

## **Digital Eye Strain: An Emerging Lifestyle Disease in COVID-19 Pandemic**

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### **Abstract:**

COVID-19 pandemic has compelled us to a life which consists of online professional activities, e-learning, etc. The advent of serial waves of this COVID-19 creates the culture of work from home for many professionals and online education replaces the option for conventional classroom teaching for students worldwide. This has resulted in prolonged unhealthy exposure to digital-screen of electronic gadgets such as computers, laptops, tablets, and smartphones. In this COVID-19 pandemic, during the lockdown and even in the post-lockdown period many health-related complications arise and one among them is ‘Digital Eye Strain’ (DES) or computer vision syndrome (CVS). The increased usage of digital screens during the lockdown period influenced the frequency of DES. All age groups especially, young adults and students as academic sessions and activities are confined to online classes and examinations have been suffering from it. In this review article, the authors want to highlight the increased phenomena of DES worldwide in the COVID-19 situation. The author has also discussed different risk factors that cause DES; the pathophysiology of DES; and various preventive strategies to combat this modern, lifestyle disease.

**Keywords:** Digital Eye Strain, Computer Vision Syndrome, COVID-19 Pandemic, Lockdown, Online Activities, Eye Health.

**Abbreviations:** DES, Digital Eye Strain; CVS, Computer Vision Syndrome; COVID-19, Coronavirus Infectious Disease-2019; SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus type-2; WFH, Work From Home; **AAO, American Academy of Ophthalmology.**

## **Introduction:**

The COVID-19 pandemic has changed in our lifestyle drastically. Now everything is happening online and that has augmented exposure to digital devices. The national lockdown was introduced on 25th March, 2020. The implementation of this national lockdown by the government resulted in the shutdown of educational institutions and most other workplaces. The work from home (WFH) has become compulsory for many and e-learning was the substitute for the classroom teaching for students ([Hindustan Times, 2020](#)). The present situation compelled our country to face the third wave of the pandemic with a new variant of coronavirus, ‘omicron’, that still demands for online classes for students, teachers and work from home for other professionals ([Times of India, 2022](#)). Consequence of it is prolonged unhealthy exposure to digital-screen of electronic gadgets such as computers, laptops, iPads, and smartphones. Lack of outdoor physical activities has compelled in people to find the entertainment from television and social media usually ([Pellegrini et al., 2020](#); [Wang et al., 2020](#)). In this COVID-19 pandemic, during the lockdown and even in the post-lockdown period many health-related complications arise and one among them is ‘Digital Eye Strain’ (DES). The increased usage of digital screens during the lockdown period influenced the frequency of DES. All age groups especially, young adults and students as academic sessions and activities are confined to online classes and examinations have been suffering from it ([Babu et al., 2021](#)) and other professionals are doing WFH. Across the world almost 70 million workers are at risk for CVS which minimizes the work productivity and lifestyle ([Parajuli et al., 2021](#)).

## **What is DES or CVS?**

**‘Digital eye strain’ or in other words the ‘computer vision syndrome’ is a collective expression for the eye and vision-related problems which are experienced during excessive use of digital**

devices such as computers, laptops, smartphones etc professionally as well as personally. Many individuals, who are regular users of computers, laptops, or smartphones face eye-related discomforts. The symptoms include headache, dry eyes, eye strain, blurring of vision, ocular discomfort, muscular strain, and stress after extensive exposure to light from e-gadgets containing LCD & LED screens (Garg et al., 2021). There are many factors involved in the development of DES. Among the major factors are the enhanced screen-time, body posture, glare, improper brightness, vision problems, etc. (Parihar et al., 2016). CVS or DES is a new age lifestyle disease of public health problem and its occurrence is increased during lockdown period which leads to early vision problems. There may be a chance of development of permanent vision problem especially in children of age <15 years for the reason that the ciliary muscles which regulate accommodation for viewing objects at varying distances, is developed during this period. Health professionals should take steps to aware the daily digital screen users (Babu et al., 2021).

It has been found that several risk factors are there for the development of CVS or DES and those factors are classified into five types: 1. Personal, 2. Environmental, 3. Computer-related, 4. Visual-related, 5. Extraocular-related (Alemayehu and Alemayehu, 2019). Personal factors which double the problem include reduced eye-blinking rate, decreased movement of eye, poor body posture, and less distance during working on a computer screen without blinking. Environmental factors include imbalanced lighting with digital screens and the surrounding environment. Computers screen-related problems are the reducing refresh rate, poor screen resolution, poor contrast, and glare. Blurred vision and double vision belong to the visual-related factors. Extraocular risk factors are headache, pain in the cervical region (Alemayehu and Alemayehu, 2019). It is reported from a recent study among 12<sup>th</sup> standard Indian students who were attending online classes during lockdown period, the average duration of digital screen exposure is increased significantly (Mohan et al., 2021).

According to a study among people in Kerala, India during lockdown period (April 2020), reported a higher percentage of people those who are regular online users are suffered by eye pain, tearing, itching, and blurred vision (Babu et al., 2021). An online survey was conducted from April'20 to July'20 among students, teachers of online classes, and general population. It

was found that the prevalence of eye strain was higher in students taking online classes compared to the general public. There was an increase in screen time during the pandemic compared to pre-pandemic time. Among students those who had greater screen time, screen distance <20 cm, used gadgets in dark were experienced higher DES score (Ganne et al., 2020). Experts at a reputed eye hospital in Kolkata, noticed a doubling in number of patients in lockdown and post-lockdown period with various symptoms such as dry eyes, eye fatigue, headache, lack of concentration, sleep disturbance, etc. (The Times of India Kolkata, 5<sup>th</sup> February 2022). Various research studies during this COVID-19 pandemic reported that DES has become a common eye problem in the city like Hyderabad, India. The common eye problem found in children and adults due to DES is itching in the eyes along with double vision, dry eyes, etc. Students are most affected as DES cases have increased three-folds among them (The Times of India Hyderabad, 14<sup>th</sup> November 2021). Usgaonkar et al., (2021) reported increase in digital activities on multiple digital e-devices was observed during lockdown which lead to eye-related problems such as itching eyes, pain behind eyes, red eyes, etc. all belong to DES (Usgaonkar et al., 2021).

Bakhir and Grandee (2020) performed an open online survey where they found that 93.6% of online respondents made significantly higher usage of digital devices during the lockdown period. Sharp increase in the use of digital devices per day was noticed especially in case of students for their educational purposes (online projects/assignments submission and assessments, etc.) (Bakhir and Grandee, 2020). Gautam et al., (2020) reported that about 80% of the employees in a Medical College and Teaching Hospital of Nepal, who used up computer work >8-11 hours/day during lockdown period are associated with CVS. About 60-70% of people who took part in the survey suffered from dry eye symptom (Gautam et al., 2020). Data obtained from a cross-sectional survey among University students in China expressed the prevalence of CVS with most highly reported symptoms such as eye dryness, heavy eyelids, etc (Wang et al., 2021). A study from Saudi Arabia also envisaged that the incidence of digital eye strain was increased i.e. almost 78% of the studied population during lockdown period (curfew in their country) (Alabdulkader, 2021).

## **Pathophysiology of DES:**

The main symptom of DES is evaporative dry eye (Akkaya et al., 2018) and that is caused by reduced and inadequate blink rate which leads to compromise of the ocular surface, and asthenopic symptoms (Bhootra, 2014) such as pain around the eyes; dry eyes or weepy eyes; blurred vision; burning or tired eyes; difficulty keeping your eyes open; vertigo, etc. Other factors that induce developing DES are poor ergonomics, poor screen resolution and contrast, improper lighting and font size of the text, glare, and decreased humidity in air-conditioned rooms, (Blehm et al., 2005). Apart from these, people who are suffering from uncorrected refractive errors, (Rosenfield, 2011) contact-lens wearers, (Kojima, 2018) people with a history of eye illnesses, (Dessie et al., 2018) or high blood sugar level, (Shah and Jani, 2015) or any autoimmune disease, are more susceptible to this disease.

Various reports suggested that the regular and constant usage of digital devices results in a drastic fall in blink rate (Patel et al., 1991; Freudenthaler et al., 2003) which leads to meibomian gland dysfunction. Meibomian gland dysfunction is a very common type of dry eye disease where the release of a proper lipid layer is got reduced or not secreted as often which means the watery substance in our eyes evaporates quicker, drying out our eyes and a sensation of burning or itching of eyes occur (Hirota et al., 2013). The constant work using a digital screen causes strain on both the internal as well as external ocular muscles. In that case, to fulfill the demands, the eyes remain always be in a state of accommodation and if this particular state is kept for longer periods, the fluidity of the visuomotor control is exhausted (Bhootra, 2014) and causes stress in eyes, and headache. Incapability of accommodation and relaxation results blurring of vision and sometimes double vision. Some photosensitive ganglion cells in our retina are blue light (482 nm) sensitive. Digital devices emitting blue light disturbs the secretion of melanin by melanocytes in the pineal gland. This melanin secretion is under control of those melanopsin-containing photosensitive ganglion cells of the retina (Sheppard and Wolffsohn, 2018). Ocular melanin shows photo-screening protective effect. It absorbs infrared visible light (blue light emission from digital devices) and UV radiation. The pigment epithelium in the anterior part of eye and the melanocytes in the iris absorb and block both blue light emission and UV radiation, thus safeguarding the rest of the eye from the detrimental effects of these wavelengths (Sarna, 1992; Sarna and Swartz, 1998).

## **Prevention and management of DES**

Digital eye strain is an emerging modern lifestyle disease in this pandemic situation. To control this public health issue, firstly, we need to increase our eyes' blinking rate at certain intervals. Vigorous and repeated blinking during digital device use must be exercised, which can help us to get rid of evaporative dry eye. An extreme dropdown of the blink rate causes evaporative dry eye which then leads to a series of other optical issues (Bahkir and Grandee, 2020). Secondly, the right positioning of the computer screen, so that it remains 4–5 inches below eye level that makes sure the eyelids and only a small inferior portion is exposed to environmental drying forces (Loh and Redd, 2008). A shorter screen distance such as at a distance of <50cm is main reason for increased DES risk in children (Shantakumari et al., 2014; Jaschinski-Kruza, 1991). Few apps are there, for use on digital devices, which can help us to keep in mind to take a break at suitable intervals. People who are working from home, a makeshift “office space” with proper set up such as screen positioning, table height, ergonomic seating arrangements, and optimal lighting will minimize the DES risk (Bahkir and Grandee, 2020).

Hazards of continuous reading habit of any articles, books, or newspapers on digital e-gadgets can be minimized by large font size and improved contrast on the interface. Audiobooks can be a solution to this problem (Bahkir and Grandee, 2020). During this pandemic time, restricted outdoor activities of children, led to an increased play of video games on smartphones for long hours without a break; this cause a new problem in children known as video game vision syndrome (Rechichi, 2017), DES and accommodative problems in children (Kozeis, 2009).

According to the study of Ichhpujani et al., (2019), higher the duration of working among online users in front of a digital device screen such as more than 4-5 hours at a stretch was found for higher DES scores which subsequently causes asthenopia (Ichhpujani et al., 2019). These digital users must focus on far away objects at time intervals that decreases the accommodative effort of the eyes for sometimes and prevents eye pain and headache. A rule of thumb is the 20-20-20 rule, i.e., after every 20 minutes of looking into the screen, a person should take a 20 second break to focus on an object located 20 feet away (Misawa et al., 1984).

<b>Preventive Strategies</b>	<b>References</b>
➤ <b>Practising increased blink rate at certain intervals</b>	Bahkir and Grandee, 2020
➤ <b>Exercise of vigorous and repeated blinking during enhanced screen time</b>	
➤ <b>Prompt positioning of the desktop</b>	Loh and Redd, 2008; Ganne et al., 2020
➤ <b>Avoidance of shorter screen distance such as at a distance of &lt;50cm</b>	Shantakumari et al., 2014; Jaschinski-Kruza, 1991
➤ <b>Ergonomic seating arrangements, and optimal lighting</b>	Bahkir and Grandee, 2020; Ganne et al., 2020
➤ <b>Using the large font size</b>	Bahkir and Grandee, 2020;
➤ <b>Sorting out contrast problem on any edge</b>	Ganne et al., 2020
➤ <b>Listening audio-books</b>	Bahkir and Grandee, 2020
➤ <b>Limiting the playing of video-games for longer period</b>	Kozeis, 2009
➤ <b>Follow the 20-20-20 thumb rule</b>	Misawa et al., 1984; Ganne et al., 2020; Coles-Brennan et al., 2019
➤ <b>Using blue-light filtering computer glasses with anti-reflective coating and anti-glare property</b>	Ganne et al., 2020; Coles-Brennan et al., 2019
➤ <b>Limiting the duration of screen-time &lt;4-5 hours/day</b>	Ichhpujani et al., 2019; Ganne et al., 2020
➤ <b>Using night-mode or reading-mode after evening</b>	Ganne et al., 2020

**Table 1: Preventive Management for DES**

Bilton (2010) described the one-two-ten (1-2-10) rule for the distances for digital devices: mobile phones at a distance of one foot; desktops and laptops at a distance of two feet; and

television at a distance of 10 feet (Bilton, 2010). The American Academy of Ophthalmology (AAO) recommends at least a distance of approximately 25 inches from the screen should be maintained during when computer-work (American Academy of Ophthalmology, 2020). AAO has not recommended any specific eyewear for DES till date. A warm fomentation followed by a gentle eyelid massage once or twice in a day helps in good functioning of the meibomian glands that keeps the eye wet. An artificial tear solution (preservative-free) can be used (Bahkir and Grandee, 2020). After COVID-19 pandemic, the demand for powerless protective lenses is increased (The Times of India Kolkata, 5<sup>th</sup> February 2022). Apart from these, few more things to be considered to get relief from this strain, for example, regular eye massages at least once or twice daily, regular physical activity, exercise, yoga, meditations, etc. must be practiced.

### **Discussion:**

Digital eye strain turns out to be a serious concern in modern days due to the widespread use of portable digital devices and lifestyles that are involved with on laptops, tabloids, smartphones, etc. The lockdown phase due to the SARS-CoV-2 outbreak increases the occurrence of DES or CVS as students went through online classes, exams and have less outdoor activities (Wang et al., 2021). DES can be managed non-pharmacologically and to some extent pharmacologically. Non-pharmacological management practices are maintaining normal blinking, exact ergonomic practices such as following the thumb rule 20-20-20 (break for 20 seconds – every 20 minutes – look 20 feet away); use of suitable lighting, right positioning of the digital devices (maintaining computer screen at >36 inches, maintaining mobile screen at >40 cm); using blue-light filtering computer glasses with anti-reflective coating; limiting the duration of screen-time <4-5 hours/day; adjusting image parameters (resolution, font size of text, contrast, luminance); using night-mode or reading-mode after evening; etc (Ganne et al., 2020).

There is a need to aware people about this emerging health problem. Restricting the overall exposure to the screen and following ergonomic practices of screen viewing are some solutions. A Standard Operating Procedures (SOP) should be authorized by the governments to shorten the duration of online classes/exams for students and online work hours for professionals to manage this global public health threat. Students and regular online users should be encouraged to use



artificial tears and eye-drops ([Sheppard and Wolffsohn, 2018](#)) and include a healthy diet rich in vitamin A such as green leafy vegetables as well as omega-3 fatty acid-containing food. In addition to it, regular thorough eye check-ups are vastly suggested ([Garg et al., 2021](#)).

### **Conclusion:**

In order to reduce the frequency and severity of vision-related problems especially DES or CVS, the utmost necessity is the arrangement of an awareness campaign by the health department and proper counseling by ophthalmologists must be provided to the regular users of the digital screens regarding the clinical manifestations and precautionary steps. To diagnose this eye strain, detailed background history and complete ocular examination of the patients are necessary. Several preventive measures are prescribed by the eye health experts should be taken in action to get relief from digital eye strain. Moreover, we should avoid unnecessary exposure to the digital screen and apt care should be given to our eyes. Further research is highly suggested to know the intensity of the problem as it can be a major health issue of modern-day.

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**Kaustav Chakraborty:** Conceptualization, Planning, Literature Search, Formal Analysis of the feedbacks from their students, colleagues and their own practical real-life experiences, Review-Writing and Editing, Supervision.

**Puja Chakraborty Ghosh:** Literature Search, Formal Analysis of the feedbacks from their students, colleagues and their own practical real-life experiences, Review-Writing and Editing.

### **Conflict of Interest:**

We declare that we have no competing interest.

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