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# Prevalence Of Computer Vision Syndrome and Predisposing Factors Among Engineering Students In Hawass University Institution Of Technology Campus, Hawassa, Ethiopia, 2020

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## Abstract

**Purpose:** There is lack of detail information about the magnitude of the computer vision syndrome (CVS) and the factors which predominantly cause CVS. As baseline data, this study is significant for future research. The purpose of this study was to assess the magnitude of CVS and associated factors on students of Hawassa university institution of technology, Hawassa, Ethiopia, 2020.

**Methodology:** Institution based cross sectional study design was used from March to May 2020. A multi stage sampling was used. Four departments were selected by using simple random sampling. Among each selected department students were selected by using systematic random sampling and based on the calculated proportion (K) of students in each department, the final sample size was 896. Each student was assessed based on their exposure to any kind of visual display terminal (VDT). Face to face interview, ocular examination and observation during VDT use was performed by five optometrists from March to May 2020. After collected data was cleaned and coded, EPI info 2002 for data entry and SPSS version 16.0 software for data analysis was used. Odds ratio with a 95% CI will be used to display results. P value less than 0.05 in multivariate logistic regressions was used to show statistical significance.

**Result:** The prevalence of computer vision syndrome was 41.7%. Urban(OR =1.66; CI = (1.14, 2.43)), no glass use(OR = 6.01; CI = (1.67, 21.63)), reading and playing game with VDT (OR = 2.33; CI = (1.33, 4.08)), reading and watching movies with VDT (OR = 1.49; CI = (1.02, 2.18)), using Smartphone (OR = 0.60; CI = (0.38, 0.95)), remote near point of convergence (OR= 3.19; CI = (1.64, 6.25)) and moderate size of VDT (OR = 0.63; CI = (0.41, 0.96)) were significantly associated with CVS. There is 0.39Ds reduction of amplitude of accommodation in students who have CVS.

**Conclusion:** Engineering students had a significant frequency of CVS, with tearing as the most common symptom. It is best to avoid using VDT such as smartphones for a variety of activities such as reading, playing games, and watching movies. Moreover, eye examinations and protective glasses should be considered to prevent CVS.

**Keywords:** CVS; Ethiopia.

## Introduction

### Background Information

CVS is a complex of eye and vision problems related to the activities that stress the near vision during the prolonged use of the VDT [1].

The main ocular symptoms reported among computer workers are eye strain, irritation, burning sensation, redness, blurred vision and double vision. Ocular surface abnormalities following an extended period of computer usage causes symptoms such as dryness of the eyes, redness, gritty and burning sensation in addition to stress, anxiety, tense neck and shoulders [2].

Computer vision syndrome affects 90% of the people who spend more than three hours of a day at a computer and 100 million people use computers daily at work in the United States [4].

It has a negative impact on health and working effectiveness like poor visual functions, increased stress level, reduced effective work hours, frequent absence from work and possible increase in errors [1].

Excessive visual demand for digital images is one of the possible causes of CVS. For that, frequent refreshing of the computer screen has being associated with decrease ocular symptoms and more user friendly [2, 3].

Engineers, technology experts, computer science professionals are highly victim peoples among office workers which makes the problem more in these individuals [6].

The worldwide prevalence of CVS ranges from 25-93%. CVS is the most frequently reported health problem occurring among 70% of computer users. 1 out of 6 patients requiring eye examinations have computer-related eye problems. Without proper vision correction, worker productivity can decrease by as much as 20% [4,5].

Prolonged use of computers, position, light intensity and spectacle wear are the factors associated with CVS. Males had a higher risk of

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developing dry eyes (OR = 1.8, 95%) and it was statistically significant. On the other hand, males were at lower risk of developing headache (OR = 0.6) and neck and shoulder pain (OR = 0.6,) compared to females, which was statistically significant. Significant correlation was found between taking less frequent breaks while working on computers with blurred vision and dry eyes [6].

Individuals who develop CVS have reduced work effectiveness and many ocular complications. In several time, CVS is treated when a patient complains about it and when they visit the clinic, but by conducting this study it is possible to prevent the predisposing factors for developing CVS. Currently, the number of individuals who are visiting the eye clinic due to CVS is increasing dramatically. There is lack of detail information about the magnitude of the problem and the factors which predominantly causes CVS in the study area. Besides that, there is lack of a previous study done in this area even if the number of victims increased. This study also has an importance for further studies as a baseline data.

## Objectives and Hypothesis

- To assess the prevalence of CVS and associated factors on students of Hawassa university, institution of technology, 2020.
- To determine the magnitude of CVS on students of Hawassa university, institution of technology, 2020.
- To identify the associated factors for CVS on students of Hawassa university, institution of technology, 2020.
- CVS has high magnitude among engineering students and the main predisposing factors are ergonomic factors mainly.
- CVS reduce the amount of amplitude of accommodation.

## Materials and Methodology

Institution based cross sectional study design was used from March to May, 2020. Hawassa city is situated on 273km from Addis Abeba and it is the capital city of south Ethiopia. Hawassa University, the faculty of technology has established almost 10 years ago. In the faculty there are 7410 students, 417 academic staffs, 17 expatriate staffs and 95 administrative staffs.

The initial sample (n) was estimated using the statistical formula:

$$n=\frac{P(1-P)Z^2}{d^2}$$

Among the calculated sample sizes, by considering the general and specific objectives the largest sample size were 896.

A multi stage sampling was used. The participants were asked in depth and assessed in what method they have been using the VDT based on the ergonomic standard use of VDT (Figure 1). After the collected data was cleaned and coded, EPI info 2002 for data entry and SPSS version 16.0 software for data analysis was used. First binary logistic regression was computed, and then factors with the P-value of less than 0.20 were re-entered to multinomial logistic regressions to identify strength of association with the dependant variable. Odds ratio with a 95% CI was used to display results. P value less than 0.05 were used to show statistical significance. Oral consent was obtained from each participant after explaining the purpose and importance of the study. The ocular examinations and evaluations were performed by professional optometrists and study participants were informed that they do have a right to not be participated in the study. Confidentiality as well as privacy of the study participants was maintained during and after data collection. Advice regarding prevention of CVS and proper utilization of VDT was given. Individuals who were diagnosed with the problem have taken a medication prescription and protective spectacle for their future use of VDT (Figure 2).

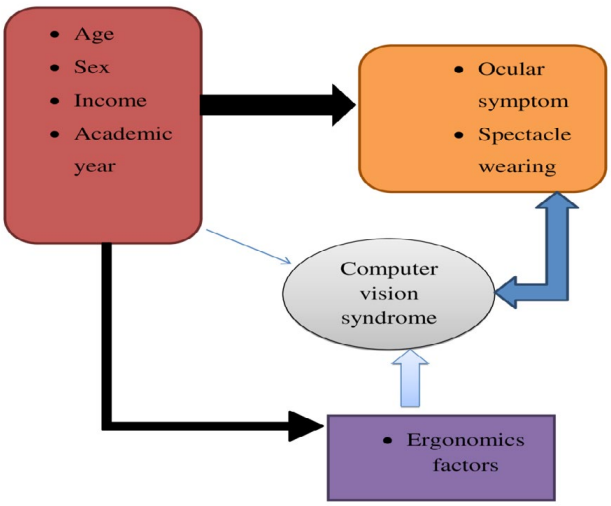


**Figure 1:** Showing the conceptual frame work of the independent variables.

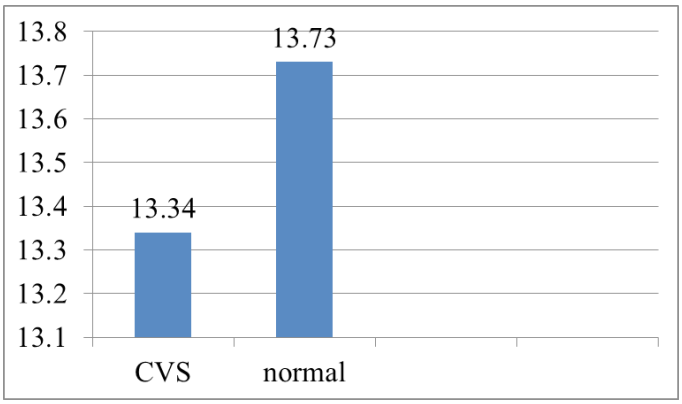


**Figure 2:** Shows the relationship and comparison of the effect of CVS on amplitude of accommodation among engineering students in Hawassa University, IOT campus, 2019.

**Visual Display Terminals(VDT)** are any kind of technological tools used for day to day activity which has a screen and need a visual demand like desk top computers, lap top computers, tablets, smart phones, iPod, any computerized monitoring devices and others are VDT.

**Computer Vision Syndrome (CVS)** is having the ocular symptoms after prolonged use of VDT either intermittently or continuously for at least one week during the last twelve months was defined as computer vision syndrome.

**Ocular Symptoms** are presence of pain in and around the eyes, headache, blurred near vision, blurred distant vision, dry eyes, sore/irritated eyes, red eyes, excessive tearing, double vision, twitching of eyelids, and changes in visualizing colors were assessed as symptoms of CVS in this study. Individual who have reported one of the above sign and symptoms was considered as positive for CVS.

## Results

Among the study participants (81.5% respondent rate), 454(55.9%) were male students and the mean age of the study participants were 21± 5.29 years and 609(75%) of the students came from urban area. Most of the students (72.9%) have less than 20 dollars monthly income (Table 1).

### Prevalence of Computer Vision Syndrome

The prevalence of CVS was 41.7% (339). CVS was more prevalent on 18 – 24 yrs of age 97.9% (332), male 61.4% (208), urban 83.8% (284), income per month less than 20 dollars 66.4% (225) and 3rd year students 21.2% (72).

Symptoms more prevalent on students who has CVS were mild tearing 52.8% (179), eye tiredness 44.8% (152), blurring of vision 38.6% (131) (Table 2).

Computer vision syndrome was more prevalent on students who spent on medium period of VDT use 51.3% (174), medium duration of VDT use 44.2% (150), near distance from VDT 48.7% (165), down ward viewing position 70.5% (239), illuminated room condition 77.6% (263), both Smartphone and laptop users 36.6% (124), medium size of VDT user 62.5% (212), medium VDT brightness 56.6% (192) and numerous activities on VDT 46.6%(158).

### Factors Associated With CVS

Factors with the P value <0.25 in binary logistic regression were included in multinomial logistic regression and urban(OR =1.66; CI = (1.14, 2.43)), no eye glass use(OR = 6.01 ; CI = (1.67, 21.63)), reading and playing game with VDT (OR = 2.33; CI = (1.33, 4.08)), reading and watching movies with VDT (OR = 1.49; CI = (1.02, 2.18)), using Smartphone (OR = 0.60; CI = (0.38, 0.95)), remote NPC (OR= 3.19; CI = (1.64, 6.25)) and moderate size of VDT (OR = 0.63; CI = (0.41, 0.96)) were significantly associated with CVS (Table 3).

### Amplitude of Accommodation with CVS

The minimum amplitude of accommodation was 6.50Ds and the maximum amplitude of accommodation was 20.50Ds. The mean amplitude of accommodation for individuals with CVS was 13.34Ds± 2.22 but for normal individuals it was 13.73DS. There was 0.39Ds reduction on the mean of amplitude of accommodation on individuals with CVS compared with the mean of amplitude of accommodation on normal individuals.

**Table 1:** Shows the socio demographic characteristics of engineering students who participate in the study in Hawassa University, IOT campus, 2019

| | | Female | Male | Total |
|---|---|---|---|---|
| **Age** | **18 – 24 yrs** | 353 (43.5%) | 441 (54.3%) | 794 (97.8%) |
| | **25 – 30 yrs** | 4 (0.5%) | 11 (1.4%) | 15 (1.8%) |
| | **>30 yrs** | 1 (0.1%) | 2 (0.2%) | 3 (0.4%) |
| **Residence** | **urban** | 233 (28.7%) | 376 (46.3%) | 609 (75%) |
| | **rural** | 125 (15.4%) | 78 (9.6%) | 203 (25%) |
| **Income per month** | | 66 (8.2%) | 102 (12.5%) | 168 (20.7%) |
| **less than 10 dollars** | | | | |
| | **10- 20 dollars** | 196 (24.1%) | 228 (28.1%) | 424 (52.2%) |
| | **>20 dollars** | 96 (11.8%) | 124 (15.3%) | 220 (27.1%) |
| **Academic year** | **1st year** | 42 (5.2%) | 63(7.8%) | 105 (12.9%) |
| | **2nd year** | 124 (15.3%) | 121(14.9%) | 245 (30.2%) |
| | **3rd year** | 102 (12.6%) | 134 (16.5%) | 236 (29.1%) |
| | **4th year** | 37 (4.1%) | 52 (6.4%) | 89 (10.9%) |
| | **5th year** | 53 (6.5%) | 84 (10.3%) | 137 (17.1%) |

**Table 2:** Shows the prevalence of CVS in engineering students in Hawassa University, IOT campus, 2019.

| | | Computer vision syndrome | | |
|---|---|---|---|---|
| | | Yes | No | **Total** |
| **Age** | **18 - 24** | 332 (40.9%) | 462 (56.9%) | 794 (97.8%) |
| | **25 - 30** | 5 (0.6%) | 10 (1.2%) | 15 (1.8%) |
| | **Above 30** | 2 (0.2%) | 1 (0.1%) | 3 (0.4%) |
| **Sex** | **male** | 208 (25.6%) | 246 (30.3%) | 454 (55.9%) |
| | **female** | 131 (16.1%) | 227 (27.9%) | 358 (44.1%) |
| **Residence** | **urban** | 284 (34.9%) | 325 (40%) | 609 (75%) |
| | **rural** | 55 (6.8%) | 148 (18.2%) | 203 (25%) |
| **Academic year** | **1st yr** | 52 (6.4%) | 53 (6.5%) | 105 (12.9%) |
| | **2nd yr** | 88 (10.8%) | 157 (19.3%) | 245 (30.2%) |
| | **3rd yr** | 97 (11.9%) | 139 (17.1%) | 236 (29.1%) |
| | **4th yr** | 37 (4.56%) | 52 (6.4%) | 89 (11%) |
| | **5th yr** | 65 (8%) | 72 (8.9%) | 137 (16.8%) |
| **Income per month** | | 72 (8.9%) | 96 (11.8%) | 168 (20.7%) |
| **< 10 dollars** | | | | |
| | **10 – 20 dollars** | 153 (18.8%) | 271 (33.4%) | 424 (52.2%) |
| | **>20 dollars** | 114 (25.1%) | 106 (13%) | 220 (27.1%) |

| | Computer vision syndrome | | |
|---|---|---|---|
| | yes | no | **total** |
| **VDT use hour per day 1 – 3 hours** | 36 (4.4%) | 37 (4.6%) | 73 (9%) |
| **3 – 6 hours** | 174 (21.4%) | 257 (31.7%) | 431 (53.1%) |
| **6 – 8 hours** | 98 (12.1%) | 137 (16.9%) | 235 (28.9%) |
| **>8 hours** | 31 (3.8%) | 42 (5.2%) | 73 (9%) |
| **VDT use duration** | | | |
| **1 – 2 yrs** | 37 (4.6%) | 44 (5.4%) | 81 (10%) |
| **2 – 4 yrs** | 150 (18.5%) | 237 (29.2%) | 387 (47.7%) |
| **4 – 6 yrs** | 121 (14.9%) | 157 (19.3%) | 278 (34.2%) |
| **>6 yrs** | 31 (3.8%) | 35 (4.3%) | 66 (8.1%) |
| **Position during VDT use** | | | |
| **Up ward** | | | |
| | 5 (0.6%) | 1 (0.1%) | 6 (0.7%) |
| **Same level** | 94 (11.6%) | 180 (22.2%) | 274 (33.7%) |
| **Down ward** | 240 (29.6%) | 292 (35.9%) | 532 (65.5%) |
| **Distance from VDT** | | | |
| **<20 cm** | 9 (1.1%) | 5 (0.6%) | 14 (1.7%) |
| **20 – 50 cm** | 165 (20.3%) | 285 (35.1%) | 450 (55.4%) |
| **50 – 100 cm** | 165 (22%) | 165 (20.3%) | 344 (42.4%) |
| **>100 cm** | 0 | 4 (0.5%) | 4 (0.5%) |
| **Room light condition** | | | |
| **Dark** | 64 (7.9%) | 77 (9.5%) | 141 (17.4%) |
| **illuminated** | 263 (32.4%) | 384 (47.3%) | 647 (79.7%) |
| **extreme illuminated** | 12 (1.5%) | 12 (1.5%) | 24 (3%) |
| **Activities on VDT** | | | |
| **reading** | 43 (5.3%) | 71 (8.7%) | 114 (14%) |
| **Watching movies** | 3 (0.4%) | 3 (0.4%) | 6 (0.7%) |
| **Drafting &designing** | 7 (0.9%) | 3 (0.4%) | 10 (1.2%) |
| **reading & movie** | 88 (10.8%) | 93 (11.5%) | 181 (22.3%) |
| **reading & game** | 39 (4.8%) | 27 (3.3%) | 66 (8.1%) |
| **Numerous activities** | 159 (19.6%) | 276 (34%) | 435 (53.6%) |
| **Type of VDT Smartphone** | 63 (7.8%) | 108 (13.3%) | 171 (21.1%) |
| **tablet** | 10 (1.2%) | 17 (2.1%) | 27 (3.3%) |
| **Lap top** | 61 (7.5%) | 103 (12.7%) | 164 (20.2%) |
| **Computerized machineries** | 0 | 1 (0.1%) | 1 (0.1%) |
| **Tablet & lap top** | 14 (1.7%) | 28 (3.4%) | 42 (5.2%) |
| **Phone & lap top** | 180 (22.2%) | 212 (26.1%) | 392 (48.3%) |
| **Break** **yes** | 92 (11.3%) | 105 (12.9%) | 197 (24.3%) |

| | | | | |
|---|---|---|---|---|
| | no | 247 (30.4%) | 368 (45.3%) | 615 (75.7%) |
| Screen filter | yes | 17 (2.1%) | 11 (1.4%) | 28 (34.5%) |
| | no | 322 (39.7%) | 462 (56.9%) | 784 (96.6%) |
| Size of VDT | small | 57 (7.1%) | 53 (6.5%) | 110 (13.5%) |
| | medium | 212 (26.1%) | 358 (44.1%) | 570 (70.2%) |
| | large | 70 (8.6%) | 62 (7.6%) | 132 (16.3%) |
| Brightness of VDT | | | | |
| | low | 133 (16.4%) | 149 (18.3%) | 282 (34.7%) |
| | medium | 192(23.6%) | 310 (38.2%) | 502 (61.8%) |
| | intensive | 14 (1.7%) | 14 (1.7%) | 28 (2.4%) |
| Table use | yes | 90 (11.1%) | 106 (13.1%) | 196 (24.1%) |
| | no | 249 (30.7%) | 367 (45.2%) | 616 (75.8%) |
| Awareness | yes | 44 (5.4%) | 72 (8.9%) | 116 (14.3%) |
| | no | 295 (36.3%) | 401 (49.4%) | 696 (85.7%) |

**Table 3:** Shows factors associated with CVS in multinomial logistic regression analysis on engineering students in Hawassa University, IOT campus, 2019.

| variables | | COR (CI) | AOR (CI) | P - value |
|---|---|---|---|---|
| Sex | male | 0.68 (0.51, 0.91) | | |
| Residence | urban | 2.33 (1.64, 3.29) | 1.66 (1.14, 2.43) | 0.008 |
| Academic year | 1st | 1.09 (0.65, 1.81) | | |
| | 2nd | 0.62 (0.41, 0.95) | | |
| | 3rd | 0.77 (0.51, 1.18) | | |
| | 4th | 0.79 (0.46, 1.35) | | |
| Glass | no | 0.15 (0.04, 0.52) | 6.01 (1.67, 21.63) | 0.006 |
| Position | up ward | 6.08 (0.71, 52.4) | | |
| | Same level | 0.64 (0.47, 0.86) | | |
| Activities with VDT | | | | |
| | reading | 1.05 (0.69, 1.62) | | |
| Drafting &designing | | 4.06 (1.04, 15.9) | | |
| Watching movies | | 1.74 (0.35, 8.73) | | |
| Reading & movies | | 1.64 (1.16, 2.34) | 1.49 (1.02, 2.18) | 0.039 |
| Reading & game | | 2.52 (1.48, 4.26) | 2.33 (1.33, 4.08) | 0.003 |
| VDT type | | | | |
| | Smartphone | 0.68 (0.47, 0.97) | 0.60 (0.38, 0.95) | 0.03 |
| | tablet | 0.68 (0.30, 1.52) | | |
| | Lap top | 0.68 (0.47, 0.99) | | |
| Tablet & lap top | | 0.79(0.45, 1.42) | | |
| Size of VDT | small | 0.93(0.56, 1.56) | | |
| | Moderate | 0.51 (0.35, 0.76) | 0.63 (0.41, 0.96) | 0.032 |
| NPC | remote | 0.28 (0.15, 0.54) | 3.198 (1.64, 6.25) | 0.001 |
| | normal | | | |

## Discussion

The prevalence of CVS in this study was 41.7% which was between the worldwide prevalence range (25- 93%) and it was higher when it's compared with studies done in Brazil (40.4%) and Pakistan (25%). But, it was lower than studies done in India (51.56%), Malaysia (68.1%), Chennai (81.9%) and Sir Lanka (67.4%). The reason for that difference between the prevalence in this study and the others was the type of the study participants; their occupation and the type of activities performed with VDT were too different. In the other studies, their occupation were secretaries, office workers and the study in Chennai it includes both medical and engineering students due to that the way of their exposure to VDT may be different. This difference can raise the prevalence either lower or higher than this study [8,9,10].

Similarly, the prevalence of CVS was lower in this study compared with the study done in Gondar (73%) related with the larger sample size and the study participant's difference that lowers the prevalence in this study [11].

Computer vision syndrome were more prevalent in this study on males (61.4%), moderate period of VDT use (51.3%), moderate duration of VDT use (44.2%), downward viewing position (70.5%), illuminated room condition (77.6%), both Smartphone and lap top users (36.6%) and medium sized VDT use (62.5%). In contrary, studies done in India and Sir Lanka females, duration, >2 hours working hour, upward viewing position, using filter, brightness were more prevalent. There were similarities on VDT working hour but the other factors were differently prevalent on this study [12, 13].

The most compliant symptoms in Sir Lanka and Gondar were headache (45.7%), dryness (31.1%), blurring of vision (31%) and eye strain (25%) but in this study tearing (52.8%) and eye tiredness (44.8%) were more prevalent [11, 13].

In Hyderabad there was significant association with close distance from VDT(less than 25inches), 4 – 8 hours per day VDT use, and no filter use. But none of those factors were significantly associated with CVS in this study [14].

Duration with VDT, sitting arrangement with VDT and filter use was significantly associated with CVS in Bengaluru which is totally different from this study; the factors associated with CVS in this study were urban residence, no glass use, reading and playing with VDT, reading and watching movies with VDT, moderate size of VDT and remote NPC.

## Conclusion

In general, engineering students had a significant frequency of CVS, with tearing as the most common symptom. It is best to avoid using VDT such as Smartphone's for a variety of activities such as reading, playing games, and watching movies. Moreover, eye examinations and protective glass should be considered to prevent CVS.

It is better to conduct further study on the effect of an eye medication treatment and glass protection to treat and prevent CVS.

## Author Contributions

All authors made substantial contributions to the conception and design, acquisition of data, analysis and interpretation of data, critical revision of the manuscript, read and approved the final version to be published, and agree to be accountable for all aspects of the work.

### Ethics Approval and Consent to Participate

Not applicable.

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