Research Paper:
Prevalence of Computer Vision Syndrome Among Iranian Medical University Employees and Graduate Students in their Occupational Environment

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Conflict of interest
The authors declared no conflicts of interest.

ABSTRACT

Background and Objectives: The prolonged use of digital screens can cause a set of visual and ocular symptoms known as Computer Vision Syndrome (CVS), which is a common health issue among computer users. This study aimed to estimate the prevalence of CVS among university employees and graduate students in their occupational environment in Iran.

Methods: A cross-sectional study was carried out in the Rehabilitation School of Iran University of Medical Science, Tehran, Iran. The study population (n=154) included all university employees and graduate students who spend at least one hour of computer work per day in their workplace. The participants completed a validated self-administered questionnaire. A descriptive analysis was performed and the prevalence of CVS was calculated. The correlations between variables were assessed using the Pearson and Spearman correlation coefficients and non-parametrical tests were used to evaluate the association between CVS and predictor variables, as well as differences between subgroups.

Results: The mean age of the sample was 37.7 ± 11.0 years (Mean±SD), 64.3% were women, 57.8% were employee, 56.5% have higher education and the mean of computer usage time was 5.08 ± 2.2 (Mean ± SD). The total prevalence of CVS was 48.7% and the most frequent symptoms were eye redness (62.3%) and burning (56.5%). A significan positive correlation was found between the number of hours working with a computer and the total score of CVS (Pearson correlation coefficient = 0.248, P=0.02). Moreover, the total score of CVS significantly differed between participants who use six or more hours the computer and those who spend less than six hours (Mann-Whitney U test: P=0.007).

Conclusion: This is the first investigation using a validated questionnaire to estimate the prevalence of CVS among computer users in the occupational environment, in Iran. The results show a relatively high prevalence of CVS these populations. The most affected are those who use the computer for a longer duration.

Keywords: Computer vision syndrome, Digital eye strain, Ocular symptoms, Occupational hazards

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1. Introduction

Nowadays, the use of computers in the workplace has become an essential part of many jobs, including office work and academic careers. In these fields, individuals might spend a significant proportion of a working day looking at computer screens. Although using computers has improved speed and efficacy in the workplace, numerous studies have shown that the prolonged use of digital screens can causea set of visual and ocular symptoms known as Computer Vision Syndrome (CVS) or digital eye strain [1, 2]. Besides, eye-related symptoms are the most common health issue among computer users [3]. Using different terminologies, (such as asthenopia, visual fatigue, computer-related visual symptoms, etc), several authors have reported a large set of CVS symptoms [4-6]. These symptoms are among these symptoms are burning, eye redness, pain in and around eyes, dry eye, blurred vision, diplopia, increased sensitivity to light, and headache, among others. The underlying physiological mechanism of CVS is not completely understood but several factors have been identified to contribute to CVS. These factors include the significant uncorrected refractive errors [7], contact lens wearing [8], reduced and incomplete blinking [9], and the long duration of computer use [5]. In a recent review, it has been observed a wide range of CVS prevalence reported from 25% to 93% in general population [10]. However, several studies have been carried out to specifically determine the prevalence of CVS in the workplace. For example, Ranasinghe et al. [11] reported a prevalence of 67.4% among a population of 2210 office workers in Sri Lanka. Rahman and Sanip [12] reported a CVS prevalence of 68.1% among university staff in Malaysia. A study on a sample of civil servant workers in Spain determined the prevalence of CVS as 65% and 50%

among contact lens wearers and noncontact lens wearers, respectively [8]. Also, Assefa et al. [13] reported the prevalence of CVS to be 73% among bank workers in Ethiopia.

Unfortunately, to the best of our knowledge, no data are available on exposure to video display terminals in the workplace, in Iran. However, some cues suggest that the use of digital electronic devices has substantially increased in the general population during recent years. For example, the Statistical Center of Iran recently reported that 48.4% of the population (36.8 million) were computer users and this number has grown by 22%, compared with 2010 [14]. According to this report, 59.7% of the population are also internet users [14].

Regarding the lack of published investigations on the prevalence of CVS among Iranian computer users in the occupational environment, this study aimed to estimate the prevalence of CVS among this population and provide a starting point for future investigation on associated factors and the prevention of this syndrome.

2. Materials and Methods

A cross-sectional study was carried out at the Rehabilitation School of Iran University of Medical Sciences (IUMS), Tehran, Iran. The study was approved by the review board and ethics committee of IUMS (IR.IUMS.REC.1399.259). and was conducted following the standards of Good Clinical Practice and international ethical principles applicable to human research according to the latest revision of the Declaration of Helsinki. All participants gave their verbal consent before taking part in the study and protection of personal data and the guarantee of digital rights was taken into account..

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Study population and sampling

For sampling, we considered all the university employees (including faculty members) and graduate students (MSc and PhD students) from five programs, namely physical therapy, audiology, occupational therapy, speech and language pathology, and technical orthopedics.

The inclusion criterion was working with a computer in the workplace for at least one hour per day, during the month preceding the study. Besides, the exclusion criteria were as follows: 1. Any uncorrected refractive error that might be a source of asthenopia (myopia and manifest hyperopia>1 diopter, oblique and against-the-rule astigmatism>0.5 diopters and with-the-rule astigmatism>0.75 diopters); 2. Any eye disease or condition that might interfere with the symptoms of CVS (trauma; eye diseases; strabismus and amblyopia; and surgical intervention and treatments, including refractive surgeries). The participants were invited to the Optometry Clinic in the Department of Optometry of Rehabilitation School, and those who met the criteria of the study were included. Then, sociodemographic information (age, gender, status and level of education) and computer usage time per day were collected, using a short written questionnaire. Moreover, the Computer Vision Syndrome Questionnaire (CVS-Q©) into Persian was applied to evaluate the ocular and visual symptoms of the participants.

Questionnaire

The CVS-Q© was originally developed and validated in Spanish by Segui et al. in 2015 [15]. This questionnaire evaluates both the frequency and intensity of 16 ocular and visual symptoms related to computer use. These symptoms are: burning, itching, the feeling of a foreign body, tearing, excessive blinking, eye redness, eye pain, heavy eyelids, dryness, blurred vision, double vision, difficulty focusing for near vision, increased sensitivity to light, colored halos around objects, feeling that sight is worsening, and headache. A severity score is calculated for each symptom, and a total score is obtained by adding these severity scores. Subjects with a total score of more than six are diagnosed as CVS sufferers. The CVS-Q© was translated into Persian, cross-culturally adapted, and validated by the authors (CVS-Q FA©, paper in preparation). The cut-off point of the CVS-Q FA© was shown to be ≥7.

Statistical analysis

A descriptive analysis of all study variables was performed. Absolute frequency and percentage were calculated for categorical data, and the Mean±SD, median and range were determined for quantitative data. The prevalence of CVS was calculated for each of the variables and categories. Moreover, the Chi-square or Fisher exact test were used to examine whether the CVS prevalences significantly differ between the subgroups. In addition, the prevalence of the 16 symptoms of the CVS-Q FA© was calculated.

The correlations between CVS and the variables studied were assessed using the Pearson and Spearman correlation coefficients. Also, pairwise comparison was performed between gender groups (males and females) and two usage time groups (those who spend ≥6 hours per day on a computer and those who spend <6 hours per day), regarding the total score of the questionnaire; the Mann-Whitney U test was employed for this comparison. All statistical tests were performed at a significance level of 0.05, and all statistical analyses were performed with SPSS V. 25.

3. Results

From July 2020 to September 2020, a total of 189 individuals gave consent to take part in the study. After taking an ocular history and performing a preliminary eye examination, 35 individuals were excluded for the following reasons: 16 had uncorrected refractive errors, three had undergone refractive surgery, and the other 16 suffered from any ocular disease such as severe dry eye (3), Meibomian gland dysfunction (2), inflamed pinguecula (2), strabismus (2), amblyopia (2), keratoconus (2), pterygium (1), cataract (1), and recurrent corneal erosion (1). Finally, 154 participants (99 females and 55 males) completed the questionnaire and were included in the study. Table 1 reports the sociodemographic characteristics and computer usage times per day of the participants. The Mean±SD age of the sample was 37.7±11.0 years (Mean±SD), with a range between 23 and 78 years. 57.8% were employees and more than half of the sample (56.5%) have higher education studies. The average hours of computer usage time was 5.08 ± 2.2 (Mean ± SD) with a range between 1 and 12 hours per day, and more than 40% of the sample used the computer more than 6 hours a day either to study or to work. The median total score in the CVS-Q FA© was 6, with a score range between 0 and 21, and the total prevalence of CVS, based on the criterion of the questionnaire, was 48.7%.

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Table 1. Distribution of the sample (n=154) of the university population and prevalence of CVS as a function of age, gender, status, education level, and computer usage time

Variable		No. (%)	Prevalence (%)	P*
Total		**154**	**48.7**	
Age (years)	20-29	42 (27.3)	42.8	0.402
	30-39	50 (32.4)	58.0	
	40-49	37(24.0)	48.6	
	50-59	22 (14.3)	36.3	
	≥ 60	3 (1.9)	66.6	
Gender	Female	99 (64.3)	49.4	0.791
	Male	55 (35.7)	47.2	
Status	Employee	89 (57.8)	52.8	0.233
	Student	65 (42.2)	43.1	
Level of education	High school graduate	15 (9.7)	33.3	0.265
	Bachelor	52 (33.8)	57.7	
	Master	56 (36.4)	42.9	
	PhD	31 (20.1)	51.6	
Usage time (hours/day)	<2	7 (4.5)	28.6	0.032
	2 - 3.5	39 (25.3)	38.5	
	4 -5.5	43 (27.9)	41.9	
	6 - 7.5	32 (20.8)	71.9	
	≥ 8	33 (21.4)	51.5	

* The p-values were found by chi-square or Fisher exact tests.

CVS symptoms

Figure 1 shows the percentage of participants who presented the different symptoms of CVS. The most prevalent symptoms were eye redness (62.3%), burning (56.5%), feeling that sight is worsening (54.5%), and headache (51.3%), besides, the least prevalent symptoms were excessive blinking (19.5%), colored halos around objects (19%), the feeling of a foreign body (16.3%), and double vision (10.4%).

CVS and gender

The median of the total score for females and males on the CVS-Q FA© was 6, range between 0 and 18 in females and 0 to 21 in males. 49.4% of females were diagnosed as CVS sufferers, while this Figure 1 was 47.2% for males (Chi-square: P=0.791), no significant difference was found between gender. Table 2 compares the preva-

lence of CVS symptoms between two gender groups. One might notice that none of the symptoms showed a significant difference between the females and males.

CVS and age

The correlation analysis showed that the age and the total score of the questionnaire were not significantly correlated. Table 1 represents the prevalence of CVS in different age groups. Those participants aged 30 to 39 years showed the highest prevalence (58.0%) and those aged 20 to 29 years showed the lowest prevalence (42.8%); the differences between the age groups were not statistically significant.

The Mean±SD computer usage time of participants was 5.08±2.20 hours per day (ranged 1-12 hours). A weak but statistically significant positive correlation was found between the number of hours working with a

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Table 2. Prevalence of CVS symptoms among females and males

Variables	Prevalence (%)		P*
	Females	**Males**	
1-Burning	56.5	52.7	0.211
2-Itching	53.5	45.4	0.337
3-Feeling of a foreign body	17.1	14.5	0.672
4-Tearing	35.3	35.5	0.920
5-Excessive blinking	21.2	20.0	0.859
6-Eye redness	62.5	63.6	0.901
7-Eye pain	31.3	38.1	0.388
8-Heavy eyelids	50.5	54.1	0.631
9-Dryness	48.4	41.8	0.426
10-Blurred vision	45.4	45.4	0.956
11-Double vision	12.1	7.2	0.345
12-Difficulty focusing for near vision	33.3	36.3	0.704
13-Increased sensitivity to light	50.5	34.5	0.109
14-Colored halos around objects	19.1	20.0	0.903
15-Feeling that sight is worsening	55.5	50.9	0.527
16-Headache	54.5	49.0	0.516

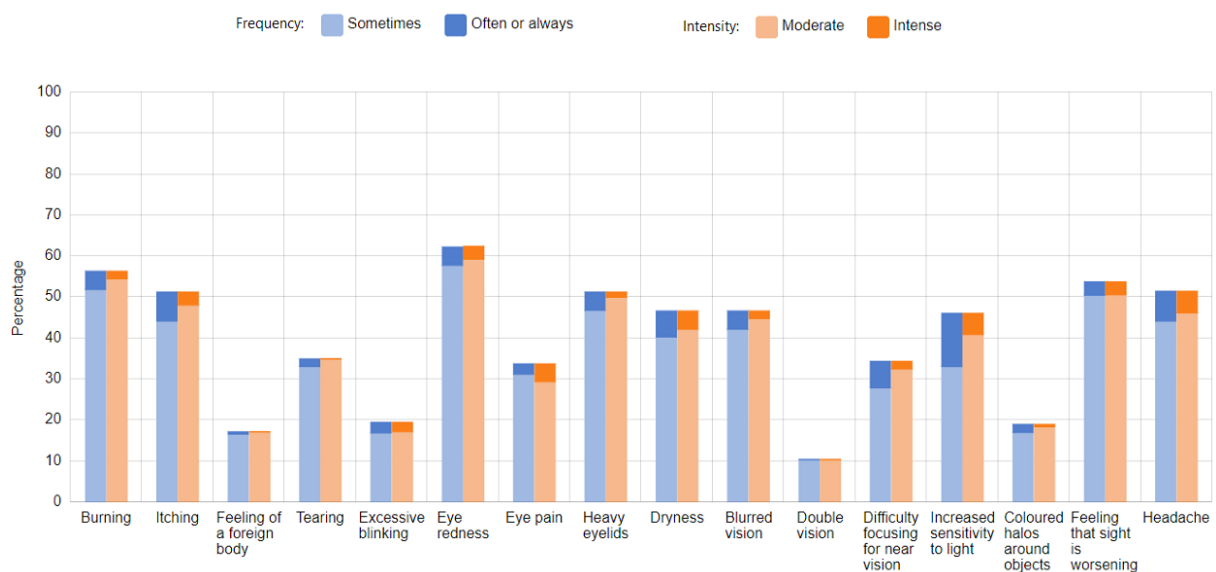*The p-values were found by the chi-square test.

Figure 1. Prevalence of each symptom of the CVS-Q FA© reported by participants

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Table 3. Prevalence of CVS symptoms and CVS among two usage time groups

Variables	Prevalence (%)		P*
	<6 h	≥6 h	
1-Burning	47.1	66.1	0.019
2-Itching	40.4	64.6	0.003
3-Feeling of a foreign body	12.3	21.5	0.121
4-Tearing	35.9	33.8	0.786
5-Excessive blinking	17.9	24.6	0.316
6-Eye redness	57.3	69.2	0.087
7-Eye pain	31.4	36.9	0.479
8-Heavy eyelids	49.4	55.3	0.466
9-Dryness	40.4	53.8	0.100
10-Blurred vision	35.9	58.4	0.007
11-Double vision	7.8	13.8	0.230
12-Difficulty focusing for near vision	30.3	40.0	0.213
13-Increased sensitivity to light	39.3	53.0	0.120
14-Colored halos around objects	15.7	24.6	0.169
15-Feeling that sight is worsening	47.1	63.0	0.051
16-Headache	44.9	63.0	0.026
Total prevalence of CVS	39.3	61.5	0.007

*The P values were found by the chi-square test.

computer and the total score of the questionnaire (Pearson correlation coefficient=0.248, P=0.02). Also, those who spent six or more hours per day on a computer had significantly higher total scores (Mann-Whitney U test: P=0.007) and higher prevalence of CVS (Chi-square test: P=0.007), compared with those who spent less than six hours. Table 3 compares the prevalence of CVS symptoms between the two usage time groups.

CVS, level of education and status

Table 1 shows the prevalence of CVS as a function of the level of education and the status of the participants. No association was found between these two variables and the total score of the questionnaire and the prevalence of CVS.

CVS and usage time

A weak but statistically significant positive correlation was found between the number of hours working with a computer and the total score of the questionnaire (Pearson correlation coefficient=0.248, P= 0.02). Also, those who spend six or more hours per day on a computer had significantly higher total scores (Mann-Whitney U test: P= 0.007) and higher prevalence (61.5%) of CVS (Chi-square test: P= 0.007), compared with those who spend less than six hours (39.3%). Table 3 compares the prevalence of CVS symptoms between the two usage time groups.

4. Discussion

The result of this study showed a relatively high prevalence of CVS among Iranian computer users in the occupational environment and particularly in those who use the computer for more than 6 hours a day.

A large majority of studies in other countries have used non-validated instruments and different criteria to diagnose CVS sufferers, so that, a wide range of prevalence has been reported, making it difficult to compare these studies among them. However, two studies have used the same instrument to estimate the prevalence of CVS. One of them determined a prevalence of 50% among Spanish civil servant workers [8], and the other one reported a prevalence of 75% among a population of university students in Spain [16]. In our study, the most prevalent symptoms were eye redness (62.3%), burning (56.5 %), feeling that sight is worsening (54.5%), and headache (51.3%). Among these symptoms, eye redness and burning are categorized as external ocular symptoms, which seem to be related to tear film instability [17]. These types of symptoms are relatively common among computer users [2, 3, 17]. Also, headache is one of the most frequently reported symptoms by computer workers. For example, the headache was the most common CVS symptom with a prevalence of 78.7% among university students in Spain [16]and a prevalence of 45.7% among office workers in Sri Lanka [11].

In our results, no statistically significant correlation was found between gender and the prevalence of CVS. This finding is inconsistent with previous investigations reporting a greater prevalence in females [5, 11, 18]. Partially, this finding may be related to the fact that the higher prevalence of CVS in females is attributed to the higher prevalence of dry eye in this gender. However, we excluded patients with eye diseases and conditions, including dry eye-related conditions, such as individuals with a history of refractive surgery, meibomian gland dysfunction, or Sjogren syndrome. Also, this finding can be explained by the fact that our sample was composed of two different age groups (ie, university employees and graduate students), which caused a very wide age range (22-78 years) in our sample. As in previous studies, the correlation between female gender and the higher prevalence of CVS was unobvious in students [16, 19] but very clear among office workers [9, 12].

The result of this study also revealed a significant correlation between the duration of computer use and the higher total score and the higher prevalence of CVS. Individuals who spent six hours or more at computer screens showed a higher prevalence and a higher total score of CVS, which means that they experienced symptoms even if they were not diagnosed as CVS sufferers. The findings of previous studies support this observation. For example, Portello et al. [9] reported a significant correlation between the number of hours of computer work and the total score of symptoms in office

workers. Furthermore, Rahman and Sanip [12] found that working with computers more than seven hours per day predisposed computer workers to get CVS. Several other studies have also shown a similar result [18, 20].

There are several limitations to our study. First of all, the small sample size reduced the statistical power of the tests and increased the margin of error. The small number of predictor variables was another limitation of this study. Besides, the prevalence of CVS might have been affected by several variables, including ergonomic practices and environmental factors, such as ambient light, temperature, humidity, and ventilation, and also the cognitive demand of the task. Even so, this is the first study of the Iranian population in which a validated instrument was used to estimate the prevalence of CVS, which is its main strength.

5. Conclusion

This was the first study that tried to estimate the prevalence of CVS with a validated questionnaire among Iranian office workers and graduate students, who might spend several hours per day working with computers in their occupational environment. Our findings showed that CVS is a relatively common health issue among this population; it seems that people who spent more time working with computers were predisposed to suffer from CVS.

Public awareness of the CVS in the university environment should be highlighted among students, teachers and administrators. The universities could carry out preventive strategies such as conducting sensitization campaigns aimed at the entire university population to provide information on the implications of this syndrome. It would be ideal to educate university population and instill in them the right practice of using digital devices.

Ethical Considerations

Compliance with ethical guidelines

Funding

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شیوع سندرم بینایی رایانه در میان کارکنان و دانشجویان تحصیلات تکمیلی دانشگاه های علوم پزشکی در محیط کاری

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چکیده

مقدمه استفاده‌ی طولانی مدت از صفحات نمایش دیجیتال می تواند مجموعه ای از مشکلات بینایی، چشمی و اسکلتی–عضلانی را در کاربران ایجاد کند که با عنوان سندرم بینایی رایانه شناخته می شود. هدف از این مطالعه تخمین شیوع این سندرم در میان کارکنان و دانشجویان تحصیلات تکمیلی درمحیط کاری بود.

مواد و روش‌ها این پژوهش به صورت مطالعه ای مقطعی در دانشکده ی توانبخشی دانشگاه علوم پزشکی ایران انجام شد. تمام کارکنان و دانشجویان تحصیلات تکمیلی که روزانه حداقل یک ساعت کار با رایانه در محل کار خود داشتند جهت ورود به مطالعه در نظر گرفته شدند. شرکت کنندگان نسخه ی ترجمه و روا شده ی سندرم بینایی رایانه را تکمیل کردند. نمره ی پرسشنامه برای هر کدام از افراد شرکت کننده در پژوهش محاسبه شد. تست های همبستگی و غیر پارامتریک جهت بررسی رابطه ی بین متغیر های مستقل و سندرم بینایی رایانه و وجود تفاوت معنی دار در میان زیرگروه های جمعیت نمونه مورد استفاده قرار گرفت.

یافته‌ها ۱۵۴ نفر در این پژوهش شرکت کردند. میزان کلی شیوع سندرم بینایی رایانه در جمعیت مطالعه ٪۴۸/۷ تعیین شد. یک رابطه ی معنی دار در میان ساعات استفاده از رایانه و نمره ی پرسشنامه وجود داشت (ضریب همبستگی: ۰/۲۱۸ و P=۰/۰۲). همچنین اختلافی معنی دار در میان نمره ی پرسشنامه افرادی که ۶ ساعت یا بیشتر کار با رایانه داشتند نسبت به افرادی که کمتر از ۶ ساعت در دروز کار با رایانه انجام می دادند مشاهده شد (P=۰/۰۰۷).

نتیجه‌گیری این پژوهش نخستین مطالعه با استفاده از پرسشنامه ای معتبر جهت تخمین سندرم بینایی رایانه درمیان کاربران ایرانی در محل کار است. نتایج پژوهش نشان داد این سندرم شیوع نسبتا بالایی در میان این جمعیت دارد. همچنین نشان داده شد که استفاده ی طولانی تر از رایانه همراه با علایم چشمی بیشتر است.

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