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# Computer vision syndrome among university students: A cross sectional study from Perak, Malaysia

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## ABSTRACT

**Introduction:**
Computer vision syndrome (CVS) is associated with the prolonged usage of computers, which causes accommodative problems in the eye, corneal dryness, reduced blink rate, and musculoskeletal symptoms due to the improper posture. This study aimed to determine the prevalence and factors associated with CVS among university students.

**Methods:**
This cross-sectional descriptive study was conducted at the Quest International University, Ipoh, Malaysia. One hundred seventy-three students from different faculties participated in the research. Computer-Vision Symptom Scale (CVSS17) and Computer Vision Syndrome Questionnaire (CVS-Q) were used to assess the CVS.

**Results:**
Most (76.7%) of the respondents suffered from CVS, where 80% were females and 72.7% were males. 76.1% of the CVS sufferers had poor head posture. A vast majority reported dull environmental illumination, leaning forward during device usage. The top line of the screen above eye level was reported by 80.9% of students who suffered from CVS, and was statistically significant.

**Conclusion:**
CVS is present amongst the participants. Correct posture, frequent breaks, proper lighting in the surroundings, and correct viewing angle help minimize CVS complications. Special attention needs to be given to the affected students.

**Keywords**
Computer Vision Syndrome Questionnaire, Computer-Vision Symptom Scale, Malaysia, student, symptoms

## Introduction

In the 21st century, personal computers are the most commonly used electronic items worldwide. All sectors of the economy, including educational institutions, use computers as an integral part of the system. [1] Research studies documented a potential health risk of developing computer vision syndrome (CVS) even with a minimum usage of three hours per day. Low back pain, tension headaches, and psychosocial stress are the most typical problems associated with CVS. [2, 3] CVS is defined as "a group of visual and ocular problems related to the prolonged use of computers and devices with video terminals" [4] Three basic mechanisms associated with CVS, musculoskeletal symptoms which is due to the improper posture when using the computer devices, accommodative problems which is evident by the double vision, blurred vision, myopia and time delay when focal length changes, and lastly the ocular surface associated complications like corneal dryness, reduced blink rate, increased corneal exposure caused by horizontal gaze at the screen of computing devices. [5-8] Around 64% to 90% of computer users suffer from CVS. [9] According to a study, 60 million computer users worldwide suffer from CVS, with an additional one million cases every year. [10] A large number of studies globally have confirmed the severity of the situation. Research from Jamaica found that 40.3% of students used a computer for more than six hours daily, which caused pain in the neck, shoulder, straining eyes, and a burning sensation in the eye. [11] A study from Saudi Arabia showed that almost all are affected by CVS (97.3%), where headache, myopia or hyperopia, and burning sensation in the eyes are widespread. [12] The outbreak of COVID-19 urged us to rethink the excessive use of computers, as a Peruvian study showed the prevalence of CVS was 80.6%, which was quite high. [13] Relatively less research has been conducted to document the effects of computer use on the physical health of Malaysian university students. Therefore, this study aimed to determine the prevalence and factors associated with CVS among university students.

## Methods

### Study period, study design, and participants

This cross-sectional descriptive study was conducted at the Quest International University (QIU) from May 2021 to December 2021. Questionnaires were distributed amongst the students of different faculties. A total number of 173 students participated in this research.

### Inclusion and exclusion criteria

All students at QIU from foundation, diploma, degree and postgraduate courses who can read, write and understand English and are willing to participate were included. Students unwilling to participate and who did not provide informed consent were excluded.

### Sample size calculation

The selection of study participants was voluntary, and a convenient sampling was used for this research. The sample size was calculated based on previous research by Reddy *et al*. [14] The sample size was calculated as 168 for a confidence interval of 95 percent and an absolute precision of 5%.

### Collection of data and questionnnaire

Questionnaires were distributed online, including basic demographic profile, posture, support, illumination, and history of pre-existing optic problems, adapted from previous studies. [8, 15, 16] To assess CVS, Two questionnaires, namely Computer-Vision Symptom Scale (CVSS17) and Computer Vision Syndrome Questionnaire (CVS-Q), were used to determine the symptoms and severity of CVS. [17, 18]

Computer-Vision Symptom Scale (CVSS17)

The CVSS17 contains 17 items with different rating scales. Two items (A30 and B7) have two response categories; 11 items (A2, A4, A21, A22, A28, A33, B8, C16, C21, C23, and C24) have three response categories; and 4 items have four response categories (A9, A17, A20, and A32). CVSS17 Score= (Sum of score) x 17/ number of valid responses. The calculated score ranges from 17 to 53 in which higher score indicates a higher level, which means more severity. Level 1, 2, 3, 4, 5 range from 17-22, 23-28, 29-35, 36-42, and 43-53, respectively. [17]

Computer Vision Syndrome Questionnaire (CVS-Q)

CVS-Q is a severity (Frequency x Intensity) rating scale that measures the frequency of symptoms with options of 'never,' 'occasionally,' and 'often or always' and rates the intensity of symptoms as moderate or intense. Total score was calculated using the formula:

$$\sum_{i=1}^{16}(frequency \text{ of symptoms occurrence})i * (intensity\ of\ symptom)i.$$

The total score ≥6, was considered to have CVS. [18]

### Independent Variables

Age, gender, ethnicity, courses of study, head posture, neck posture, back posture, environmental illumination, lean forward during device usage, usage of back supporting chair, computer screen and eye level, adjustability of the screen, usage of glare filter, duration of computer usage were independent variables.

### Dependent variables

Prevalence and severity of symptoms of CVS.

### Data management and statistical analysis

Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS v26). Chi square and fisher exact test was performed. p value < 0.05 was considered as statistically significant.

**Ethical committee approval**

Participation in this study was completely voluntary. Informed consent was also obtained. The subjects were free to participate or withdraw from the research at any time. Confidentiality and anonymity were integral parts of the research to protect participants' privacy. We obtained approval from the QIU Research Ethics committee.

## Results

**Table 1: Socio-demographic variables of respondents (n=173)**

| Demographic profile | n | (%) |
|---|---|---|
| Age | | |
| 17-18 | 9 | (5.2) |
| 19-20 | 35 | (20.3) |
| 21-22 | 74 | (43.0) |
| >22 | 54 | (31.4) |
| Gender | | |
| Male | 77 | (44.8) |
| Female | 95 | (55.2) |
| Ethnicity | | |
| Chinese | 106 | (61.6) |
| Malay | 5 | (2.9) |
| Indian | 48 | (27.9) |
| Others | 13 | (7.6) |
| Courses | | |
| MBBS | 50 | (29.1) |
| Pharmacy | 8 | (4.7) |
| Business | 33 | (19.2) |
| Biomedical | 6 | (3.5) |
| Arts | 15 | (8.7) |
| Others | 60 | (34.9) |

Table 1 shows the demographic profile of the students (n=173), with 55.2% female and 44.8% male. Most of the participants were Chinese (61.6%), followed by Indian (27.9%), others (7.6%), and Malay (2.9%). In other courses (social sciences, engineering), students contributed the highest responses (34.9%), followed by MBBS (29.1%), business (19.2%), and Biomedical courses (3.5%).

**Table 2: Summary of CVSQ and CVSS17 score**

| Inventory | n | (%) | Mean | (SD) | Mdn | (IQR) |
|---|---|---|---|---|---|---|
| CVSQ | | | | | | |
| Negative | 40 | (23.3) | | | | |
| Positive | 132 | (76.7) | | | | |
| CVSS17 | | | 31.7 | (7.1) | 32.0 | (11.0) |

Table 2 depicts the overall score from the CVSQ and CVSS17 questionnaire responses, where 76.7% of the respondents suffered from CVS with a mean±SD of 31.7±7.1 (CVS 17), falls under the category of level 3 (score ranges from 29-35).

Table 3 describes the relationship between sociodemographic profile with CVS. Participants who were positive for CVS were 79.6% of > 22 years, 78.4% of 21-22 years, 77.8% of 17-18 years, and 68.6% of 19-20 years. 80% of the females and 72.7% of the males were positive for CVS. 80% of the Malay students were positive for CVS, followed by Chinese, Indians, and others. Based on CVS prevalence, art students (86.7%), followed by the MBBS (82%) and students from the school of business (81.8%), school of pharmacy (75%), and biomedical sciences (66.7%).

**Table 3: Association between computer vision syndrome and sociodemographic profile**

| Demographic profile | Negative n | (%) | Positive n | (%) | chi | (df) | P value |
|---|---|---|---|---|---|---|---|
| Age | | | | | | | |
| 17-18 | 2 | (22.2) | 7 | (77.8) | 1.678 | (3) | 0.642[×] |
| 19-20 | 11 | (31.4) | 24 | (68.6) | | | |
| 21-22 | 16 | (21.6) | 58 | (78.4) | | | |
| >22 | 11 | (20.4) | 43 | (79.6) | | | |
| Gender | | | | | | | |
| Male | 21 | (27.3) | 56 | (72.7) | 1.26 | (1) | 0.262[×] |
| Female | 19 | (20.0) | 76 | (80.0) | | | |
| Ethnicity | | | | | | | |
| Malay | 1 | (20.0) | 4 | (80.0) | 0.717 | | 0.92[a] |
| Chinese | 24 | (22.6) | 82 | (77.4) | | | |
| Indian | 11 | (22.9) | 37 | (77.1) | | | |
| Others | 4 | (30.8) | 9 | (69.2) | | | |
| Courses | | | | | | | |
| MBBS | 9 | (18.0) | 41 | (82.0) | 4.779 | | 0.428[a] |
| Pharmacy | 2 | (25.0) | 6 | (75.0) | | | |
| Business | 6 | (18.2) | 27 | (81.8) | | | |
| Biomedical | 2 | (33.3) | 4 | (66.7) | | | |
| Arts | 2 | (13.3) | 13 | (86.7) | | | |
| Others | 19 | (31.7) | 41 | (68.3) | | | |

[a]Fisher's exact test was performed

[×]p>0.05

Table 4 shows the association of CVS with posture and support. Good head posture was observed amongst 78% of the CVS sufferers, whereas 76.1% had poor head posture. Regarding neck posture & back posture, 79.2% and 79.6% had poor posture, respectively. Dull environmental illumination was reported by 79.5% of the CVS-positive respondents, and 73.5% leaned forward during device usage. The top line of the screen above eye level was reported by 80.9% of students who suffered from CVS and 19.1% of the non-sufferers, which was statistically significant. 79.4% CVS positive respondents said that the computer screen top line was (0-30 degrees) at or slightly below eye level. Half of the students reported that the top line of the screen was below eye level (more than 30 degrees). 77.5% of the CVS-affected population used adjustable screens, and 72.1% with the glare filter. Regarding the duration of computer usage amongst the CVS sufferers, 4-6 hours and >6 hours were practiced by 74.6% and 76.9% of students, respectively.

Table 5 depicts the association between CVS and the respondents' underlying history of optic problems. Most of the CVS-positive respondents (78%) use spectacles, while 22% of the non-sufferers use them. Contact lenses were

**Table 4: Association between computer vision syndrome with posture and support**

| Posture and Support | Negative n | (%) | Positive n | (%) | chi | (df) | P value |
|---|---|---|---|---|---|---|---|
| Head Posture | | | | | | | |
| Good | 13 | (22.0) | 46 | (78.0) | 0.075 | (1) | 0.784[×] |
| Poor | 27 | (23.9) | 86 | (76.1) | | | |
| Neck Posture | | | | | | | |
| Good | 14 | (29.8) | 33 | (70.2) | 1.546 | (1) | 0.214[×] |
| Poor | 26 | (20.8) | 99 | (79.2) | | | |
| Back Posture | | | | | | | |
| Good | 19 | (27.5) | 50 | (72.5) | 1.183 | (1) | 0.277[×] |
| Poor | 21 | (20.4) | 82 | (79.6) | | | |
| Environmental Illumination | | | | | | | |
| Dark | 0 | (0.0) | 2 | (100.0) | 2.085 | | 0.558[a] |
| Dull | 8 | (20.5) | 31 | (79.5) | | | |
| Bright | 28 | (23.1) | 93 | (76.9) | | | |
| Very Bright | 4 | (40.0) | 6 | (60.0) | | | |
| Lean Forward During Device Usage | | | | | | | |
| No | 18 | (20.2) | 71 | (79.8) | 0.949 | (1) | 0.330[×] |
| Yes | 22 | (26.5) | 61 | (73.5) | | | |
| Usage of Back Supporting Chair | | | | | | | |
| No | 19 | (22.9) | 64 | (77.1) | 0.012 | (1) | 0.913[×] |
| Yes | 21 | (23.6) | 68 | (76.4) | | | |
| Computer Screen at Eye Level | | | | | | | |
| Top line of the screen above eye level | 9 | (19.1) | 38 | (80.9) | 8.093 | (2) | 0.017[*] |
| Top line (0-30 degree) at or slightly below eye level | 22 | (20.6) | 85 | (79.4) | | | |
| Top line of the screen below eye level (more than 30 degrees) | 9 | (50.0) | 9 | (50.0) | | | |
| Adjustable Screen | | | | | | | |
| Non-adjustable | 11 | (25.6) | 32 | (74.4) | 0.174 | (1) | 0.677[×] |
| Adjustable | 29 | (22.5) | 100 | (77.5) | | | |
| Screen with Glare Filter | | | | | | | |
| No | 16 | (18.6) | 70 | (81.4) | 2.085 | (1) | 0.149[×] |
| Yes | 24 | (27.9) | 62 | (72.1) | | | |
| Duration of Computer Usage | | | | | | | |
| <4 hours | 0 | (0.0) | 5 | (100.0) | 1.148 | | 0.654[a] |
| 4-6 hours | 15 | (25.4) | 44 | (74.6) | | | |
| >6 hours | 25 | (23.1) | 83 | (76.9) | | | |

[a]Fisher's exact test was performed
[*]$p<0.05$, [×]$p>0.05$

used by 76.5% of the CVS-positive and 23.5% CVS negative respondents. Pre-existing myopia, hyperopia, astigmatism, and diplopia were less evident amongst the CVS sufferers.

## Discussion

CVS is a medical condition that requires attention; if unnoticed, it has severe health implications. The risk of CVS has increased at an alarming rate during the COVID-19 pandemic as the use of computers; smartphones became rampant as a part of the new public health measures to curb the SARS-CoV-2 virus spread. Face-to-face university activities were switched to the online mode, which significantly increased the time spent on electronic gadgets incurring adverse effects at the ocular/visual level. [13] The present study was conducted among university students from different faculties and showed the prevalence of CVS was 76.7%. The outcome of this research is in accordance with another study, where a higher rate of CVS (78.6%) was observed. [19] A similar research done by Rahman *et al*. on the Malaysian University staff showed a 68.1% prevalence of CVS, which is lower than ours. [20] Another study by Reddy *et al*. amongst Malaysian university students showed that 89.9% presented CVS, which is higher than our findings. [14] Coronel-Ocampos *et al*. also reported a large number of participants (82.5%) had presented CVS. [21]

**Table 5: Association between computer vision syndrome with history of optic problems of the respondent**

| Optic Problems | Negative n | (%) | Positive n | (%) | chi | (df) | P value |
|---|---|---|---|---|---|---|---|
| Usage of spectacles | | | | | | | |
| Yes | 27 | (22.0) | 96 | (78.0) | 0.412 | (1) | 0.521× |
| No | 13 | (26.5) | 36 | (73.5) | | | |
| Usage of contact lenses | | | | | | | |
| Yes | 8 | (23.5) | 26 | (76.5) | 0.002 | (1) | 0.966× |
| No | 32 | (23.2) | 106 | (76.8) | | | |
| Pre-existing myopia | | | | | | | |
| Yes | 25 | (25.8) | 72 | (74.2) | 0.79 | (1) | 0.374× |
| No | 15 | (20.0) | 60 | (80.0) | | | |
| Pre-existing hyperopia | | | | | | | |
| Yes | 5 | (26.3) | 14 | (73.7) | | | 0.775× |
| No | 35 | (22.9) | 118 | (77.1) | | | |
| Pre-existing astigmatism | | | | | | | |
| Yes | 9 | (24.3) | 28 | (75.7) | 0.03[a] | (1) | 0.862× |
| No | 31 | (23.0) | 104 | (77.0) | | | |
| Pre-existing diplopia | | | | | | | |
| Yes | 0 | (0.0) | 4 | (100.0) | | | 0.574× |
| No | 40 | (23.8) | 128 | (76.2) | | | |

[a]Fisher's exact test was performed
×p>0.05

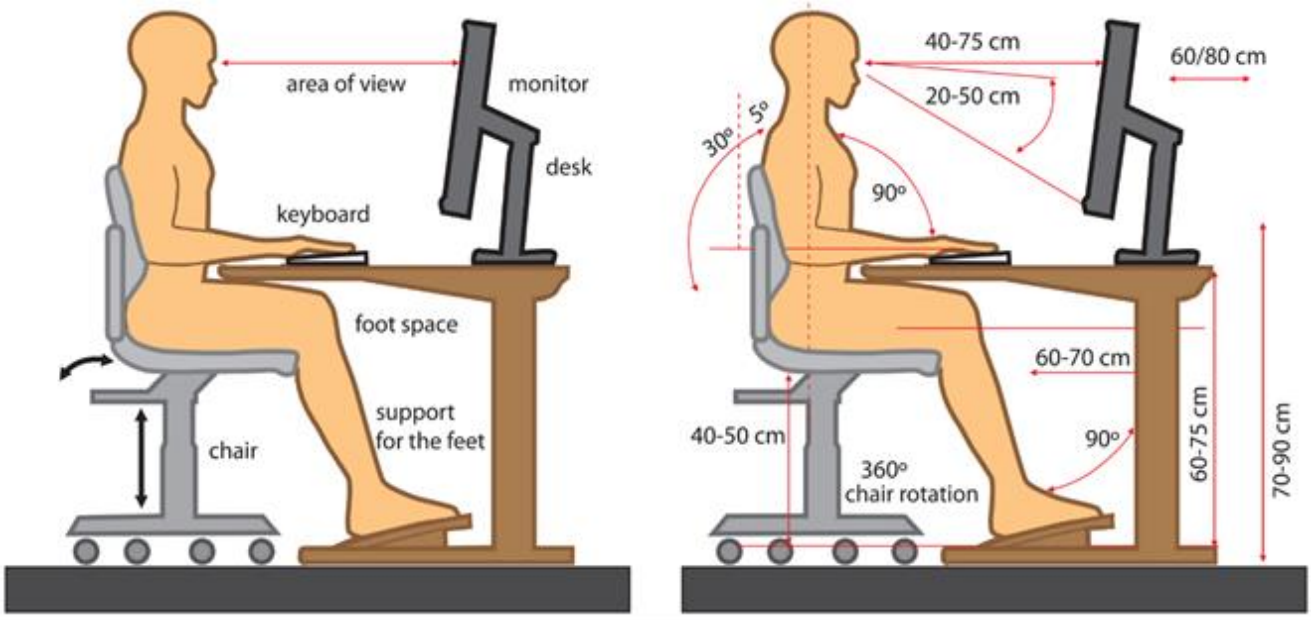


Figure 1: Proper body positioning for computer use. [27]

The higher the hours of use of the digital device, the greater the risk of digital eye strain (DES), and it is prevalent in medical students. [22] In contrast, a relatively less (59.5%) prevalence of CVS was observed among keyboard users. [23] Conversely, when compared to a study involving office workers, a lower prevalence rate (50 - 70%) was evident. [24, 25] These dissimilarities may be due to the variations in the usage of computers according to the demands of electronic devices in specific careers, which causes more occurrences of CVS in students. Also, when considering the work offices, implementing proper preventive measures, such as intermittent breaks during work hours, and workplace ergonomic workplace arrangements may have been preventing CVS. This contrasts with the medical students' context, where long hours of study and time spent with electronic gadgets became a potential threat to their health [26]. The higher rate of prevalence reported in this study also allows us to rethink the ocular health associated with the widespread usage of computers, laptops, and other displays during the pandemic. This unintentional exposure to electronic devices has more significant health consequences in the future, so we intend to bring it to light to draw attention and take significant measures. We

observed that more females were positive for CVS compared to male respondents. A study by Logaraj *et al*. found males were at a higher risk of developing symptoms of redness, burning sensation, blurred vision, and dry eyes. In contrast, females developed headaches and neck and shoulder pain. [19] We found that CVS sufferers significantly reported a top line of the screen was above eye level. According to the American Optometric Association, optimally, the computer screen should be 15 to 20 degrees below eye level (about 4 or 5 inches) as measured from the center of the screen and 20 to 28 inches from the eyes. [Figure – 1] [27] The possible explanation for the association between CVS and viewing angle is due to the long hours one spends in front of a computer with a different viewing angle. More sustained effort is required for visual accommodation, which, in turn, strains the eye and is most likely the reason for discomfort, such as a sensation of tearing and blurred vision, associated with CVS [28].

We observed a rise in CVS directly related to the number of hours spent on computer screens; the more exposure, the more the chances of being affected. A study by Reddy *et al*. showed similar results; > 2 hours of continuous computer use was significantly associated with the occurrence of CVS symptoms [14]. More pronounced visual symptoms were seen in people spending 6-9 hours at a computer, [29] whereas some researchers observed more rampant usage, i.e., >8 hours daily. [30] Prolonged computer usage without short breaks leads to the problem of shifting focus on the screen, documents, and keyboard. The constant process of drifting and refocusing on the fuzzy pixel of text on the screen strains the eye and makes it fatigued. We found no significant relationship between pre-existing myopia or hypermetropia and the CVS, following a study from Saudi Arabia, where investigators found that refractive errors did not have a significant association with CVS. [31, 32]

## Conclusion

We conclude that CVS is present amongst students. Taking short breaks, proper posture, less duration using the computer, adequate illumination, and correct viewing angle may alleviate symptoms of CVS. Our findings underline the importance of preventing CVS among university students and encouraging the use of computers in an ergonomic way to get the advantage of posture-related health risks. Suitable preventive measures must be adopted, giving special importance to those presenting risk factors.

## Limitation and future scope

Our research has certain limitations. First, potential selection bias, as we only included participants from one university in the state of Perak, therefore, the outcome of the study cannot be inferred to a broader aspect. Second, as this study is cross-sectional in nature, impossible to attribute causality between the variables caused CVS amongst participants. Last but not least we have not measured sleep hours, stress etc., which could be more relevant in this context.

## Abbreviations

Computer vision syndrome (CVS), Computer Vision Syndrome Questionnaire (CVS-Q), Computer-Vision Symptom Scale (CVSS17), Quest International University (QIU)

## Relevance of the study

The present study is significant because it highlights the importance of proper posture, ergonomic arrangement, and computer usage time. Our research analysis also features the high prevalence of CVS among students, which needs suitable preventive measures and self-awareness to reduce the risk of developing severe consequences.

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## Authors' contribution

All authors contributed equally to study planning, data collection, data analysis/ interpretation, manuscript writing, manuscript revision, All atuthors finally approved the manuscript. Agreement to be accountable for all aspects of the work was also accepted by all authors.

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## Availability of data and materials

All data underlying the results is available as part of the article, and no additional source data is required.

## Competing interests

None declared.

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