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Research Article

Impact of Digitalization in the Eye Strain during Covid-19 Lockdown Period: An Epidemiological Study

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Abstract

Background: Over past few months due to COVID-19 lockdown, our society has been in indoor settings where the education, work and entertainment are through digital platform. This created an increase in rate of digital eye strain. Method & materials: An epidemiological observational study conducted during lockdown period among people of Kerala with a structured and validated questionnaire using Google form. People with age ≥ 18 years, using digital screen on continuous basis were included in the study.Inform consent were collected from the participants before the survey.The statistical analysis were done using SPSS software. Results and Discussions: A total of 584 were participated in the study where more than 86% reported at least one symptom. Smart phone and computer were the major platform used by participants mainly for learning and entertainment.31% of participants were continuously using digital screen for >2hours.One fourth of participants were using the screen for >9 hours and a 20% uses the screen in dark room or dim light for >5 hours. 66% had mild and 2.2% had severe symptoms.Headache was the common symptom found followed by eye pain and neck/shoulder/joint pain. Females were found to be more prone to develop CVS. Headache, eye redness, burning, etc. were correlated with duration of use. Conclusion: The digital screens demands high visual strain, much attention and care should be taken for vision problems and related issues.Since we are depending on digital screens for many of the daily activities, the information related to CVS and associated discomfort along with the prevention strategies should be explained by health professionals.

Keywords: Digital Eye Strain, Computer vision syndrome, Lockdown, COVID-19

INTRODUCTION

Digital screens are inevitable for our day to day existence since it turned out to be a part of each movement today. There is an ever-increasing number of individuals with vision problem and eye strain due to computerized screen use in this century. After lockdown many health issues arises and one among them is computer vision syndrome, CVS. The usage of digital screens was increased during the lockdown period, which influenced the incidence rate of CVS with high demand of ophthalmological care. Almost all professionals were demanded to work from home using digital platform, academic sessions were changed into digital platform etc. led to prolonged usage of digital screens. The use of the digital screen is not confined to any age category.[1] Studies revealed that youngsters' are additionally utilizing digital platform for entertainment and occurring eye strain related issues.[1] Recent researches demonstrated that 50 - 90% of individuals had some of the manifestations related with computer vision syndrome.[2,3]

CVS (Computer vision syndrome), also known as Digital Eye Strain, depicts a group of eye and vision-related issues that arise from prolonged use of Computer, smartphones, and other digital screens. Numerous people experience eye pain and vision issues when using computerized screens for prolonged periods. The degree of uneasiness seems to increase with the exposure time.[4]

The major factor that leads to CVS or digital eye strain is the lighting, duration of usage, posture, glare, brightness, vision problems, etc.[5] The evidence for CVS leads to permanent eye damage is less but it will cause inefficiency in daily activity and can occur the same infrequent intervals.[6] CVS is a noticeable developing condition and it has been exceptionally risen during the time of lockdown which lead to ophthalmology consultations and early visual issues. One of the major concerns is that children of age less than 15 yrs. may develop the permanent vision problem because of the development of ciliary muscle during this period. The health professionals should be vigilant in educating the regular users of digital screen regarding the pros and cons of its continuous use.

The main aim of this study was to analyse the usage of digital screen and the associated vision related problems occurred in people residing in Kerala, during lockdown due to COVID pandemic.

MATERIALS AND METHODS

Study design and Study settings

This study was an observational cross-sectional survey among people in Kerala during the lockdown period announced due to COVID-19 (April 2020). Those who use the digital screen in their daily life for any purpose. The survey was conducted using a Google form questionnaire which was circulated through social media.

Ethics, Privacy and Confidentiality:

The study was based on an online questionnaire in which, the participants were well-informed about the purpose, benefits, privacy and all other information. Those who are interested to participate should give consent which directs them to questions and others will be exited automatically. The data collected were solely accessible to the investigators and assured that all provided informations would be used for only research purpose with strict confidentiality.

Subject recruitment and Study participants

Google forms were prepared and circulated through social media to the regular users of digital screen. It consists of both questionnaire and informed consent. Those with age greater than 18 years, and using digital screen on continuous basis were included in the study. People who are using digital screen for more than 6 hours per day as part of job or any work before the introduction of lockdown were excluded. A total of 584 people participated in the study and majority of the participants were students and teachers involved in digital class rooms for academic purposes.

Survey questionnaire & Data collection

A structured and validated survey questionnaire containing both open and closed ended inquiries were used. The questionnaire was framed in English language based on various studies and guidelines. A pilot study was conducted with a couple of populace to ensure that they could comprehend the inquiries and respond with reliable answers. Before commencement of the study, all flaws in study questionnaire were amended. Age, gender, purpose of use, platforms that are using, various timing of use, usage in dark room, symptoms occurred, intensity and frequency of symptoms occurred and so on were inquired.

Selection of symptoms

A total of 20 symptoms were included in the study based on various journals and American optometric association [4,7,8,9,10,11,12]. All the major and commonly seen eye related symptoms and associated problems due to continuous use of screens like back pain, neck or shoulder pain, wrist or finger pain etc. were included.

Grading of Frequency and Intensity

The presence of clinical symptom was assessed by Question no 17, followed by its grading. Those who responded “never” for Question no 17, can quit the grading question. For grading frequency and intensity, three response categories were chosen to differentiate the symptoms with a low possibility of error. The levels of intensity were categorised into mild (1-4), moderate (5-7) and severe (8-10) whereas the frequency was graded into occasionally (1-3 days/ week), often (> 3 day/week) and very often (all days in a week)

Differentiation between blurred and hazy vision

While assessing the clinical symptoms both blurred vision and hazy vision were added as options. In order to avoid confusion among participants, explanation was provided along with the questionnaire. In case of hazy vision, we will feel like looking through fog or a dirty window whereas the blurred vision is like, out focused images in camera. For better understanding C McAlinden *et al.* method was adopted, that is, providing an accompanying image, to reduce the possibility of inconsistent responses by misunderstanding.[11]

Statistical analysis:

The statistical analysis was done using SPSS version 25 and G Power version 3.1.9.2. The variables were expressed in both frequencies and percentage and Pearson's Chi-square test was used to compare the various factors, with CI 95% and $P< 0.05$.

RESULTS

Out of 584 participants, 63.9% were females and 36.13% males. The mean age was found to be 22.44 ±4.4 years. The major digital screen platforms used by them television, smartphone, laptop/computer and iPad/tablet. Even though everyone used the mobile phone frequently usage of TV and laptop/desktop was only between 50-65%. The utilization of digital screens was categorised under entertainment (94.5%), academic (78.3%) and official purpose (20.4%).

Among all participants 14.6% had previous history of dry eyes and 15.9% had refractory errors. In both cases the female community had higher rate of incidence. A total of 26.4% were using spectacles or contact lens wherein, 18.96% were male and 30.56% were females. More than 30% reported that the CVS was not affected their lifestyle or ophthalmological health. 22.27% male and 13.94% of female population were not willing to reduce the usage of digital screen to prevent the CVS. The main reason was the unawareness of long term effects of eye strain. Average number of symptoms that occurred was 3.05 of which a major proportion was from female side.

Assessment of timings of digital screen usage shown that majority of them was continuous users. About 52.13% of male and 41.55% of females were using the digital screen continuously for more than 1 to 2 hours. The duration of usage revealed that most of the participants were using the screen for 5-8 hours. But the rate of usage of digital screen more than 8 hours per day was >25%. Majority of them used the screens not only in daylight but also in dark light or room light for less than 2 hours.

The response for continuous usage of digital screens was obtained as, 21.9% were using for more than 2 hours without any rest, whereas 37% of them used for more than one hour. Many of them were concerned about the brightness due to power issues and light. More than 85% of participants maintained their brightness below 50%. As the brightness is linked with day light and room light, in outdoor it should be increased for exact visibility but in indoor high level of brightness can affect eyes and sometimes even lead to headache with a short duration of use. The time at which maximum number of people used the digital screen was night (38%). Even after mid night there was high number of users which in turn could affect the sleep pattern. During morning and evening it was 18.7% and 24.5 % respectively. (Table 2)

Among 584 people, 13.4 % didn’t experience any kind of symptoms. Based on observation, we couldn’t ignore any one of the response as some of the symptoms has the potential to affect our lifestyle or it can lead to permanent damage. 53% of respondents reported headache followed by neck/shoulder /back pain (33%), which could be due to

improper posture or position. Eye pain, tearing, itching, and blurred vision were the other reported symptoms.

It was observed that the rate of occurrence of almost all symptoms were high in females, compared to males. Psychological or physical issues could have been a contributing factor for this gender difference. Males were having a high rate of double vision, excessive blinking, eye redness and tearing but all other symptoms were predominantly seen in females. (Table 3)

The intensity and frequency of symptoms experienced by the population demonstrated that 72.3% had occasional symptoms and 66% reported mild disturbances. But 5.6% reported that they were always experiencing any one of the symptom and 2.2% had severe conditions. 31.17% reported with moderate intensity. Around 16.3% had a blurred vision and 7% had hazy vision after prolonged use of digital screen. (Table 4)

To analyse the correlation between the variables, Pearson correlation was used. The correlation between age and symptoms revealed that visual disturbances like burning; difficulty focusing for near vision; and feeling that sight is worsening; had a slightly positive correlation whereas headache had a negative correlation.

When assessing gender with symptoms, redness of the eye had shown a negative correlation whereas neck/shoulder/ back pain and total number of symptoms revealed a slightly positive correlation. Headache had a positive correlation which was very likely to occur in females and youth. (Table 5)

Continuous usage of digital screen influenced frequency and severity of symptoms and showed a positive correlation with blurred vision, joint pain in wrist and finger, increased sensitivity to light etc. (Table 6)

Table 1: Demographic details

	Male	Female	Overall
Age	23.19 (± 4.37)	22.01 (± 4.41)	22.44(± 4.4)
Sex	211(36.1%)	373(63.9%)	584(100%)
Digital screens			
Computer/laptop	57.34%	48.25%	51.5%
Television	55.92%	68.90%	64.2%
Smartphone	99.05%	98.93%	99%
Tablet/ iPad	9.95%	7.238%	8.2%
Purpose			
Academic	67.30%	84.71%	78.3%
Entertainment	95.26%	92.49%	94.5%
Job	31.27%	14.74%	20.4%
Previously diagnosed dry eyes	13.27%	15.28%	14.6%
Refractory errors			
Yes	14.69%	16.62%	15.9%
No	62.6%	61.4%	61.8%
Not Know	22.74%	21.98%	22.3%
Wearing Glasses or Contact lens	18.96%	30.56%	26.4%
Concept of CVS in lifestyle and eyes			
Affect	63.03%	69.97%	67.5%
Not Affect	36.97%	30.02%	32.5%
Not Willing to decrease use of digital screen	22.27%	13.94%	17%
Average Number of symptoms	2.74(± 2.69)	3.21(± 2.69)	3.05(± 2.6)

Table 2: Timing and brightness of digital screens

	Male	Female	Overall
Continuous basis			
No	3.31%	4.29%	3.9%
Occasionally	44.54%	54.15%	50.7%
Always	52.13%	41.55%	45.4%
Hours spending			
≤ 2hours	4.73%	6.43%	5.8%
2-5 hours	28.90%	32.70%	31.3%
5-8 hours	34.12%	32.43%	33%
8-11 hours	18.96%	18.77%	18.8%
11-14 hours	9.00%	6.12%	7.2%
≥14 hours	4.26%	2.95%	3.8%
Dark Room usage			
≤ 1 hours	35.07%	47.75%	43%
1-4 hours	35.54%	37.80%	37%
4-7 hours	18.48%	11.26%	13.9%
7-10 hours	8.05%	1.88%	4.1%
>10 hours	2.84%	1.60%	2.1%
Continuous Usage			
<1 hour	28.91%	32.17%	31%
1-2 hours	37.44%	36.73%	37%
2-3 hours	21.80%	21.98%	21.9%
>3 hours	11.84%	9.11%	10.1%
Level of Brightness in room light			
0-10%	19.43%	26.27%	23.8%
11-25%	37.91%	32.97%	34.8%
26-50%	25.59%	28.41%	27.4%
51-75%	12.8%	8.31%	9.9%
76-100%	4.26%	4.02%	4.1%
Most Spending time			
Morning	15.63%	20.37%	18.7%
Noon	6.63%	20.10%	15.2%
Evening	25.59%	23.86%	24.5%
Night	46.44%	33.2%	38%
After Midnight	5.69%	2.41%	3.6%

Table 3: Prevalence Rate of symptoms

Symptoms	*Male*	*Female*	*Overall*
Blurred Vision	12.32%	15.01%	14.04%
Burning	10.90%	10.99%	10.95%
Coloured halos	0.94%	2.68%	2.05%
Difficulty focusing for near vision	6.63%	6.70%	6.67%
Double vision	3.31%	2.68%	2.91%
Dryness	12.79%	15.28%	14.38%
Excessive blinking	9.95%	9.11%	9.41%
Eye pain	32.70%	35.92%	34.76%
Eye redness	15.63%	8.31%	10.95%
Fatigue	12.79%	16.35%	15.06%
Feeling of a foreign body	4.74%	4.82%	4.79%
Feeling that sight is worsening	6.16%	6.70%	6.50%
Headache	38.38%	61.66%	53.25%
Heavy eyelids	7.10%	12.06%	10.27%
inability to hold object well	3.79%	4.02%	3.93%
Increased sensitivity to light	10.90%	16.08%	14.21%
Itching	15.16%	19.83%	18.15%
Joint pain in wrist and finger	15.63%	15.54%	15.58%
Neck/shoulder/back pain	27.96%	35.92%	33.04%
Tearing	27.01%	22.25%	23.97%
No Symptoms	15.63%	11.79%	13.41%

Table 4: frequency and intensity of symptoms

	Male	**Female**	**Overall**
Frequency of symptoms			
Occasionally	66.82%	75.33%	72.3%
Quite often	11.37%	7.77%	9.06%
Often/Always	6.16%	5.09%	5.5%
Intensity of symptoms			
Mild	64.93%	66.75%	66.1%
Moderate	33.17%	30.83%	31.7%
Severe	1.89%	2.41%	2.2%
Objects vision after prolonged usage			
Clear	79.62%	75.06%	76.7%
Blurred	10.42%	19.57%	16.3%
Hazy	9.95%	5.36%	7%

Table 5: Correlations with Demographics

	Correlation	p-value
	Age	
Burning	0.098*	0.018
Difficulty focusing for near vision	0.095*	0.022
Feeling that sight is worsening	0.087*	0.036
Headache	-0.89*	0.032
	Sex	
Eye redness	-0.113**	0.006
Headache	0.224**	0.000
Neck/shoulder/back pain	0.081*	0.050
Number of symptoms	0.084*	0.042

The data analyzed by the Pearson Correlation by using Significance (2 tailed).
** Correlation is significant at p < 0.05 level, **Correlation is significant at p < 0.01 level*

Table 6: Correlations with Usage

	Correlation	p-value
	Continuous basis usage	
Joint pain in wrist and finger	0.111**	0.007
Frequency of symptoms	0.149**	0.000
Intensity of symptoms	0.124**	0.003
Number of symptoms	0.115**	0.006
	Hours spending in digital screen	
Blurred Vision	0.126**	0.002
Dryness	0.116**	0.005
Headache	0.095*	0.022
Increased sensitivity to light	0.091*	0.027
Joint pain in wrist and finger	0.148**	0.000
Neck/shoulder/back pain	0.119**	0.000
Frequency of symptoms	0.131**	0.002
Number of symptoms	0.158**	0.000
	Usage in dark room	
Blurred Vision	0.089*	0.032
Double vision	0.113**	0.006
Eye pain	0.095*	0.022
Joint pain in wrist and finger	0.122**	0.003
Frequency of symptoms	0.100*	0.016
Intensity of symptoms	0.124**	0.003
Number of symptoms	0.129**	0.002
	Frequency of continuous usage	
Blurred Vision	0.082*	0.049
Burning	0.119**	0.004
Coloured halos	0.084*	0.043
Dryness	0.136**	0.001
Feeling that sight is worsening	0.121**	0.003
Itching	0.084*	0.042
Joint pain in wrist and finger	0.167**	0.000
Neck/shoulder/back pain	0.082*	0.049
Tearing	0.135**	0.001
Frequency of symptoms	0.082*	0.048
Objects after prolonged use	0.121**	0.003
Number of symptoms	0.187**	0.000

The data analyzed by the Pearson Correlation by using Significance (2 tailed).

** Correlation is significant at p < 0.05 level, **Correlation is significant at p < 0.01 level*

DISCUSSION

The modern era specialised in digitalisation, rooted deeply in this lockdown period. The implementation of classes, jobs and the other works through digital media brings the children, youth and all categories of people into this.

Present scenario obliged the whole world to shift everything include studies, jobs, etc. into digital platform. The portable systems and other screens were increased in this duration. From the result it was found that that smartphones were the most widely using one. This study was mainly focused on the usage of digital media and the occurrence of CVS in people residing in Kerala. The result revealed that increased frequency and severity of symptoms were reported in participants with less than 25 years of age.

Even though majority of the symptoms were temporary over a period of continuous use these can lead to permanent visual related problems. Various studies indicated that 70-90% of prolonged screen users experience some of the symptoms under CVS.[10, 11]

The recommended period of usage of screen in adults is eight hours and it should be 2 hours for youngsters.[13] But present situation demands more and which can induce digital eye strain. In this study, age, gender and duration of usage were correlated with the symptoms and found to be significant. CVS is not considered as a syndrome affecting the people residing in a particular geographical location or depends on their working status like IT professionals, computer oriented officials etc., but it is observed as a common problem affecting all categories of people throughout the world.

Iqubal M *et at.* Conducted a study regarding CVS among medical students in 2018, which showed a very less rate of symptom occurrence compared to our study[7]. Another study conducted by Reddy S *et al*. in 2013 regarding eye strain in one university and obtained a result less than the previous study.[15] Dessie A. *et al*. in 2018 reported that in Northwest Ethiopia the level of symptoms was about 33%[8]. In all studies the predominant symptom was headache. Study done by Logaraj M *et al*. revealed that as the time of usage increases the chances of CVS and severity of symptoms also increases.[16] Compared to all other studiers our study states that the usage increased along with associated symptoms.

The blue light emerges from screens are beneficial during daytime to a limit because they boost attention, reaction times, and keep us awake, whereas at night they often impede sleep. Blue light is one of the shortest, yet highest energy wavelengths in the spectrum, therefore it flickers easier and longer than other types of weaker wavelengths. This flickering will produce a glare that reduces the visual contrast, affecting sharpness and clarity of vision. This will lead to eye strain, physical and mental fatigue, headaches, tearing, itching, coloured halos and other symptoms. Eyes will protect retina from UV lights and only minute level will enter but for blue light there is no protection or filter. Prolonged exposure to blue light may lead to macular cellular damage, which may lead to loss of vision.[17]

The better way to prevent these issue by following 20-20-20 (Every 20 minutes, look at something 20 feet away for 20 seconds) standard rule proposed by Dr. Jeff Anshell and using anti-glare glass, adjustment of light, posture and other methods.[18] These study reported that to more than 86% had at least any one of the symptom. Among these the majority of them were youngsters. Especially in females the rate of symptoms and intensity was high when compared with males.

The major reason behind CVS might be the lack of knowledge regarding this syndrome or unaware of protective measures for safe use of digital screen. The major limitations were the self-reported symptoms and ophthalmic examination could have given more accurate results. More studies are required especially from the ophthalmologic clinics to assess the incidence, severity and frequency, as well as the factors affecting the development of CVS.

The main limitations of this study were ophthalmic examination was not done to measure CVS and the symptoms reported were self-reported. Symptoms that might not be recognized by users would be left unreported. To minimize the unduly effect of self-reported measurement, we have adopted and used standard protocol. Although we have used a protocol that measures CVS symptoms that can be occurred while using computer, some of the symptoms of CVS including blurred vision and eye strain might be caused by uncorrected refractive error that could potentially overestimate the prevalence [35]. According to the current study, the prevalence of CVS among risk groups for refractive error such as aged population and who do not use eyeglass/spectacle was not significantly different compared to their counterparts that show the influence of the bias was not significant. But in the future study, we recommend that the influence of uncorrected refractive error should be addressed methodologically and the measurement of CVS can be supported by ophthalmic examination.

CONCLUSION

Digital screen has become an integral part of life from beginning of this century. The digital screens demands high visual strain which can lead to vision problems and related issues. When the exposure time and posture varies the intensity of CVS can change.

Proper education by ophthalmologists or healthcare professional should be provided to the regular users of digital screen regarding the clinical manifestations and prevention strategies, in order to decrease the frequency and severity of vision related problems. Moreover, the unwanted exposure to the digital screen should be avoided and appropriate care should be given to the eyes.

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