Original Article

Computer Vision Syndrome and Ergonomic Practices among Students and Professionals

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ABSTRACT

Purpose: To investigate the frequency of Computer vision syndrome (CVS) and its association with ergonomic practices among students and professionals.

Study Design: Cross sectional observational study.

Place and Duration of Study: Online survey.

Methods: This study involved a pre-tested self-designed structured questionnaire distributed through Google Forms to gather responses from students and professionals regarding symptoms of CVS. The form was shared with approximately 2500 individuals, the response rate was 10.04%, resulting in 251 responses. After careful review, 237 responses were deemed suitable for inclusion in the study. The chi-square test was used and p-value less than 0.05 was considered statistically significant.

Results: The relationship between symptoms of CVS (headache, body fatigue or tiredness, burning sensation, blurred vision, and dry eyes) and various ergonomic practices (screen time, longest uninterrupted time, breaks during screen use, screen size, type of screen, font size, refresh rate, and screen resolution) was seen in 237 subjects. The study revealed increased frequency of CVS symptoms when using screens. There was a statistically significant effect of prolonged screen time ($p<0.05$), smaller screen sizes ($p<0.05$), lower refresh rates ($p<0.05$), small font size ($p<0.05$) and lower screen resolutions ($p<0.05$) on the severity of CVS symptoms.

Conclusion: These findings enhance our understanding of the complex relationship between ergonomics and visual discomfort, and they will guide future interventions aimed at improving visual comfort and ergonomics in screen-based environments.

Keywords: Backache, Musculoskeletal Diseases, Computer Vision Syndrome, Headache, Dry Eye Syndrome.

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INTRODUCTION

Digital eye strain, also called computer vision syndrome (CVS), encompasses a spectrum of symptoms related to visual and muscular discomfort caused by prolonged use of digital devices such as computers, smartphones, tablets, and televisions.[1] This syndrome emerged with the advent of computers in the mid-20th century and has become increasingly prevalent due to the widespread adaptation of smartphones which now serve numerous functions previously done by computers.[2] Around 64% to 90% of computer users experience CVS, affecting roughly 60 million people.[3]

The symptoms associated with CVS primarily manifest as ocular discomfort, including eye strain, irritation, dry eye, burning sensations, and blurred vision.[4] However, it is not limited to ocular issues alone; non-ocular symptoms like shoulder, neck, and back pain are also commonly reported among individuals experiencing CVS.[5] Research indicated that individuals spending more than four hours per day

using computers are at a higher risk of developing visual impairments than non-users. Contributing factors to CVS include poor workplace ergonomics, improper posture during device usage, and extended periods of screen exposure.[6]

The integration of electronic devices like computers, tablets, iPads, and smartphones has become indispensable in educational institutions and workplaces, driven by the availability of digital tools and resources. However, alongside the benefits, there is a growing concern about the impact of CVS on students and professionals who extensively use these gadgets. Reports suggest that visual impairments and occupational hazards associated with CVS can adversely affect job satisfaction and productivity.[7,8] Addressing the challenges posed by CVS requires a multifaceted approach, with ergonomics playing a crucial role in mitigating its impact. Ergonomics focuses on adapting tasks and environments to suit the individual's needs, aiming to reduce discomfort and enhance productivity.[9,10]

Numerous studies have delved into the challenges faced by students and professionals concerning computer vision syndrome (CVS).[11,12] Cross-sectional studies have highlighted the severity of CVS symptoms in students due to subpar ergonomic practices, emphasizing the urgent need for targeted interventions.[13,14] Likewise, studies focusing on professionals have reported a higher prevalence of CVS, underlining the crucial role of awareness and adaptation of proper ergonomic practice.[15,16] Despite widespread global application of ergonomics to mitigate CVS risks among professionals, there is a noticeable gap in Pakistan regarding the application of ergonomic principles to tackle this issue effectively. This research seeks to conduct a comparative analysis of CVS symptoms and assess ergonomic strategies to develop tailored interventions that improve overall well-being among computer users, making a pioneering effort to study both students and professionals in this context.

METHODS

This study followed a cross-sectional survey design and targeted a population comprising students and professionals. The survey involved a pre-tested self-designed structured questionnaire distributed through Google Forms to gather responses from students and professionals. Social networks including LinkedIn, Twitter, Facebook, email, and WhatsApp were utilized to reach potential participants. The study was conducted after approval by the ethical institutional review board (TUF/CO/MPO/921) of The University of Faisalabad on April 26, 2024.The questionnaire consisted of three main sections: the first part collected demographic information, the second part focused on symptoms related to computer vision syndrome (CVS), and the third part gathered data on screen time and ergonomic practices.

The sample size was determined using an online sample calculator. The forms were shared with approximately 2500 individuals but the response rate was 10.04%, resulting in 251 responses. After careful review, 237 responses were deemed suitable for inclusion in the study. This structured methodology ensured systematic data collection and analysis, focusing on crucial aspects of CVS symptoms and ergonomic practices among the selected population group. The most common CVS symptoms were headache, body fatigue or tiredness, burning sensation, blurred vision, and dry eyes while ergonomic practices included screen time, longest uninterrupted time, breaks during screen use, screen size, type of screen, font size, refresh rate, and screen resolution. The association between these CVS symptoms and ergonomic practices was estimated.

Data were analyzed and interpreted by using SPSS version 20. The Chi-square test was applied and p-values less than 0.05 were considered statistically significant with a confidence interval of 95%.

RESULTS

Out of 237 participants, 113 were males (47.68%) and 124 were females (52.32%). The mean age of participants was 28.3 years (range 20 to 50 years). Eighty-one participants were students (34.18%), while the remaining belonged to different professions (65.83%).

Significant correlations between headaches and ergonomic parameters, such as screen size, type, font size, refresh rate, and resolution, were found using statistical analysis, notably the chi-square test (Table 1).

Similarly, the study discovered correlations between ergonomic practices such screen duration, screen size, screen type, font size, and screen resolution and bodily fatigue or tiredness (Table 2).

Table 1: *Association between Headache and Ergonomic Practices.*

Variable		None	Mild	Moderate	Severe	P value	Chi-square
Screen time	<1 hour	30	40	16	6	>0.05	22.35
	1-4 hour	28	34	14	6		
	5-8 hour	20	4	12	8		
	>8 hour	8	4	4	0		
Longest uninterrupted time	<20 minutes	18	25	10	4	<0.05	13.86
	1-2 hour	24	33	10	8		
	>2 hour	47	24	26	8		
Breaks during screen use	Yes	74	78	42	16	>0.05	7.87
	No	15	4	4	4		
Screen Size (in inches)	<14	10	11	2	6	<0.05	36.61
	14-15	37	43	20	6		
	16-20	26	20	22	8		
	21	16	8	2	0		
Type of Screen	CRT	2	8	2	4	<0.05	31.06
	Flat Screen	71	35	28	10		
	Do not know	16	39	16	6		
Font Size	<6	13	4	4	2	<0.05	27.58
	6-8	16	32	6	6		
	9-15	54	44	36	12		
	>15	6	2	0	0		
Refresh Rate	unknown	47	10	34	0	<0.05	23.56
	<60 Hz	55	5	22	0		
	60-120 Hz	28	2	14	2		
	>120 Hz	12	0	6	2		
Screen Resolution	Less than 640×480	6	4	6	0	<0.05	38.53
	800×600	3	13	8	6		
	1024×768	53	22	16	4		
	Unknown	28	43	16	10		

Table 2: *Association between Body Fatigue or Tiredness and Ergonomic Practices.*

Variable		None	Mild	Moderate	Severe	P value	Chi square
Screen time	<1 hour	10	35	44	6	<0.05	46.02
	1-4 hour	12	30	36	4		
	5-8 hour	8	12	10	14		
	>8 hour	8	4	4	0		
Longest uninterrupted time	<20 minutes	4	25	26	2	>0.05	10.14
	1-2 hour	14	24	29	8		
	>2 hour	20	32	39	14		
Breaks during screen use	Yes	32	73	87	18	>0.05	6.76
	No	6	8	7	6		
Screen Size in inches	<14	0	10	15	4	<0.05	30.91
	14- 15	18	39	43	6		
	16-20	10	26	36	14		
	21	10	6	10	0		
Type of Screen	CRT	2	4	8	2	<0.05	16.79
	Flat Screen	32	53	45	14		
	Do not know	4	24	41	8		
Font Size	<6	0	12	9	2	<0.05	33.71
	6-8	12	23	19	6		
	9-15	20	46	64	16		
	>15	6	0	2	0		
Refresh Rate	Unknown	24	44	62	12	>0.05	17.63
	<60 Hz	4	7	6	0		
	60-120 Hz	10	28	24	12		
	>120 Hz	0	2	2	0		

Screen Resolution	Less than 640×480	2	4	6	4	>0.05	15.79
	800x600	2	9	12	6		
	1024×768	22	32	33	8		
	Unknown	12	36	43	6		

Table 3: *Association between Burning Sensation and Ergonomics.*

Variable		None	Mild	Moderate	Severe	P value	Chi-square
Screen time	<1 hour	22	40	27	6	>0.05	12.48
	1-4 hour	22	32	24	4		
	5-8 hour	6	18	12	8		
	>8 hour	6	6	4	0		
Longest uninterrupted time	<20 minutes	12	20	23	2	>0.05	10.67
	1-2 hour	14	37	16	8		
	>2 hour	30	39	28	8		
Breaks during screen use	Yes	50	85	63	12	<0.05	10.56
	No	6	11	4	6		
Screen Size	<14 in	4	13	12	0	>0.05	12.90
	14- 15 i	26	37	33	10		
	16-20	16	36	18	8		
	21in	10	10	4	2		
Type of Screen	CRT	6	4	4	2	>0.05	4.48
	Flat Screen	36	57	41	10		
	Do not know	14	35	22	6		
Font Size	<6	4	9	10	0	<0.05	22.12
	6-8	10	25	21	4		
	9-15	36	62	34	14		
	>15	6	0	2	0		
	Unknown	38	58	38	8		
Refresh Rate	<60 Hz	2	10	5	0	>0.05	14.14
	60-120 Hz	16	26	22	10		
	>120 Hz	0	2	2	0		
Screen Resolution	Less than 640×480	2	6	2	6	<0.05	41.39
	800×600	2	10	17	0		
	1024×768	28	35	24	8		
	Unknown	24	45	24	4		

Furthermore, the research investigated correlations between burning sensation and ergonomic elements, such as screen resolution, font size, and breaks during screen usage (Table 3).

Correlations between ergonomic practices such as screen size, type, refresh rate, resolution, screen time, and blurred vision are shown in Table 4.

Lastly, correlations between ergonomic elements (such as screen size, refresh rate, resolution, and duration) and dry eye are depicted in Table 5.

Table 4: *Association between Blurring of Vision and Ergonomics.*

Variable		None	Mild	Moderate	Severe	P value	Chi square
Screen time	<1 hour	48	18	17	12	<0.05	16.51
	1-4 hour	34	16	28	4		
	5-8 hour	12	14	10	8		
	>8 hour	6	4	4	2		
Longest uninterrupted time	<20 minutes	20	16	13	8	>0.05	7.07
	1-2 hour	35	10	20	10		
	>2 hour	45	26	26	8		
Breaks during screen use	Yes	89	46	51	24	>0.05	0.64
	No	11	6	8	2		
Screen Size	<14	9	10	8	2	<0.05	21.74
	14- 15	45	24	23	14		
	16-20	28	14	26	8		

	21	18	4	2	2		
	CRT	4	2	4	6		
Type of Screen	Flat Screen	63	38	33	10	<0.05	17.91
	Do not know	33	12	22	10		
	<6	9	6	6	2		
Font Size	6-8	25	8	21	6	>0.05	17.26
	9-15	60	38	32	16		
	>15	6	0	0	2		
	unknown	70	24	34	44		
Refresh Rate	<60 Hz	8	2	7	0	<0.05	26.62
	60-120 Hz	20	26	16	14		
	>120 Hz	2	0	2	0		
	Less than 640×480	2	6	4	4		
Screen Resolution	800×600	10	4	11	4	<0.05	20.32
	1024×768	41	26	16	12		
	Unknown	47	16	28	6		

Table 5: *Relationship between Dry Eyes and Ergonomics.*

Variable		None	Mild	Moderate	Severe	P value	Chi-square
	<1 hour	50	20	23	2		
Screen time	1-4 hour	24	24	30	4	<0.05	34.79
	5-8 hour	10	12	12	10		
	>8 hour	6	4	6	0		
	<20 minutes	20	18	17	2		
Longest uninterrupted time	1-2 hour	25	20	26	4	>0.05	6.41
	>2 hour	45	22	28	10		
Breaks during screen use	Yes	83	52	61	14	>0.05	1.92
	No	7	8	10	2		
Screen Size	<14	11	6	12	0		
	14- 15	37	32	33	4	<0.05	38.05
	16-20	26	16	22	12		
	21	16	6	4	0		
	CRT	6	2	6	2		
Type of Screen	Flat Screen	59	36	41	8	>0.05	3.98
	Do not know	25	22	24	6		
	<6	11	2	8	2		
Font Size	6-8	21	16	19	4	>0.05	14.59
	9-15	52	42	42	10		
	>15	6	0	2	0		
	Unknown	62	30	40	10		
Refresh Rate	<60 Hz	6	6	5	0	>0.05	19.28
	60-120 Hz	20	34	24	6		
	>120 Hz	2	0	2	0		
	Less than 640×480	4	4	4	4		
Screen Resolution	800×600	4	8	13	4	<0.05	23.35
	1024×768	41	20	28	6		
	Unknown	41	28	26	2		

DISCUSSION

The findings of this study highlight the frequency of CVS symptoms and how ergonomic factors influence them. The research included 237 individuals, with an average age of 28.30 years. The majority of respondents were professionals, representing a diverse group of people who use screens daily for business or other purposes. Headache, blurred vision, and dry eyes are some of the most frequently experienced symptoms of CVS. According to a study by Reddy et al, people who spend a lot of time in front of electronic devices frequently experience these symptoms.[17] Furthermore, the range of severity noted in this study is consistent with the results of previous studies, emphasizing the range of discomfort experienced by people who use digital devices.[18] The results of this study support earlier research showing the relationship between screen time and CVS

symptoms in terms of ergonomic variables. Extended screen time (>8 hours) has been linked to more severe symptoms, which is consistent with research by Ranasinghe et al, that showed a positive correlation between prolonged screen exposure and symptoms of CVS.[19]

Similar to the current study, Ranasinghe et al, discovered a favorable link between extended screen time and symptoms of CVS.[19] The current study, however, makes a distinction between various screen time lengths (>8 hours) and offers a more detailed examination of the severity of symptoms linked to each category. A deeper understanding of the relationship between prolonged screen exposure and CVS symptoms is made possible by the current study's distinction of screen time durations. Through the identification of distinct thresholds (>8 hours) linked to heightened symptom severity, this study provides practical guidance for individuals and organizations seeking to address the negative consequences of extended screen usage.

Furthermore, the correlation found in this study between smaller screen sizes (less than 14 inches) and a higher prevalence of symptoms aligns with the findings of Kim et al, who emphasized the negative impacts of smaller screens on ergonomics and visual comfort.[20]Findings about font size and refresh rate also agree with other studies. Consistent with the findings of this investigation, studies conducted by Portello JK et al, have shown that reduced refresh rates and smaller font sizes are linked to higher levels of visual tiredness and discomfort.[18] While the current study assesses the relationship between refresh rate and a wider spectrum of CVS symptoms, Portello JK et al, only concentrated on subjective pain.[18]

The association between refresh rate and different CVS symptoms is examined in this study, which builds on earlier research and sheds light on the complex effects of refresh rate on musculoskeletal and visual health. Furthermore, the incorporation of several categories for refresh rates in the study improves the accuracy of suggestions for the optimization of refresh rates to mitigate symptoms of CVS.

Because of sample size limitations and potential biases from self-reported data, the study's conclusions may not entirely represent all populations at risk for CVS. Cross-sectional design also limits causal inference. Future research should include more diverse samples, combine objective and self-reported data, and explore ergonomic interventions. Collaboration with tech developers could also help reduce CVS prevalence.

CONCLUSION

In addition to our understanding of the complex interaction between ergonomics and visual discomfort, the study also shows the correlation between certain ergonomic factors like screen size and refresh rate with symptoms of CVS. This study provides new insights into certain ergonomic aspects and their consequences on individual symptoms, even as it validates previously documented connections between ergonomic practices and symptoms of CVS. Through comparison and integration of these results with other studies, this work contributes to the current discussion on CVS. It directs future research projects to enhance ergonomics and visual comfort in situations involving screens. Moreover, the study's rigorous methodology which includes a well-structured questionnaire and a strong statistical analysis supports the validity and dependability of the results, increasing their significance in the field of CVS research.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(TUF/CO/MPO/921)**.

Informed Consent

Informed consent was obtained from all participants as a mandatory step before proceeding with the survey. A statement regarding informed consent was included at the beginning of the Google form, and respondents were required to agree to this statement before continuing with the questionnaire.

REFERENCES

1. **Anbesu EW, Lema AK.** Prevalence of computer vision syndrome: a systematic review and meta-analysis. Sci Rep. 2023;**13(1):**1801. Doi: 10.1038/s41598-023-28750-6.

2. **Altalhi A, Khayyat W, Khojah O, Alsalmi M, Almarzouki H.** Computer Vision Syndrome Among Health Sciences Students in Saudi Arabia: Prevalence and Risk Factors. Cureus. 2020;**12(2):**e7060. Doi: 10.7759/cureus.7060.
3. **Mowatt L, Gordon C, Santosh ABR, Jones T.** Computer vision syndrome and ergonomic practices among undergraduate university students. Int J Clin Pract. 2018;**72(1)**. Doi: 10.1111/ijcp.13035.
4. **Kanwal B, Kiran A, Iqbal MJ, Khalil I, Maryam A.** Role of Vitamin D3 Supplementation in the Treatment of Dry Eye Syndrome. Pak J Ophthalmol. 2024;**40(2)**. Doi: 10.36351/pjo.v40i2.1766
5. **Noreen K, Ali K, Aftab K, Umar M.** Computer vision syndrome (CVS) and its associated risk factors among undergraduate medical students in midst of COVID-19. Pak J Ophthalmol. 2021;**37(1)**. Doi: 10.36351/pjo.v37i1.1124
6. **Zainodin EL, Abu Bakar NA.** Computer vision syndrome and ergonomic practices among university office workers. hs [Internet]. 2020 Aug. 7. Available from: https://healthscopefsk.com/index.php/research/article/view/89. Accessed 29 August 2024.
7. **Arumugam S, Kumar K, Subramani R, Kumar S.** Prevalence of computer vision syndrome among information technology professionals working in Chennai. World J Med Sci. 2014;**11(3):**312-4. http://idosi.org/wjms/11(3)14/5.pdf
8. **Jabeen S, Khalid M, Shahid R, Khalil I, Haider S, Jamil U.** Effect of Ergonomic Practices on Computer Vision Syndrome (CVS) symptoms among undergraduate and postgraduate IT students of University of Chakwal: Effect of Ergonomic Practices on CVS symptoms. J Ther Rehab Sci. 2023:40-47. Doi: 10.54393/tt.v4i04.183
9. **Khan R, Surti A, Rehman R, Ali U.** Knowledge and practices of ergonomics in computer users. J Pak Med Assoc. 2012;**62(3):**213-217. PMID: 22764450.
10. **Cardoso B, Mateus C, Magalhães R, Rodrigues MA.** Ergonomic intervention program for office workers: a case study about its effect in computer vision syndrome and musculoskeletal discomfort. Ergonomics. 2023:1-12. Doi: 10.1080/00140139.2023.2288543.
11. **Hassan A, Kashifq M, Masud Z, Raza MA.** Prevalence of Computer Vision Syndrome (CVS) amongst the Students of Khyber Medical University, Peshawar. Ophthalmol Update. 2017;**15(2)**.
12. **Arif S, Tulsani J, Naqvi S, Sharma K.** Computer Vision Syndrome among Computer Operators Working at a Tertiary Care Hospital--A Study of Prevalence, Knowledge, Ergonomics and Other Associated Factors. JEvol Med Dent Sci. 2020;**9(51):**3856-3862.
13. **Hassan HMJ, Ehsan S, Arshad HS.** Frequency of computer vision syndrome & ergonomic practices among computer engineering students. Int J Sci Res. 2016;**5(5):**121-125.
14. **Yaacob NSM, Abdullah AM, Azmi A.** Prevalence of Computer Vision Syndrome (CVS) Among Undergraduate Students of a Health-related Faculty in a Public University. Malays J MedHealth Sci. 2022;**18:**348-354.
15. **Boadi-Kusi SB, Abu SL, Acheampong GO, Adueming PO, Abu EK.** Association between Poor Ergophthalmologic Practices and Computer Vision Syndrome among University Administrative Staff in Ghana. J Environ Public Health. 2020;**2020:**7516357. Doi: 10.1155/2020/7516357.
16. **Boadi-Kusi SB, Adueming PO, Hammond FA, Antiri EO.** Computer vision syndrome and its associated ergonomic factors among bank workers. Int J Occup Saf Ergon. 2022;**28(2):**1219-1226. Doi: 10.1080/10803548.2021.1897260
17. **Reddy SC, Low C, Lim Y, Low L, Mardina F, Nursaleha M.** Computer vision syndrome: a study of knowledge and practices in university students. Nepalese journal of ophthalmology: a biannual peer-reviewed academic journal of the Nepal Ophthalmic Society: NEPJOPH. 2013;**5(2):**161-8. https://doi.org/10.3126/nepjoph.v5i2.8707
18. **Portello JK, Rosenfield M, Bababekova Y, Estrada JM, Leon A.** Computer-related visual symptoms in office workers. Ophthalmic Physiol Opt. 2012;**32(5):**375-382. Doi: 10.1111/j.1475-1313.2012.00925.x.
19. **Ranasinghe P, Wathurapatha WS, Perera YS, Lamabadusuriya DA, Kulatunga S, Jayawardana N, et al.** Computer vision syndrome among computer office workers in a developing country: an evaluation of prevalence and risk factors. BMC Res Notes. 2016;**9:**150. Doi: 10.1186/s13104-016-1962-1.
20. **Kim DJ, Lim CY, Gu N, Park CY.** Visual fatigue induced by viewing a tablet computer with a high-resolution display. Korean JOphthalmol. 2017;**31(5):**388-393. Doi: 10.3341/kjo.2016.0095

Authors Designation and Contribution

Bushra Kanwal; Optometrist: *Concepts, Design, Data acquisition, Manuscript preparation, Manuscript editing, Manuscript review.*

Iqra Khalil; Optometrist: *Literature search, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review.*