

Factors Associated With Computer Vision Syndrome Complaints In Computer Science Students

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ABSTRACT

Computer Vision Syndrome (CVS) has a global prevalence of 60%-90% among computer users where the total number of sufferers is estimated to reach > 60 million individuals per year and continues to appear one million new cases in the world. Based on the results of preliminary studies conducted on Computer Science students FMIPA ULM, it is known that the duration of computer use in a day for all respondents (100%) is >4 hours, this causes CVS sufferers among students to increase. The purpose of this study is to analyze the correlation of eye visibility, duration of computer use, and length of rest to CVS complaints in students majoring in computer science. The study used a *cross sectional* quantitative design with a population of 193 students and a sample of 72 taken through proportional random sampling. The research instrument used a questionnaire adapted from previous research for the variables of duration of computer use, length of rest, and CVS complaints, while the eye visibility variable used a tape meter. The results of Chi-Square testing showed that there was a correlation between eye distance (p-value = 0.018), duration of computer use (p-value = 0.002), and duration of rest (p-value = 0.001) with CVS complaints. Students are advised to adjust their eye distance with a computer screen as far as 50-100cm, take a break for 10 minutes when working in front of a computer for 1 hour, and adjust work patterns so that they are not long in front of the computer.

Keywords: CVS, students, computers

INTRODUCTION

The American Optometric Association (AOA) defines *computer vision syndrome (CVS)* as a set of eye symptoms caused by prolonged use of computers, tablets, mobile phones and other electronic devices. (1). CVS is also a generalized eye problem related to the type of close work that individuals suffer when using computers. The *Occupational Safety and Health Administration (OSHA)* describes CVS as a disorder of the eyes and vision when using computers excessively. (2). Individuals can be diagnosed with CVS if they experience complaints of vision due to computer use > 4 hours per day. (3). Symptoms or complaints of CVS are classified into four types, namely asthenopia symptoms including headaches, dry eyes, pain, tension and eye fatigue, ocular surface-related symptoms which include irritated and watery eyes, visual symptoms which include double and blurred vision and difficulty in focusing vision, and also extra-ocular symptoms which include pain in the back, neck and shoulders. (4).

Referring to data on *internet use worldwide*, the total number of computer users in 2019 was 4.119 billion, in 2020 there were 4.585 billion, and increased dramatically in 2021 with 4.661 billion users. Meanwhile, based on a survey from the Indonesian Internet Service Providers Association (APJII), internet users in the Indonesian region recorded up to 78% in 2023 or around 215 million people from a total of 275 million people. (5). Data from the Central Statistics Agency for 2018-2021 states that 65.37% of internet users in Indonesia are residents aged 19-49 years with 22.32% active student users. This causes CVS sufferers among students to increase (6).

CVS has a global rate of 64%-90% in computer users and a total of 60 million sufferers and will increase to 1 million new cases each year.(7). Then according to Dabrowiecki in 2019 in the past 30 years there were up to 70% of total computer users who had CVS. Surveys conducted in America, 70-90% of computer users are affected by CVS, especially if their use exceeds 4 hours a day. Whereas in Indonesia, based on a study by Nopriyadi et al in 2019 with a sample of 117 employees where there were 95 respondents or 81.2% affected by CVS, where the details of eye disorders were tired and tense 54.3%, neck pain 28.7%, shoulder pain 27.7%, headache with 25.5% and red eyes which were only 5.3%.

Excessive computer/laptop use may increase the risk of CVS. Laptops are currently a common tool used by students during learning. This is because laptops make it easier for students to carry out lecture activities, but the high use of laptops raises the risk of CVS in students, one of which is in students of the Computer Science Study Program (Prodi), Faculty of Mathematics and Natural Sciences, Lambung Mangkurat University (FMIPA ULM). This study program is synonymous with computer devices, computing systems and *computer programming*. This makes students in this study program have to spend most of their time using laptops. Based on a study from Logaraj et al, it was found that the prevalence of CVS sufferers in students majoring in computer science (86.67%) was higher than that of medical (78.6%) and engineering (81.9%) students. (8).

Loh & Reddy in 2008 said that CVS risk factors are classified into three types, namely due to individual aspects which include age, eye refractive disorders, eye distance, computer usage time, angle of vision, length of rest after computer use, and posture of computer use), computer factors (use of antiglare covers and poor screen resolution) and environmental factors (room lighting and imbalance of computer lighting with the environment). (1). Paying attention to the viewing distance when using a computer is a major aspect in an effort to reduce eye complaints such as red, watery, irritated and dry eyes as well as the onset of double vision and blurriness. Using a computer at a viewing distance of <50 cm has a risk of experiencing CVS.(9).

Duration is the time individuals use computers to support their work. Long computer usage time will cause long-term complaints and often even when the work has been completed. Prolonged use of the eye muscles increases the likelihood of CVS (10). (10). This is in accordance with a study from Wudya (2020) which explains that of the 77 respondents who had a duration of staring at a computer screen for 4 hours, 69 respondents experienced CVS complaints. Wudya also said that the duration/length of screen exposure was significantly associated with the occurrence of CVS in computer science students. This study shows that screen exposure duration above 4 hours is at risk of CVS up to 7.3 times. (11).

A computer break is the duration of a break after doing screen work. Efforts to minimize CVS disorders can be implemented through taking breaks in between computer use. The break time can be 10-15 minutes after doing computer work that continues for 1-2 hours. (12) (13). This is in line with a study from Atika et al in 2023 with 29 respondents where the results explained that the majority of respondents who rested under 10 minutes had CVS complaints, namely 130 people or 62.2%. (14). Referring to this explanation, the researcher has an interest in conducting research related to factors related to CVS complaints in Ilkom FMIPA ULM students.

METHODS

The research was conducted at the Computer Science Study Program (Prodi Ilkom), Faculty of Mathematics and Natural Sciences, Lambung Mangkurat University (FMIPA ULM) with a period of 2 months from October-November 2023. The independent variable used is CVS complaints while the independent variables are eye visibility, duration of computer use, and length of rest. This study uses a sampling method, namely *proportional random sampling*. Respondents of this study were active students of the Ilkom FMIPA ULM class of 2021, 2022, and 2023, totaling 193 students. Based on the *Lemeshow* test, the results obtained were 65 research samples, then the results of this calculation were added with a correction factor of 10% so that the results obtained 72 students who were sampled. Data collection techniques by measuring and filling out questionnaires. The instrument used by researchers is an adaptation questionnaire from Muhammad Fadhil Ahmadiyah's research entitled "Incidence of *Computer Vision Syndrome* in Students of the Faculty of Medicine, Hasanuddin University Class of 2020" for CVS complaint variables, duration of computer use, and length of rest, while eye visibility variables are measured using a tool in the form of a tape meter. Data analysis using the SPSS application, namely the *chi-square* test with a 95% confidence level.

RESULTS AND DISCUSSION

Univariate analysis has the aim of explaining the distribution and frequency of the characteristics of respondents and each variable in this study. The following is a description of the distribution and frequency based on the characteristics and variables in this study.

Tabel 1. Characteristics of Respondents Based on Age, Gender, and Batch

No	Respondent Characteristics	Frequency (n)	Percentage (%)
Age			
1.	17 - 20	55	76,4
2.	21 - 23	17	23,6
Gender			
1.	Man	56	77,8
2.	Woman	16	22,2
Batch			
1.	2021	24	33,3
2.	2022	25	34,7
3.	2023	23	31,9
Total		72	100

Source: Primary Data Year 2023

Table 1 explains that of the 72 respondents, the majority were respondents aged 17-20 years with 76.4% (55 respondents). This is because the research respondents came from the 2021, 2022, and 2023 batch of students where the majority of respondents' birth years were in 2003, 2004, and 2005. In addition, the gender of respondents was dominated by men with 77.8% (56 respondents). This is because basically the number of male students in the computer science study program is more than the number of female students. The number of male students in the class of 2021 was 73.4% or 47 people out of a total of 64 students, class of 2022 was 85.07% or 57 people out of a total of 67 students, and class of 2023 was 74.1% or 46 people out of a total of 62 students.

Table 2. Frequency Distribution of Respondents Based on *Computer Vision Syndrome* Complaints

Variables	Frequency (n)	Percentage (%)
CVS Complaints		
No Complaints	29	40,3
Complaints	43	59,7
Eye View Distance		
50-100 cm	40	55,6
<50/>100 cm	32	44,4
Duration of Computer Use		
<4 Hour	31	43,1
≥4 Hour	41	56,9
Length of Break		
Good	38	52,8
Not good	34	47,2

Source: Primary Data Year 2023

Referring to the presentation of the results in table 2, it can be understood that the total respondents with CVS complaints were 43 respondents (59.7%) and those without CVS complaints were 29 respondents (40.3%). This explains that the majority of respondents experienced CVS complaints. Referring to table 2, it can be understood that there are 40 respondents (55.6%) working at an eye distance of 50-100cm. While respondents who worked at an eye distance of <50 />100cm were 32 respondents (44.4%). The results showed that the majority of respondents worked with visibility that was not at risk compared to those at risk. Based on table 2, it can be seen that respondents with computer usage time above 4 hours were 31 respondents or 43.1%. While respondents who have computer usage time below 4 hours are 41 respondents or 56.9%. This explains that the majority of respondents have a computer usage duration of less than 4 hours. Based on Table 2, respondents who rested well were 38 respondents (52.8%) while respondents who did not rest well were 34 respondents (47.2%). The study results state that the dominant respondents who take good breaks compared to those who do not.

Bivariate analysis is needed to observe the correlation of independent variables to the dependent variable, namely to correlate eye distance, duration of computer use and length of rest to CVS complaints for students of the Ilkom FMIPA ULM Study Program.

Table 3. Analysis of the Relationship between Free Variables and Complaints of *Computer Vision Syndrome*

Variabel	CVS Complaints				Total		P-value α= 0,05
	Complaints		No Complaints				
	N	%	N	%	N	%	
CVS Complaints							
No Complaints	19	47,5	21	52,5	40	100	0,018
Complaints	24	75,0	8	25,0	32	100	
Eye View Distance							
50-100cm	12	38,7	19	61,3	31	100	0,002
<50/>100cm	31	75,6	10	24,4	41	100	
Duration of Computer Use							
<4 Hour	16	42,1	22	57,9	38	100	0,001

Variabel	CVS Complaints				Total		P-value α= 0,05
	Complaints		No Complaints				
	N	%	N	%	N	%	
≥4 Hour	27	79,4	7	20,6	34	100	

Source: Primary Data Year 2023

Relationship between Eye Distance and Computer Vision Syndrome Complaints

Based on Table 3, it is known that there are 40 respondents who fall into the ideal visibility category (50-100 cm) and 32 respondents who fall into the non-ideal visibility category (<50/>100 cm). Table 3 also explains that in the group with ideal visibility (50-100 cm) the majority did not experience CVS complaints (52.5% or 21 respondents) compared to those who experienced CVS complaints (47.5% or 19 respondents). Whereas for groups who are accustomed to using computers with non-ideal visibility (<50/>100 cm) the majority experience CVS complaints (75.0% or 24 respondents) compared to those who do not have CVS complaints (25.0% or 8 respondents). The results of the bivariate test using chi-square obtained a *p-value* of 0.018 ($p < 0.05$) which can be interpreted that there is a significant correlation between eye visibility and CVS disorders.

There is a significant correlation between eye distance and CVS disorders, which can be understood because based on table 3, it was found that the at-risk group, namely those with <50 />100 cm visibility habits, experienced the majority of CVS complaints (75% or 24 respondents) compared to the non-risk group, namely those with 50-100 cm visibility habits (47.5% or 19 respondents). Field findings also corroborate the results that there is a significant correlation between eye distance and CVS disorders, where the at-risk group (75% or 24 respondents) mostly complained of eye fatigue symptoms, 75% (18 respondents), followed by watery eyes and headache, 70.8% (17 respondents) (Figure 1).

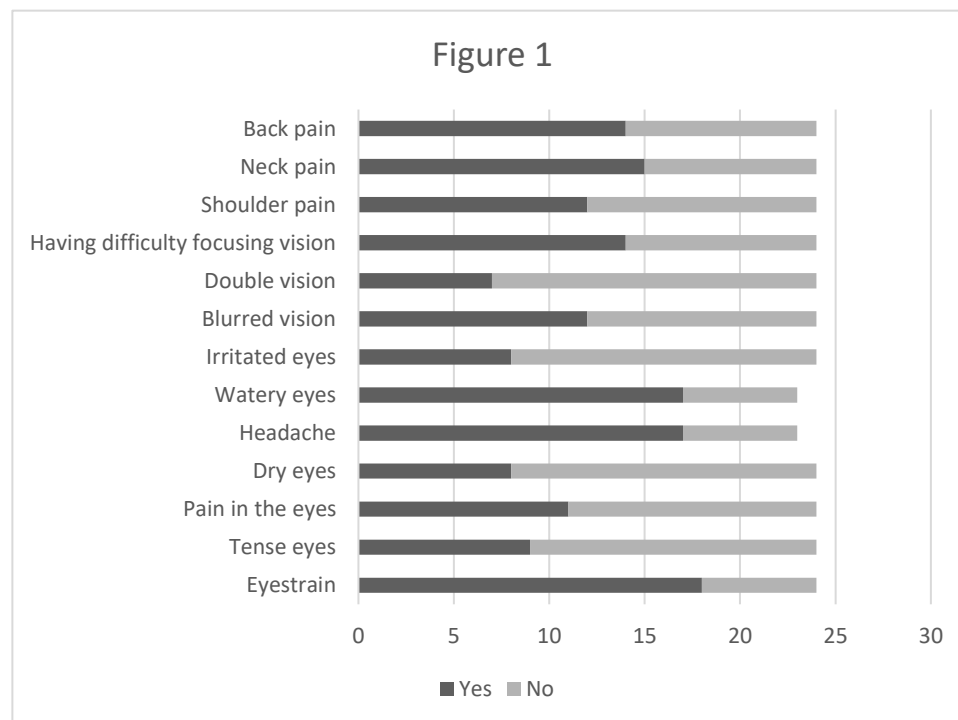


Figure 1: CVS symptoms in respondents with eye distance <50/>100 cm

This is also in accordance with the researcher's observations where respondents more often work on assignments in groups in the campus environment, both in classrooms and in canteens that do not have ergonomic tables and chairs. This causes respondents to be unable to adjust their viewing distance from the computer screen due to limited space. Respondents also often work on assignments in a sitting position while holding a laptop so that the distance between their eyes and the laptop screen is <50 cm. Very close eye distance to the computer screen can cause CVS complaints, namely eye fatigue because the eyes are forced to see visual objects (light) at close range and force the retina to work extra. This is what the respondents did because the form of task they were doing was a "coding" task. *Coding* is the activity of writing a set of codes (a combination of letters, numbers, or signs of a small size) as a way of communicating through a computer. (15). Through codes, we can command the computer to do certain things based on its instructions, so it requires high accuracy and concentration, causing respondents to keep their eyes close to the laptop screen.

This is also in line with the theory that eye fatigue can be caused by the eye muscles working continuously, especially when in close view. (16). When staring at a computer with a distance of <50 cm, the eye runs the accommodation system to focus so that the light can fall right on the retina to make the object can be seen clearly. (17). The continuous accommodation process makes the ciliary muscle tired, causing visual impairment, which is one of the symptoms of CVS.(18). The main factor that causes eye fatigue is the very close viewing distance of the computer screen, which makes the eyes have to work hard to keep seeing from a close distance for a long duration, while the function of the eye itself is basically not aimed at seeing objects at too close a distance.(19).

The results of this study are supported by a study from Valentina in 2019 proving that there is a significant correlation between eye distance and CVS disorders of students majoring in computer science with a *p-value* of 0.028, and a study from Moonti et al in 2022 found that eye distance is related to student CVS disorders where the *p-value* is 0.016. Moonti et al mentioned that computer users who look at the screen <50 cm have a 7.7 times higher risk of developing CVS compared to those working at a distance of >50 cm. The study from Arum et al in 2022 also explained that there was a significant correlation between eye visibility and CVS disorders where the *p-value* was 0.000.

Relationship between Duration of Computer Use and Computer Vision Syndrome Complaints

Based on Table 3, it is known that there are 31 respondents who fall into the category of working with non-risky duration (<4 hours) and 41 people who fall into the category of working with risky duration (≥4 hours). Table 3 also explains that in the group working with a non-risky duration (<4 hours) the majority did not experience CVS complaints (61.3% or 19 respondents) compared to those who experienced CVS complaints (38.7% or 12 respondents). As for the group working with risky duration (≥4 hours) the majority experienced CVS complaints (75.6% or 31 respondents) compared to those who did not have CVS complaints (24.4% or 10 respondents). The results of bivariate tests using *chi-square* obtained a *p-value* of 0.002 ($p < 0.05$) which can be interpreted that there is a significant correlation between the duration of computer use and CVS disorders.

There is a significant correlation between the duration of computer use and CVS disorders, which can be understood because based on Table 3, it was found that the at-risk group, namely those working with a duration of ≥4 hours, experienced the majority of CVS complaints (75.6% or 31 respondents) compared to the non-risk group, namely those working with a duration of <4 hours (38.7% or 12 respondents). Field findings also corroborate these results, where the at-risk group (31 people) mostly complained of eye fatigue symptoms, 77.4% (24 respondents), followed by

headache symptoms, 64.5% (20 respondents), and neck pain symptoms, 58.1% (18 respondents) (Figure 2).

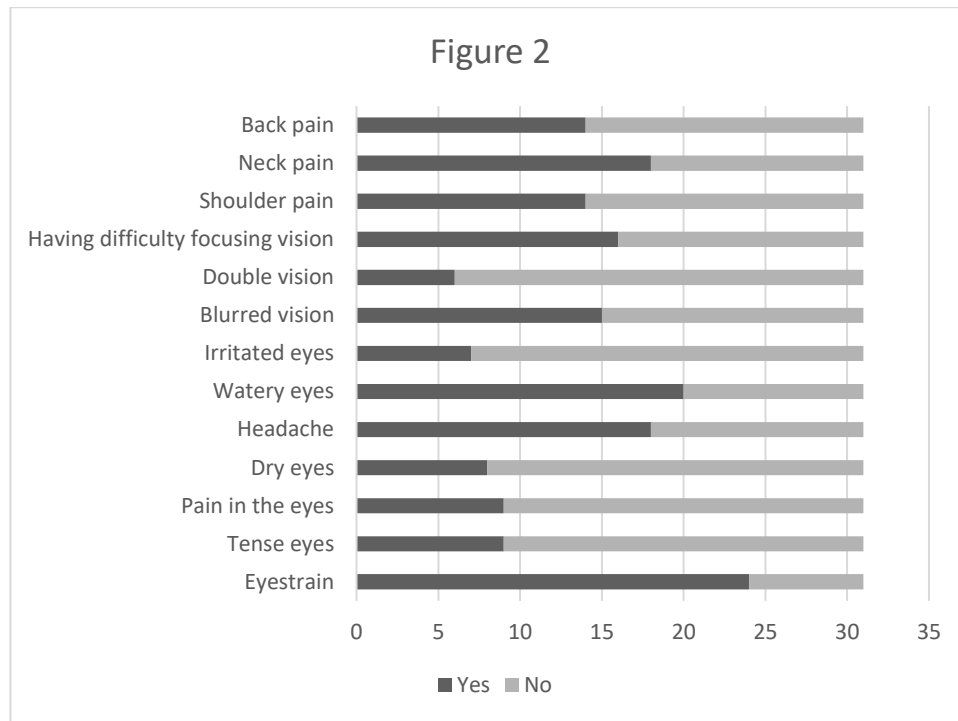


Figure 2. CVS Symptoms in Respondents with ≥ 4 hours of Computer Use Duration

This is in line with the researcher's observations where respondents work more in front of a computer with a duration of ≥ 4 hours due to the respondents' busy lecture schedule. Respondents in this study were taken from three batches, namely batches 2021, 2022, and 2023. The class of 2021 has an average of 2 courses a day, while the classes of 2022 and 2023 have an average of 3 courses a day. Busy class hours require respondents to stare at the computer screen longer because they need laptop media to support their lectures. Staring at the monitor for a long duration can cause eye complaints because the eye muscles or intrinsic muscles are forced to look at visual objects which can cause eye fatigue. Suffering from eye fatigue for a long time can result in head and neck pain.

This is in accordance with the theory that explains that the duration of computer use with a longer time has a tendency to cause long-term complaints that persist even when the work is done. (10). When compared to letters on paper, letters on the monitor have an angle with a blurrier level. This makes it more difficult for the eyes to stay focused so that the eyes relax their organs at the back of the monitor or termed as dark focus or *resting point of accommodation* (RPA) (20). Eye organs that relax at RPA and focus on the screen can cause eye fatigue and strain, which are symptoms of CVS. (21). Headaches can also occur when using a computer, as the eyes are required to forcefully contract and relax in order to show a clear and focused image. The repetitive movements of the eyeballs are caused by looking at the computer monitor thousands of times each day and cause stress on the eye muscles. This results in a feeling of discomfort in the area behind the eyes, leading to complaints of head and neck pain when staring at electronic devices. (21).

The results of this study are in accordance with a study from Julia et al in 2023 which explains that there is a significant correlation between the duration of computer use and students' CVS disorders with a *p-value* of 0.03. Julia mentioned that the correlation between these variables is due to the fact that when using electronic devices, there are certain mechanisms such as decreasing the level of life that makes the eyes dry easily and also repetitive eye movements cause fatigue in the eyes. This process causes the symptoms of CVS. This study is also supported by a study from Jundiah in 2023 which explains that there is a significant correlation between the duration of computer use and student CVS complaints with a *p-value* of 0.000. A study from Valentina in 2019 which states that there is a significant correlation between the duration of computer use and CVS complaints of students majoring in computer science where the *p-value* is 0.02.

Relationship between Length of Rest and Complaints of Computer Vision Syndrome

Based on Table 3, it is known that there are 38 respondents who fall into the category of well rested and 34 people who fall into the category of not well rested. Table 3 also explains that in the well-rested group the majority did not experience CVS complaints (57.9% or 22 respondents) compared to those who experienced CVS complaints (42.1% or 16 respondents). As for the group that did not rest well, the majority experienced CVS complaints (79.4% or 27 respondents) compared to those who did not have CVS complaints (20.6% or 7 respondents). The results of bivariate tests using chi square obtained a *p-value* of 0.001 ($p < 0.05$) which can be interpreted that there is a significant correlation between length of rest and CVS disorders.

The existence of a significant relationship between length of rest and CVS complaints can be understood because based on Table 3, it was found that the at-risk group, namely those who did not rest properly, experienced the majority of CVS complaints (79.4% or 27 respondents) compared to the non-risk group, namely those who rested properly (42.1% or 16 respondents). Field findings also corroborate these results, where the at-risk group mostly complained of eye fatigue symptoms (88% or 24 respondents), watery eyes (70.4% or 19 respondents), and neck pain (63.0% or 17 respondents) (Figure 3).

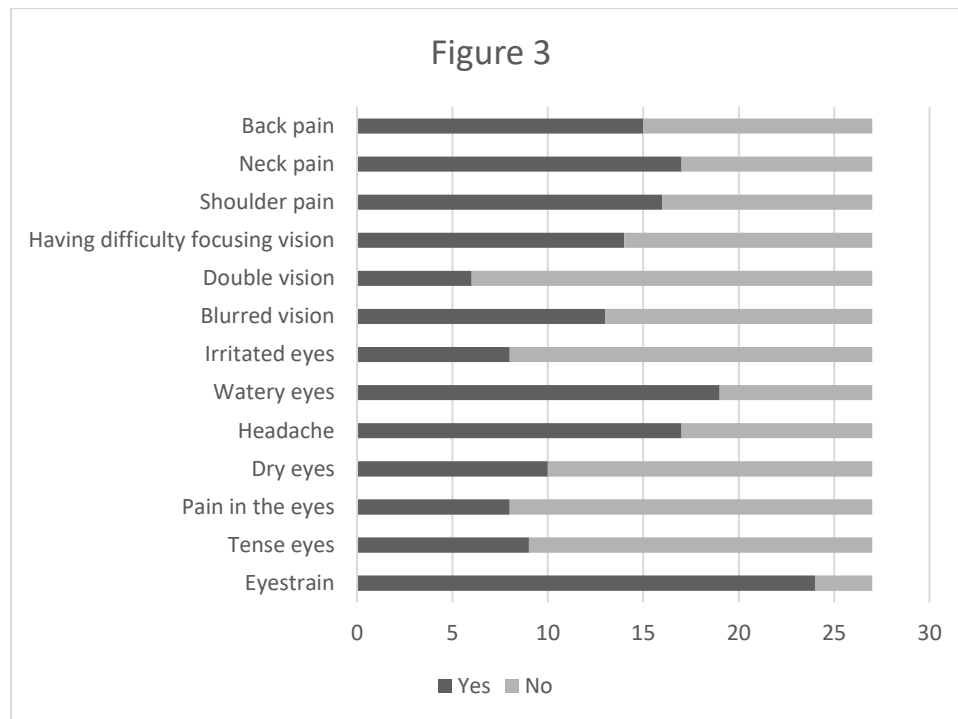


Figure 3. CVS Symptoms in Respondents with Poor Resting Time

This result is in line with the researcher's observation that respondents more often do work that requires a long time in front of a computer. Respondents are often given complex tasks and projects that require in-depth analysis, design, and implementation. This process often takes significant time to complete. Respondents are also often involved in software development, which requires writing code, testing, and debugging (*coding*) (52). The process can take a long time, especially if the project is large or has a high level of complexity. This results in a lack of breaks when using the computer, which can lead to CVS symptoms. Continuous computer use without adequate rest can reduce blinking rates, leading to dry and tired eyes.

This is in accordance with the theory which explains that eye breaks for computer users are needed because when using a computer the eyes make continuous accommodation and try to focus on the monitor. Rest time aims to restore one's mental and physical fitness. Therefore, time management when doing work and also rest time is a major factor. Taking short breaks in between work tends to be more efficient than taking long breaks only once. When resting the eyes have sufficient blinking time, blinking is a way of maintaining the pear film through tear secretion. The eyelids help spread the fluid to all areas of the eye surface and maintain its moisture level during blinking. If there is no such moisture, the cornea will dry out, become opaque and injured. (21). Breaks of at least 10 minutes every 1 hour have been shown to reduce eye-related or musculoskeletal-related disorders. A person who takes a 10-minute break every hour is better than taking a long break every 2 to 3 hours while using the device. It is recommended that every 10 minutes those who use a computer for 1 hour consecutively (12). In addition to these methods, the Indonesian Ministry of Health has also issued a good rest method for computer users. The method is called 20-20-20. This means that every time you work in front of a laptop for 20 minutes, it is recommended to take a 20-second break, by observing an object 6 m or 20 feet away.

The results of this study are in line with a study from Jundiah et al in 2023 which proves that there is a significant correlation between the length of rest against CVS disorders of computer science students with a *p-value* of 0.001, and a study from Arum et al in 2020 proves that there is a significant correlation between the length of rest against CVS disorders. Arum et al mentioned that the frequency of breaks after using a computer can increase comfort and also make the eyes more relaxed. Taking a short break for 5-10 minutes is considered better than a long break but after two to three hours of using the computer. Another study from Aditya et al in 2022 stated that there was a significant correlation between the length of breaks and CVS disorders where the *p-value* was 0.02.

There are several limitations to this study, namely the measurement of CVS complaints is only based on the symptoms felt by respondents without any medical examination so that it is subjective. In addition, the limitation in this study is that the instrument for measuring eye visibility variables still uses a round cloth meter, not using an anthropometric meter.

CONCLUSION

Based on the results of the study, it can be concluded that there is a significant relationship between eye visibility, duration of computer use, and length of rest with CVS complaints in students of the Ilkom FMIPA ULM Study Program. The advice for students of the Communication Science Study Program is to always remember that the demands of lectures and assignments carried out have the potential to cause CVS complaints. Therefore, students are advised to be able to adjust the distance between their eyes and the computer screen as far as 50-100cm. Students are also advised to take a good break after working in front of the computer. Rest can be done for 10 minutes after working in front of the computer for 1 hour, besides that rest can also be done by the 20-20-20 method, which is resting for 20 seconds after working for 20 minutes by looking at objects as far as 20 feet (6 meters). In addition, it is necessary for students to organize their work patterns so that they do not work in front of the computer for too long. Students can work on tasks in groups so that the assigned tasks can be completed more quickly.

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