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# Prevalence and Associated Factors of Computer Vision Syndrome Among Undergraduate Students of Malaysia During the COVID 19 Pandemic

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## Abstract

Computer Vision Syndrome (CVS) is the eye and vision related problems due to prolonged use of computer devices. The burden of computer vision syndrome among computer users is a rising concern in this modern era, furthermore during the pandemic of Covid-19 where most learning is carried out virtually and therefore prolonged usage of computer devices among students in comparison to pre Covid-19 period. The cross-sectional study carried out was to determine the prevalence of CVS among undergraduate students in Melaka Manipal Medical College during the Covid-19 pandemic. The study also investigated the association of CVS with gender, screen time, screen brightness and pre-existing eye conditions. This study was conducted from June 2020 to July 2020 for a duration of 6 weeks. An online google form questionnaire was made consisting of 23 questions about demographic profile and habits on digital screen usage of the participants. 133 participants took part in our study. The collected data was processed with Microsoft Excel 2013 while Chi square statistical test was done using Epi Info software (version 7.2.4). The prevalence of CVS symptoms among the undergraduate students of Melaka Manipal Medical College was recorded to be 90.98% while a high percentage of 68.42% participants felt that their CVS symptoms either began or worsened after starting the online classes due to the Covid-19 pandemic. The most common symptoms of CVS experienced by the participants were pain in the neck, back or shoulders (64%), followed by fatigue (56%) and headache (47%). Females were significantly more likely to have symptoms of CVS compared to males. Furthermore, the students who spent >4 additional hours per day on digital devices during the Covid-19 pandemic were significantly more likely to have symptoms of CVS compared to the students who spent <2 additional hours per day.

## Keywords

Computer Vision Syndrome (CVS), Covid-19, Undergraduate Medical Students

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## 1. Introduction

It is undeniable how advancement of technology has brought tremendous benefits to the current era but despite it, prolonged use of computer devices can also bring equal parts of disadvantages such as vision and musculoskeletal disorders together with increased communication barriers among one another. [1-4] The exposure to computer screen time has undoubtedly increased making them more susceptible to Computer Vision Syndrome (CVS). [1, 2, 5] CVS, also known as Digital Eye Strain, is defined by the American Optometric Association as a complex of eye and vision related problems due to the prolonged use of computer devices. [1, 2, 4-10] CVS occurs due to the eyes and brain which are reacting differently to how a letter is viewed on screen and printed material. [5, 6, 11, 12] The common symptoms associated with CVS include, a) Asthenopia - sore

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eyes, eyestrain, tired eyes, b) Ocular surface related - dry eyes, irritated eyes, watery eyes, contact lens problems, c) Visual related - blurred vision, double vision, the slowness of focus change, presbyopia d) Extra ocular related - neck pain, shoulder pain, back pain. [1, 2, 5, 6, 7, 12, 13]

These symptoms are mostly temporary and disappear at the end of the computer work, but a minority may experience the symptoms continuously. [2, 6, 14] If an intervention is not initiated, the majority of these symptoms will recur and might worsen in the future. [6, 8, 14] Headache is the most prevalent out of the symptoms of CVS.[8] About 60 million people are affected by CVS worldwide and about a million new cases are added every year. [2, 4, 7, 12, 15] About 90% of university students studying in Malaysia experienced at least one symptom of CVS.[16] CVS is more prevalent at the moment, during the Covid 19 pandemic, as people spend more time on screens. The most common complaints seen during the tele-health appointments now are related to blurry vision and headaches. [17]

The factors contributing to CVS can be of three types, a) Personal factors – poor sitting posture, improper viewing angle, improper viewing distances, ocular diseases and medical diseases, b) Environmental factors – imbalance of light between the surrounding and the computer screen, poor lighting, c) Computer factors – glare of the display, poor resolution, poor contrast, slow refresh rate. [1, 4-6, 8, 10, 14, 18]

Many studies show that CVS is often observed in individuals using digital screens for more than 2 hours per day. [4, 16] However, a study done in India in 2014 shows that there is no association between the total number of hours spent on the digital screen and CVS.[19] Duration of computer use in years is also associated with CVS. [1, 6, 12] Lighting is an important modifiable external environmental factor. [8, 14] Dark background screens require lower light levels, and overhead lights and windows can contribute to a glare.[1, 2, 8, 10, 14, 18] Usage of screen filters can reduce the reflection and glare on a computer screen.[14] Refractory errors that are not corrected contribute to CVS. [8, 14] Eyeglasses and contact lenses used are to be prescribed to satisfy the demands of the visual symptoms from time to time after proper eye examination. [2, 8, 14] Minor vision problems that are not or under corrected contribute to vision problems and discomfort. [14] In addition to the CVS symptoms, other musculoskeletal problems such as joint pain in the fingers and to a lesser frequency, shoulder pain [3, 8], inability to hold the objects well and difficulty to write using a pen afterwards is prevalent among prolonged mobile phone users. [20]

There are no studies done which assesses the prevalence of Computer Vision Syndrome among undergraduate students during the recent Covid-19 pandemic, where the digital device use has increased due to the online classes. However, studies have been done for Computer Vision Syndrome by other Malaysian universities before Covid-19 but the study has not been conducted in our university, Melaka Manipal Medical College. The objective of our study is to determine the prevalence of Computer Vision Syndrome among undergraduate students in Malaysia during the Covid-19 pandemic. Furthermore, we would also like to determine its association with gender, screen time, screen brightness and pre-existing eye conditions.

# 2. Methodology

## 2.1. Study Design, Study Time, Study Setting, Study Population

This analytical cross-sectional study was carried out from June 2020 to July 2020 for a duration of 6 weeks. The study was conducted at Melaka Manipal Medical College, Muar campus, Johor and Melaka campus, Melaka, Malaysia respectively. Our target population were the undergraduate students of Bachelor of Medicine and Bachelor of Surgery (MBBS) based on Muar campus and as for the Melaka campus batches from MBBS, Bachelor in Dental surgery (BDS) and Foundation in Science (FIS) students were included in the study. The population of MBBS students is 662, BDS with a population of 221 and FIS with a population of 175. Therefore, the total population of the study is 1058.

## 2.2. Sample Size

The sample size of the study was calculated using Epi Info application version 7.2.4. The total study population of our research was 1058 as calculated previously. The expected frequency was the prevalence of symptoms of CVS among University students in Malaysia, which was 89.9% [16] and the acceptable margin of error was set to 6%.

Formula to calculate sample size:

$$n \geq \frac{NZ^{2}_{1-a/2}\,p(1-p)}{d^{2}(N-1) + Z^{2}_{1-a/2}\,p(1-p)}$$

Where:

Significance level ($\alpha$) = 0.05

Estimated proportion ($p$) = 0.899

Estimation error ($d$ ) = 0.06

Population size ($N$) = 1058

Z value = $1.96^{2}$

The minimum sample size required was 89 as calculated by Epi Info application.

After taking into consideration the 30% non-response rate, the final sample size was calculated.

Formula to calculate final sample size:

$$n_{final} = \frac{n_{calculated}}{1-n_{non-response}} = \frac{89}{1-0.3} = 127.1$$

Therefore the final sample size calculated after rounding off was 127.

## 2.3. Sampling

The sampling method used was purposive sampling which is a non probability sampling method. The inclusion criteria were that the student must be studying either MBBS, BDS or FIS and must have given voluntary consent. Those who didn't consent were excluded.

## 2.4. Data Collection

Data was collected by an online survey. The google form with the questionnaire was distributed through social media. Modified version of a questionnaire used in a previous study was used with the permission from the initial author.[20] The modified questionnaire consisted of 23 questions inquiring the participants of their demographic data and habits on digital screen usage.

The questions included were age, gender, nationality, batch, type of digital screen being used, screen time per day before the Covid-19 pandemic, additional screen time per day since the Covid-19 pandemic, screen time per day in a dark room, whether screen time is continuous or interrupted, screen illumination level, whether screen time used was mostly at night or during the day, whether they had any symptoms of CVS, if the symptoms began/worsened after online classes started due to the Covid-19 pandemic, if they were previously diagnosed with dry eyes, whether they take topical eye drops for dry eyes, whether they have any refractive errors, whether they are wearing glasses or contact lenses, if the objects were clear, blurred or hazy after prolonged screen time, if they have any musculoskeletal problems after prolonged smartphone use, how long they spent this way on the screen (in years), what they frequently use to interact with the screen (touch screen, touch pad, note pen, mouse and keyboard), if they used books, screens or both to study before the Covid-19 pandemic, and whether they feel that digital screens affect their lifestyle and eye health.

## 2.5. Data Processing and Analysis

Data was collected using an online survey. The data collected was processed with Microsoft Excel 2013. If at least one symptom out of headache, fatigue, dry eyes, excessive tearing, blurred near vision, blurred distant vision, eye strain, double vision, eye twitching, eye redness and irritation, difficulty refocusing the eyes and neck/ back/ shoulder pain were present, CVS was considered present.

The processed data was analyzed using Epi Info Version 7.2.4 software from Centers for Disease Control and prevention website (CDC). The frequency and percentage were calculated for all the qualitative variables. The independent variables considered were gender, additional hours spent on digital devices per day since the Covid 19 pandemic, continuous or interrupted digital screen usage, brightness level of the screen, hours spent in a dark room, whether most screen time is spent during the day or the night, number of years of prolonged screen use, presence of dry eyes, whether using topical eye drops for that dry eye disease, presence of refractive errors and whether wearing glasses or contact lenses. The dependent variable was CVS. The statistical tests used to find out the association between the independent variables and dependent variables are shown in table 1 below. The measure of association used was odds ratio. The level of significance was 0.05.

**Table 1.** Statistical tests used to find out the association between the independent and dependent variables.

| Independent variable | Dependent variable | Statistical test |
|---|---|---|
| Gender | CVS | chi square test |
| Additional hours spent on digital devices per day since the Covid 19 pandemic | CVS | chi square test |
| Continuous or interrupted digital screen usage | CVS | chi square test |
| Brightness level of the screen | CVS | chi square test |
| Hours spent in a dark room | CVS | chi square test |
| Most screen time during the day or night | CVS | chi square test |
| Number of years of prolonged screen use | CVS | chi square test |
| Presence of dry eyes | CVS | chi square test |
| Using any topical eye drops for the dry eye disease | CVS | chi square test |
| Presence of refractive errors | CVS | chi square test |
| Wearing glasses or contact lenses | CVS | chi square test |

## 2.6. Ethical Considerations

The research was approved by the Research Ethics Committee, Faculty of Medicine, Melaka Manipal Medical College, Malaysia. The students were informed that their participation in the study was completely voluntary and none

were forced to partake in the study. An informed online consent form with proper explanation for the reason of the study was taken. The participants' information was only used for research purposes and their confidentiality was maintained.

## 3. Results

There were a total number of 133 questionnaires filled up by participants of our study from the google form link sent to them. The results from table 2 tabulates the frequency of age, gender and programme of the participants of our study. As for the age of participants, there were 23.31% from the age group of <22 years and 76.69% of participants from the age group ≥22 years. The mean age of participants of our study were 22 years of age with the minimum age 17 and maximum of 27 years of age. As for the gender category, most of our participants were females, 72.18%, leaving males as 27.82% of our respondents. In terms of the programme studied by our participants, the highest response was of MBBS programme with 69.93%, followed by BDS programme with a response rate of 19.55% and the remaining were FIS programme which was 10.53%.

**Table 2.** The sociodemographic profile of the undergraduate students (n=133).

| Variables | n (%) |
|---|---|
| Age | |
| <22 years | 31 (23.31%) |
| ≥22 years | 102 (76.69%) |
| Mean (SD) | 22.17 (1.82) |
| Minimum- maximum | 17-27 |
| Gender | |
| Male | 37 (27.82%) |
| Female | 96 (72.18%) |
| Programme | |
| MBBS | 93 (69.93%) |
| BDS | 26 (19.55%) |
| FIS | 14 (10.53%) |

Table 3 represents the digital device usage among the participants. When asked about the frequent digital screen that they use, 127 (95.49%) of participants use the mobile phone, 111 (83.46%) participants use the laptop, 59 (44.36%) use tablet/ipad/note and 11 participants (8.27%) use the ordinary computer screen. Multiple responses were allowed for this question. When asked about the time spent on the digital screen per day before the Covid 19 pandemic, 1 participant (0.75%) responded as less than 1 hour, 9 participants (6.77%) responded as 1-2 hours, 29 participants (21.80%) responded as 2-3 hours, 41 participants (30.83%) responded as 3-4 hours, 28 participants (21.05%) responded as 4-6 hours and 25 participants (18.80%) responded as more than 6 hours. When asked about the additional hours spent on the computer per day since the Covid 19 pandemic, no participants had spent less than 1 hour, 6 participants (4.51%) spent 1-2 hours, 8 participants (6.02%) spent 2-3 hours, 16 participants (12.03%) spent 3-4 hours, 16 participants (12.03%) spent 4-6 hours and 87 participants (65.41%) spent more than 6 hours. When asked about the number of hours spent watching the screen in a dark room, 69 participants( 51.88%) spent less than 1 hour, 35 participants (26.32%) spent 1-2 hours, 18 participants (13.53%) spent 2-3 hours, 7 participants (5.26%) spent 3-4 hours, 1 participant (0.75%) spent 4-6 hours and 3 participants (2.26%) spent more than 6 hours. When asked if the number of hours spent on a digital screen are continuous or interrupted, 45 participants (33.83%) spent time continuously while 88 participants (66.17%) selected interrupted. When asked about the level of brightness to which their digital screen is illuminated, 25 participants (18.80%) selected less than 10% brightness, 28 participants (21.05%) selected 11-25% screen brightness, 52 participants (39.10%) selected 26-50% brightness, 20 participants (15.04%) selected 51-75 % brightness and 8 participants (6.02%) selected 76-100%. When asked if they spend most of their screen time during the day or night, 110 participants (82.71%) spend most of their screen time during the day and 23 participants (17.29%) spend most of their screen time during the night. When asked about the number of years spent this way on the screen, 43 participants (32.33%) spent nearly one year, while 18 participants (13.53%) spent nearly 2 years, 14 participants (10.53%) spent nearly 3 years, 18 participants (13.53%) spent nearly 4 years and 40 participants (30.08%) spent more than or equal to 4 years. When asked whether they use touch screen, touchpad, note pen or mouse and keyboard, 110 participants (82.71%) use touch screen, 38 participants (28.57%) use touchpad, 17 participants (12.78%) use note pen and 73 participants (54.89%) use mouse and keyboard. Multiple responses were allowed for this question. When asked whether they used screens books or both before the Covid-19 pandemic to study, 5 participants (3.76%) used screens, 40 participants (30.08%) used books and 88 participants (66.17%) used both screens and books. When the participants were asked if digital screens affected their lifestyle and health, 120 participants (90.23%) selected yes and 13 participants (9.77%) selected no.

**Table 3.** Digital device usage (n=133).

| Variables | n (%) |
|---|---|
| The frequent computer digital screen used [a] | |
| Mobile phone | 127 (95.49%) |
| Laptop | 111 (83.46%) |
| Tablet/ ipad/ Note | 59 (44.36%) |
| Ordinary computer screen | 11 (8.27%) |
| Hours spent on the digital screen per day before the Covid 19 pandemic | |
| <1 h | 1 (0.75%) |
| 1-2 h | 9 (6.77%) |
| 2-3 h | 29 (21.80%) |

| | |
|---|---|
| 3-4 h | 41 (30.83%) |
| 4-6 h | 28 (21.05%) |
| >6 h | 25 (18.80%) |
| Additional hours spent on the computer per day since the Covid 19 pandemic | |
| <1 h | 0 (0.00%) |
| 1-2 h | 6 (4.51%) |
| 2-3 h | 8 (6.02%) |
| 3-4 h | 16 (12.03%) |
| 4-6 h | 16 (12.03%) |
| >6 h | 87 (65.41%) |
| Hours spent watching the screen in a dark room | |
| <1 h | 69 (51.88%) |
| 1-2 h | 35 (26.32%) |
| 2-3 h | 18 (13.53%) |
| 3-4 h | 7 (5.26%) |
| 4-6 h | 1 (0.75%) |
| >6 h | 3 (2.26%) |
| The hours spent on the digital screen are | |
| interrupted | 88 (66.17%) |
| continuous | 45 (33.83%) |
| The level the digital screen is illuminated (brightness) in room light | |
| ≤ 10% | 25 (18.80%) |
| 11-25% | 28 (21.05%) |
| 26-50% | 52 (39.10%) |
| 51-75% | 20 (15.04%) |
| 76-100% | 8 (6.02%) |
| Most of the screen time spent during the day or during the night | |
| Day | 110 (82.71%) |
| Night | 23 (17.29%) |
| Number of years spent this way on the screen | |
| Nearly 1 year | 43 (32.33%) |
| Nearly 2 years | 18 (13.53%) |
| Nearly 3 years | 14 (10.53%) |
| Nearly 4 years | 18 (13.53%) |
| ≥ 4 years | 40 (30.08%) |
| Frequently using,[a] | |
| Touch screen | 110 (82.71%) |
| Mouse and Keyboard | 73 (54.89%) |
| Touchpad | 38 (28.57%) |
| Note pen | 17 (12.78%) |
| Before the Covid 19 pandemic, was usually studying medicine using | |
| Both | 88 (66.17%) |
| Books | 40 (30.08%) |
| Screens | 5 (3.76%) |
| Do you feel that the digital screens affect your lifestyle and eye health? | |
| Yes | 120 (90.23%) |
| No | 13 (9.77%) |

a = multiple answers were allowed for this question

Table 4 represents the presentation of CVS symptoms among our participants. 63.91% complained of neck/ back/ shoulder pain, 55.64% of fatigue, 47.37% of headaches, 43.61% of eye strain, 28.57% of blurred distant vision, 21.80% of dry eyes, 18.80% of eye redness and irritation, 17.29% of difficulty in refocusing eyes, 14.29% of blurred near vision, 10.53% of excessive tearing, 6.77% of eye twitching, and 3.01% of double vision. Multiple responses were allowed for this question. Out of the 113 participants who took part in our study, 68.42% said that their symptoms have worsened after online classes started due to the Covid-19 pandemic and a staggering 90.98% presented with at least one symptom of CVS. After prolonged exposure to screens, the objects were clear to 60.15% of participants, blurred to 28.57% of participants, and hazy to the remaining 11.28% of participants. In regard to musculoskeletal symptoms after prolonged smartphone use 19.55% complained of joint pain in fingers and wrist, 10.53% of shoulder pain, 9.77% complained of difficulty in writing with a pen, 3.01% of inability to hold objects well, while 51.88% of participants had no musculoskeletal complaints. Multiple responses were allowed for this question.

**Table 4.** Presentation of the symptoms (n=133).

| Variables | n (%) |
|---|---|
| Symptoms of CVS [a] | |
| Neck / back / shoulder pain | 85 (63.91%) |
| Fatigue | 74 (55.64%) |
| Headaches | 63 (47.37%) |
| Eye strain | 58 (43.61%) |
| Blurred distant vision | 38 (28.57%) |
| Dry eyes | 29 (21.80%) |
| Eye redness and irritation | 25 (18.80%) |
| Difficulty in refocusing eyes | 23 (17.29%) |
| Blurred near vision | 19 (14.29%) |
| Excessive tearing | 14 (10.53%) |
| Eye twitching | 9 (6.77%) |
| Double vision | 4 (3.01%) |
| Symptoms worsened after online classes due to the Covid-19 pandemic | |
| Yes | 91 (68.42%) |
| No | 42 (31.58%) |
| Presence of CVS | |
| Present | 121 (90.98%) |
| Absent | 12 (9.02%) |
| Details of objects seen after prolonged hours on digital screen | |
| Clear | 80 (60.15%) |
| Blurred | 38 (28.57%) |
| Hazy | 15 (11.28%) |
| Musculoskeletal symptoms after prolonged smartphone use [a] | |
| Joint pain in fingers and wrist | 26 (19.55%) |
| Shoulder pain | 14 (10.53%) |
| Difficulty in writing with a pen | 13 (9.77%) |
| Inability to hold objects well | 4 (3.01%) |
| None | 69 (51.88%) |

a = multiple answers were allowed for this question

Table 5 indicates the previously diagnosed eye diseases. Out of our studied population of 133 students, 93.98% of them did not have pre-existing dry eye disease, whereas 6.02% of them agreed that they suffered from it. 95.49% of them disagreed with using topical eye drops and only 4.51% of them used them. Furthermore, out of 133 students, the ones who had refractive errors were 48.87%, those who didn't have were 31.58% and 19.55% were not aware if they had any refractive errors. Lastly they were inquired about their use of glasses or contact lenses for the rectification of their refractive errors and it was found that 68.42% used glasses,

2.26% used contact lenses while 29.32% did not use any type of corrective lenses.

**Table 5.** Previously diagnosed eye diseases (n=133).

| Variables | n (%) |
|---|---|
| Do you have a previously diagnosed dry eye disease | |
| Yes | 8 (6.02%) |
| No | 125 (93.98%) |
| Are you using any topical eye drops for this dry eye | |
| Yes | 6 (4.51%) |
| No | 127 (95.49%) |
| Do you have any refractive errors? | |
| Yes | 65 (48.87%) |
| No | 42 (31.58%) |
| I don't know | 26 (19.55%) |
| Are you wearing glasses or contact lenses? | |
| Glasses | 91 (68.42%) |
| Contact lens | 3 (2.26%) |
| None | 39 (29.32%) |

The association between various factors and CVS is represented in table 6. Gender is significantly associated with CVS. Females are 4.25 times more likely to have CVS than males (95% CI for OR 1.25-14.38; P value: 0.014). Spending more than 4 hours of additional screen time during the Covid-19 pandemic is significantly associated with CVS. Those who spend more than 4 additional hours per day on digital devices during the pandemic are 6.86 times more likely to have CVS than those who spend less than 2 additional hours per day (95% CI for OR 1.06-44.17; P value: 0.022).

The other variables were found to be insignificant. Students who studied MBBS were 1.42 (95% CI for OR 0.28-7.31; P value: 0.675) times more likely and students who studied BDS were 3.85 (95% CI for OR 0.32-46.50; P value: 0.26) times more likely to have CVS compared to the students who studied Foundation In Science Programme. Students who spent more than 2 hours in a dark room were 1.24 times likely to have CVS compared to the students who spent less than 2 hours in a dark room (95% CI for OR 0.25-6.02; P value: 0.791). The students who had continuous screen time were 0.48 times less likely to have CVS compared to the students who had interrupted screen usage (95% CI for OR 0.14-1.57; P value: 0.215). The students who used a screen brightness of 0-25% were 1.32 (95% CI for OR 0.37-4.76; P value: 0.671) times more likely and the students who used a screen brightness of 76-100% were 0.75 (95% CI for OR 0.08-7.05; P value: 0.804) times less likely to have symptoms of CVS compared to the students who used a screen brightness of 26-75%. The students who spent most screen time during the night were 0.37 times less likely to have symptoms of CVS compared to the students who spent the most screen time during the day (95% CI for OR 0.10-1.36; P value: 0.123).

Although not significant, 100% of the students who were previously diagnosed with dry eye disease and 100% of the students who used eye drops for that dry eye disease had CVS. The students who were diagnosed with refractive errors were 2.03 times more likely to have CVS compared to the students who either didn't have or didn't know if they had any refractive errors (95% CI for OR 0.58-7.11; P value: 0.259). The students who wore either glasses or contact lenses were 1.83 times more likely to have CVS compared to those who didn't wear any type of corrective lenses (95% CI for OR 0.54-6.16; P value: 0.325). Students who have had prolonged digital screen use for 2 - 4 years were 1.25 (95% CI for OR 0.30-5.21: P value: 0.756) times more likely, while the students who have had prolonged digital screen use for more than 4 years were 2.46 (95% CI for OR 0.48-12.51; P value: 0.264) times more likely to have CVS compared to the students who have had less than 2 years of prolonged digital screen use.

**Table 6.** Association between various factors and Computer Vision Syndrome.

| Independent variables | Computer Vision Syndrome | | Odds ratio (95% CI) | Chi-square | P value |
|---|---|---|---|---|---|
| | Present n (%) | Absent n (%) | | | |
| Gender | | | | | |
| Female | 91 94.79% | 5 (5.21%) | 4.25 (1.25-14.38) | 6.116 | 0.014 |
| Male | 30 (81.08) | 7 (18.92%) | Reference | | |
| Programme | | | | | |
| MBBS | 83 (90.22%) | 9 (9.78%) | 1.42 (0.28-7.31) | 0.176 | 0.675 |
| BDS | 25 (96.15%) | 1 (3.85%) | 3.85 (0.32-46.50) | 1.262 | 0.261 |
| FIS | 13 (86.67%) | 2 (13.33%) | Reference | | |
| Additional screen time during the Covid 19 pandemic | | | | | |
| < 2 hours | 4 (66.67%) | 2 (33.33%) | Reference | | |
| 2-4 hours | 21 (87.50%) | 3 (12.50%) | 3.5 (0.44-28.14) | 1.500 | 0.220 |
| >4 hours | 96 (93.20%) | 7 (6.80%) | 6.86 (1.06-44.17) | 5.270 | 0.022 |
| Screen time in dark room | | | | | |
| <2 hours | 97 (90.65%) | 10 (9.35%) | Reference | | |
| >2 hours | 24 (92.30%) | 2 (7.69%) | 1.24 (0.25-6.02) | 0.070 | 0.792 |
| Screen time | | | | | |
| Continuous | 39 (86.67%) | 6 (13.33%) | 0.48 (0.14–1.57) | 1.540 | 0.215 |
| Interrupted | 82 (93.18%) | 6 (6.82%) | Reference | | |
| Level of digital screen brightness in room light | | | | | |
| 0-25% | 49 (92.45%) | 4 (7.55%) | 1.32 (0.37-4.76) | 0.180 | 0.671 |

| Independent variables | Computer Vision Syndrome | | Odds ratio (95% CI) | Chi-square | P value |
|---|---|---|---|---|---|
| | Present n (%) | Absent n (%) | | | |
| 26-75% | 65 (90.28%) | 7 (9.72%) | Reference | | |
| 76-100% | 7 (87.50%) | 1 (12.50%) | 0.75 (0.08-7.05) | 0.062 | 0.804 |
| Most screen time during day or night | | | | | |
| The day | 102 (92.73%) | 8 (7.27%) | Reference | | |
| The night | 19 (82.61%) | 4 (17.31) | 0.37 (0.10- 1.36) | 2.373 | 0.123 |
| Previously diagnosed dry eye disease | | | | | |
| Present | 8 (100%) | 0 (0%) | Undefined | 0.844 | 0.358 |
| Absent | 113 (90.40%) | 12 (9.60%) | Reference | | |
| Use of eye drops | | | | | |
| Yes | 6 (100%) | 0 (0%) | Undefined | 0.623 | 0.430 |
| No | 115 (90.55%) | 12 (9.45%) | Reference | | |
| Refractive errors | | | | | |
| Yes | 61 (93.85%) | 4 (6.15%) | 2.03 (0.58-7.11) | 1.274 | 0.259 |
| No/ don't know | 60 (88.24%) | 8 (11.76%) | Reference | | |
| Wearing glasses/ contact lens or none | | | | | |
| glasses/ contact lenses | 87 (92.55%) | 7 (7.45%) | 1.83 (0.54-6.16) | 0.970 | 0.325 |
| None | 34 (87.18%) | 5 (12.82%) | Reference | | |
| Number of years of prolonged digital screen use | | | | | |
| <2 years | 54 (88.52%) | 7 (11.48%) | Reference | | |
| 2-4 years | 29 (90.63%) | 3 (9.38%) | 1.25 (0.30-5.21) | 0.097 | 0.756 |
| ≥4 years | 38 (95.00%) | 2 (5%) | 2.46 (0.48-12.51) | 1.248 | 0.264 |

## 4. Discussion

The analytical cross-sectional study that we conducted aimed to measure the prevalence of Computer Vision Syndrome among the undergraduate students of Melaka Manipal Medical College, Malaysia during the Covid-19 pandemic and to determine its association with gender, screen time, screen brightness and pre-existing eye conditions. The prevalence of CVS among the students of MMMC was recorded to be 90.98%. In comparison with another cross-sectional study conducted in International Medical University in Malaysia which records the prevalence of CVS among their participants to be 89.9%. [16] A study conducted among the medical students of Sohag University Hospital, Egypt reveals the prevalence of CVS among their participants to be 86%.[20] Another study carried out among undergraduate students at the University of Colombo, Sri Lanka shows the prevalence of CVS to be 70.5%. [21] The present study also shows that a high number of 68.42% participants feel that their symptoms of CVS have worsened after the online classes due to the Covid 19 pandemic. This could be due to the additional hours spent on the screens since the pandemic. The present study determined that a staggering 65.4% of students spent >6 additional hours on the screens since the pandemic while before the pandemic most students spent just 3-4 hours or 4-6 hours (12% each) per day on screens. According to our study, the three most common symptoms of CVS were pain in neck, back or shoulders which were experienced by 64% of the students followed by fatigue experienced by 56% of students and headache by 47% of the students. Similarly, a cross-sectional study conducted among computer engineering students in Pakistan determined the most common symptoms to be headache, eye strain, neck pain, tiredness and redness of the eyes. [4] Another cross-sectional study conducted among university students in Saudi Arabia revealed eye strain to be the most common symptom followed by burning sensation in the eyes. [9]

The present study determined a significant association between gender and the symptoms of CVS. Females were more likely to have symptoms of CVS than males. This finding is consistent with a cross-sectional study done among the students of professional colleges of Agartala, India [12] which also shows that the gender is significantly associated with CVS while a different cross-sectional study done among the university students in Ajman, United Arab Emirates shows that females are at a higher risk of developing headache than males. [18] The present study also determined a significant association between the additional hours spent on the screens after the Covid 19 pandemic and the symptoms of CVS. The students who spent >4 additional hours per day were more likely to have symptoms of CVS than the students who spent <2 additional hours per day. However although not significant, the students who spent 2-4 additional hours per day were also more likely to have symptoms of CVS compared to those who spent <2 additional hours per day. In a cross-sectional study done by the International Medical University in Malaysia, it was determined that the students who used computers for more than 2 hours experienced symptoms of CVS significantly more often than those who used the computer upto 2 hours. [16] In another cross-sectional study done among computer user government employees in Debre Tabor town in Ethiopia it was determined that workers who used computers for more than

4.6 hours per day were more likely to have symptoms of CVS compared to those who used the computers for less than 4.6 hours. [7] The other factors such as screen time in a dark room, whether the screen time is continuous or interrupted, brightness level of the digital screen, whether most screen time is spent during the day or night, presence of previously diagnosed eye diseases and number of years of prolonged digital screen use were not significantly associated with CVS according to the present study.

The main limitations of the study was that the diagnosis of CVS was purely subjective to the participants and that no ophthalmological evaluation was carried out to find out objective results. Furthermore, the study was conducted in only one private institution in Malaysia and therefore cannot be generalized to all students in Malaysia.

It is unavoidable that online learning is part of students' daily routine due to physical closure of educational institutions as a result of the current Covid 19 pandemic, thereby increasing students screen time which can lead to development and worsening of CVS. Students need to be educated on CVS and adhere to measures to reduce it, such as and not limited to: following the 20-20-20 rule; taking a 20 second break to view something 20 feet away every 20 minutes as recommended by the American Optometric Association. Further studies could be conducted along with ophthalmological evaluation to get a more objective view on the prevalence of CVS among students. Studies could also be conducted to assess in depth the prevalence and severity of musculoskeletal symptoms due to prolonged mobile phone use as there seem to be less studies conducted on this topic.

## 5. Conclusion

From the present study, it is concluded that 90.98% of students of Melaka Manipal Medical College experienced one or more symptoms of CVS during the time period of Covid 19 pandemic. The most common symptom was neck, back or shoulder pain followed by fatigue and headache. 68.42% of participants felt that their symptoms either began or worsened after starting online classes due to the pandemic. Students who spent >4 additional hours per day were more likely to have symptoms of CVS compared to the students who spent <2 additional hours per day on screens since the Covid 19 pandemic.

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## References

[1] Abiy MA, Mogess MA. Pathophysiologic Mechanisms of Computer Vision Syndrome and its Prevention: Review. World Journal of Ophthalmology & Vision Research. 2019;2(5).

[2] Wimalasundera S. Computer vision syndrome. Galle Medical Journal, 2018; 11(1) pp 25–29.

[3] Toh SH, Coenen P, Howie EK, Straker LM (2017) The associations of mobile touch screen device use with musculoskeletal symptoms and exposures: A systematic review. PLoS ONE 12(8):e0181220. https://doi.org/10.1371/journal.pone.0181220

[4] Hassan, Junaid & Ehsan, Sarah & Arshad, Hafiz. (2016). Frequency of Computer Vision Syndrome & Ergonomic Practices among Computer Engineering Students. International Journal of Science and Research (IJSR). 5. 121-25.

[5] Assefa NL, Weldemichael DZ, Alemu HW, Anbesse DH. Prevalence and associated factors of computer vision syndrome among bank workers in Gondar City, northwest Ethiopia, 2015. Clin Optom (Auckl). 2017 Apr 10;9:67-76. doi: 10.2147/OPTO.S126366. PMID: 30214362; PMCID: PMC6095566.

[6] T R Akinbinu, Y J Mashalla. Knowledge of computer vision syndrome among computer users in the workplace in Abuja, Nigeria. Journal of Physiology and Pathophysiology. 2013; 4(4): 58-63.

[7] Dessie A, Adane F, Nega A, Wami S D, & Chercos D H. Computer Vision Syndrome and Associated Factors among Computer Users in Debre Tabor Town, Northwest Ethiopia. Journal of Environmental and Public Health, 2018; 1-8. doi:10.1155/2018/4107590

[8] American Optometric Association. The Effects of Computer Use on Eye Health and Vision. St. Louis, MO: American Optometric Association; 1997.

[9] Al Rashidi SH, Alhumaidan H. Computer vision syndrome prevalence, knowledge and associated factors among Saudi Arabia University Students: Is it a serious problem? Int J Health Sci (Qassim). 2017 Nov-Dec;11(5):17-19. PMID: 29114189; PMCID: PMC5669505.

[10] Agarwal S, Goel D, Sharma A. Evaluation of the Factors which Contribute to the Ocular Complaints in Computer Users. J Clin Diagn Res. 2013 Feb;7(2):331-5. doi: 10.7860/JCDR/2013/5150.2760. Epub 2012 Dec 24. PMID: 23543722; PMCID: PMC3592304.

[11] Sheppard AL, Wolffsohn JSDigital eye strain: prevalence, measurement and amelioration BMJ Open Ophthalmology 2018;3:e000146. doi: 10.1136/bmjophth-2018-000146

[12] Das S, Das R, Kumar A. Computer Vision Syndrome and Its Risk Factors Among Professional College Students of Agartala: A Cross Sectional Study. International Journal of Scientific Research, June 2016; 5:27-29.

[13] Klamm J, Tarnow KG. Computer vision syndrome: a review of literature. Medsurg Nurs. 2015;24(2):89–93.

[14] Loh KY, Reddy SC. Understanding and preventing computer vision syndrome. Malaysian Family Physician 2008;3(3):128-130. PubMed PMID: 25606136; PubMed Central PMCID: PMC4170366.

[15] Sen A, Richardson S. A study of computer-related upper limb discomfort and computer vision syndrome. J Hum Ergol. 2007;36(2):45–50.

[16] Reddy SC, Low CK, Lim YP, Low LL, Mardina F, Nursaleha MP. Computer vision syndrome: a study of knowledge and practices in university students. Nepal J Ophthalmol. 2013;5(10):161-168.

[17] Victoria F. Are your eyes hurting during the corona virus pandemic? You may have "computer vision syndrome" [Internet]. Forbes; 2020. Available from: https://www.forbes.com/sites/victoriaforster/2020/06/01/are-your-eyes-hurting-during-the--coronavirus-pandemic-you-may-have-computer-vision-syndrome/#2f8444586cf9

[18] Shantakumari N, Eldeeb R, Sreedharan J, Gopal K. Computer use and vision-related problems among university students in Ajman, United Arab Emirate. Ann Med Health Sci Res 2014;4:258-63.

[19] Arumugam S, Kumar K, Subramani R, Kumar S. Prevalence of Computer Vision Syndrome among Information Technology Professionals Working in Chennai. World Journal of Medical Sciences. 2014;11(3):312-4.

[20] Mohammed I, Ahmed E, Mohammed E, Hosam E. Computer Vision Syndrome Survey among the medical students in Sohang University Hospital, Egypt. Ophthalmology Research: An International Journal. 2018;8(1):1-8.

[21] Thilakarathne MM, Udara HM, Thucyanthan B, Ranasinghe P. Prolonged computer use and its effects on vision among undergraduates in University of Colombo, School of Computing. 2017.