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Influence and Outcome of the COVID-19 Pandemic on Digital Eye Strain in Children

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Abstract: ***The term "digital eye strain" (DES) refers to a group of visual and ocular problems brought on by extended usage of digital electronic gadgets. Dry eyes, itchiness, a feeling of a foreign body, watering, blurred vision, and headaches are its hallmarks. Eye strain can also cause non-ocular symptoms such a stiff neck, generalised weariness, headaches, and backaches. In the years before COVID-19, a varying incidence of 5 to 65% has been recorded. Outdoor activities were limited for all age groups due to lockdown regulations during the pandemic, and digital learning took over for nearly two years. The prevalence of DES increased to 50–60% in children alone, but the symptoms also widened to encompass recently developed esotropia and vergence abnormalities.***

One of the most important eye health issues is myopia. Following proper ergonomics, such as reducing average daily screen time, frequent blinking, better lighting, minimising glare, taking regular breaks from the screen, occasionally shifting focus to a distant object, and adhering to the 20-20-20 rule can help manage DES. High-resolution screens, built-in antireflective coating, matte-finished glass, edge-to-edge displays, and image-smoothing visual effects are examples of innovations in this area. The recommendations for optimising digital screens, cutting-edge technology for spectacle lenses, and built-in filters to enhance visual comfort should be the focus of further research. Our understanding of how to approach DES from an etiological standpoint needs to change in order to investigate tailored remedies.

The purpose of this review article is to understand the pathophysiology of various manifestations, risk factors that predispose to them, different types of treatment choices, as well as evolving trends in DES prevalence following COVID-19.

Keywords: COVID-19; aesthenopia; computer vision syndrome; digital device; digital eye strain; smartphone.

I. INTRODUCTION

Digital eye strain, also known as computer vision syndrome, refers to a group of eye and vision-related problems that result from prolonged use of digital devices such as computers, smartphones, tablets, and e-readers. The symptoms of digital eye strain can include Eye Discomfort: Individuals often experience symptoms like dryness, irritation, burning sensation, or a feeling of grittiness in the eyes. Blurred Vision: Prolonged staring at digital screens can lead to difficulty in focusing, causing blurred vision. Headaches: Eyestrain can trigger headaches, especially those that originate from the brow region. Neck and Shoulder Pain: Poor posture while using digital devices can lead to discomfort in the neck and shoulders. Difficulty in Focusing: Switching focus between screens and other objects can become challenging. Light Sensitivity: Some individuals become more sensitive to light (photophobia) due to digital eye strain.

Several factors contribute to digital eye strain, includes Blue Light Exposure: Digital devices emit blue light, which can interfere with the sleep-wake cycle and cause eye discomfort. Screen Glare: Glare from bright lights or windows can cause eyestrain when using digital screens. Poor Lighting: Insufficient or excessive lighting in the room can strain the eyes. Improper Viewing Distance and Angle: Viewing screens at the wrong distance or angle can cause focusing problems and neck strain.

To reduce digital eye strain, individuals can follow the 20-20-20 rule: every 20 minutes, take a 20-second break and look at something 20 feet away to give the eyes a rest. Additionally, adjusting screen brightness, using blue light filters or special computer glasses, and ensuring proper ergonomics can help alleviate symptoms. If symptoms persist or worsen, it's essential to consult an eye care professional for a comprehensive eye exam.

II. RELATED WORK

As of last update in September 2021, there was limited direct evidence regarding the impact of COVID-19 on eyes. However, there were some reported cases of eye-related symptoms and complications associated with COVID-19. These includes: Conjunctivitis (Pink Eye): Some individuals with COVID-19 experienced symptoms of conjunctivitis, an inflammation of the thin, transparent layer of tissue (conjunctiva) that covers the white part of the eye and lines the inside of the eyelid.

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Conjunctivitis can cause redness, itching, and increased tear production. Eye Irritation: Individuals with COVID-19 sometimes reported eye irritation, discomfort, or a feeling of grittiness in the eyes. Possible Transmission through the Eyes: While the primary mode of COVID-19 transmission is respiratory, there was concern early in the pandemic that the virus could potentially be transmitted through the eyes. This was one reason why eye protection (such as goggles) was recommended for healthcare workers in certain situations.

It's essential to note that while these eye-related symptoms were reported, they were not the most common symptoms of COVID-19. The virus primarily affects the respiratory system, and symptoms such as fever, cough, and difficulty breathing are more typical.

As the understanding of COVID-19 has continued to evolve, and research has progressed, new information about the virus's impact on various organs and systems, including the eyes, may have emerged. For the most current and specific information about COVID-19 and its effects on the eyes, I recommend consulting reputable sources such as the World Health Organization (WHO) or the Centers for Disease Control and Prevention (CDC). Additionally, consulting an eye care professional or healthcare provider for any concerning eye symptoms is always advisable.

III. COVID -19 AND IT'S IMPACT

In order to finish the required curriculum on time after the COVID-19 epidemic, students from primary and secondary schools were urged to participate in e-learning, in addition to those who were now enrolled in universities. The advice provided by the relevant authorities was insufficient to teach professors and students when and how to employ e-learning techniques. Without any restrictions, our kids are rapidly spending the majority of their waking hours (almost 8 hours each day) in front of screens from smartphones or computers. E-learning strategies can affect our children's vision in both positive and negative ways.

Additionally, during this pandemic, students used online platforms for communication, amusement, and information. Adults were encouraged to continue working from home due to the rise of COVID-19 instances, which resulted in them spending a lot of time in front of screens. Due to their confinement at home, they used online platforms for communication, amusement, and information.

Blue light with wavelengths between 380 and 500 nm is produced by computer displays and mobile phone screens, and it can be harmful to human health. The eyes may be exposed to these high-energy waves, which may irritate them or even harm their retinas. The dazzling effect of blue light can cause a variety of symptoms, including dry eyes, blurred vision, headaches, near sightedness, and eye fatigue.

Eye pain is inversely correlated with the amount of time spent staring at a digital screen. Due to the enormous increase in recent years in the use of digital devices, many millions of people of all ages are at risk of developing DES. Even while the illness's symptoms are frequently transient, it can still leave its victims in constant, excruciating agony and have a significant financial impact. According to scientists, prolonged exposure to the blue light produced by electronic devices can have negative effects. Long-term exposure can harm the eyes chemically, destroying retinal cells and increasing the risk of age-related macular degeneration. The most vulnerable age group is that of children.

IV. RESEARCH METHODOLOGY

A. Methods

Using search terms like "Digital Eye Strain," "Eyestrain," or "Computer Vision Syndrome," a literature review was conducted using PubMed, Google Scholar, and Scopus. For this narrative review's argument, pertinent articles were found and included.

B. Results

According to studies done in the UK, 68% of kids use computers often, and 54% start using the internet once they turn three. Similar research estimated that adults in the UK spend 4 hours and 45 minutes each day on screens. According to studies conducted in India, DES affects 69% of adults and 50% of children. Indian eye doctors discovered that although computer-using and specialised ophthalmologists were more aware about symptoms and diagnostic signals, they were uninformed about treatment approaches. With 87% of those aged 20 to 29 reported using two or more digital devices at once, social media use and multitasking are particularly common among younger adults. Precision spectral filters help in minimising symptoms of micro-fluctuation of accommodation, while the usage of computer glasses corrects refractive errors and aids in symptom reduction.

When using a computer or other digital screen device for an extended period of time, children who normally have uncorrected vision problems including farsightedness and astigmatism, poor eye focusing, or poor eye coordination may experience visual symptoms.

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By the time they are three years old, 68% of children in England regularly use computers, and 54% of them participate in online activities (2). Additionally, according to other studies, adults in the United Kingdom spend between 4 and 45 minutes a day in front of a screen (3), but persons in the United States spend about 2/3 of their time (5 hours or more) using digital devices (4).

According to Sheppard and Wolffsohn (7), 27.5% of persons experience itchy, burning, or irritated eyes; 31.5% experience dry eyes; 30.6% experience eye strain; 22.3% experience headaches; 39.8% experience weary eyes; 26.3% experience sensitivity to bright lights; and 30.8% experience eye discomfort. Online learning has a negative impact on eye health, and the COVID-19 pandemic process has led to an increase in eye tiredness (8). The frequency of DES among computer users in the state of Bihar was investigated through research in India. It was discovered that DES occurred 69 percent of the time. Approximately 30% of respondents used computers daily for 4-6 hours.

Eyestrain and fatigue were reported as the main symptoms by 59 (59%) of the participants, followed by headache in 57 (57%) of the participants, pain in the neck, shoulder, wrist, or back in 51 (51%) of the participants, dry eyes in 37 (37%) of the participants, and blurred vision in 35 (35%) of the participants. 11 people (11%) mentioned CVS. Taking breaks between tasks was the most widely used prophylactic measure, used by 79 individuals (79%). In the current study, 25 (25%) and 46 (46%) participants took preventative breaks after one hour and twenty minutes, respectively (9). 86% of medical students who spent three hours or more per day on the computer experienced one or more DES symptoms, according to Egyptian research (10). Dry eyes, a headache, impaired vision, eye strain, neck and shoulder pain, fatigue, and red eyes were additional symptoms. Similar findings are shown by a study from Bulgaria. 7.4% of the students in the study reported constant eye discomfort, and 25% reported frequent irritability.

9.6% of the students reported having dry, gritty, or scratchy eyes all the time, and 19.1% reported having it frequently (11). Eye fatigue (60 and 48%), eye strain (58 and 31%), ocular discomfort (44 and 31%), headaches (43 and 26%), dry eyes (39 and 34%), and burning eyes (40 and 22%) are among the findings of studies conducted in Israel and the USA (12). Though they lack a variety of treatment alternatives, computer-using and specialised ophthalmologists are better knowledgeable than traditional ophthalmologists regarding symptoms and diagnostic signals (13).

According to recent findings from Indian study, children with DES are typically 13 + 2.45 years old. 3.9 1.9 hours on average were spent using a digital device, which is an increase from 1.9 1.1 hours in the pre-COVID period (P = 0.0001). The most common digital device used by participants (n = 134, or 61.7%) was a smartphone. A total of 108 kids (49.8%) used online programmes for longer than two hours each day. In that group, the frequency of DES was 50.23%. 12.9% had moderate instances, 26.3% had light cases, and 11.1% had severe cases. The most frequently reported symptoms (n = 117, 53.9%) were itchiness and headache. Age >14 years (P = 0.04), being a man (P = 0.0004), having a smartphone (P = 0.003), using a device for more than five hours (P = 0.0007), and playing mobile games for more than one hour per day (P = 0.0001) were all discovered to be independent risk factors for DES in children (14). In the modern digital age, playing games and apps and browsing the internet are common activities for our children (8). Additionally, the majority of kids lack the self-control needed to establish personal boundaries.

It was discovered that women were more likely to have CVS. The length of use was positively connected with symptoms including headache, ocular redness, burning, etc. (15). The development of e-classes for such children during the present pandemic has added excessive strain on their already taxed eyes.

V. DES DIAGNOSIS AND MEASUREMENT

The evaluation of DES has been done using both objective and subjective methods. To offer indices of visual fatigue, objective assessments of variables such crucial flicker-fusion frequency, blink rate and completeness, accommodative function, and pupil features may be used. A 10-item questionnaire created by Hayes et al. (16) and used in numerous research is an example of a subjective approach.

It takes into account the DES symptoms and rates each symptom separately. Another six-item visual fatigue assessment uses a Likert scale to allow users to rate their ability to see, strange sensations around the eyes, weary eyes, numb eyes, headaches, and dizziness when staring at the screen (7). Another instrument that researchers may employ to evaluate visual and ocular problems in computer users is the Rasch-based Computer-Vision Symptom Scale. A single symptom severity score (CVS score) of six or above is regarded as diagnostic of the disease (17) and is obtained by having users rate the frequency and severity of 16 symptoms they experience when using a computer in the self-administered Computer Vision Syndrome Questionnaire (CVS-Q).

In unbiased assessments, DES' physiological basis is taken into consideration. However, the precise mechanism underlying DES is yet uncertain. Critical flicker-fusion frequency (CFF) and blinking characteristics have been used often in recent DES research to evaluate visual functions (7).

Typical non-pharmacological and pharmaceutical therapies include ergonomic practises, keeping regular blinking, using suitable lighting, placing the digital device carefully, modifying image qualities (resolution, text size, contrast, and brightness), and taking pauses. One of the pharmaceutical management strategies is the use of artificial tears.

Reddy et al. (18) found that focusing on distant objects while taking breaks from screens has a much better prognosis than taking breaks alone for lowering DES symptoms.

The 20/20/20 approach, which involves focusing on objects more than 20 feet away for 20 seconds after using a visual display unit for 20 minutes, is highly recommended in the literature (19). Additionally, a popular but underappreciated ergonomic strategy for preventing eye strain is to use antiglare displays in electronic gadgets.

There is conflicting research on the antiglare screen's benefits for DES prevention. Reddy et al. (18) and Scullica et al. (21) reported that screen filters have no influence on DES symptoms, contrary to the findings of Ranasinghe et al. (17) and Shantakumari et al. (20) who found that people who used antiglare displays had fewer DES symptoms. According to some research, a good method to prevent DES among screen users is to increase ergonomic health literacy behaviours and establish an ergonomic work environment. It has been found that utilising precision spectrum filters minimises the symptoms of micro-fluctuation of accommodation, while wearing computer glasses corrects refractive errors and lessens symptoms.

There is debate surrounding anti-glare lenses, and there is no consensus on how to use them. Artificial tears and omega-3 fatty acid intake are effective treatments for dry eye problems. Users can increase their effective blinking rate, which is believed to be one of the most important factors in preventing DES, with the use of on-screen hints, audial prompts, or wink glasses. In a qualitative European study including 368 kids ages 9 to 16, participants were asked about the drawbacks they saw with utilising technology in general and the internet specifically. The use of eyeglasses after lengthy internet use may assist to lessen the variety of eye disorders, such as eye strain and eye irritation (22). An innovative therapy approach called "Warming Device" could be a good substitute.

VI. CONCLUSIONS

In this population, prolonged use of digital devices significantly increased during home-isolation. Digital eye strain incidence increased during curfew. Regular eye exams should be encouraged to ensure the use of optimum prescription use and meet the specific visual demands required for the use of digital devices. Eye-health strategies and awareness campaigns should be employed on the importance of regular eye exams, decreasing screen time, practising the 20-20-20 rule, and the use of rewetting drops to help reduce the symptoms of digital eye strain during this period.

Because of DES, a "Shadow Pandemic" is developing. The current trend of e-learning programmes and its effects are unintentionally pushing a generation of children towards a higher risk of DES.

VII. RECOMMENDATIONS

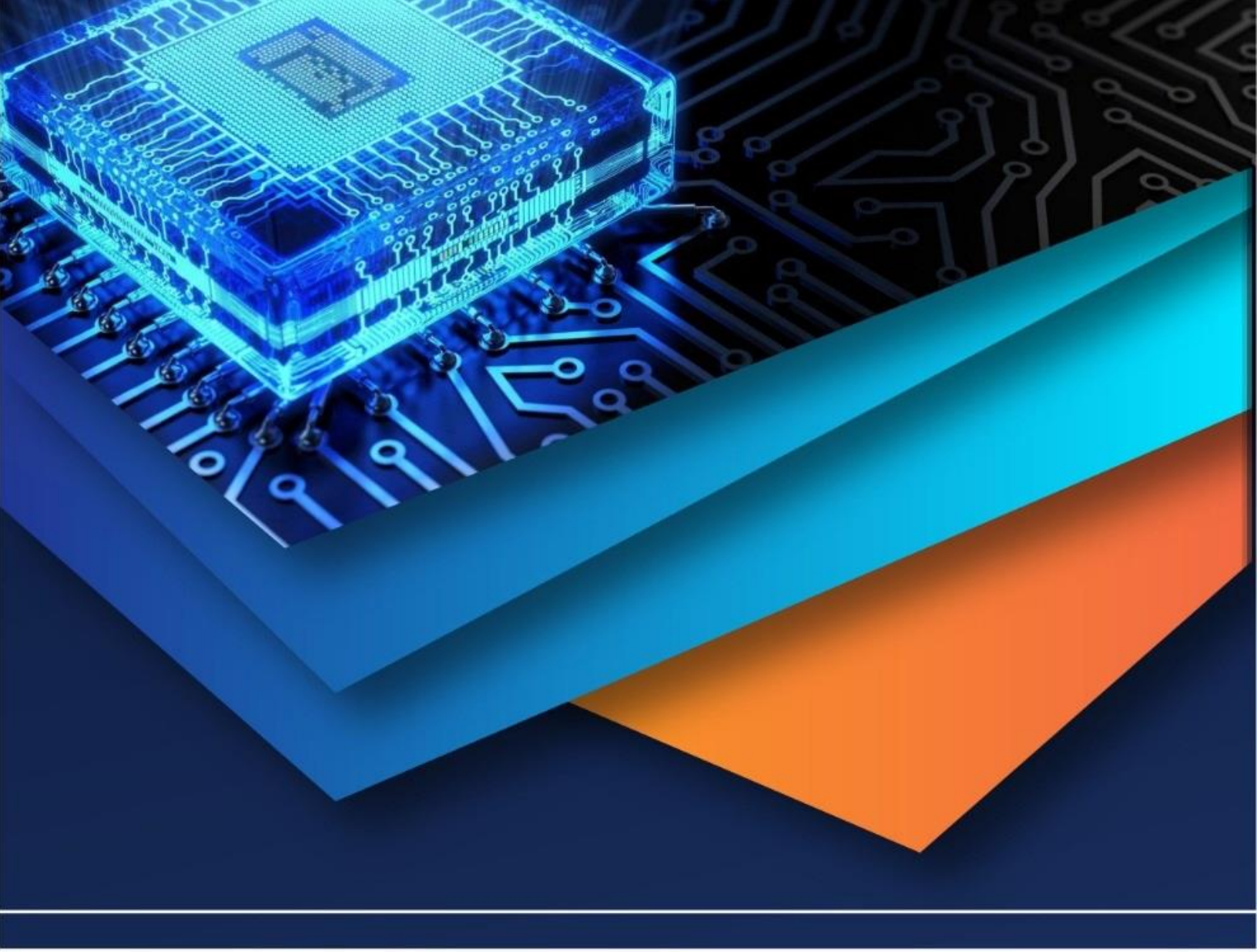
While there is a dearth of similar data for children, there is a wealth of research to assess the prevalence of DES among adult screen users. Given the COVID-19 epidemic and the growing problem of children using screens for more than 12 hours per day, it is critical that politicians in the health and education sectors offer advice (for example, restricting students' access to e-learning in order to cut down on screen time). Adults who work from home frequently and use digital gadgets should be given similar guidelines. Ophthalmologists can also learn about computer vision syndrome's diagnosis and cutting-edge treatment options.

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