IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

From Screen Strain To Visual Resilience: Effect Of Ophthalmic Exercise On Computer Vision Syndrome Severity In South Indian College Students

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Abstract

Computer Vision Syndrome (CVS) is a growing concern among college students due to excessive screen exposure from academic and personal device usage. Symptoms such as eye strain, dryness, blurred vision, and headaches impact concentration and productivity. While behavioural adjustments like screen breaks are commonly advised, ophthalmic exercises offer a potential low-cost, non-pharmacological alternative. This study assessed the effectiveness of structured ophthalmic exercises in reducing CVS severity among college students. A quasi-experimental, pre-test, post-test control group design was conducted among 60 students aged 18–25 years with confirmed CVS (CVS-Q score ≥6), purposively sampled from computer-based disciplines. Participants were randomly assigned to intervention (n=30) and control (n=30) groups. The intervention group practised six ophthalmic exercises—palming, blinking, eye rolling, visual scanning, focusing, and glancing—three times daily for eight weeks. Data were collected using the CVS-Q tool at pre-test, post-test I (4 weeks), and post-test II (8 weeks), and analysed using SPSS v23.0. Repeated measures ANOVA and chi-square tests were used to determine effectiveness and associations. The intervention group showed a significant reduction in CVS scores from 8.23 to 3.87 and 2.93 over time, while the control group's scores remained largely unchanged. The group-by-time interaction was statistically significant ($p < 0.001$). CVS severity was also significantly associated with gender, VDT

exposure duration, and years of computer use. The results suggest that ophthalmic exercises are effective in reducing CVS severity. These exercises can serve as a practical intervention to reduce digital eye strain among students

Keywords: Computer Vision Syndrome, ophthalmic exercise, digital eye strain, visual display terminals, university students, intervention study

INTRODUCTION

Computer Vision Syndrome (CVS) has emerged as a pervasive health challenge in the 21st century due to increasing ubiquity of digital devices in professional, academic, and personal domains. CVS, also termed digital eye strain, is defined as a spectrum of visual and ocular symptoms resulting from prolonged use of digital screens such as computers, tablets, and smartphones. Symptoms typically include eyestrain, blurred vision, dry eyes, headache, difficulty focusing, and musculoskeletal discomfort such as neck and shoulder pain[1]. The widespread integration of screen-based technologies into daily life, especially following the shift toward remote work and online education post-pandemic, has further amplified exposure risks.

Recent evidence indicates that CVS affects a significant portion of digital screen users. A study showed that a pooled prevalence of CVS was 66% among screen users[2]. Other studies have reported even higher prevalence figures, with some ranging up to 97% in certain subgroups[3]. In a survey among university students in Saudi Arabia, 73.7% reported symptoms consistent with CVS[4]. Another study among medical and engineering students found that engineering students who tended to spend more hours on screens were more likely to experience dry eyes, headaches, and musculoskeletal symptoms[5]. These findings reflect a troubling trend: nearly two-thirds to three-quarters of digital users globally may suffer from CVS.

The pathophysiology of CVS is multifactorial, involving both ocular and extraocular mechanisms. Key contributing factors include decreased blink rate during screen use, leading to tear film instability and dry eye symptoms, prolonged accommodation causing ciliary muscle fatigue, and vergence stress from sustained near focus[6]. Uncorrected refractive errors, poor lighting, glare, improper seating posture, and suboptimal screen positioning further exacerbate symptom severity[7]. Despite increasing awareness of these risk factors, the primary emphasis has often remained on ergonomic interventions and behavioural guidelines, such as the "20-20-20 rule" (every 20 minutes, look at something 20 feet away for 20 seconds), proper seating posture, and adjusting screen brightness[8]. However, these passive strategies may not suffice in mitigating symptoms, particularly for users with prolonged or unavoidable screen exposure.

Emerging attention has turned toward active interventional strategies, particularly ophthalmic exercises, which target the physiological causes of visual fatigue. These exercises designed to improve accommodation, convergence, and ocular motility offer a non-pharmacological and low-cost approach to enhance visual comfort. A study on Indonesian medical students found that participants performing twice-weekly ocular exercises for one month reported a statistically significant reduction in CVS symptom

scores compared to controls ($p < 0.001$)[9]. Similarly, a study among hospital nursing staff demonstrated significant improvement in symptomatology after a week-long intervention involving daily eye exercises ($t = 2.20$, $p < 0.05$)[10]. These findings suggest that eye exercises may help alleviate visual discomfort and improve ocular endurance.

Due to the growing burden of CVS and the limitations of existing management strategies, there is a pressing need for evidence-based, accessible, and sustainable interventions. While behavioral and ergonomic modifications are necessary, adjunctive approaches such as ophthalmic exercises may offer an effective and scalable solution—if validated through rigorous study. However, the variability in existing methodologies, absence of long-term data, and reliance on subjective outcomes represent significant gaps in the current literature. The present study seeks to address this gap by evaluating the effectiveness of a structured ophthalmic-exercise program in reducing the severity of Computer Vision Syndrome. This study aimed to assess the effectiveness of ophthalmic exercises on Computer Vision Syndrome among the students using computers.

METERIALS AND METHODS

The researcher used a quantitative research, quasi-experimental, pre-test, post-test control group design to assess the effectiveness of ophthalmic exercises on the severity of Computer Vision Syndrome (CVS) among college students in a university in South India. The students aged 18 to 25 years, from undergraduate and postgraduate programs in disciplines such as Computer Science, Information Technology, Computer Applications, and Engineering, who used visual display terminals (VDTs) like computers, mobile phones, or tablets for a minimum of three hours per day. Students were included if they had a confirmed CVS diagnosis (CVS-Q score ≥6), refractive errors (myopia, hyperopia, astigmatism, or presbyopia), and were able and willing to provide informed consent. Students with eye diseases like glaucoma or cataract, those already performing ophthalmic exercises, or under treatment for other eye-related conditions were excluded.

A purposive sampling technique was used to select 60 students, 30 each for the intervention and control groups. The sample size was calculated using G*Power 3.1 software for repeated measures ANOVA. With an effect size of 0.5513, power of 95%, and significance level of 5%, the minimum required sample was 23 per group. Accounting for a 20% attrition rate, the final sample size was fixed at 30 students in each group to ensure adequate statistical power.

Demographic data such as age, gender, education, sleep hours, and screen usage and variables related to eye health, including blinking habits, screen distance, use of antiglare screens, and history of eye treatment, Computer Vision Syndrome Questionnaire (CVS-Q), were used to collect data. The CVS-Q assessed 16 symptoms including burning, itching, tearing, dryness, headache, and blurred vision. Symptoms were rated based on their frequency and intensity, and total scores were calculated using a standardized scoring algorithm. A score of 6 or more indicated the presence of CVS, with severity classified as mild (6–12), moderate (13–19), or severe (≥20).

The intervention group that received structured ophthalmic exercise regimen comprising six types of exercises: palming, blinking, eye rolling, visual scanning, focusing, and glancing. These were demonstrated over three consecutive days, with participants performing the exercises thrice daily during morning, evening, and night breaks for approximately 10 minutes per session over a period of 8 weeks. Participants were also provided with an information booklet and a tracking sheet to record exercise adherence. A dedicated WhatsApp group was created to send reminders three times a day. The control group received the same intervention only after the study period, ensuring ethical parity.

Both groups underwent assessments at three time points like prior to the intervention (pre-test), at the end of the fourth week (post-test I), and at the end of the eighth week (post-test II), using the same standardized tool for consistency in evaluation. Data were analyzed using SPSS version 23.0. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize demographic and baseline characteristics. Inferential statistics included the Chi-square test to assess associations between variables and repeated measures ANOVA to evaluate the effectiveness of the ophthalmic exercise intervention across time points. A p-value less than 0.05 was considered statistically significant.

RESULTS

Sociodemographic variables:

The mean age of the students was 20.59 ± 1.74 years. majority of participants were aged 18–20 years, with 60% in the intervention group and 56.67% in the control group. Females constituted 46.67% of the intervention group and 60% of the control group, while males accounted for 53.33% and 40% respectively. Most participants were Hindus, comprising 90% in the intervention and 96.67% in the control group. Regarding sleep, 50% of the intervention group and 40% of the control group slept 6–7 hours daily. VDT use for 3–5 hours was reported by 76.66% (intervention) and 63.33% (control). No significant demographic differences were found ($p > 0.05$) (Table 1).

Table 1: Sociodemographic variables among the students with Computer Vision Syndrome in the Intervention and Control Group. (N=60)

Variable	Sub-variable	Intervention Group		Control group		χ^2 test value	d.f	P value
		No.	%	No.	%			
Age in years	18 - 20 years	18	60	17	56.67	0.069	1	0.793 (NS)
	20 – 25 years	12	40	13	43.33			
Gender	Male	16	53.33	12	40	1.071	1	0.301 (NS)
	Female	14	46.67	18	60			
Religion	Hindu	27	90	29	96.67	0.268	1	0.605
	Muslim	2	6.67	1	3.33			
	Christian	1	3.33	0	0			
Education	Under-Graduates	30	100	30	100	----	--	----
Hours of sleep per day	4-6 hrs	9	30	13	43.33	1.152	2	0.562
	6-7 hrs	15	50	12	40			
	7-8 hrs	6	20	5	16.67			
VDT exposure in hours	3-5 hrs	23	76.66	19	63.33	1.27	1	0.260 (NS)
	>5 hrs	7	23.33	11	36.66			
Years of Exposure in computer work	1-2 years	11	36.67	6	20	2.277	2	0.320 (NS)
	2-4 years	13	43.33	18	60			
	>4 years	6	20	6	20			

NS – Non-significant

Variables related to eye health

The majority of students in the intervention group (60%) reported having eye problems, whereas most in the control group (66.67%) did not. A higher proportion in both groups had no prior treatment history, with 66.67% in the intervention group and 73.33% in the control group. Most students had not withdrawn from any eye-related treatment (96.67% intervention, 86.67% control) and did not follow any special diet for eye health (86.67% and 93.33%, respectively). The majority never used anti-glare screens (73.33% intervention, 86.67% control) and often or sometimes used breaks to refresh their eyes. Most students had a blink rate of either 10 or 8 per minute and sat 5–10 inches (56.67%) or 10–15 inches (40%) from their screens (Table 2).

Table 2: Variables related to eye health among the students with Computer Vision Syndrome in the Intervention and Control Groups (N=60)

Variable	Sub variable	Intervention Group		Control group		χ^2 test value	d.f	P value
		No.	%	No.	%			
Eye Problems	Yes	18	60	10	33.33	4.286	1	**0.038* (S)**
	No	12	40	20	66.67			
Previous history of treatment	Medical	8	26.67	8	26.67	2.095	2	0.351 (NS)
	Surgical	2	6.67	0	0			
	Both	--	0	--	0			
	None	20	66.67	22	73.33			
Withdrawal of treatment	Withdrawal of wearing spectacles	1	3.33	1	3.33	1.964	1	0.161 (NS)
	Discontinued using eye lubricants	0	0	1	3.33			
	Discontinued yoga	0	0	2	6.67			
	None	29	96.67	26	86.67			
Any special diet for eye health	Yes	4	13.33	2	6.67	0.741	1	0.389 (NS)
	No	26	86.67	28	93.33			
Use of Anti-glare screen	Often	1	3.33	2	6.67	3.444	2	0.179 (NS)
	Sometimes	7	3.33	2	6.67			
	Never	22	73.33	26	86.67			
Use of break time to refresh the eyes	Often	4	13.33	3	10	1.067	2	0.586 (NS)
	Sometimes	13	43.33	17	56.67			
	Never	13	43.33	10	33.33			
Blink Status	10 per minute	12	40	7	23.33	7.308	3	0.063 (NS)
	12 per minute	5	16.67	8	26.67			
	8 per minute	12	40	8	26.67			
	16 per minute	1	3.33	7	23.33			
Distance between the seat and computer screen	5-10 inches	17	56.67	10	33.33	3.416	2	0.181 (NS)
	10-15 inches	7	23.33	12	40			
	16-20 inches	6	20	8	26.67			
Underlying health problem	Yes	1	3.33	0	0	1.017	1	0.313 (NS)
	No	29	96.67	30	100			

NS – Non-significant: S – Significant

Pretest level of Computer Vision Syndrome Scores

In the pretest assessment of Computer Vision Syndrome (CVS) among students with CVS, the majority in both groups had mild symptoms. In the intervention group, 93.33% had mild CVS and 6.67% had moderate CVS, while in the control group, 80% had mild and 20% had moderate CVS. No students in either group exhibited severe CVS. The mean CVS score was 8.23 (SD = 2.50) in the intervention group and 9.17 (SD = 3.15) in the control group. The difference in mean scores between the two groups was not statistically significant, as indicated by a t-test value of 1.270 and a p-value of 0.209 ($p > 0.05$) (Table 3).

Table 3: Computer Vision Syndrome Scores among the students with CVS in the Intervention and Control groups in the Pretest. (N=60)

Group	CVS score						Mean	SD	t-test value	P-value
	Mild CVS (6-12)		Moderate CVS (13-19)		Severe CVS (≥20)					
	No.	(%)	No.	(%)	No.	(%)				
Intervention	28	93.33	2	6.67	0	0	8.23	2.501	1.270	0.209 NS
Control	24	80	6	20	0	0	9.17	3.152		

NS – Non-significant

Effectiveness of Ophthalmic Exercise on Computer Vision Syndrome Severity

The mean CVS score significantly decreased from 8.23 (SD = 2.50) at pre-test to 3.87 (SD = 2.14) at post-test I, and further to 2.93 (SD = 1.86) at post-test II. The overall reduction across the three assessments was statistically significant (F = 97.827, p = 0.000). Repeated contrast tests showed a very highly significant improvement from pre-test to post-test I (F = 112.876, p = 0.000), and from post-test I to post-test II (F = 16.523, p = 0.000), confirming the effectiveness of the intervention over time (Table 4).

Table 4: Mean and Standard Deviation of Computer Vision Syndrome in the Intervention group in the Post-Test (N=30)

Assessment	Mean	SD	One-way ANOVA repeated measures test value		Repeated Contrast test result		
			F-value	P-value	Comparisons	F-value	P-value
Pre test	8.23	2.501	97.827	0.000	Pre-test Vs post-test I	112.876	**0.000*** (S)**
Post test I	3.87	2.145			Post-test I Vs Post-test II	16.523	**0.000*** (S)**
Post test II	2.93	1.856					

***(S)- Very Highly Significant**

Comparison of CVS in the Intervention and Control Groups in the Pretest, Post-Test I and Post-Test II

In the pre-test, the mean CVS score was 8.23 (SD = 2.50) for the intervention group and 9.17 (SD = 3.15) for the control group. Following the ophthalmic exercise intervention, the intervention group showed a marked decrease in scores to 3.87 (SD = 2.14) at post-test I and 2.93 (SD = 1.86) at post-test II, while the control group scores remained nearly unchanged. The repeated measures ANOVA indicated very highly significant effects for group (F = 60.114, p = 0.000), assessment time (F = 26.653, p = 0.000), and their interaction (F = 20.020, p = 0.000), confirming the effectiveness of ophthalmic exercises (Table 5).

Table 5: Comparison of Mean and Standard Deviation among the students with CVS in the Intervention and Control Group in the Pretest, Post-Test I and Post-Test II

Assessment	Intervention group		Control group		2x3 ANOVA repeated measures test result		
	Mean	SD	Mean	SD	Source	F-value	P-value
Pre test	8.23	2.501	9.17	3.152	Group	60.114	**0.000*** (S)**
Post test1	3.87	2.145	8.83	3.206	Assessment	26.653	**0.000*** (S)**
Post test2	2.93	1.856	8.80	3.033	Assessment* Group	20.020	**0.000*** (S)**

***(S)-Very Highly Significant**

Association with sociodemographic and clinical variables

The findings indicated that the pretest level of Computer Vision Syndrome (CVS) among students was significantly associated with gender ($p \leq 0.023$), Visual Display Terminus (VDT) exposure ($p \leq 0.001$), and years of computer work experience ($p \leq 0.007$). However, no significant association was found with other demographic variables such as age, religion, education, and total hours of sleep. Similarly, CVS levels were not significantly associated with eye problems, special diets for eye health, use of antiglare screens, blink rate, screen distance, withdrawal from treatment, or the use of breaks to rest the eyes during screen exposure.

DISCUSSION

The present study demonstrated that ophthalmic exercises significantly reduced the severity of Computer Vision Syndrome (CVS) among university students. In the pretest assessment, the majority of students in both intervention (93.33%) and control groups (80%) exhibited mild CVS symptoms, with none showing severe symptoms. These baseline scores were statistically comparable ($p = 0.209$), suggesting initial group equivalence. These findings align with Massa et al. (2025), who reported mild to moderate symptoms as the predominant baseline profile in a cohort exposed to digital screens, with no significant pre-intervention differences between intervention and control groups[11].

In the post-intervention analysis, a significant and sustained reduction in CVS scores was noted among participants who engaged in structured ophthalmic exercises. The mean scores in the intervention group dropped from 8.23 at pretest to 3.87 and 2.93 at post-test I and II respectively, demonstrating the intervention's effectiveness over time. This aligns with findings by Barata et al. (2025), who emphasized the therapeutic potential of visual function training in reducing digital eye strain symptoms linked to accommodation and vergence anomalies[12].

Comparative analysis between the intervention and control groups further reinforced these outcomes. While the control group's mean CVS scores remained consistently high from pretest to post-test II, the intervention group experienced a substantial decline. The repeated measures ANOVA showed very highly significant differences across groups ($F = 60.114$, $p = 0.000$) and over time ($F = 26.653$, $p = 0.000$), validating the intervention's impact. These results are consistent with the conclusions drawn by Barzegari et al. (2025), who found that the lack of screen-time management and absence of structured visual breaks significantly contributed to the persistence of CVS symptoms in university students[13].

Furthermore, the pretest CVS levels were significantly associated with gender ($p \leq 0.023$), duration of VDT exposure ($p \leq 0.001$), and years of computer use ($p \leq 0.007$). This was supported by a study by Al Ashkar et al. (2024) who found that prolonged screen time and being female were significantly associated with a higher prevalence of Computer Vision Syndrome (CVS), reinforcing the role of demographic and behavioural factors in symptom severity[14].

LIMITATION

The sample was restricted to students from a single university, limiting the generalizability of the findings. Self-reported measures may have introduced recall bias or response bias. The short follow-up duration may not capture the long-term effects of ophthalmic exercises on Computer Vision Syndrome. The external factors such as lighting conditions, screen resolution, or individual visual ergonomics were not controlled, which could have influenced the severity of symptoms and intervention outcomes.

CONCLUSION

The study concluded that ophthalmic exercises were highly effective in reducing the severity of Computer Vision Syndrome (CVS) among university students. A significant reduction in CVS scores was observed in the intervention group over an 8-week period, while the control group showed minimal change. The intervention proved beneficial, simple, and non-pharmacological in addressing digital eye strain. Significant associations were found between CVS and variables such as gender, screen exposure duration, and years of computer use, highlighting the need for targeted preventive strategies in high-risk student populations.

Funding: Nil

Conflicts of Interest: Nil

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