Original Article

Prevalence of Digital Eye Strain and Computer Vision Syndrome (CVS) Among Radiologists: A Survey-Based Cross-Sectional Study

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Abstract

Objective: To determine the prevalence of digital eye strain (DES) or computer vision syndrome (CVS) among radiologists and evaluate associated risk factors.

Methods: A cross-sectional study was conducted across multiple cities in Pakistan from January to April 2025. A reliable and validated CVS questionnaire was distributed to radiology physicians to assess CVS symptoms. Risk factor assessment was performed by acquiring relevant demographic and ocular health-related information, as well as data on the workplace environment and ergonomics. Non-parametric methods were employed for both univariate and multivariate analyses to determine the associations between the CVS score and various demographic and health-related variables.

Results: Out of 242 participating radiologists, 44.6% were males and 55.4% females. The overall prevalence of CVS was 56.6%. The most frequently reported symptoms were headache (73.4%), worsening of eyesight (59.1%), and heavy eyelids (57.9%). Higher CVS scores were significantly associated with postgraduate residents, longer daily working hours, and fewer work breaks. Frequent breaks and older age were identified as protective factors.

Conclusion: CVS is a prevalent occupational hazard among radiologists in Pakistan, closely linked to extended digital screen time and work-related demands. Addressing modifiable risk factors can help reduce the symptom burden and improve radiologists' comfort and diagnostic performance.

Keywords: Computers, Eyestrain, Occupational Diseases, Radiologists, Picture Archiving and Communication Systems.

Contributions:
MF - Conception, Design
AA WWQ- Acquisition, Analysis, Interpretation
MF - Drafting
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Introduction

The advancement of computer technology has resulted in a colossal transformation of the modern work environment over the last few decades.[1] Along with numerous benefits, it has also brought about an array of detrimental health-related adverse effects. One major emerging occupational health concern attributed to the extended use of digital screens is digital eye strain (DES). As eye strain has predominantly been studied among computer users, it is often referred to as computer vision syndrome (CVS).[2] Digital eye strain, according to the American Optometric Association, is defined as a complex of ocular and vision-related problems associated with prolonged viewing of digital screens, such as computers, tablets, e-readers, and cell phones.[3] It encompasses a range of symptoms, including ocular fatigue, dryness, burning, itching, and redness of the eyes, photophobia, blurred or double vision, foreign body sensation, excessive tearing, headaches, and neck or shoulder pain.[4] These symptoms tend to worsen with prolonged digital screen time,[5] and can negatively impact both productivity and overall quality of life.[6]

DES affects a considerable proportion of the global population and is emerging as a significant public health concern. The 2016 Digital Eye Strain Report conducted in the United States reported an overall prevalence of 65%, with women experiencing symptoms more frequently than men. It also indicated that 75% of the individuals who used multiple digital devices simultaneously reported DES symptoms.[3] A recent meta-analysis established a pooled prevalence of DES at approximately 66%, with significant regional differences, identifying Pakistan as having one of the highest rates, while Japan reported the lowest.[7]

Occupational exposure plays a crucial role in the development of CVS. Numerous studies have documented its prevalence in office workers and IT professionals with extended screen exposure.[8,9] However, a deeper investigation into its impact on healthcare professionals is warranted, particularly in the context of modern, technology-driven clinical environments that rely extensively on digital tools for both diagnostic and administrative tasks.

The field of radiology, in particular, has been overhauled after the introduction of picture archiving and communication systems (PACS) and high-resolution digital displays, which are indispensable in modern diagnostic workflows. Radiologists are predominantly susceptible to CVS as they spend extensive hours interpreting scans on digital displays, which involves continuous, high-concentration viewing of images for long periods on brightly illuminated screens. This extended digital engagement results in several physiological impacts. First, prolonged screen time leads to a reduced blink rate and incomplete blinking. This altered blinking pattern leads to ocular surface dryness. Second, prolonged near work while viewing digital images requires continuous accommodative effort that strains ciliary muscles and causes asthenopia. Third, suboptimal workstation ergonomics and poor posture throughout the day predispose radiologists to chronic neck and back pain.[10] All these effects compromise the well-being of radiologists and impair their diagnostic accuracy and efficiency.

Given these potential impacts of DES, it is crucial to assess its prevalence and contributing factors in this professional population. Therefore, this study was designed to investigate the prevalence of DES among radiologists in Pakistan and identify its risk factors using a structured, survey-based approach. Our goal is to provide valuable insights to implement evidence-based preventive strategies and workplace modifications to improve visual comfort and occupational health in radiology professionals.

Materials And Methods

This survey-based cross-sectional study was conducted from January 2025 to April 2025 after approval by the Institutional Ethics Committee (approval no. 840/RC/FFH/RWP). The study population comprised radiology residents and consultants practising in various public and private hospitals and diagnostic centres across various cities in Pakistan. Interns and radiographers were excluded from the study. A sample size of 242 was calculated using OpenEpi software (version 3.01, Open Source Epidemiologic Statistics for Public Health, USA), considering an estimated prevalence of 65.4%, absolute precision of 6%, and 95% confidence interval. A non-probability consecutive sampling technique was employed to recruit participants.

A structured, self-administered questionnaire was distributed both by hand and online via Google Forms. Informed consent was obtained at the beginning of the survey, and the confidentiality of the participants was maintained. The questionnaire was divided into sections that included demographic information, ocular health-related questions, work habits, and workstation ergonomics. These sections were adapted from the validated questionnaire by Vertinsky et al.[11]. Symptoms of eye strain and computer vision syndrome were assessed utilizing the reliable and validated CVS questionnaire (CVS-Q) developed by Seguí et al.[12]. It included a total of 16 ocular symptoms. The frequency of symptoms was identified by asking participants how often they experienced a particular symptom and grading it as follows: always or often =2, sometimes or occasionally = 1, and never = 0. The intensity of the perceived symptom was identified by grading the severity as 1 = mild to moderate and 2 = severe. Symptoms reported as never occurring were automatically scored as 0 on the intensity scale. The total score was calculated as described by Seguí et al. Participants with a total score of ≥ 6 were defined as having CVS. Further stratification was performed according to the following criteria: a total score of 6–12 was considered mild CVS, 13–19 was deemed moderate CVS, and a score of 20 or more was considered severe CVS.[13]

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 23. Categorical variables are displayed as frequencies and percentages. Because the data, including the CVS score, were not normally distributed, nonparametric tests were applied. The CVS score is presented as the median and interquartile range (IQR). Univariate analysis was performed to examine the association between independent variables and CVS scores. The Mann–Whitney U test was applied to determine any statistically significant difference between two groups, while the Kruskal–Wallis test was used for comparisons involving more than two groups. Subsequently, a multivariate analysis was conducted using multinomial logistic regression to identify independent predictors of CVS severity. A p-value of < 0.05 was considered statistically significant.

Results

A total of 242 radiology professionals participated in the study; of these, 108 (44.6%) were men and 134 (55.4%) were women. The majority of the participants were aged between 30 and 39 years (58.3%). Fifty percent were postgraduate residents, 7.9% were registrars, and 42.1% were consultants. Among the participants, 48.8% used corrective lenses for distance, reading, or both. Thirty-two percent had a history of regular use of eye drops, most commonly artificial tears (11.6%). Twenty-one-point-five percent had never undergone an eye examination, while 35.5% reported having an ophthalmic evaluation within the previous year. Demographic and personal eye care details are described in Table 1.

Table 1: Demographic and ocular-health related parameters

Variables	Characteristics	Frequency (n)	Percentage (%)
Gender	Male	108	44.6
	Female	134	55.4
Age	< 30 years	63	26
	30 to 39 years	141	58.3
	40 to 49 years	27	11.2
	50 to 59 years	11	4.5
	60 years and above	0	0
Professional rank	Consultant	102	42.1
	Registrar	19	7.9
	Postgraduate Resident	121	50
Years of practice	< 1 year	23	9.5
	1–5 years	133	55
	6–10 years	67	27.7
	> 10 years	19	7.9
Use of corrective lenses	Yes	118	48.8
	No	124	51.2
Purpose of corrective lenses worn	For Reading	15	6.2
	For Distance	75	31
	For Both	28	11.6
	Not Applicable	124	51.2
Use of eye drops	Yes	32	13.2
	No	210	86.8
Visit to an ophthalmologist	Never	52	21.5
	More than a year ago	104	43
	Within the last year	86	35.5

Most radiologists (93.8%) reported that PACS was their preferred mode of viewing scans, with most participants spending 76–100% of their total annual working time on PACS. The diagnostic modality used most frequently was CT scans (60.7%). Details regarding the working environment and ergonomics of the workstation are outlined in Table 2.

Table 2: Work habits and working environment of participants

Variables	Characteristics	Frequency (n)	Percentage (%)
Preferred workflow mode	Films	15	6.2
	PACS	227	93.8
Total yearly working time (percent) spent in reviewing cases using films	0%	31	12.8
	1 to 25%	161	66.5
	26 to 50%	34	14
	51 to 75%	16	6.66
	76 to 100%	0	0
Total yearly working time (percent) spent in reviewing cases using PACS	0%	0	0
	1 to 25%	8	3.3
	26 to 50%	28	11.6
	51 to 75%	96	39.7
	76 to 100%	110	45.4
Hours per day spent reviewing cases	<4 hours	12	5
	4 to 6 hours	90	37.2
	7 to 9 hours	101	41.7
	>9 hours	39	16.1
The diagnostic technique most frequently used	Conventional radiographs (plain films)	15	6.2
	Sonography	64	26.4
	Computed Tomography (CT) scans	147	60.7
	Magnetic Resonance Imaging (MRI)	16	6.6
	Miscellaneous (nuclear medicine studies, angiography, etc.)	0	0
Frequency of breaks taken during work	Once a day	93	38.4
	Twice a day	58	24
	Every 2 hours	51	21.1
	At least every hour	40	16.5
Duration of breaks	< 5 min	36	14.9
	5–10 min	67	27.7
	11–15 min	74	30.6
	> 15 min	65	26.9
No. of monitors at workstation	One	92	38
	Two	102	42.1
	More than two	28	11.6
	Number varies	20	8.3
Type of monitor	LCD	223	92.1
	CRT	0	0
	Both	8	3.3
	Don't know	11	4.5
Resolution of the monitor	Low resolution (512 pixels)	0	0
	Medium resolution (1000–1600 pixels)	36	14.9
	High resolution (2000–2500 pixels)	107	44.2
	Screen resolution varies	35	14.5
	Don't Know	64	26.4
Screen flicker	Yes	31	12.8
	No	211	87.2
Lighting optimization of the workstation	Yes	179	74
	No	63	26
Ability to adjust viewing distance	Yes	195	80.6
	No	47	19.4
Ability to adjust the height of the workstation	Yes	136	56.2
	No	106	43.8
Height adjustment performed	Yes	117	48.3
	No	19	7.9
	Not Applicable	106	43.8

The prevalence of CVS among the respondents was 56.6% (n = 242, 95% CI: 50.4%–62.8%). The median CVS score was 6 (IQR: 4; 12). A total of 6.6% (n = 16) of participants reported no CVS symptoms, with a score of zero. Mild CVS was present in 36% (n=87), moderate CVS in 19.8% (n=48), and severe CVS in only 0.8% (n=2). The most commonly reported symptoms were headache (73.4%), followed by worsening of eyesight (59.1%), heavy lids (57.9%), and burning sensation of eyes (56.6%). The least commonly perceived symptoms were coloured haloes around objects (17%), eye redness (22.7%), double vision (24%), and foreign body sensation (28.9%) (Figure 1). The severity of symptoms is demonstrated in Figure 2.

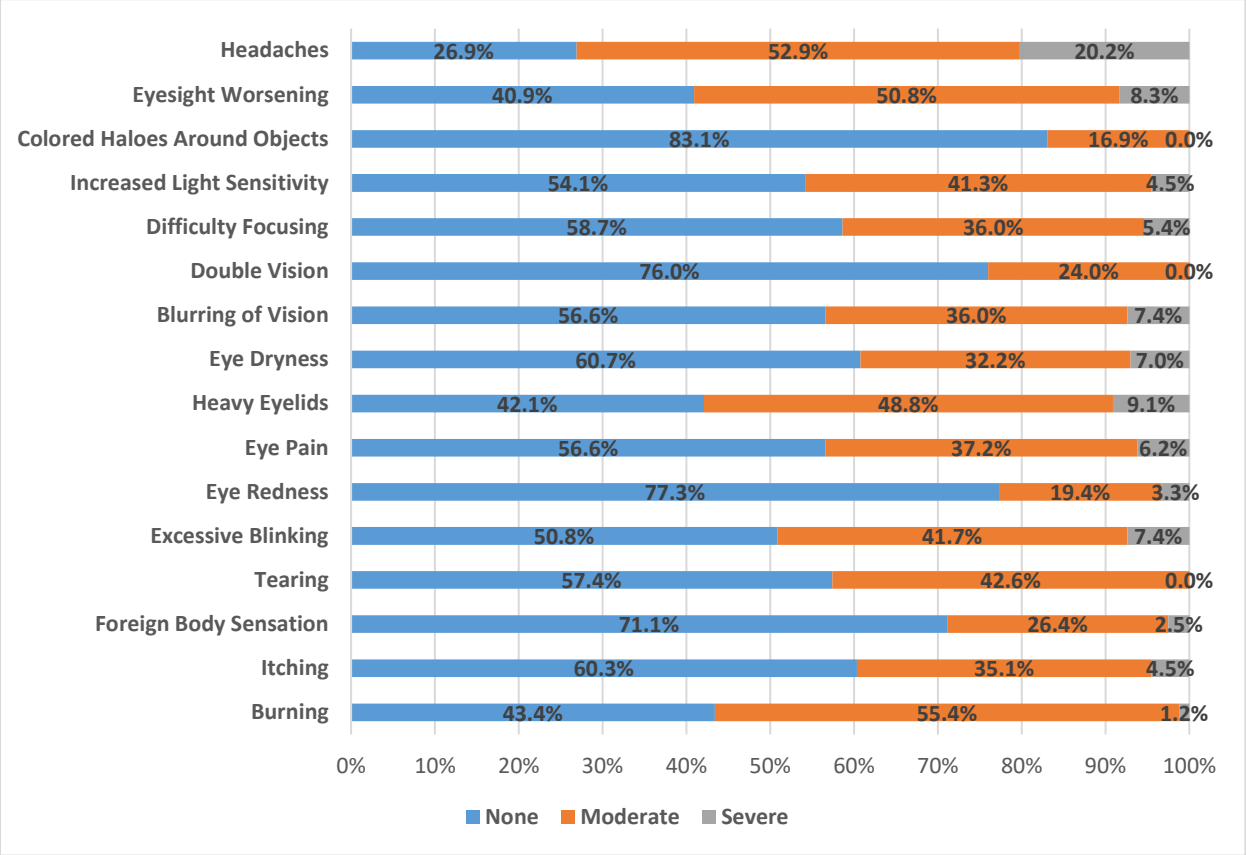

Figure 1: Frequency of CVS Symptoms

Postgraduate residents had significantly higher CVS scores (p=0.016). Longer working hours (7–9 h or more) and fewer breaks during the workday were also significantly associated with greater CVS scores (p=0.000 and p=0.01, respectively). Additionally, CVS scores were higher among those who preferred PACS as the primary viewing mode (p=0.026) and those who reported noticeable screen flicker (p=0.015).

Multinomial logistic regression analysis identified professional rank as a significant predictor of CVS (p = 0.001), with postgraduate residents having increased odds of reporting CVS symptoms (OR = 1.931, 95% CI: 1.311–2.844). Similarly, a greater number of hours per day spent reviewing cases was also a significant predictor of CVS (p=0.000, OR=2.42, 95% CI: 1.538-3.821). Protective factors against CVS included taking more frequent breaks during working hours (p=0.001, OR=0.548, 95% CI: 0.383–0.785) and older age groups (p=0.001, OR=0.396, 95% CI: 0.229-0.685).

Discussion

This study explored the prevalence of computer vision syndrome (CVS) among radiologists in Pakistan and examined its associated risk factors. CVS was identified in 56.6% of radiologists, which is in close alignment with a study conducted in Saudi Arabia that reported an overall prevalence of 50.5%.[11] An Indian study concluded that all 47 radiologists participating in the study reported symptoms of eye strain that led to fatigue, irritation, blurry vision, and headache toward the end of the day.[10] Although these prevalence rates are slightly lower than the global average for computer users, they underscore a significant occupational health concern. The median CVS score of 6 and the distribution of CVS severity grades highlight that while severe cases are rare, mild-to-moderate symptoms are quite prevalent. Similar findings were reported by Alhasan et al., who identified that the majority of radiologists in Saudi Arabia experienced mild-to-moderate symptoms.[13]

Our study population included more female participants (55.4%) and postgraduate residents (50%). This is consistent with a previous study conducted in Pakistan.[14] PACS was identified as the preferred viewing mode by an overwhelming majority of our study population (93.8%), a finding that has been well established in the literature.[15] The most frequently reported symptoms in our study were headache (73.4%), worsening eyesight (59.1%), heavy lids (57.9%), and burning sensation (56.6%), whereas coloured haloes around objects (17%), eye redness (22.7%), double vision (24%), and foreign body sensation (28.9%) were the least common symptoms. Some similarity in symptom frequency was observed in the study by Alhasan et al.[13]

Our study identified that professional rank, longer working hours, and fewer breaks were significant predictors of CVS. These results are similar to those of previous studies.[11,14] However, no significant associations were found between sex and CVS scores, which contrasts with the findings of a study by Tahir et al.[14]

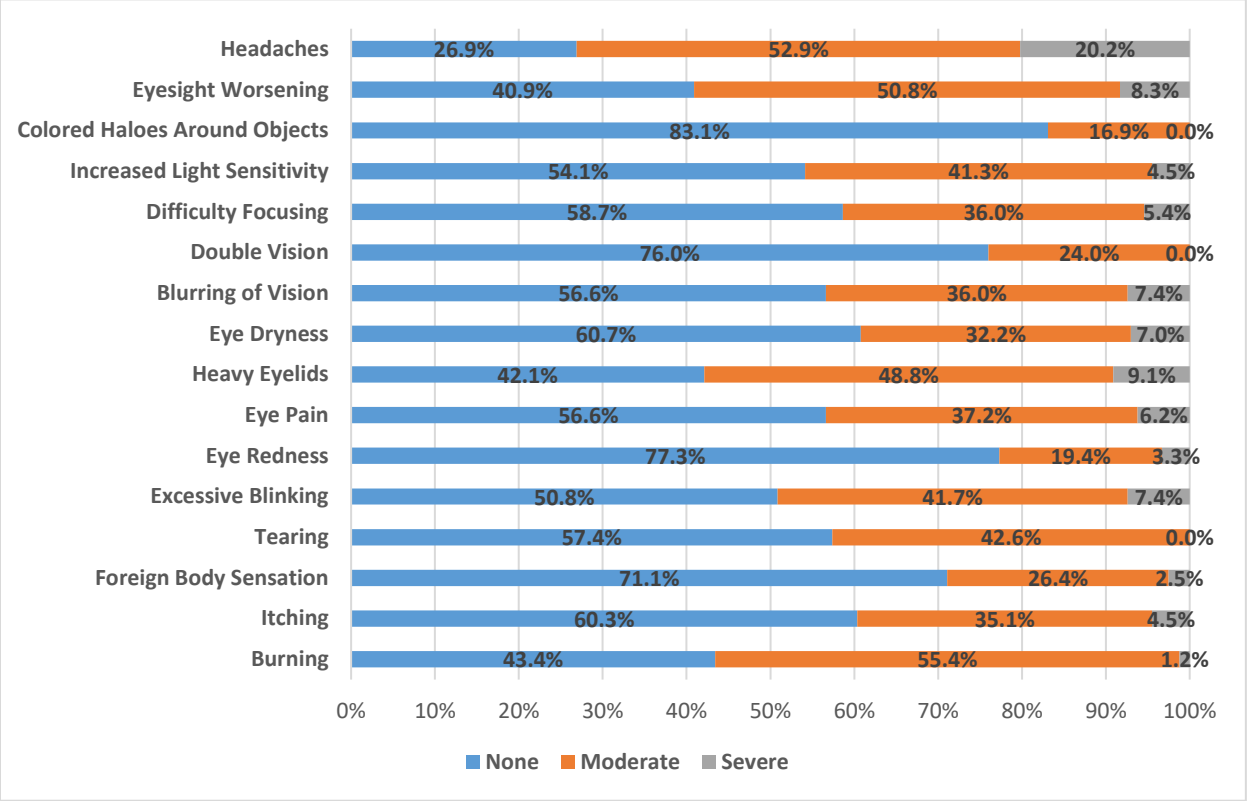

Figure 2: Intensity of CVS Symptoms

The results of this study highlight the impact of digital eye strain on the health and well-being of radiologists. This has the potential to affect their diagnostic accuracy and productivity in the workplace. Over time, chronic visual fatigue can lead to an increase in the number of medical errors.[16,17] It can also lead to physician burnout and job dissatisfaction.[18] Therefore, studies have suggested preventive strategies to mitigate this problem. These include taking frequent short breaks, undergoing periodic eye examinations, improving workstation ergonomics, and improving the work environment.[19] Our study also highlighted the significant impact of taking frequent breaks in reducing CVS symptoms.

This study utilised a validated CVS-Q questionnaire to quantify eye strain in radiologists. A wide array of variables was tested as potential risk factors to identify predictors and associations accurately. However, certain limitations were encountered during the study, including reliance on participants' self-reported symptoms, which can introduce potential biases and inaccuracies. Second, a lack of objective measurements may also impact the overall prevalence and severity of symptoms.

Future studies should employ longitudinal designs to establish causality and incorporate objective measures, such as blink rate monitoring, tear film evaluation, and ergonomic assessments. Additionally, interventional studies evaluating the effectiveness of preventive strategies could offer practical solutions for reducing CVS symptoms. Targeted studies on high-risk groups, such as postgraduate residents, could lead to early preventive measures and workplace policy adjustments.

Conclusions

CVS is a prevalent occupational concern among radiologists in Pakistan. Addressing this issue requires practical steps to include interventions that would help protect ocular health and the overall well-being of radiologists. This would ultimately lead to improved diagnostic performance and productivity at the workplace.

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