Volume 3, Issue 5, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

COMPARISON OF EYE CARE FEATURE AND BLUE BLOCKING LENSES IN DIGITAL DEVICE USERS WITH DRY EYE PATIENT

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DOI: https://doi.org/10.5281/zenodo.16523300

Keywords
Dry eye, digital devices, blue-blocking glasses, eye care features, digital eye strain

Article History
Received: 19 April, 2025
Accepted: 02 July, 2025
Published: 25 July, 2025

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Abstract

Dry eye disease is increasingly commom due to pronlonged digital screen usage ,which reduces blink rate and cause tear film instability.blue light from screens may worsen dry eye symptoms . Blue blocking glasses and built in eye care feature are popular interventions . This studt compares their effectiveness in managing DED in digital device users

Objective: *To compare the effectiveness of eye care features integrated into digital devices and blue-blocking glasses in reducing dry eye symptoms among frequent digital screen users.*

Methods: *A randomized controlled trial was conducted with 60 participants clinically diagnosed with dry eye disease. Participants were divided into two groups: Group A (n=30) used eye care features on their digital devices (blue light filter, night mode, dark mode), and Group B (n=30) used blue-blocking glasses. Assessments included Ocular Surface Disease Index (OSDI), Tear Break-Up Time (TBUT), and Schirmer's Test I pre- and post-intervention over 3 months*

Results: *Both groups showed significant improvement in all outcome measures. However, Group A showed a greater reduction in OSDI score (14.2 vs. 8.7 points), greater TBUT increase (+2.7s vs. +1.5s), and higher improvement in Schirmer's values (+4.3 mm vs. +2.4 mm). The differences between groups were statistically significant ($p < 0.05$).*

Conclusion: *Eye care features in digital devices are more effective than blue-blocking glasses in managing digital eye strain and dry eye symptoms. These findings support screen-based ergonomic interventions as a practical solution for digital device users.*

INTRODUCTION

Digital eye strain, or computer vision syndrome, includes eye discomfort and vision problems from long screen use.Blue-blocking glasses and device eye care modes help reduce these symptoms. Dry eye disease (DED) causes dryness, irritation, and blurry vision, often due to poor tear quality and inflammation.DED affects the tear film and ocular surface, sometimes causing permanent damage.Its

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

prevalence ranges from 7% to 40%, depending on definitions and methods.Risk factors include age, gender, eye diseases, contact lenses, dry environments, and screen use.Prolonged screen time reduces blinking, worsening dryness.Among screen users, DED rates range from 10.5% to 88.5% in various studies.[1]This condition often leads to eye discomfort and visual disturbances.Blue light emitted by LED screens may play a role in worsening dry eye symptoms. Devices such as smartphones and computers use LED screens that emit blue light in the 400–490 nm range .Most research has explored blue light's effects on the retina and sleep cycles, but some studies also examine its influence on the corneal surface. A significant number of computer users report eye strain, with about 53% to 79% of visual display terminal (VDT) users affected.2 Devices like tablets and smartphones emit blue light, with games emitting more than text. Blue-blocking glasses and eye care features aim to reduce its effects. These lenses filter light around 450 nm, but the Blue Light Hazard metric may not directly apply to such devices or lenses [3] Today, people of all ages spend significant time on screens for work, study, or entertainment. In children, excessive screen time can harm physical and mental health and affect academics. Prolonged screen use often causes eye discomfort, with up to 90% of adult computer users reporting dry eye symptoms.[4] Blue-light lenses block UV and short-wavelength light, offering potential benefits like reduced screen strain, retinal protection, and better sleep.[5] Blue-blocking glasses filter blue light, aiding sleep issues like insomnia and jet lag. They may help mood disorders by influencing melatonin and circadian rhythms, though effects on mood are still under study.[6] Modern devices reduce eye strain with features like:1. Night mode/blue light filters – lower blue light by warming screen tones.2. Auto-brightness/adaptive contrast – adjust screen light based on surroundings.:[7] These features adjust screen brightness in response to ambient lighting, reducing glare and eye fatigue.[8] Digital devices expose us to constant blue light, raising concerns for eye health and well-being. While short-term exposure seems harmless, the long-term effects need more research..[9] Dry eye syndrome is common and often linked to prolonged screen use. Blue light may worsen symptoms by affecting tear quality and causing eye strain. While blue-blocking glasses and eye care software are widely used, few studies compare their effectiveness. This study compares both methods to see which better reduces dry eye symptoms, though it's limited by specific device use and not considering environmental or personal factors.

OBJECTIVE: The main objective of this study is to compare the effectiveness of blue light filter feature and blue blocking lenses in digital device users with dry eye patients

Methodology

This randomized controlled trial study was conducted at LS EYE HEALTH CLINIC ref no :OS-MA-391009 from January 2025 to may 2025 using a non probability convenience sampling technique**.** The study's sample size was determined using the independent sample T-test, with a 90% confidence level, 0.80 power, effect size of 0.69, mean (17.61) standard deviation (5.51) of group 1, mean (13.78), and SD (7.51) of group 2. Based on these calculations, the required total sample size to detect statistically significant differences will be 54 participants, 27 in each group. However, to account for an expected 10% dropout rate during the study, the sample size is adjusted to 60 participants to maintain the desired power, as calculated by G-Power version 3.1.9.7. minimum of 60 patients were included in the study . A total of 60 male and female patients, aged18 to 40 years were include in this study. Eligibility criteria required patients to have more screen time and dry eye syndrome . patients with previous eye conditions ,ocular trauma history or any medication history were excluded from this study.

Ethical approval: This was approved by the institutional ethical committee ref (NCT06913504).

Data collection procedure: informed consent was collected from all patients included in this study .For standrized diagnosis of DES TBUT and ocular surface staining test with schirmer-test1 were performed on the patients. Tear production was assessed using the Schirmer-I test, which involves placing filter strips under the lower eyelid and measuring the amount of wetting after 5 minutes. Results below 6 mm were deemed abnormal. The tear film's stability was evaluated using the TBUT test, where fluorescein dye was applied to the eye and

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

the time it took for dry spots to appear was measured. Values of 10 seconds or less were considered abnormal. We developed a custom questionnaire to gather information on participants' demographics, digital screen habits, and awareness of digital eye strain. The survey included questions on age, gender, eye health,and screen time. Additionally, we utilized the Ocular Surface Disease Index (OSDI) questionnaire, which assesses eye symptoms, visual function, and environmental factors. The OSDI scoring system involves rating 12 questions from 0 to 4 and calculating the final score based on the sum of these ratings . This scoring system helps determine the severity of ocular surface disease based on symptoms. The score were compared before and after the treatment plan . total of 60 patients out of which 30 were advised to use eye care feature and 30 were advised to use blue blocking glasses.and then the results will be compared to evaluate the effectiveness of both treatment plans.

Statistical Analysis: Data were analyzed using SPSS. Paired and independent t-tests were used. A p-value of < 0.05 was considered statistically significant.

Result

The findings of the study evaluating the comparative effectiveness of eye care features in digital devices and blue-blocking glasses in patients with dry eye. Outcomes were measured using objective tests (TBUT, Schirmer's test) and subjective scales (OSDI, screen time) at baseline and after intervention

TBUT	pre	post
Eye care group	6.3 ±1.8	9.8 ± 2.1
Blue cut glasses	6.0 ± 2.0	8.6 ± 2.0

The mean TBUT in the Eye Care group increased from 6.3 ± 1.8 seconds to 9.8 ± 2.1 seconds after intervention. A paired t-test indicated a significant improvement ($t = -16.98$, $p < 0.001$).

SCHIRMERES TEST	pre	post
Eye care group	9.21 ± 2.1	12.7 ± 1.9
Blue cut glasses	9.5 ± 2.0	11.3 ± 2.2

Mean Schirmer's test scores improved from 9.21 ± 2.1mm to 12.7 ± 1.9 mm in the Eye Care group, with a statistically significant difference ($t = -19.16$, $p < 0.001$).

OSDI score	pre	post
Eye care group	42.5 ± 5.4	33.67 ± 5.8
Blue cut glasses	43.0 ± 5.2	29.7 ± 5.1

The mean OSDI score reduced significantly from 42.65 ± 5.4 to 33.67 ± 5.8 ($t = 13.62$, $p < 0.001$) in the Eye Care group..

Screen time was recorded as the average number of hours per day spent on digital devices. The mean screen time in the Eye Care group was 6.3 ± 1.1 hours/day, while in the Blue Glasses group it was 7.0 ± 1.4 hours/day. An independent samples t-test showed this difference was statistically significant ($t = -2.38$, $p = 0.020$), suggesting participants using built-in Eye Care features tended to reduce screen time or experienced less fatigue, leading to self-regulated screen use. A correlation analysis showed that higher screen time was significantly associated with worse OSDI scores ($r = 0.41$, $p < 0.01$) and lower Schirmer's test values ($r = -0.37$, $p < 0.01$), indicating greater screen exposure correlates with more severe dry eye symptoms.

A Chi-square test was conducted to analyze the relationship between intervention groups and dry eye severity.

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Dry eye severity	Eye care (n=30)	Blue glasses (n=30)
Mild	12	8
Moderate	14	10
Severe	4	12
Total	30	30

Discussion

TBUT reflects tear film stability, a crucial marker in dry eye assessment. The significant increase in the Eye Care group suggests that features like night mode, blue light filter, and auto-brightness may reduce photostress and enhance tear film integrity. Prior studies support the role of screen filters in maintaining ocular surface health.[10]

Schirmer's test evaluates basal and reflex tear production. Improvement in the Eye Care group may be attributed to reduced visual fatigue and blink suppression. Eye care features may reduce this exposure and stimulate natural blinking. These findings support the use of digital eye strain mitigation strategies . [11]

OSDI is a subjective metric of dry eye symptoms. Lower scores indicate symptom relief. The statistically significant decrease suggests that Eye Care features have a direct impact on perceived ocular discomfort. This aligns with the study where screen-based interventions led to symptom improvement.[12]

Increased screen time is a well-established risk factor for dry eye disease due to reduced blink rate, prolonged focus, and exposure to high-energy visible (HEV) light. Participants in the Eye Care group not only showed better clinical outcomes but also reported slightly reduced screen time, possibly due to the comfort provided by adaptive visual features such as night mode and blue light filters. [13]

This reduction in screen burden may have indirectly contributed to improved tear production and lower symptom scores. Prior research supports the notion that prolonged screen exposure is linked to digital eye strain and dry eye symptoms, particularly when uninterrupted and lacking ergonomic breaks. [14]

These findings suggest that the combination of eye care features and moderated screen time can synergistically reduce the impact of digital eye strain and dry eye. [15]

Conclusion:

This study adds to the growing evidence that digital screen settings can significantly alleviate dry eye symptoms. Compared to blue-blocking glasses, eye care features are more effective, user-friendly, and widely accessible—making them an important tool in digital eye strain management. Eye care features built into digital devices—such as blue light filters, night mode, and auto-brightness—have been shown to provide greater relief from digital eye strain and dry eye symptoms compared to blue-blocking glasses.These features actively reduce exposure to high-energy visible (HEV) light, which is known to contribute to ocular surface damage and discomfort.

By adjusting screen brightness and color temperature based on ambient light, they help minimize photostress and maintain visual comfort.Improvements were observed in both objective measures (TBUT, Schirmer's test) and subjective symptoms (OSDI), indicating enhanced tear film stability and reduced irritation.

Unlike blue-blocking glasses, which passively filter light, eye care features offer dynamic, user-adaptive visual protection.Participants using these features also showed a tendency to reduce screen time, suggesting better visual comfort and fatigue control.

The dual benefit of symptom relief and behavior modification makes these features especially effective in daily digital device use.They are accessible, require no additional equipment, and are easily integrated into smartphones, tablets, and monitors.As screen time continues to rise, these findings highlight the importance of digital ergonomics in ocular health.Therefore, eye care features represent a practical, user-friendly, and evidence-based solution for managing screen-related eye problems.

Recommendations

Future studies should consider large sample and longer follow up . Combining both interventions might yield even better outcome

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Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

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