Journal of Clinical & Experimental Ophthalmology

Malik et al., J Clin Exp Ophthalmol 2018, 9:6
DOI: 10.4172/2155-9570.1000773

Research Article Open Access

Effect of Late Night Studying and Excessive Use of Video Display Terminals on the Ocular Health of Medical Undergraduate Students in A Tertiary Care Hospital

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Received date: August 20, 2018, **Accepted date:** December 18, 2018, **Published date:** December 31, 2018

Abstract

Purpose: To evaluate the effect of late night study and excessive use of smart phones on the ocular health of medical undergraduate students.

Design: An observational and cross-sectional study.

Participants: Two hundred and fifty nine normal and healthy M.B.B.S students of age 18-25 y were included in the study over a period of two months.

Methods: All the volunteers underwent an interview in form of a questionnaire. A complete ophthalmic examination was done including snellen visual acuity assessment, anterior segment examination with slit lamp, posterior segment with direct or indirect ophthalmoscopy; Schirmer's test and tear film break up time.

Results: A total of 259 subjects were included in the study and maximum subjects 160 (61.8%) were females. According to age, the students were divided in two groups as I and II with age of 17-20 y and 21-23 y respectively. Maximum 195 (75.3%) students belonged to group I. Maximum subjects 245 (94.5%) were using only smartphones and 239 (92.27%) subjects were using smartphones for more than 2 y. The maximum 136 (52.51%) students studied at night with maximum using tube light 112 (43.24%). A significant association was seen between the digital device used and age of the subject (p value=0.01). Number of symptoms experienced by the students showed significant relationship with the number of hours of smartphone usage (p value=0.02). Source of light in which the students studied at night was significantly associated with the number of symptoms experienced (p value=0.03). An association between usage of smartphones (hours) showed significant relationship with slit lamp examination (tear debri) and Schirmer's (less than 15 mm) with p value of 0.03, 0.05 respectively.

Conclusion: Source of light used to study at night and number of hours of use of devices shows relationship with symptoms. Smart phone users showed computer-related eye problems in more than half of the subjects.

Keywords: Video display terminals; Dry eyes; Smart phones.

Introduction

With the increasing competition and lifestyle changes, students have reversed their body clock nowadays, as they prefer to study late night than getting up early in the morning. This not only disturbs their sleep wake cycle but also has adverse effects on the eyes and the body.

Retinal light exposure in the early subjective night will delay the timing of the clock while light exposure in the late subjective night and early subjective morning will advance the timing of the clock. This implies that minor changes in indoor lightening condition may have a major impact on human circadian cycle and its deregulation, which is also observed in certain sleep disturbances associated with ageing, shift work and rapid time zone changes [1]. Induction of suppression of pineal melatonin production to variation in the timing of light exposure has been observed in human [2]. Lipofuscin is a potential photosensitizer and may increase the risk of retinal photo damage and contribute to the development of age related maculopathy [3].

The ocular and non-ocular complaints of computer users have been collectively termed as 'Computer Vision Syndrome' (CVS). CVS is defined by the American Optometric Association as "a complex of eye and vision problems related to activities, which stress the near vision and which are experienced in relation or during the use of computer" [4]. Today's visual requirements includes video display terminal (VDT's) like viewing laptop, tablet, computers, electronic book readers, smart-phones but smartphones are most common used VDT as portable devices for telecommunication along with its use for the internet, games, and online communities [5]. Due to around the clock usage of smartphones manufacturers are producing screens with increased brightness for easy reading and technology is based on blue light which is shorter wavelength so there is a high probability of damaging vision if used for a long period of time [6,7]. However liquid crystal displays (LCD`s) and smartphones induce dry eye symptoms, visual fatigue, neck and back pain more frequently than ordinary books due to factors such as poor lightening, glare and screen brightness [8-10,12]. Dry eyes and related symptoms are associated with reduced blink rate and horizontal gaze causing wider opening of the palpebral fissure that lead to increased evaporation through exposed area [10].

Keeping these things in view this study was planned to evaluate impact of late night studying and excessive use of VDT's on the ocular health of medical undergraduate students.

Materials and Methods

The proposed observational and cross-sectional study was conducted, over a period of two months. Two hundred and fifty nine normal and healthy individual's perusing MBBS who were using various VDT's were included in the study. The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee of the institute. Informed written consent was obtained from all subjects prior to their enrolment in this study. The subjects less than 17 y of age, history of ocular surgery or contact lens use in the past, known cases of migraine or chronic systemic or topical drug users were excluded from the study; Clinical assessment of the subjects was done by taking ophthalmic and medical history. All the volunteers otherwise deprived of any health problem underwent an interview in form of a questionnaire. Structured questionnaire included three sections concerning with bio data of the subject, employment/ergonomic complaints and knowledge about CVS. The subjects were asked to state the occurrence of symptoms, specify the hours of usage of digital devices, working distance, and years since they have been working on digital devices and refractive error if any. Most of questions were multiple choice questions except few where subjects were free to give their view regarding their methods of action.

All the subjects underwent monocular visual acuity (both uncorrected visual acuity and best corrected visual acuity (BCVA)) with internally normal illuminated Snellen's chart at distance of 6 meter under illuminated condition. Near visual acuity was measured at 35-40 cm. Subjective refraction were carried out in every subject. Presence of any refractive error equal to or greater than +/-0.50 D was considered significant. All the subjects underwent orthoptics with emphasis on near point of convergence. Near point of convergence was measured at primary gaze by moving the single dot target (here, tip of a pen) in a straight line at the level of the eyes along the scale towards the eye. Convergence less or equal to 15 cm was considered defective. All the subjects were monocularly told to read plates of Ishihara chart in a well lit room. Maximum time given to read one plate was 3 s. Reading of all the plates was considered normal. All subjects underwent a complete ophthalmic examination of anterior segment with slit lamp and posterior segment with direct ophthalmoscopy. Indirect binocular ophthalmoscopy was carried out after dilatation with tropicamide 1% eye drop when it was found necessary. Tear film was stained with sterile 2% fluorescein strip and time period was looked for at which the fluorescein stained tear film breaks after a blink and first dark spot appeared on cornea when examined on slit lamp. Reading less or equal to 10 s was considered abnormal tear film break up time (TBUT). Manual keratometer (Bausch and Lomb type KMS 6) was used for calculating Tear film thinning time (TTT). Standard 3 mires are formed and patient is asked to blink for just once and then they were told not to blink any further. The time when the mires broke was considered as TTT which if less than or equal to 10 s was considered abnormal. Schirmer's test I was carried out to calibrate amount of gross tear secretion using Whatman-41 filter paper measuring 35 mm × 5 mm in lower fornix for 5 min.

Wetting scale less than or equal to 15 mm was considered abnormal. Scale reading less than or equal to 5 mm was considered severe dry eye, 6 to 10 mm was considered moderate dry eye and 11 to 15 mm was considered mild dry eye. A reading of more than 15 mm was considered as normal.

Data management and statistical analysis

Interpretation and analysis of obtained results was carried out using IBM SPSS version 22 (Statistical Package for Social Sciences, 22.0 version) for descriptive statistics. The prevalence of computer related disorders and the qualitative data obtained were expressed in terms of frequencies and percentages. Chi-square test was used to determine the significance of observed differences between the variables.

Results

A total of 259 subjects were included in the study and among them maximum subjects 160 (61.8%) were females. The students were divided in two groups as I and II with age of 17-20 y and 21-23 y respectively. Maximum 195 (75.3%) students belonged to group I. Maximum 122 (47.1%) students were from first year professional year of MBBS. Table 1 shows the frequency of various time variables and different devices. The data also demonstrates that 94.5% subjects were using only smartphones, while 2.70% subjects were using only laptops. A total of 92.27% subjects were using smartphones for more than 2 y. Subjects were also asked about their time of study which was divided into 'Early morning', 'Evening' and 'Night'. The maximum 136 (52.51%) students studied at night. When asked to comment about the source of light from the students who studied at night, maximum 112 (43.24%) studied in tube light followed by 38 (14.67%) who studied in lamp. A total of 17 (6.56%) students still preferred to study in dim light.

Characteristics	**n (%)**
Video display terminals used	
Smartphone	245 (94.6)
Laptop	7 (2.7)
Smartphone+Laptop	7 (2.7)
Hours of smartphone used	
<3 h	35 (13.5)
>3 h	224 (86.5)
Years since use of smartphones	
<2 y	20 (7.7)
>2 y	239 (92.3)
Hours of study	
<1 h	31 (12)
2-3 h	137 (52.9)
3-4 h	59 (22.8)
>4 h	32 (12.4)

Time of study	
Early morning	23 (8.9)
Evening	100 (38.6)
Night	136 (52.5)
Source of light	
Tubelight	112 (43.2)
Lamp	38 (14.7)
Dim light	17 (6.6)
Not applicable	92 (35.5)
Total	259

Table 1: Frequency of various time variables of the used video display terminals.

The maximum subjects 214 (82.62%) were using only smartphone for more than 3 h a day.

Table 2 shows frequency of eye problems and awareness about CVS. Maximum (66.02%) had more than 3 symptoms (Table 2). Frequency distribution of various ocular parameters among device users is shown in Table 3. It shows that on slit lamp examination 8.10% subjects had tear debris and Schirmer test less than 15 mm in which maximum subjects belonged to those using smartphones only. TBUT was less than 10 s in 48 (18.53%) subjects while it was within normal limits in 211 (81.47%) subjects. TTT was found to be less than 10 s in 54 (12.35%) subjects amongst which maximum belonged to the category of subjects using smartphones only.

Characteristics	**n (%)**
Eye problems	
Yes	135 (52.1)
No	124 (47.9)
Consulted a doctor	
Yes	152 (58.7)
No	107 (41.3)
Awareness about symptoms	
Yes	67 (25.9)
No	192 (74.1)
Symptoms experienced	
≤ 3 Symptoms	88 (34)
>3 Symptoms	171 (66)
Measure of relief	
Take a break and remain seated	24 (9.3)
Take a break and move around	60 (23.2)
Take a break and close my eyes	142 (54.8)
Blink more frequently	26 (10)
Others	7 (2.7)
Awareness about CVS	
Yes	92 (35.5)
No	167 (64.5)
Source	
Not answered	171 (66)
Friend	28 (10.8)
Radio	9 (3.5)
Internet	28 (10.8)
Doctor	20 (7.7)
Others	3 (1.2)
Total	259

Table 2: Frequency of eye problems and awareness about CVS.

Refractive error	**n (%)**
≤ 3 Diopters	143 (55.2)
>3 Diopters	116 (44.8)
Tear debris	
Present	21 (8.1)
Absent	238 (91.9)
Schirmer's	
≤ 15 mm	92 (35.5)
>15 mm	167 (64.5)
TBUT	
≤ 10 s	48 (18.5)
>10 s	211 (81.5)
TTT	
≤ 10 s	54 (20.8)
>10 s	205 (79.2)
Convergence insufficiency	
Yes	32 (12.4)
No	227 (87.6)
Total	259
TTT: Tear film Thinning Time; TBUT: Tear film Breakup Time.	

Table 3: Frequency distribution of various ocular parameters among device users.

Relationship of various devices used with other variables is tabulated in Table 4. Age and years since smartphone use showed significant impact among all different types of device users with p value of 0.01 and 0.05 respectively. It also shows association between the digital devices used and years of usage of digital device in which 227 (87.64%) subjects were using devices for more than 2 y (Table 4).

	Smartphone n (%)	Laptop n (%)	Smartphone+laptop n (%)	Total	P value
Age					
17-21 y	187 (72.2)	6 (2.3)	2 (0.77)	195 (75.28)	0.01
21-23 y	58 (22.4)	1 (0.39)	5 (1.93)	64 (24.71)	
Year of MBBS					
1st year	116 (44.8)	4 (1.54)	2 (0.77)	122 (47.10)	0.65
2nd year	80 (30.9)	2 (0.77)	2 (0.77)	84 (32.43)	
3rd year	26 (10)	1 (0.38)	1 (0.39)	28 (10.81)	
4th year	23 (8.9)	0	2 (0.77)	25 (9.65)	
Hours of smartphone use					
<3 h	31 (11.97)	2 (0.77)	2 (0.77)	35 (13.51)	0.23
>3 h	214 (82.62)	5 (1.93)	5 (1.93)	224 (86.48)	
Years since smartphones use					
<2 y	18 (6.95)	2 (0.77)	0	20 (7.72)	0.05
>2 y	227 (87.64)	5 (1.93)	7 (2.70)	239 (92.27)	
Symptoms					
<3	86 (33.20)	1 (0.39)	1 (0.39)	88 (33.97)	0.27
>3	159 (61.39)	6 (2.31)	6 (2.31)	171 (66.02)	
SLE					
Wnl	225 (86.87)	6 (2.31)	7 (2.70)	238 (91.89)	0.61
Tear debris	20 (7.72)	1 (0.38)	0	21 (8.10)	
Schirmer					
<15 mm	84 (32.43)	4 (1.54)	4 (1.54)	92 (35.52)	0.61
>15 mm	161 (62.16)	3 (1.15)	3 (1.15)	167 (64.47)	
TBUT					
≤ 10 s	45 (17.37)	2 (0.77)	1 (0.38)	48 (18.53)	0.75
>10 s	200 (77.22)	5 (1.93)	6 (2.31)	211 (81.46)	
TTT					
≤ 10 s	49 (18.91)	2 (0.77)	3 (1.15)	54 (20.85)	0.29
>10 s	196 (75.67)	5 (1.93)	4 (1.54)	205 (79.15)	
Convergence insufficiency					
Yes	32 (12.35)	0	0	32 (12.35)	0.35
No	213 (82.24)	7 (2.70)	7 (2.70)	227 (87.64)	

Total	245 (94.59)	7 (2.70)	7 (2.70)	259 (100)	

Table 4: Relationship of various devices used with other variables.

Table 5 demonstrates that 142 patients (54.8%) were using smartphones for more than 3 h and hence experienced more than 3 symptoms. In this study significant association was found between the number of symptoms experienced by the subjects and the number of hours of smartphone use (p value=0.02). A total of 18 subjects out of 38 patients (i.e., 47.37%) studying under a study lamp at night were experiencing more than 3 symptoms, whereas 10 out of 17 subjects (i.e., 58.82%) studying under dim light at night experienced more than 3 symptoms which suggests the source of light in which the subjects studied during night was also associated significantly with the number of symptoms experienced by the subjects (p value=0.03).

	≤ 3 symptoms N (%)	**>3 symptoms N (%)**	**Total**	**P value**
Hours				
≤ 3 h	6 (6.81)	29 (16.95)	35 (13.51)	0.02
>3 h	82 (93.18)	142 (83.04)	224 (86.48)	
Years				
≤ 2 y	5 (5.68)	15 (8.77)	20 (7.72)	0.37
>2 y	83 (94.3)	156 (91.22)	239 (92.27)	
Digital device used				
Smartphone	86 (97.72)	159 (92.98)	246 (94.98)	0.27
Laptop	1 (1.13)	6 (3.50)	7 (2.70)	
Smartphone+laptop	1 (1.13)	6 (3.50)	7 (2.70)	
Time of study				
Early morning	9 (10.22)	14 (8.18)	23 (8.88)	0.85
Evening	34 (38.63)	66 (38.59)	100 (38.61)	
Night	45 (51.13)	91 (53.21)	136 (52.50)	
Source of light				
Not responded	31 (35.22)	61 (35.67)	92 (35.52)	0.03
Tube light	30 (34.09)	82 (47.95)	112 (43.24)	
Under study lamp	20 (22.72)	18 (10.52)	38 (14.67)	
Dim light	7 (7.95)	10 (5.84)	17 (6.56)	
Total	88	171	259	

Table 5: Relationship of ocular symptoms with the other variables.

Table 6 shows that a total of 15 students using smartphones for more than 3 h a day had tear debris when examined under the slit lamp. Hours of usage of smartphones showed significant relationship with slit lamp examination (tear debris) and Schirmers (less than 15 mm) with (p value=0.03, 0.05) respectively. There was no association seen between refractive error<3 Diopter (D) and >3 D with age and gender (p value=0.30, 0.17) respectively.

Characteristics	**≤ 3 h N (%)**	**>3 h N (%)**	**Total**	**P* value**
Tear film debris				
Absent	29 (82.85)	209 (93.30)	238 (91.89)	0.03
Present	6 (17.14)	15 (6.69)	21 (8.10)	
Schirmer's				
≤ 15 mm	17 (48.57)	75 (33.48)	35 (13.51)	0.05
>15 mm	18 (51.42)	149 (66.51)	224 (86.48)	
TBUT				
≤ 10 s	8 (22.85)	40 (17.85)	48 (18.53)	0.47

>10 s	27 (77.14)	184 (82.14)	211 (81.46)	
TTT				
≤ 10 s	8 (22.85)	46 (20.53)	48 (18.53)	0.75
>10 s	27 (77.14)	178 (79.46)	211 (81.46)	
Convergence insufficiency				
Yes	6 (17.14)	26 (11.60)	54 (20.84)	0.35
No	29 (82.85)	198 (88.39)	205 (79.15)	
Refractive error				
≤ 3 Diopters	16 (45.71)	127 (56.69)	143 (55.21)	0.22
>3 Diopters	19 (54.28)	97 (43.30)	116 (44.78)	
Total	35	224	259	
TTT: Tear film Thinning Time; TBUT: Tear film Break up Time; P* value: Calculated by Chi square test.				

Table 6: Relationship between smart phone usage time and ocular parameters.

Table 7 shows that there was no significant association seen between refractive error with age (p value=0.30) or gender (p value=0.17). The association between refractive error and the source of light used for late night study was statistically insignificant (p value=0.33). As far as convergence insufficiency was concerned 12.36% students had near point of convergence less than 15 cm. There was no association noted among refractive error and convergence insufficiency. The association between refractive error and VDT used by the subject was statistically insignificant (p value=1.18). There was no association observed between refractive error and the number of hours or years of smartphone use with (p value=1.4, 0.91) respectively and number of symptoms with (p value=3.14, 1.46) respectively.

	≤ 3 Diopter N (%)	>3 Diopter N (%)	Total	$P^{\#}$ value
Age (y)				
17-20	107 (41.31)	88 33.97	195	0.3
21-23	36 (13.89)	28 (10.81)	64	
Gender				
Male	57 (22.00)	43 (16.60)	100	0.17
Female	87 (33.59)	73 (28.18)	159	
Time of study				
Early morning	15 (5.79)	8 (3.08)	23	2.28
Evening	50 (19.30)	50 (19.30)	100	
Night	78 (30.11)	58 (22.39)	136	
Source of light				
Not responded	52 (20.07)	40 (15.44)	92	0.33
Tube light	60 (23.16)	52 (20.07)	112	
Under study lamp	22 (8.49)	16 (6.17)	38	
Dim light	9 (3.47)	8 (3.08)	17	
Convergence insufficiency				
Yes	13 (5.01)	19 (7.33)	32	3.14
No	130 (50.19)	97 (37.45)	227	
P# value: Calculated by Chi square test.				

Table 7: Relationship of various late night study variables with the refractive error.

Discussion

In the current study 75.3% of subjects were in age group ≤ 20 y which is in accordance to other studies in which majority of the subjects were less than 20 y of age from 11-25 y. The use of VDTs cut across ages, including children but the youths seem the worst hit by this 'technological miracle' craze as they constitute the greater percentage of the labour force, with very few of them not having access to computers today [13].

All the participants were undergraduates while the majority of the subjects being females i.e. 61.8% which is consistent with a study by Ranasinghe et al. in which 65% respondents were females [12]. There is predominance of females probably because there were more females in undergraduate batches when the study was in progress. 92.5% subjects used smart phones alone followed by laptops. Roberts et al. claimed that globally, cell phones are the preferred method of accessing the internet i.e. around 73% people access net with smartphones [14].

Similar to other studies where 42.9% subjects used VDT for more than 2 h and out of which 20% used it for 4-6 h this study suggests preponderance of subjects who used digital devices for more than 3 h and had been using them since>5 y [15]. This study shows that 'increase in the number of symptoms would increase with increased number of hours.

In accordance to the study conducted by Shantakumari et al. in UAE, headache was the most prevalent symptoms among the respondents (45.63%) followed by eyestrains and blurred vision [16]. Other symptoms elicited in the subjects were pain, burning, irritation, double vision, dryness of the eyes, neck pain and slow focusing. Dry eye can manifest as a result of decreased blink rate and prolonged exposure of ocular surface causing desiccation of the eye [17].

It was noted that 44.4% respondents had refractive error while glasses were being used only by 40%. Edema et al. concluded that correction of refractive error and wearing properly prescribed glasses were much more powerful factors relieving asthenopic symptoms in VDT users [18].

Data suggests that 35.5% were aware of CVS and that 14.7% of the participants resorted to dim light while studying. In accordance with other studies [13], some respondents report of screen glare and poor illumination cause of their discomfort while working on digital devices. Akinbinu et al. claimed that the level of knowledge about CVS was very low suggesting a serious knowledge gap exists about CVS in studied literate population and possibly in the general population [19].

Unlike other studies the number of hours of digital device usage showed significant relation with the source of light and the number of symptoms [20]. Gur et al. have reported decreased convergence range significantly before and 4 d after work on computer [21].

Wimalasundera et al. concluded that spending long time on computer screen without pause leads to problem of shifting focus screen, documents and keyboard [22]. The constant process of drifting and refocusing on fuzzy pixel of texts on computer screen can leave eyes strained and fatigued. In the present study Schirmers was affected by the hours of usage of VDT's which is consistent with study done by Raj et al. which advocated that TBUT, optical coherence tomogram based tear meniscus height and tear meniscus area were significantly influenced by computer usage in normal healthy individuals [23].

However, convergence insufficiency was not significantly correlated with symptoms in the current study. In the present study source of light used to study at night showed significant impact on the ocular symptoms. Similarly Walls et al. advocated for the use of incandescent and warm-white lamps instead of cool-white fluorescent lamps as change in lighting sources may lead to an increase in eye diseases like cataract and pterygia unless there is greater control of UV exposures from many of the fluorescent lights [24]. Kitchel also suggested that irreparable damage to the human retina is possibly caused by UV light especially in young children which poses to be a serious public health issue [25].

Conclusion

Hours of use of devices and source of light used to study at night shows relationship with symptoms. Nearly more than half of the subjects show some computer-related eye problems. Headache, eyestrain and blurred vision are the most common visual related problems associated with usage of digital devices. Improper viewing distances from the digital device screens, screen filters/anti-glare glasses not being used and using computer for long hours without taking frequent breaks were found significantly contribute to the symptoms. As the universities are adopting this technology to enhance the educational perspects students, tutors and staffs in universities use computers increasingly for their work and social networking. Hence more attention needs to be given in an attempt to reduce the impact of computer related vision problems and increase the overall productivity of all the people who are a part of the university. The interruptions in the computer work of the students posed by the headaches and dry eyes, as seen, could prove to decrease their productivity and hence needs to be addressed.

It is recommended that further studies on a large scale should be carried out to explore the extent and knowledge about CVS in the developing countries for the purpose of designing strategies for bridging-up the knowledge gap and minimize the impact of CVS on the people at risk.

Financial Support

This research was supported financially by the Indian Council of Medical Research.

Conflict of Interest

No conflict of interest declared by authors.

Acknowledgement

Dr. Shweta Chauhan for her constant encouragement, Mr. Shubham Pandey, Assistant Professor Statistics for Statistical analysis, Mr. Ankit, Lecturer, Department of Biostatistics for Statistical analysis and Mr. Surendra Singh Bhandari, office Assistant for technical support.

Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee of the institute. Informed written consent was obtained from all patients prior to their enrolment in this study.

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