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ORIGINAL ARTICLE

Study of Computer Vision Syndrome among Najran University Students Attending the Ophthalmology Clinic from 2017 to 2019

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ABSTRACT

Background: Computer Vision Syndrome (CVS) is attributed to the interactions between the ocular defense mechanisms and the screen and/or its environment. CVS is affected by glare, distance between eyes and screen, brightness, light intensity in the screen and surrounding, screen contrast, and exposure duration. The symptoms and signs are blurred vision, focusing problems, burning sensation, redness, ocular pain, headache, tears disorders, neck and shoulder pain. The objective was to determine the ocular manifestations and their relation to some of controllable factors affecting the CVS among Najran University students, who attended the ophthalmology clinic from 2017 to 2019.

Methods: It was an observation cross-sectional study.

Results: The number of the CVS patients was 143; 63% were males and 37 % were females. The study showed that the symptoms and signs increased with decreased distance between the patient and the screen. The symptoms and signs were directly related to the exposure per years, but not to daily exposure per hours. Epiphora was the most common symptom (70% of patients). Blurred vision significantly occurred in males than in females ($p < 0.01$). Ocular pain & strain occurred in 64% of the patients. Headache in both genders was 60% and is significantly related to exposure per years ($p < 0.05$). Burning sensation occurred in 50% and was strongly related to duration per years. Both itching and dry eye occurred in 60% of patients. While itching was strongly related to age groups, dry eye was related to the daily exposure.

Conclusions: With the revolution of screens, CVS would increase; thus more awareness and researches are required.

Keywords: Computer; Dry eye; Epiphora; Headache.



INTRODUCTION

The American optometrist association was the first who defined Computer Vision Syndrome (CVS) as the complex of the eye and vision problems related to near work; which are experienced during and related to computer use. The symptoms of CVS are due to the interactions between the ocular defense mechanisms and the screen of computerized instrument and/or its environment [1]. There are many ocular defense mechanisms including blinking and tears secretion; the first secures the globe from outside hazards and keeps the globe moist by distribution of tears and by prevention of evaporation, while the latter keeps the globe in moist condition [2-8]. Blinking can occur as a reflex and spontaneously. In adults, its rate is about 15/minute and its duration is from 300-400 msec for each blink. The average time between blinks is 2.8 sec. in men and just under 4 sec. in women [4]. Most blinks are not associated with complete closure of the eye [4-6]. When eyes focus at a near object, three mechanisms occur simultaneously; these are convergence,

accommodation and miosis [6]. When the usual near work occurs at 25 to 40 cm, 2.5 to 4 dioptres of accommodation are required to clearly see near objects. The accommodative amplitude declines with fixed rate even among different population. The amplitude is one of the most reliable biomarkers of human age [5]. The visual system has a good response and can easily maintain focusing on most written and printed material; that is known by its dense black and sharp edges characters which make a big contrast from the white background [9-11]. Computer screen has characters that do not have this contrast or sharp edges. The centers of the characters are the brightest area and their edges are of the least intensity. The visual system can not continue focusing on these characters at the same plane. The eyes shift out to a point called the resting point of accommodation (RPA) [9-12]. The eyes regularly move to the RPA, and then go back to focus on the screen, this continuous flexing of the ocular muscles leads to fatigue, burning, and itching sensations; and thus helps to develop CVS [9-12].

All of these factors affect the eyes and the brain; so that they react differently to what is on the screen than they do to printed material [10,11]. Also, computer users blink much less frequently than normal, so that the tear evaporation increases and dry eyes develops. The symptoms and signs are blurred vision, focusing problems, burning sensation, redness, ocular pain, headache, tear disorders, neck and shoulder pain [10-15].

There are many factors that affect CVS, these include glare, the distance between the eye, the screen and the document, the luminance (brightness), the difference of light intensity between the screen and its immediate environment, the readability of the screen and the document [13,15,16]. As computers and digital instruments continue to play an evolutionary role in both our personal and professional life, more people are expected to experience vision problems associated with computer use [13]. About 60 million people suffer from CVS globally; a million new cases occur every year. Time of exposure to the screens of the digital instruments affects their impacts on the users; if a person stays more than two hours each day using screens; he/she is likely to experiences some symptoms of CVS [17].

The objective was to determine the ocular manifestation and their relation to some ergonomic factors among Najran University students, who attended the ophthalmology clinic from 2017 to 2019.

METHODS

The study was an observational cross-sectional study about the presentation and effects of some factors that affect the CVS –as near work- and as dry eye problems; among the students of Najran University, who attended the ophthalmology clinic in Najran University Teaching Hospital during the

academic years 2017-2019. Written informed consent was obtained from all participants. The number of the students diagnosed as CVS was 143 out of 428 of the students attending the clinic during the academic years 2017-2018 and 2018-2019.

Full ocular examinations to the entire group were held with consultant ophthalmologists. The diagnosis depended on the usage of computers and digital instruments (smart phones) more than two hours per day for at least 2 years and on the exclusion of other common diseases that may cause the patients' complaint. The ergonomic factor that needed measurements (the distance between the screen and the patient) was measured directly in the clinic. The questionnaire included the symptoms and signs of CVS and ergonomics measurements. The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee of Najran University.

STATISTIC ANALYSIS

Data were entered and analyzed using version 23 of IBM SPSS Corporation. IBM SPSS, NY, USA.

RESULTS

The total number of the patients diagnosed with CVS among the students was 143, 63% were males and 37 % were females. The patients were divided according to their age into only two groups due to the small range of the ages, and according to development of ocular system growing process. So they were divided into 18-21 years group and 22-25 years group (**Table1**). Moreover, the patients were divided into groups according to the distances between the screens and the patients' eye and then these distances as regards the symptoms and signs. The same was done regarding the duration of exposure per day (hours) and the total years of exposure (**Tables 2, 3, 4**).

Table 1: showing the statistics of symptoms and signs among the patients

age	sex		Number of patients	Headache	Burning sense	Blurred vision	itching	epiphora	Dry eye	Ocular pain & strain	Red eye
18-21	Male	Number	47	26	24	30	22	30	32	23	33
		% from male in this group		55%	51%	64%	47%	64%	68%	49%	70%
		% from group		33%	30%	38%	28%	38%	40%	29%	41%
		% from all		18%	17%	21%	15%	21%	22%	16%	23%
	Female	Number	33	21	13	13	21	22	17	21	19
		% from female in this group		64%	39%	39%	64%	67%	52%	64%	58%
		% from group		26%	16%	16%	26%	28%	21%	26%	24%
		% from all		15%	9%	9%	15%	15%	12%	15%	13%
		whole group	Number	80	47	37	43	43	52	49	44
% from group			59%	46%	54%	54%	65%	61%	55%	65%	
% from all			33%	26%	30%	30%	36%	34%	31%	36%	
22-25	Male	Number	43	28	23	23	31	33	26	20	26
		% from male in this group		65%	53%	53%	72%	77%	60%	47%	60%
		% from group		44%	37%	37%	49%	52%	41%	32%	41%

age	sex	Number of patients	Headache	Burning sense	Blurred vision	itching	epiphora	Dry eye	Ocular pain & strain	Red eye
	% from all		20%	16%	16%	22%	23%	18%	14%	18%
	Female	Number	20	11	11	9	13	15	12	14
	% from female in this group		55%	55%	45%	65%	75%	60%	60%	70%
	% from group		17%	17%	14%	21%	24%	19%	19%	22%
	% from all		8%	8%	6%	9%	10%	8%	8%	10%
	whole group	Number	63	39	34	32	44	48	38	40
	% from group		62%	54%	51%	70%	76%	60%	51%	63%
	% from all		27%	24%	22%	31%	34%	27%	22%	28%
All groups	Number	143	86	71	75	87	100	87	76	92
% from all groups			60%	50%	52%	61%	70%	61%	53%	64%

Table 2: showing the relationship between Time of exposure per day (hrs) and the symptoms and signs among the patients

Time of exposure per day (hrs)	N	Headache	Burning sense	Blurred vision	itching	epiphora	Dry eye	Ocular pain	redness	
5	Number	30	20	13	18	22	22	18	11	21
	% within group		66.67%	43.33%	60.00%	73.33%	73.33%	60.00%	36.67%	70.00%
	% within S/S group		23.26%	18.31%	24.00%	25.29%	22.00%	20.69%	14.47%	22.83%
6	Number	43	24	21	24	22	28	26	23	28
	% within group		55.81%	48.84%	55.81%	51.16%	65.12%	60.47%	53.49%	65.12%
	% within S/S group		27.91%	29.58%	32.00%	25.29%	28.00%	29.89%	30.26%	30.43%
7	Number	31	16	19	18	21	22	19	17	20
	% within group		51.61%	61.29%	58.06%	67.74%	70.97%	61.29%	54.84%	64.52%
	% within S/S group		18.60%	26.76%	24.00%	24.14%	22.00%	21.84%	22.37%	21.74%
8	Number	21	14	10	8	12	17	12	17	14
	% within group		66.7%	47.6%	38.1%	57.1%	81.0%	57.1%	81.0%	66.7%
	% within S/S group		16.28%	14.08%	10.67%	13.79%	17.00%	13.79%	22.37%	15.22%
9	Number	12	9	4	4	5	8	8	5	6
	% within group		75.00%	33.33%	33.33%	41.67%	66.67%	66.67%	41.67%	50.00%
	% within S/S group		10.47%	5.63%	5.33%	5.75%	8.00%	9.20%	6.58%	6.52%
10	Number	6	3	4	3	5	3	4	3	3
	% within group		50.00%	66.67%	50.00%	83.33%	50.00%	66.67%	50.00%	50.00%
	% within S/S group		3.49%	5.63%	4.00%	5.75%	3.00%	4.60%	3.95%	3.26%
All groups		143	86	71	75	87	100	87	76	92

Table 3: showing the relationship between Duration of exposure (years) and the symptoms and signs among the patients

Duration of exposure (years)	N	Headache	Burning sense	Blurred vision	itching	epiphora	Dry eye	Ocular pain & strain	redness	
5	Number	6	2	4	4	3	3	5	5	5
	% within group		33.33%	66.67%	66.67%	50.00%	50.00%	83.33%	83.33%	83.33%
	% within S/S group		2.33%	5.63%	5.33%	3.45%	3.00%	5.75%	6.58%	5.43%
6	Number	34	21	21	24	22	28	26	23	28
	% within group		61.76%	61.76%	70.59%	64.71%	82.35%	76.47%	67.65%	82.35%
	% within S/S group		24.42%	29.58%	32.00%	25.29%	28.00%	29.89%	30.26%	30.43%
7	Number	48	31	19	18	21	22	19	17	20
	% within group		64.58%	39.58%	37.50%	43.75%	45.83%	39.58%	35.42%	41.67%

	% within S/S group	36.05%	26.76%	24.00%	24.14%	22.00%	21.84%	22.37%	21.74%	
8	Number	36	21	10	8	12	17	12	17	14
	% within group	58.33%	27.78%	22.22%	33.33%	47.22%	33.33%	47.22%	38.89%	
	% within S/S group	24.42%	14.08%	10.67%	13.79%	17.00%	13.79%	22.37%	15.22%	
9	Number	11	6	4	4	5	8	8	5	6
	% within group	54.55%	36.36%	36.36%	45.45%	72.73%	72.73%	45.45%	54.55%	
	% within S/S group	6.98%	5.63%	5.33%	5.75%	8.00%	9.20%	6.58%	6.52%	
10	Number	8	5	4	3	5	3	4	3	3
	% within group	62.50%	50.00%	37.50%	62.50%	37.50%	50.00%	37.50%	37.50%	
	% within S/S group	5.81%	5.63%	4.00%	5.75%	3.00%	4.60%	3.95%	3.26%	
All groups		143	86	71	75	87	100	87	76	92

Table 4: showing the relation between the distance between Subject & the screen (cm) and the symptoms and signs among the patients

Distance	N	Headache	Burning sense	Blurred vision	itching	epiphora	Dry eye	Ocular pain	redness	
21-23	Number	24	16	9	15	15	18	11	10	15
	% within group	66.67%	37.50%	62.50%	62.50%	75.00%	45.83%	41.67%	62.50%	
	% within S/S group	18.60%	12.68%	20.00%	17.24%	18.00%	12.64%	13.16%	16.30%	
24-26	Number	46	26	28	21	28	34	31	25	30
	% within group	56.52%	60.87%	45.65%	60.87%	73.91%	67.39%	54.35%	65.22%	
	% within S/S group	30.23%	39.44%	28.00%	32.18%	34.00%	35.63%	32.89%	32.61%	
27-29	Number	32	22	16	15	20	22	22	20	23
	% within group	68.75%	50.00%	46.88%	62.50%	68.75%	68.75%	62.50%	71.88%	
	% within S/S group	25.58%	22.54%	20.00%	22.99%	22.00%	25.29%	26.32%	25.00%	
30-32	Number	33	18	15	22	18	21	16	16	17
	% within group	54.5%	45.5%	66.7%	54.5%	63.6%	60.6%	48.5%	51.5%	
	% within S/S group	20.93%	21.13%	29.33%	20.69%	21.00%	22.99%	21.05%	18.48%	
33-35	Number	8	4	3	2	6	5	3	5	7
	% within group	50.00%	37.50%	25.00%	75.00%	62.50%	37.50%	62.50%	87.50%	
	% within S/S group	4.65%	4.23%	2.67%	6.90%	5.00%	3.45%	6.58%	7.61%	
All groups	Number	143	86	71	75	87	100	87	76	92
	% from all groups	60.1%	50%	52.4%	60.8%	69.9%	60.8%	53.1%	64.3%	

DISCUSSION

The importance of ergonomics during dealing with screens was established and mentioned in many researches [12, 17-19]. Concerning the distance between the patient and the screen, the study showed that the symptoms and signs increase as the distance decreased. These results were documented in literature, e.g. Sen A [17], Olawole SO [12], Agarwal S [18], and Zunjic A [19]. Kumar SB found that the students who used the computer at short distance (less than 20 inches) were at higher risk to develop CVS (burning sensation, headache, blurred vision and dry eyes) compared to students who used the computer at a distance of more than 20 inches [20]. Our study showed that the relation between the duration of exposure to screen per day in hours and the number of the symptoms and signs is variable and not significant; higher in 5 and 8 hours per day while moderate in 6 and 7 hours per day in both age groups. This result is discordant with the results of studies done by Sen A [17], Noreen K [21], Mussa A [22], Shrivastava S [23] and Kumar SB [20]. All found that there is a strong relation between time of exposure and the number of symptoms and signs. Noreen K found that eye fatigue and headache are significantly associated with the time of exposure to screen [21]. There are many studies that showed different results

concerning the effects of the duration of exposure. Rahman ZA and Sanip S reported in their study that more than 7 hours of computer usage is significantly associated with symptoms of CVS [24]. In another study; researchers reported that the ocular symptoms including eye strain, itching and burning are more common in those who use the computer more than 6 hours [18]. Meanwhile, Chiemeke S et al. stated that CVS symptoms are more common in those who use computer for more than 8 hours daily [25]. Dessie A et al. found that those who used computer for >4.6 hours per day were 2.29 times more likely to get CVS compared to those who used computer for 4.6 hours or less [26]. While Ghassemi M and Ayatollahi M reported that more than two hours a day can cause CVS and occurred in 26% of the computer users. They found that the most frequent symptom was ocular pain (41%) [27]. Ahmed DJ and Alwan EH stated that the use of VDT for more than six hours per day is a risk factor for developing nearly all symptoms of CVS [28]. However, this differences may be due to environmental, social behavior and/or due to the break times and frequencies of the break times during the usage of mobiles and computers [26]. The study showed that the duration of work in front of screen per years is directly related to eye symptoms and signs, longer duration

results in more symptoms and signs. Same observations were observed by Noreen K et al. [21] and Mussa A [22]. In spite of this result, the study showed that there is no significant relation between red eye and the duration per years ($p=0.19$). Also, there was no difference among age groups and between genders concerning the complaint of red eye due to use of mobile and computer. The prevalence of red eye was 58-70% among different groups which is higher than the results of a study done by Sen A, who found that red eye occurs in less than half (46%) of the patients [17]. However, red eye and epiphora (excessive tearing) were the most common symptoms among the age group 18-21 years both occurred in 65% of this age group. While in the 22-25 age group, the most common symptom was excessive tearing (76% of the group). Concerning all groups, the most common symptom was epiphora (70% of the all patients). This result is concordant with the result obtained by Ahmed DJ and Alwan EH, who found red eye in 72.3% [28]. While the result is higher than results of a study done by Mussa A (epiphora occurred in 54% of the patients) [22] and Ghassemi M and Ayatollahi M (epiphora occurred in 18% of patients) [27]. Concerning blurred vision, the study showed that the prevalence of blurred vision was associated with significant gender variation ($p=0.01$) as it occurred more in male (64% and 54%) than female (39% and 45%) in both group of age. But there is no significant difference between age groups. The result is higher than the result of a study done among the employees of the Securities and Exchange Commission in Abuja, Nigeria in which they reported 10.1% only [9]. The result is similar to the results found by Dessie A, et al (62.60%) [26],²⁶and by Mowatt L and Gordon C (51.6%) [29]. Other previous studies that showed the association of blurred vision with computer usage include Anshel J [30], Rajev et al. [31], Amalia H et al. [32], Chiemekwe S et al. [25] and Olawole SO [12]. The result of the prevalence of blurred vision is lower than the results of a study done by Ahmed D and Alwan E, in which they found that blurred vision is the second common symptom (75.7%) [28]. The study showed that there is no significant relation between duration of exposure per hour and blurred vision. This result is different from the result of the a study done by Ahmed D and Alwan E, in which they found significant correlation ($P < 0.001$) [28]. The study showed that Ocular pain & strain have strong relation to the distance ($p=0.05$), this is mentioned by Quant J et al. [33]. The study showed that Ocular pain & strain have strong relation to the time of exposure per day (hours). But there is no significant association between them and the duration per years ($p=0.21$). The study showed that

Ocular pain & strain occurred in 64% of the patients. This result is near to the result found by Mowatt L et al. who reported eye strain among 67% of patients [29]. But the study is higher than the results of Noreen K et al. who found that eye fatigue occurred in 15% of cases [21], Dessie A et al. found eyestrain in (47.63%) [26], Ghassemi and Ayatollahi M in (41%) [27], and Agarwal S et al. in (53.8%) [18]. This result is lower than that found by Sen A and Richardson M (87%) [17].

The study revealed a significant difference in some symptoms and signs between male and female ($p=0.03$), especially blurred vision which occurred more in male (59%) than female (42%) while ocular pain occurred more in female (62%) than male (48%). This result is different from a result found in a study done in Erbil hospital in which they found blurred vision occurred more in female than male [28]. The study found that there is no significant difference ($p=0.07$) between male and female and between different age groups concerning headache; headache occurred in both sex equally 60%. This result is same as reported by Sen A and Richardson M (61%) [17]. While the result is different from a result found in a study done by Ahmed D and Alwan E; in which they found that headache occurred more in female than male [28]. The result is higher than the result of a study done by Ghassemi M and Ayatollahi M who reported headache in (38%) of cases [27].

The study showed that there is a significant relation ($p < 0.05$) between headache and the duration of exposure per years. The same observation was a proved by Ahmed D and Alwan E who reported significant correlation between time-consuming on computer and headache ($P < 0.001$) [28].

Also, the study showed that there is a strong relation between the burning sensation and the duration per years; while there are variations in the relation with the daily exposure per hours. The results is discordant with the result found by Logaraj M et al. study, in which they found that there is a strong relation between burning sensation and the time of exposure per hours [34]. Burning sensation occurred in 50% of the students, this result is lower than that found by Smita Agarwal S et al. (66.7%) [18], Mowatt L et al. (61.9%) [29], and Sen A and Richardson M (55%) [17], while it is higher than that found by Ghassemi M and Ayatollahi M (15%) [27], Khola Noreen K et al. (33%) [21]. Slaveykov K et al. found in their study that burning sensation is one of the common symptoms of CVS [35]. Also; Professor Laura B. Pincus stated that burning sensation is one of the common problems that face computer users [36]. Concerning itching, the study found that it occurred in 60% of the student, the result is higher than the results of Ghassemi M and Ayatollahi M

(15%); and there is strong relation to the age group of the male ($p < 0.05$) [27]. Itching occurred in 72% of the male age group 22-25 year while occurred only in 42% in male age 18-21 year. Agarwal S et al. found that itching occurred in (47.6%) [18], Dessie A et al. in (47.40%) [26], and Noreen K in (48%) [21], all these results are similar to that of male aged 18-21 year. Ahmed D and Alwan E in (79.8%) [28], which is near to the results of the male aged 22-25 year. The study found that there is variable relation between itching and the time of exposure per hour. This is same as reported by Slaveykov K et al in their study; in which they found that itching is one of the common symptoms of CVS [35]. But this result is different from result of a study done by Ahmed D and Alwan E; in which they found that there is a significant correlation ($P < 0.001$) [28]. The study showed that dry eye was found in 60% of the patients and there is no difference according to the age group and to the gender. Rosenfield M mentioned that dry eye is one of two principal ocular causes of the CVS, the other being oculomotor anomalies [37].

The result is higher than that found by Mowatt L et al (26.2%) [29], and it is more than what Iqbal M reported (28%) [38]. Also, the study showed that the relation between the duration of exposure per hours (5 hrs and more) and the dry eye is nearly fixed; that the average is 62% with STDEV of 0.0385; which indicate few variations. This result is discordant with the result found by Slaveykov K et al., who found a significant correlation between increased hours of computer use and the dry eyes [35]. Sheedy JE and Shaw-McMinn PG considered dry eye is one of the primary symptoms and it a main cause of the other symptoms [39,40].

The limitations of the research include; being hospital-based; small sample size, being non applicable on the whole population. The seasonal and environmental variation of symptoms was not included as confounding factors; such as dry eye during summer and the humidity of the air.

CONCLUSIONS

With the advancement of smart phone and computerized machines, CVS will increase and there should be more and more awareness. This needs more studies to cover a lot of points that were not covered by this research.

Conflicts of interest: no conflicts of interest

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