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Original Research Article

A cross sectional overview of digital eye strain: a growing health concern in this digital age in central India (Madhya Pradesh)

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ABSTRACT

Background: The physical discomfort and collection of symptoms after digital screen use for longer than two hours at a time is referred by the Vision Council as digital eye strain (DES). Common symptoms of DES are eyestrain, headache, blurred vision, dry eyes and pain in neck and shoulders. This study aims to know about the prevalence; factors associated with and awareness about preventive measures for DES among college students.
Methods: A cross-sectional study was conducted for 2 months in 2017 among randomly selected 200 college students of 20 to 30 years of age in Indore city of Madhya Pradesh using a pre-designed semi-structured questionnaire.
Results: Mean age of participants was 22.5 years; of which 58% were females. Of the respondents, 89.5% (179 students) reported experiencing DES. Average distance from digital screen, brightness level of digital device, use of digital device before going to sleep and awareness about appropriate distance of digital screen from eyes had statistically significant association with having digital eye strain. 98% of respondents were unaware of the term DES while >60% did not have knowledge about the harmful blue light emitted by digital devices, protective use of digital screen filters, appropriate distance of viewing digital screen and the 20-20-20 rule of taking breaks in between screen time.
Conclusions: Since digital device use is a necessary evil; better ergonomic practices to avoid DES should be adopted. Opportunistic health promotion and patient education undertaken by ophthalmologists on an OPD basis is one solution.

Keywords: Digital eye strain, Computer vision syndrome, Blue light, Blue blocking filter

INTRODUCTION

Digital eye strain (DES) has been a concern for the last 20 years or so and with the ever increasing use of digital devices ranging from computers, laptops, tablets and smartphones, the screen time of a millennial has increased exponentially. In April 2019, WHO made recommendations regarding screen time for under-five children: no screen time for less than 2 year olds; not more than 1 hour for children aged 2-4 years, less is better.[1]

Several individuals suffer from physical discomfort after screen use for longer than two hours at a time. The Vision Council refers to this collection of symptoms as digital eye strain.[2] The term 'computer vision syndrome (CVS)' has been widely used in literature; however, since many other digital devices are now in common use, 'digital eye strain' is a more appropriate term.[3] The most common symptoms associated with DES are eyestrain, headache, blurred vision, dry eyes and pain in the neck and shoulders.[4] The ocular symptoms can be split in two categories-those associated with accommodation (namely, headache, blurred vision and difficulty refocusing) and those closely related to dry eye (irritated/burning eyes, dry eyes, tired eyes, sensitivity to bright lights and eye discomfort).[5,6]

Digital device imprints are not as sharply defined as the print on paper. Moreover, viewing distances and angles tend to differ from normative non-digital viewing. Hence, eye focus and movement requirements for digital viewing impose additional strain on our visual systems.[4] Another cause of DES is considered to be blue light, also called high-energy visible (HEV) light, emitted by digital devices which increases eye strain more so than other colors that have a longer wavelength.[7]

Ways to relieve DES include: eyewear solutions; taking frequent breaks from using digital devices; reducing overhead lighting to eliminate screen glare; positioning yourself at arm's distance away from the screen; increasing text size on devices to better define content on the screen.[2]

DES affects about 90% of the people who spend three hours or more a day at a computer.[8] There is clearly a surge in the use of digital screens which is here to stay. However, paucity of studies regarding correct practices and awareness to avoid DES remain despite proven hazards of this condition which led to this exercise. This study aims to know about the prevalence, factors associated with and awareness about preventive measures for DES among college going students of Indore city, Madhya Pradesh.

METHODS

A cross-sectional study was conducted for a duration of 2 months in 2017 among randomly selected 200 college going students of age group 20 to 30 years in Indore city using a pre-designed semi-structured questionnaire enquiring into their digital device use pattern, symptoms of DES experienced by them, and their awareness regarding preventive measures for DES. Those who did not consent were excluded from the study. Sample size was calculated using the formula $[z_{1-a/2}^2 p(1-p)]/d^2$; taking expected proportion (p) of 90%; absolute error (d) of 5%; at type I error (a) of 5% and 95% confidence interval (CI). Those who experienced one or more symptom related to digital device use were considered to have DES. Data collected was entered in Excel sheet and analysed using software SPSS v.20.0. Descriptive statistics was expressed as frequency and percentage. Chi square and Fischer's exact tests were applied accordingly. In this study the respondents were made aware about the causes and preventive measures for DES; however they could not be followed up for change in their digital screen practices and DES symptoms.

RESULTS

Of the respondents 42% students were males and 58% females; mean age being 22.5 years. Figure 1 represents the age distribution of the college going students in this study. The digital device preference among the students was maximum (61%) for smartphones, 32.5% for PCs/laptops and 6.5% for television. Majority (63.5%) reported using digital devices for social networking, 29% for college related work, 4% for gaming and 3.5% for other purposes. Of the respondents 89.5% (179 students) reported experiencing DES and only 10.5% (21 students) did not. Table 1 depicts the intensity of various symptoms of DES experienced by the respondents.

Table 1: Prevalence of various symptoms of digital eye strain (n=200).

S. No.	Intensity of symptoms	None	Very mild	Mild	Moderate	Severe	Very severe
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Occular symptoms							
1.	Watery eyes	41 (20.5)	61 (30.5)	70 (35.5)	14 (7.0)	14 (7.0)	-
2.	Dry eyes	39 (19.5)	24 (12.0)	57 (28.5)	71 (35.5)	8 (4.0)	1 (0.5)
3.	Itchy eyes	68 (34.0)	20 (10.0)	32 (16.0)	39 (19.5)	40 (20.0)	1 (0.5)
4.	Pain behind eyes	76 (38.0)	18 (9.0)	70 (35.0)	26 (13.0)	8 (4.0)	2 (1.0)
5.	Tired eyes	33 (16.5)	60 (30.0)	49 (24.5)	49 (24.5)	8 (4.0)	1 (0.5)
6.	Redness of eyes	45 (22.5)	27 (13.5)	78 (39.0)	43 (21.5)	6 (3.0)	1 (0.5)
Visual symptoms							
1.	Blurred vision	46 (23.0)	55 (27.5)	38 (19.0)	21 (10.5)	40 (20.0)	-
2.	Double vision	80 (40.0)	28 (14.0)	39 (19.5)	46 (23.0)	7 (3.5)	-
3.	Difficulty focusing	7 (3.5)	63 (31.5)	127 (63.5)	2 (1.0)	1 (0.5)	-
Other symptoms							
1.	Shoulder pain	77 (38.5)	23 (11.5)	32 (16.0)	62 (31.0)	5 (2.5)	1 (0.5)
2.	Neck pain	42 (21.0)	79 (39.5)	54 (27.0)	22 (11.0)	3 (1.5)	-
3.	Back pain	39 (19.5)	44 (22.0)	61 (30.5)	50 (25.0)	6 (3.0)	-
4.	Headache	22 (11.0)	45 (22.5)	80 (40.0)	48 (24.0)	5 (2.5)	-

Table 2 shows the distribution of various factors associated with DES among the respondents and Table 3 the awareness regarding preventive measures that can be taken to prevent DES. Maximum (60%) respondents reported doing nothing on experiencing the symptoms of DES. 22% stated stopping the use of digital devices; 13% rubbed their eyes and 2.5% each reported either taking some eye medication or seeking a doctor's help.

Table 2: Factor (s) associated with digital eye strain.

S. No.	Factor (s) associated with DES	Frequency N (%)	P value
1.	**Duration of digital device use daily (continuous+intermittent) (hours)**		0.425
	1-2	21 (10.5)	
	2-3	66 (33.0)	
	3-5	45 (22.5)	
	>5	68 (34.0)	
2.	**Duration of digital device use daily (continuous) (hours)**		0.685
	1-2	105 (52.5)	
	2-3	30 (15.0)	
	3-5	6 (3.0)	
	>5	59 (29.5)	
3.	**Average distance of digital screen from eyes**		0.010*
	One palm	19 (9.5)	
	Two palm	78 (39.0)	
	One arm	82 (41.0)	
	Don't know/Not sure	21 (10.5)	
4.	**Use of digital device (s) before going to sleep at night**		0.010*
	Regularly	38 (19.0)	
	Sometimes	119 (59.5)	
	Rarely	25 (12.5)	
	Never	18 (9.0)	
5.	**Use of more than one digital device simultaneously**		0.090
	Regularly	32 (16.0)	
	Sometimes	52 (26.0)	
	Rarely	74 (37.0)	
	Never	42 (21.0)	
6.	**Level of digital screen with respect to eyes**		0.126
	Above the level of eyes	22 (11.0)	
	Below the level of eyes	101 (50.5)	
	At the level of eyes	77 (38.5)	
7.	**Type of light used in room while digital device use**		0.661
	Fluorescent	185 (92.5)	
	Natural (Sunlight)	15 (7.5)	
8.	**Brightness level of digital device used**		0.005*
	0-25%	60 (30.0)	
	25-50%	106 (53.0)	
	50-100%	30 (15.0)	
	Don't know/not sure	4 (2.0)	
9.	**Work station well ventilated**		0.775
	Yes	118 (59.0)	
	No	82 (41.0)	
10.	**Wear glasses to correct refractive error**		0.164
	Yes	132 (66.0)	
	No	68 (34.0)	

*Statistically significant values.

Table 3: Awareness regarding preventive measures for digital eye strain.

S. No.	Preventive measures associated with DES	Frequency N (%)	P value
1.	**Awareness about term DES**		0.361
	Yes	4 (2)	
	No	196 (98)	

Continued.

S. No.	Preventive measures associated with DES	Frequency N (%)	P value
2.	**Awareness about harmful blue light from digital screens**		
	Yes	72 (36)	
	No	128 (64)	0.241
3.	**Knowledge about appropriate distance of eyes from screen**		
	Yes	60 (30)	0.018*
	No	140 (70)	
4.	**Knowledge about protective digital screen filters**		
	Yes	78 (39)	0.392
	No	122 (61)	
5.	**Knowledge about regular interval of eye checkups**		
	Once a month	23 (11.5)	
	Once a year	128 (64.0)	
	Once every 5 years	43 (21.5)	0.155
	Never	6 (3.0)	
6.	**Knowledge about 20-20-20 rule**		
	Yes	34 (17)	0.136
	No	166 (83)	

*Statistically significant values.

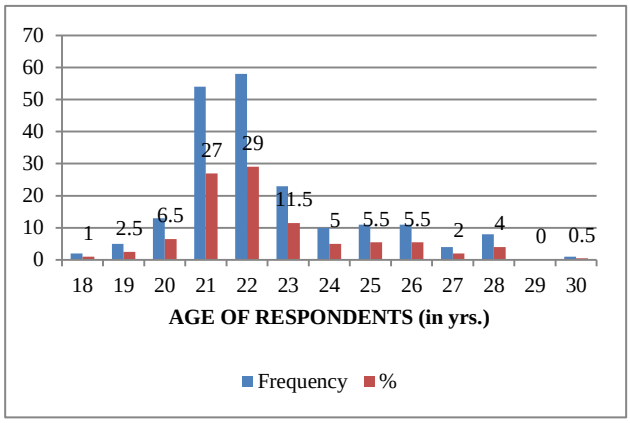

Figure 1: Age distribution of respondents (college going students).

DISCUSSION

Prevalence

In the present study, 89.5% students stated experiencing the symptoms of DES which is similar to that reported by Logaraj et al and Reddy et al.[9,10] The prevalence of DES or CVS ranged from 53-73% in several other studies on computer users.[11-17] In a study in Malaysia conducted on 795 university students aged between 18 and 25 years, 89.9% of students surveyed feeling any type of symptom of DES.[10]

Age/gender

Mean age of 22.5 years and female predominance (58%) for DES which was found in this study was also shown in studies by Shantakumari et al and Mowatt et al on university students in UAE and Jamaica respectively.[12,18] However, various other studies on college students or computer users found a male preponderance of DES; mean age being between 21 to 25 years.[9,11,15,16,19]

Digital device preference

Smartphones and laptops were the most frequently used devices reported in similar studies by Ichhpujani et al and Margareta et al.[20,21] Students used digital devices mainly for social networking and college projects.

Symptoms

In the present study, 96.5% had difficulty in focusing, 89% had headache, 83.5% tired eyes, 80.5% each had dry eyes and back pain, 80% had watery eyes. Studies done by Shantakumari et al and several others also reported headache as the most common or disturbing symptom following the use of digital devices.[10,14,18,19,22] Similar to the present study results, the other common symptoms which included tired eyes, watery eyes, dry eyes and back pain were also found by Moldovan et al among Romanian computer using medical students.[23] Blurred vision was the most common symptom reported by Lakachew et al among bank workers and Dessie et al among computer users in Ethiopia.[16,17] Choi et al and Pinitpuwadol et al did comparative studies to explore the effect of digital device (smartphone and e-book respectively) use on tear film and ocular symptoms.[24,25] They concluded that the group using digital device showed higher fatigue, burning, and dryness scores than the control group; and digital device use significantly decreased FBUT and NIBUT. Study done by Krupinski et al and Salve et al on radiologists and workers engaged in jewellery manufacturing respectively revealed that these professions also pose risk in terms of high visual demands in their work hours and resulted in visual strain symptoms similar to digital eye strain.[26,27] Lodina et al demonstrated significant increase in neck/shoulder

discomfort from baseline induced by visually demanding computer screen task.[28]

Factors associated with DES

Average distance from digital screen, brightness level of digital device, use of digital device before going to sleep at night and awareness about the appropriate distance of digital screen from eyes had statistically significant association (<0.05) with having digital eye strain according to the present study. Inappropriate sitting posture and level of viewing digital screens were significantly associated with various symptoms of DES as reported in studies done by Lakachew et al and many others.[17] Duration of digital screen time was shown be significantly associated in several studies.[9,10,13,19,21,29,30] Better ergonomic practices' knowledge and practicing the preventive measures is significantly associated with DES symptoms as shown in studies done by Ranasinghe et al, Agarwal et al and Shantakumari et al.[11,14,18] Contact lens wearers are more likely to suffer DES than non-lens wearers according to Tauste et al.[31] Critical fusion frequency decreased significantly after visual task according to Lin et al who studied the effects reflected glare and visual field lighting.[32]

Knowledge about preventive measures for DES

In the present study, 98% were unaware of the term DES while >60% respondents did not have knowledge about the harmful blue light emitted by digital devices, the protective use of digital screen filters, the appropriate distance of viewing digital screen and the 20-20-20 rule of taking breaks in between screen time.

In the study done by Sitaula et al only 22.9% had pre-existing knowledge of CVS and only 25.5% of them were practicing the ideal viewing distance.[19] According to the study done by Palavets et al, a filter that eliminated 99% of the emitted blue light was no more effective at reducing symptoms of DES than an equiluminant neutral density filter.[33] There is little evidence at this time to support the use of blue blocking (BB) filters to minimize near work–induced asthenopia. Study by Bhargavaa et al demonstrated the beneficial effect of orally administered omega-3-fatty acids in alleviating dry eye symptoms and decreasing tear evaporation rate in patients suffering from CVS related dry eye.[34] According to the comparative randomized double masked multicentric clinical trial by Biswas et al to find out the efficacy and safety of a herbal eye drop (itone) with artificial tear and placebo in CVS: the herbal eye drop preparation was found significantly better than artificial tear.[35]

CONCLUSION

Digital device use in myriad forms ranging from smartphones to laptops lead to a high prevalence of a varied number of asthenopic symptoms collectively known as DES which is aggravated more due to inappropriate practices like inappropriate distance from digital screen, inappropriate brightness levels and their use before going to sleep. Also, since use of digital devices in present times is a necessary evil; thus, better ergonomic practices like keeping the digital device at an arm's length or more than 50 cm; using protective digital filters/screens/eye wears; taking visual breaks from screen (20-20-20 rule) and having annual eye checkups is a feasible solution for such a public health concern. Also, more people should be made aware of the preventive measures that can be taken to prevent DES. Opportunistic health promotion and patient education undertaken by ophthalmologists on an OPD basis is one solution.

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