare filter on their monitor. In terms of the distance between the eyes and the monitor, 112 (57.7%) had less than 50 cm. Up to 105 (54.1%) monitor positions were discovered to be

below eye level. The majority (156, 80.4%) used their devices for an average of over four hours in a single day. While using the device, 92 (47.4%) wore glasses and 8 (4.1%) wore contact lenses. Of the participants, 51 (26.3%) had a history of refractive errors, such as myopia or astigmatism. Only 4 (2.1%) were taking medication at the time of the study.

**Table 2. Distribution of CVS Symptoms**

| Symptoms | N | % |
|---|---|---|
| Headache | 134 | 73% |
| Burning | 129 | 69% |
| Itching | 67 | 67% |
| Increased sensitivity to light | 120 | 67% |
| Tearing | 84 | 62% |
| Blurred vision | 99 | 59% |
| Eye pain | 112 | 58% |
| Heavy eyelids | 107 | 55% |
| Eye redness | 87 | 51% |
| Feeling that sight is worsening | 115 | 46% |
| Dryness | 46 | 45% |
| Excessive blinking | 77 | 43% |
| Difficulty of focusing near vision | 130 | 40% |
| Feeling of a foreign body | 89 | 35% |
| Double vision | 142 | 24% |

The results show that most students (142, 73%) reported experiencing headaches, followed by a burning sensation in the eyes (134, 69%), itchy eyes (129, 67%) and

increased sensitivity to light (130; 67%). The most frequently reported issue by respondents was double vision (46, 23.7%).

**Table 3. Result of Univariate Analysis**

| Variable | N | % |
|---|---|---|
| **Duration use** | | |
| ≥ 3 hours | 118 | 61% |
| < 3 hours | 76 | 39% |
| | 194 | |
| **Taking breaks** | | |
| < 15 minutes | 78 | 66% |
| ≥ 15 minutes | 40 | 34% |
| | 118 | |
| **CVS incidence** | | |
| Yes | 95 | 80% |
| No | 23 | 20% |
| | 118 | |

The univariate analysis showed (Table 3) the incidence of CVS; of the 118 (61%) students who used the computer constantly for over three hours, 78 (66%) took a break of less than 15 minutes and 95 (80.5%) experienced CVS, whereas 23 (19.5%) did not.

**Table 4.** Results of Bivariate Analysis

| Variable | CVS | | | | OR (95% CI) | *p*-value |
|---|---|---|---|---|---|---|
| | Yes | | No | | | |
| **Duration use** | **N (141)** | **%** | **N (53)** | **%** | 2.694 (1.410 – 5.146) | .002 |
| ≥ 3 hours | 95 | 67% | 23 | 43% | | |
| < 3 hours | 46 | 33% | 30 | 57% | | |
| **Taking breaks** | **N (95)** | **%** | **N (23)** | **%** | 8.870 (3.127 – 25.154) | .000 |
| < 15 minutes | 72 | 76% | 6 | 26% | | |
| ≥ 15 minutes | 23 | 24% | 17 | 74% | | |

The bivariate analysis using the Chi-square test revealed a significant association between the duration of computer use ($p = .002$) and break time ($p = .000$) and the occurrence of CVS (Table 4). The odds ratio (OR) value shows that operating on a computer constantly for over three hours increases the risk of CVS by 2.694 times while taking a break of less than 15 minutes increases the risk by 8.870 times.

## DISCUSSION

In this study, the prevalence of CVS was found to be 80% among medical students who used a computer for more than three hours continuously without taking a break of at least 15 minutes. According to Iqbal *et al.*, CVS was shown to be prevalent in 86% of the participants who spent three hours a day on digital devices. Students who used digital devices for three hours a day were found to be more likely to have one or more CVS manifestations. In Bali, CVS was found to be prevalent in 74% of students, with a higher prevalence in women, a distance between the user's eyes and monitor of less than 50 cm, monitor lower than eye level, computer use lasting more than 4 hours, and rests of less

than 15 minutes between computer use and wearing glasses (Darmaliputra & Dharmadi, 2019). Because this study was conducted during the Covid-19 pandemic lockdown, which impacted the duration of time spent on VDT such as computers or laptops, the frequency of this study was determined to be higher than the findings in Bali, before the pandemic occurred. In our study, students spend at least 2-6 hours per day online, and that does not necessarily include assignments that require students to use the computer for extended periods. Apart from the need to maintain space between individuals during the lockdown, we are compelled to use audio-visual media such as video conferences or virtual courses via computers/laptops and other devices for most communication.

The duration of exposure to these devices is critical in the development of certain vision-related symptoms and some musculoskeletal disorders associated with CVS incidence. In Islamabad, 93.6% (381/407) of respondents reported an increase in their use of digital devices during lockdown of up to 5 hours or more, with 40.9% (85/208) of respondents being students (Bahkir & Grandee, 2020). In China, the prevalence of CVS was found to be 74.3% higher in students who took only online classes, compared to students who took lectures in classrooms at 50.79%. In comparison to students who did not attend online classes, those who attend online classes spend around 7-9 hours each day in front of a digital screen (Wang et al., 2021).

These findings are in line with another study conducted on medical students, which discovered that the most significant risk factor was daily computer use of 3 hours or more ($p = .001$) (Abudawood, Ashi, & Almarzouki, 2020). According to a study, CVS symptoms typically begin to manifest and are reported after three hours of continuous

computer use without a break (Sen & Richardson, 2007). Similarly, a study reported a prevalence of CVS of 55% among engineering students, with 79% (164) of students experiencing CVS for a duration of computer use > 3 hours per day, while another 52% (175) of students who used computers for < 3 hours per day did not experience CVS (Mani & Menon, 2016). Previous research reported that respondents who used their laptops excessively had a 2.5 times increased risk of developing CVS; these findings are in line with the OR value of 2.526 in this study (Muchtar & Sahara, 2016). A correlation was found to exist between increased screen exposure duration and symptoms, and the results were statistically significant ($p$ = .001) (Bahkir & Grandee, 2020).

Other results that found that visual fatigue was experienced more in VDT users of more than 4 hours (Parihar et al., 2016). As in the study mentioned by Dharmaliputra, individuals who took a break of less than 15 minutes after using a computer for over four hours were 78.3% more likely to develop CVS (Darmaliputra & Dharmadi, 2019). In our study, we discovered that taking breaks of less than 15 minutes was significantly associated with CVS ($p$ = .000). According to Kumasela's study, most respondents (42.5%) took only a 10-15 minute break after using the computer, which contributed to the most vision-related complaints of any duration (Kumasela, Saerang, & Rares, 2013). A study in India reported that students who worked with computers continuously without taking a break had a higher risk of developing CVS symptoms compared to students who frequently took short breaks (Logaraj, Madhupriya, & Hegde, 2014). Another study found that among 547 college students (68.8%), taking a break between computer use is one of the most common preventive measures to relieve CVS symptoms, with an average break

of 15 minutes (Reddy et al., 2013). However, no studies have shown the ideal rest time because many factors affect the incidence of CVS.

Our study found that the most common symptom reported by students was headache 73% (142), as found in previous studies (Bahkir & Grandee, 2020; Cantó-Sancho, Sánchez-Brau, Ivorra-Soler, & Seguí-Crespo, 2020; Iqbal et al., 2018; Reddy et al., 2013). Headaches can be a presentation of eye strain, an undiagnosed refractive error or the result of prolonged exposure to bright light (Bahkir & Grandee, 2020). Headaches are followed by visual symptoms such as a burning sensation in the eyes (69%; 134) (Agarwal, Goel, & Sharma, 2013; Al Rashidi & Alhumaidan, 2017; Humayun, 2020), itchiness (69%; 134) (Agarwal et al., 2013; Altalhi et al., 2020; Cantó-Sancho et al., 2020) and increased sensitivity to light (67%; 130) (Altalhi et al., 2020; Khola, Kashif, Aftab, & Muhammad, 2021; Lertwisuttipaiboon, Pumpaibool, Neeser, & Kasetsuwan, 2016).

The eye-focusing mechanism will respond differently when reading printed text and viewing the VDT screen. There are significant differences between reading printed text and looking at a computer screen in terms of viewing distance, gaze angle, blink rate, text display and the necessity for accommodation, as in the widening of the palpebral fissure while reading (Chang, Chou, & Shieh, 2013; Lee, Ko, Shen, & Chao, 2011). When computer use is prolonged, the ciliary muscles of the eyes are forced to work continuously to maintain clarity and focus on objects on the computer screen, putting the eye muscles under repeated stress, and the eyes begin to experience muscle tension followed by eye fatigue (Affandi, 2005). CVS is more likely to develop in computer users who rarely or never rest because although the eyes cannot normally remain focused on an object/image

generated by pixels on the computer screen for an extended period, the eye must maintain focus continuously when looking at the screen, thus reducing the frequency of blinking and increasing tear film evaporation (Assefa et al., 2017). Thus, visual work performed on digital devices such as computers/laptops require frequent saccadic eye movements, continuous accommodation and vergence (simultaneous movement of the pupil of the eye towards or away from one another during focusing), all of which require continuous relaxation and contraction of the eye muscles (Alemayehu & Alemayehu, 2019).

Studies have shown that many people still tend to ignore the symptoms of CVS, even though symptoms can be prevented by taking breaks to relax the eye muscles (Rahman & Sanip, 2011).

A previous study of engineering students in India involving 339 respondents stated that 79.3% (164) of students experienced CVS with a duration of computer use > 3 hours a day (Mani & Menon, 2016). The finding is close to this study, which found that 80% of 194 medical students used devices for > 3 hours and continuously experienced CVS. Another important difference between the two studies is that the previous study considered three hours a day to be the initial manifestation of CVS symptoms, while in this study, we did not record the onset of CVS manifestation when using the device but rather obtained a response composed of 'Yes' and 'No', thus requiring the respondent to choose the statement that best fit the actual situation. There is no missing data in this study.

The limitation of this study is that the researcher was unable to observe the respondents directly because the research was conducted during the COVID-19 pandemic, when it was essential to follow health protocols to minimise direct contact/exposure between individuals to reduce the spread of COVID-19. The duration of computer use and the length of rest were the only variables examined in this study; other variables (such as age, gender, use of glasses or contact lenses, blinking frequency, type of lighting, type of computer, use of antiglare screens, monitor distance and viewing angle) were omitted. This research is not perfect for diagnosing CVS because there is no clinical examination by an expert in the form of the Schirmer test, visual acuity examination and refractive error to confirm the diagnosis of CVS. This research was conducted exclusively in the Faculty of Medicine, Muhammadiyah Surabaya, with a limited sample, and hence cannot be considered to represent the entire population. Because the data were collected through self-reported surveys, this could be a source of bias. Furthermore, because this is a cross-sectional study, establishing a causal association between risk variables and disease is difficult.

## CONCLUSIONS

The incidence of CVS among medical students is still high. Concerns have been raised concerning the health issues of the widespread use of digital devices during the Covid-19 pandemic. There is an urgent need to build institutional policies that involve all stakeholders to develop effective strategies for preventing adverse health impacts.

Computer users require more awareness and intervention strategies as a protective measure to avoid CVS. It is highly recommended that users participate in training based on correct ergonomic principles to use computers effectively and optimise body posture for the work environment**.**

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