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EVALUATION OF DIGITAL EYE FATIGUE IN COMPUTER USERS: AN OPTOMETRY PERSPECTIVE

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Abstract

Digital Eye Strain (DES) is an increasingly common problem among computer users due to prolonged screen use. The study aims to assess the prevalence and severity of DES in different age groups, as well as identify the main factors that play a role in this condition. Over the past few decades, the use of digital devices such as computers, *tablets*, and *smartphones* has experienced a significant increase. DES is a set of symptoms in the eyes and vision associated with long-term use of digital devices. Common symptoms that are often reported include dry eyes, blurred vision, headaches, and eye fatigue. Several studies show that the prevalence of DES is quite significant, especially among office workers, students, and students who frequently interact with digital screens. This phenomenon received serious attention in the field of optometry because it can affect a person's quality of life and productivity. Various factors can affect how severe DES is, such as length of screen time, lack of lighting, body position, and visibility to the screen. Therefore, a thorough assessment is needed to understand the extent to which DES affects computer users and how optometric methods can be utilized to mitigate its adverse effects. This study aims to analyze the association between the length of computer use and the level of degenerative eye syndrome (DES) in users and evaluate the effectiveness of optometrative interventions, such as the use of special corrective lenses, exposure adjustments, and recommendations for rest, in reducing DES symptoms among computer users. The method used was *a cross-sectional* study involving participants between the ages of 18 and 60 years. Participants include lecturers, students, and teaching staff in the ARO Leprindo environment. Data was obtained through a structured questionnaire that evaluated the duration of screen use, DES symptoms, and lifestyle factors. A thorough eye examination is carried out, including visual acuity testing, refractive assessment and analysis of the tear layer. This study emphasizes the significance of routine optometrical assessments and interventions to reduce the negative effects of excessive use of digital devices on eye health.

Keywords: Digital Eye Fatigue, Optometry, Computer Vision Syndrome, Screen Time, Eye Health.

Introduction

With the advancement of digital technology, more and more people are spending a long time in front of screens, resulting in an increase in complaints about eye problems. Digital Eye *Strain* (DES), often referred to as Computer *Vision Syndrome* (CVS), includes a variety of symptoms such as eye strain, dryness, and blurred vision. This research is oriented towards the assessment of DES optometry, investigating the extent of its presence, risk factors, as well as possible actions to reduce its effect on eye health. Digital eye fatigue, a growing public health problem, is a condition characterized by visual impairment and/or discomfort in the eyes due to the use of digital devices, caused by various factors that put a strain on the eyes. This review aims to provide an overall summary of the literature on digital

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eye fatigue research, with a particular emphasis on clinical symptom management. Around 90 percent of digital device users experience signs of fatigue due to screen use. Various studies indicate that the following factors contribute to eye fatigue due to digital use: uncorrected refractive errors (including presbyopia), problems with accommodation and convergence, changes in blinking patterns (such as reduced frequency and incomplete blinking), overexposure to too bright light, closer working distances, and smaller text sizes. Since a symptom can arise as a result of one or more causes, it is important to adopt a holistic approach (Anna Sulley, 2018).

Recommended management strategies include: (i) accurate correction of refractive errors, including astigmatism and presbyopia; (ii) the handling of the synergy problem, with the aim of inducing or maintaining a small degree of heterophoria (~1.5Δ Exo); (iii) blinking training to maintain normal blinking patterns; (iv) the use of lubricating eye drops (artificial tears) to relieve symptoms of dry eyes; (v) more comfortable wearing of contact lenses, especially at the end of the day and in challenging conditions; (vi) color filter prescriptions in all types of vision correction, in particular blue light-absorbing filters; and (vii) handling accommodation issues. Prevention is a key approach to managing digital eye strain, which includes: (i) creating an ergonomic work environment and implementing good work practices (through patient education and the implementation of ergonomic policies in the workplace); and (ii) conducting eye examinations and treatments to address vision problems. Special considerations are needed for individuals at high risk of developing eye strain due to digital use, such as computer workers and contact lens users.

Method

The methodology section outlines the approach taken to investigate and analyze digital eye fatigue in computer users from an optometry point of view. This study relies on qualitative and quantitative data to assess the prevalence, causes, and effectiveness of various interventions in treating *Computer Vision Syndrome* (CVS).

1. Research Design

This study uses a mixed method approach, combining observational research and experimental analysis:

- **Observational Studies** : The study began with the collection of observational data to assess the prevalence of digital eye fatigue among various groups of computer users, including students, office workers, and other professionals.
- **Experimental Interventions** : Various optometry interventions such as the use of special computer glasses, ergonomic adjustments, and blue light filters were tested in a controlled environment to measure their effectiveness in reducing symptoms of digital eye fatigue.

2. Sample Selection

- **Population** : The study targeted individuals who used digital screens for at least 4 hours per day. The sample population includes diverse demographic groups in terms of age, gender, and occupation to represent a broad spectrum of screen users.
- **Sample Size** : A total of 60 participants will be recruited for this study, with an even distribution across three main categories: students, office workers, and freelancers.
- **Inclusion Criteria** : Participants must have normal to corrected vision and not have an eye condition that could interfere with the digital eye fatigue assessment.

3. Data Collection Methods

- **Surveys and Questionnaires** : Participants will complete a self-reported survey at the beginning of the study to provide baseline data on screen usage habits, symptoms of digital eye strain, and existing vision correction.

- **Measurement of Visual Acuity and Blink Speed** : During the use of the screen, participants will undergo an optometry test to measure visual acuity and blink speed. This test will help evaluate the impact of screen time on performance and eye comfort.
- **Ergonomic Assessment** : Observations will be made regarding the participant's workspace settings, including screen distance, lighting, and posture. This data will be used to identify environmental factors that contribute to eye strain.
- **Symptom Tracking** : Over a four-week period, participants will record the severity and frequency of digital eye fatigue symptoms, such as blurred vision, dry eyes, and headaches. Symptom notes will be used to track changes during the different phases of the intervention.

4. Experimental Intervention

Participants will be divided into three groups, each receiving a different optometry intervention:

- **Group 1** : Participants will use **computer glasses** that are specially designed for use in front of a screen. The glasses will feature an anti-reflective coating and a blue light filter to reduce tension.
- **Group 2** : Participants will receive **an ergonomic training program** , which includes instructions on screen position, proper lighting, and posture.
- **Group 3 (Control Group):** No specific intervention will be given; participants will continue their usual screen use habits.

5. Result Size

The effectiveness of the intervention will be measured using subjective and objective data:

- **Subjective Measurement** : Changes in digital eye fatigue symptoms self-reported by participants before and after the intervention.
- **Objective Measurement** : Comparison of pre and post-intervention results from visual acuity tests, blink frequency measurements, and workspace ergonomics.

6. Data Analysis

- **Quantitative Analysis** : Statistical tools will be used to analyze survey data and tests to determine the significance of the improvement of digital eye fatigue symptoms.
- **Qualitative Analysis** : Qualitative data from participant interviews and feedback will be analyzed to understand their experience with each intervention, providing insight into the most practical and effective solutions.

7. Ethical Considerations

- **Informed Consent** : All participants will give informed consent before taking part in the study, and they will be fully informed of the purpose and procedures of the study.
- **Confidentiality** : Personal and medical data collected during the study will be kept confidential and used only for research purposes.
- **Participant Safety** : Any discomfort experienced by the participant during the study will be closely monitored, and the participant may withdraw at any time.

8. Limitations

- **Self-Report Bias** : Reliance on self-reported symptoms can give rise to bias, as participants may exaggerate or underestimate the severity of their eye strain.
- **Short-Term Follow-up** : The study's four-week intervention period may not capture the long-term effects of optometry solutions on digital eye fatigue.

Result

The increasingly intensive use of computers in today's digital era has led to an increase in the prevalence of complaints of digital eye strain (DES). DES is a set of visual and ocular symptoms that arise due to the use of digital devices such as computers, tablets, and smartphones for a long period of time. Common symptoms include dry eyes, blurred vision, eye fatigue, and headaches. From an optometry perspective, the management and prevention of DES requires a multifactorial approach that includes work environment regulation, behavior modification, and optometrical interventions such as the use of corrective lenses with anti-reflection coatings.

This study examines the prevalence and risk factors of DES in computer users, and provides an overview of effective optometrical management strategies. Literature studies show that the frequency of DES complaints increases with the duration of computer use, with additional risk factors including age, lighting conditions, viewing distance, and ergonomic position. Interventions such as the 20-20-20 technique (looking at an object 20 feet away for 20 seconds every 20 minutes), the use of lubricating eye drops, and lenses with blue light filters have been shown to reduce DES symptoms. The use of electronic *devices* when carrying out activities both in the office, workplace that uses electronic devices and schools has a great influence on eye health.

The management of DES from an optometry point of view also emphasizes the importance of regular evaluation of eye conditions to detect and correct refractive errors that may worsen DES symptoms. The study concludes that a comprehensive optometrical approach and personalized care are key to minimizing the negative impact of DES and improving the quality of life of computer users.

Table 1. Device Usage Comparison (*device*) electronics before and after the activity

	12-14 Jam	15-17 Jam	3-5 Jam	6-8 Jam	9-11 Jam	more than 3 Hours	more than 18 Hours
Before				**After**			
12-14 jam	13	0	12	11	24	1	0
15-17 jam	19	7	3	6	11	4	6
3-5 jam	0	0	11	3	4	8	2
6-8 jam	2	0	12	6	4	11	1
9-11 jam	3	0	13	19	4	1	1
more than 3 hours	0	1	3	6	0	8	12
more than 18 hours	1	5	8	9	4	0	2

Table 2. Frequency and percentage of rest requirements from digital device screens

How often do you think you need to take breaks from the screen when using a digital device?	Frequency	Percentage
10 minutes	16,2	27
20 minutes	16,8	28
30 minutes	16,8	28
40 minutes	10,2	17
Total	60	100

Discussion

Causes & risk factors

Looking at a computer or digital screen often makes the eyes work harder. As a result, the unique characteristics and high visual demands of computer and digital screen displays make many people susceptible to the development of vision-related symptoms. Uncorrected vision problems can increase the severity of computer vision syndrome (CVS) or symptoms of digital eye strain. Viewing a computer or digital screen is different from reading printed pages. Often the letters on a computer or handheld device are not as precise or sharp as intended, the contrast between the letters in the background is reduced, and the glare and reflections on the screen can make vision difficult.

The viewing distances and angles used for this type of work are also often different from those commonly used for other reading or writing tasks. As a result, eye focusing and eye movement requirements for digital screen displays can place additional demands on visual systems. Additionally, the presence of even minor vision problems can often significantly affect comfort and performance in front of a computer or when using other digital screen devices. Uncorrected or undercorrected vision problems can be a major contributing factor to computer-related eye strain. Even people who have prescription glasses or contact lenses may feel they are not suitable for the specific viewing distance of their computer screen. Some people tilt their heads at odd angles because their glasses are not designed to look at computers or they bend toward the screen to see them clearly. Their posture can cause muscle spasms or pain in the neck, shoulders or back.

In most cases, CVS symptoms occur because the visual demands of a task exceed the individual's visual ability to do so comfortably. People most at risk of developing CVS are those who spend two or more hours in front of a computer or use a digital screen device every day.

Symptom

The most common symptoms associated with CVS or digital eye strain are:

- Eye strain.
- Headache.
- Blurred vision.
- Dry eyes.
- Neck and shoulder pain.

These symptoms may be caused by:

- Poor lighting.
- Glare on digital screens.
- Improper visibility.
- Poor sitting posture.
- Uncorrected vision problems.
- A combination of these factors.

The extent to which individuals experience visual symptoms often depends on their level of visual ability and the amount of time spent looking at digital screens. Uncorrected vision problems such as **nearsightedness** and **astigmatism**, inadequate eye focusing or coordination abilities, and eye changes due to aging, such as **presbyopia**, can all contribute to the development of visual symptoms when using a computer or digital screen device.

Many visual symptoms experienced by users are temporary and will decrease after stopping using a computer or digital device. However, some people may experience a persistent decline in visual abilities, such as blurred distance vision, even after stopping working in front of a computer. If nothing is done to address the cause of the problem, the symptoms will continue to recur and may worsen with future use of digital screens.

Diagnosis

CVS, or digital eye fatigue, can be diagnosed through **a thorough eye exam**. Testing, with a particular emphasis on visual needs at the working distance of a computer or digital device, may include:

- The patient's history to determine any symptoms the patient is experiencing and the presence of general health problems, medications taken, or environmental factors that may contribute to symptoms related to computer use.
- Measurement of visual acuity to assess the extent to which vision may be affected.
- Refraction to determine the exact strength of the lens, which is needed to compensate for any refractive errors (nearsightedness, nearsightedness, or astigmatism).
- Test how the eyes focus, move, and work together. To obtain a single, clear picture of what is being seen, the eye must effectively change focus, move, and work in unison. This test will look for problems that prevent the eye from focusing effectively or make it difficult to use both eyes at the same time.

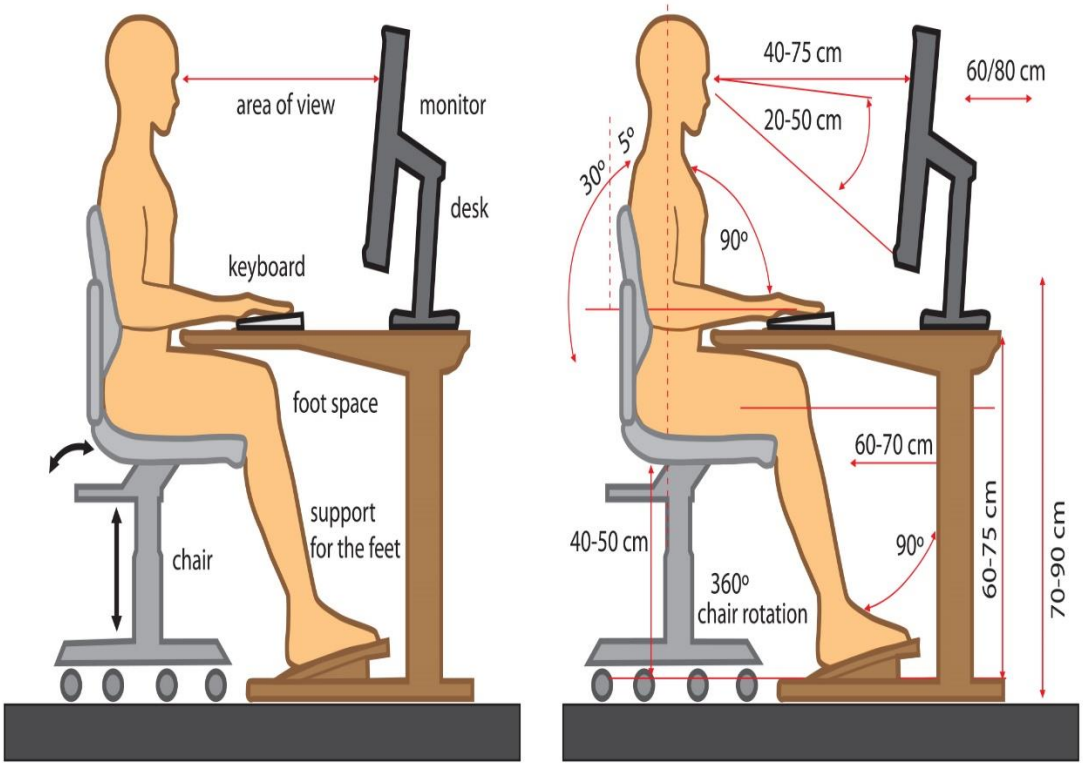
This test can be done without the use of eye drops to determine how the eye responds under normal vision conditions. In some cases, such as when some of the eye's focus may be hidden, eye drops may be used. The eye drops temporarily prevent the eye from changing focus while the test is being performed. Using the information obtained from these tests, along with other test results, the optometrist can determine the presence of CVS or digital ocular strain and suggest treatment options.

Treatment

Solutions to vision problems caused by digital screens are diverse. However, these problems can usually be overcome by doing regular eye care and changing the way you look at screens.

In some cases, people who do not need the use of glasses for other daily activities may benefit from glasses that are prescribed specifically for computer use. In addition, people who already wear glasses may find that their current prescription for glasses does not provide optimal vision for viewing computers.

- Glasses or contact lenses prescribed for general use may not be adequate for working in front of a computer. Lenses prescribed to meet the unique visual demands of computer use may be required. Custom lens design, lens power, or lens color or coating can help maximize visual capabilities and comfort.
- Some computer users experience problems with eye focusing or eye coordination that cannot be adequately corrected with glasses or contact lenses. A vision therapy program may be necessary to address this particular problem. Vision therapy, also called visual training, is a structured program of visual activities prescribed to improve visual abilities. The program trains the eyes and brain to work together more effectively. This eye exercise helps correct deficiencies in eye movement, eye focusing, and eye cooperation and strengthens the eye-brain connection. Treatment can include training procedures in the office as well as at home.



Picture 1. Computer Viewing Position

Proper body position when using a computer. Some important factors in preventing or reducing CVS symptoms have to do with computers and how to use them. This includes lighting conditions, seat comfort, location of reference material, monitor position, and use of rest time.

- **Location of the computer screen.** Most people feel more comfortable looking at a computer when their eyes are looking down. Ideally, the computer screen should be 15 to 20 degrees below eye level (about 4 or 5 inches) measured from the center of the screen and 20 to 28 inches from the eye.
- **Reference material.** These materials should be placed on the keyboard and under the monitor. If this is not possible, document storage can be used next to the monitor. The goal is to position the document, so that the document head does not need to be repositioned from the document to the screen.
- **Lighting.** Position the computer screen so that it does not glare, especially from overhead lights or windows. Use blinds or curtains on windows and replace the table light bulb with a lower power bulb.
- **Anti-glare screen.** If there is no way to minimize glare from the light source, consider using a screen glare filter. This filter reduces the amount of light reflected off the screen.
- **Sitting position.** The chair should have comfortable cushioning and fit the body. The height of the seat should be adjusted so that the legs can rest flat on the floor. The arm should be adjusted to provide support while typing and the wrist should not rest on the keyboard while typing.
- **Rest.** To prevent eye strain, try to rest your eyes when using the computer for a long time. Rest your eyes for 15 minutes after two hours of continuous computer use. Also, every 20 minutes of using the computer, look into the distance for 20 seconds to give your eyes a chance to refocus.

- **Flashing.** To minimize the risk of dry eyes when using a computer, try blinking as often as possible. Blinking keeps the front surface of the eye moist.

Regular eye exams and proper viewing habits can help prevent or reduce the development of symptoms associated with CVS.

Prevention

Prevention or reduction of vision problems related to CVS or digital eye strain involves taking steps to control the lighting and glare on the device's screen, establishing the appropriate working distance and posture for viewing the screen and ensuring that even minor vision problems are corrected correctly.

Advice for people with computer vision syndrome

- **Do not bring vision problems to work.** Although glasses are not necessary for driving, reading, or other activities, they can still provide benefits for mild vision problems exacerbated by computer use. A prescription for light glasses may be necessary to reduce visual pressure while working. It is recommended that computer users undergo a thorough eye exam every year.
- **The glasses must match the demands of the job.** If the glasses are worn for distance vision, reading, or both, they may not provide the most efficient vision for looking at a computer screen, which is about 20 to 30 inches away from the eye. Tell your doctor about job duties and measure visibility at work. Accurate information will help get the best vision improvement. Patients can benefit from one of the new lens designs made specifically for computer work.
- **Minimize discomfort due to blue light and glare.** Blue light from LED lights and fluorescent lights, as well as monitors, *tablets*, and mobile devices, can negatively affect vision in the long run. Special lens tinting and coatings can reduce the adverse effects of blue light. Minimize glare on your computer screen by using a glare reduction filter, changing the position of the screen, or using curtains, blinds, or window coverings. In addition, it keeps the screen clean; dirt-free, and fingerprint removal can reduce glare and improve clarity.
- **Adjust the work area and computer to make it comfortable.** When using a computer, most people prefer a work surface with a height of about 26 inches. Tables and chairs are usually 29 inches tall. Place the computer screen 16 to 30 inches away. The top of the screen should be slightly below horizontal eye level. Tilt the top of the screen at a 10 to 20 degree angle.
- **Use an adjustable stand.** Place the reference material at the same distance from the eyes as the computer screen and as close to the screen as possible. That way, the eyes don't have to change focus when looking from one to the other.
- **Take breaks to work on alternative tasks throughout the day.** After working in front of a computer for a long time, do anything that doesn't require your eyes to focus on something close.

Conclusion

The study confirms that digital eye fatigue is a common problem among computer users, and optometry interventions have proven to be effective in reducing the symptoms experienced. The use of computer glasses and the application of ergonomic principles are highly recommended to prevent digital eye fatigue and maintain long-term eye health.

With the increasing reliance on digital devices, digital eye fatigue is becoming a more common problem. From an optometry point of view, early detection, proper eyewear, ergonomic adjustments, and practical strategies such as the 20-20-20 rule are essential in managing and preventing digital eye fatigue. Awareness of these measures, coupled with regular eye care, can significantly reduce the negative impact of screen use in the long term on vision health.

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