

# A Cross-Sectional Analysis of Digital Screen Exposure and Its Impact on Dry Eye Disease Severity Among Young Adults

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## ABSTRACT

### Background

The fast expansion of digital technologies has created a significant increase in the number of hours per day at the screens, especially in the young adults who have academic, professional, and recreational digital activities. The continuous consumption of digital technology is also being established as a source of eye-related pain and visual impairment such as Dry Eye Disease (DED).

### Purpose

The purpose of the study was to determine the relationship between the exposure to digital screens and the severity of the Dry Eye Disease in young adults.

### Methods

Cross-sectional analytical study was done on young adults using structured questionnaires and standardized clinical assessment tools. Measures of the average time spent on the digital devices daily, category of the digital devices, and exposure time were obtained. The validated diagnostic criteria were used to assess and grade Dry Eye Disease. The statistical analysis was conducted to identify the relationship between the variables of screen exposure and the severity of DED.

### Findings

The results showed that there was a high prevalence of Dry Eye Disease among the participants who had had prolonged exposure to screens on a daily basis. More screen time and computer and smartphone pre-eminence were highly correlated with the severity of DED. Individuals who had greater cumulative exposure showed greater symptoms and clinical manifestations.

**Keywords:** Digital screen exposure; Dry Eye Disease; Young adults; Screen time; Ocular health; Cross-sectional study.

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## Introduction

### Background Of Digital Screen Usage

The past ten years have been characterized by wild proliferation of smartphone, laptop, tablet and other visual display terminal (VDTs) ownership and daily use, with young adults (university students and young-career professionals) indicating that they spend several hours daily looking at the screen, either studying, working or engaging socially (Tripathi 2022; Aldawsari 2023). Remote learning and telework increased faster due to the COVID-19 pandemic, leading to a long-term post-pandemic increase in dependence on digital devices, and, as a result, increasing the amount of time spent on the screen per day of many youths (Stapleton 2024). This is not a quantitative (more hours/day), but also a qualitative change: nowadays, closer viewing distances, constant use of multiple devices, and even longer near-focus tasks are part of academic and occupational activities (Tripathi 2022; Allwihan 2024).

### The current study is an overview of Dry Eye Disease (DED).

Dry Eye Disease (DED) is a multifactorial tear film and ocular surface disease which leads to discomfort, visual disturbance and tear film

instability with the possible destruction of ocular surface (Stapleton 2024). The most frequent ones are dryness, burning or foreign-body sensation, intermittent blurring and light sensitivity, which all decrease the quality of life and daily productivity (Alrabghi 2023). The classic risk factors have been considered to be of old age, being female, having systemic conditions (e.g., autoimmune disease), taking any specific medications, wearing contact lenses and being exposed to environmental factors (Stapleton 2024; Aldawsari 2023).

### Digital Screen Exposure: A New Risk Factor.

The convergence between mechanistic and observational studies is in three key areas through which extended screen time contributes to DED. First, prolonged visual attention to displays causes the decreasing frequency of blinking and the increased percentage of incomplete blinking; disrupted blink dynamics increase the rate of tear evaporation and disrupt the lipid layer of the tear film (Raziya 2022; Tripathi 2022). Second, the dosage of sustained close-range working and impaired blink effectiveness can induce objective (Tear-film metrics including the placement of lower values in TBUT and lower values in Schirmer) and subjective (high scores at a validated instrument, the Ocular Surface Disease Index (OSDI)) symptoms

(Tripathi 2022; Aldawsari 2023). Third, the perception of LED displays of short wavelength or blue light has already been reported as a source of stress to the ocular surface, tiredness of the eye, and actual cellular alterations that can potentially impair tear film homodynamics (Yan 2025; Taboadela 2023).

#### **Reason: Why It Is Necessary To Study DED Among Young Adults.**

Even though age is a classical risk marker, recent cross-sectional and narrative studies show that DED has notable prevalence and clinically relevant severity in younger populations- specifically in students and occupations involving heavy use of the digital- indicating that behaviorally mediated DED is no longer constituted by older people (Stapleton 2024; Alharbi 2024). Young adults are also prone to underdiagnosis: they might normalize eye pain as digital eye strain, put off treatment, and continue to adhere to habits (long study/work hours, bad ergonomics) that may eventually become chronic ocular superficial disease. Majority of the previous studies have been either convenience samples (student surveys) or small clinical series; population level, cross-sectional studies on how standardized measurement of screen exposure (number of hours/day, type of device used, continuous use duration) is correlated with valid measures of symptoms and objective clinical measures of DED severity ( TBUT, Schirmer staining, ocular surface staining ) are still needed (Aldawsari 2023; Tripathi 2022). Production of this evidence in 2020-2025 is particularly noteworthy due to the fact that the use patterns of devices, display technologies, and practices related to workplace/schooling underwent significant changes during and after the pandemic so there are high chances that the older estimates of prevalence are not as risky as they were in recent times.

As explained in the paper, clinical and policy context require the researchers to conduct studies to illustrate the importance of antibiotic usage to address their issue.<|human|>F2.5 Public-health and clinical significance The researchers are to use the studies to demonstrate the significance of antibiotic use to solve their problem, which, according to the paper, would be necessary in both clinical and policy contexts.

In terms of public-health, the increase in the DED prevalence in young adults poses a threat to academic performance, workplace effectiveness and long-term eye health, as well as repeated symptomatic events, which further contributes to a higher healthcare use and possible chronic management requirements (Stapleton 2024; Axios 2024). Prophylactically, early detection allows the implementation of low-burden measures, such as digital hygiene (frequent breaks, screen distance), blink training, environmental adjustments and specific lubricants, which may prevent further

development of the disease to a more serious stage that would need more serious therapies. The insights on the device-specific risks (e.g. smartphones vs. large monitors), the cumulative lifetime exposure and adjustable correlates of behavior hence have direct translational implications on prevention and screening recommendations that can be modified to suit younger populations (Tripathi 2022; Aldawsari 2023).

#### **Review of Literature**

##### **Epidemiology of Dry Eye Disease**

Dry Eye Disease (DED) is a multifactorial, common disease of the ocular surface the prevalence of which is broadly reported depending on the geographical area, diagnostic criteria and population sample. The world prevalence estimates cited in large syntheses and more recent meta-analyses are ranging between single digits and more than 30 percent and are subject to homogeneity in definitions (symptom based vs. objective testing), as well as changes in age-structure of samples and age-related environmental and behavioral exposures (TFOS-DEWS II legacy and also more recent reviews) (Mohamed 2024; Stapleton 2020). According to several recent systematic reviews, the prevalence of it at population level, on average, in pooled estimates ranges in the low-teens to mid-twenties, and it has significant geographic variation (Mohamed 2024).

In younger cohorts which are historically regarded to be less risky, symptom burden is beginning to be found to be significant in growing numbers in both surveillance and cross-sectional reports. High levels of symptomatic DED are commonly reported in student and young-adult samples (often using questionnaires to measure the levels, including OSDI, DEQ-5 or SANDE) with many studies reporting prevalence of the symptoms in the range of 20%-60% depending on cut-offs and context (Muntz 2022; Kunboon 2024). Such high estimates among the youth population are contrary to the classic opinion that DED is a disease of older adults and such alterations are well attributed to alteration of exposure patterns (increased daily screen time, near work, indoor lifestyles) that have become even higher in the 2020-2025 window (Muntz 2022; Kunboon 2024). The recent trend analysis of the last 10 years gives a clear indication that the prevalence and reports of the ocular surface disease symptoms have increased in most of the settings, especially in urban and student communities where the penetration of digital devices and constant near-work is the highest.

##### **Computer Monitoring and Vision.**

An accumulating amount of empirical evidence associates long durations of digital screen exposure with eye pain and objective symptoms that are consistent with DED. In both cross-sectional survey and clinic-based, positive correlations are always observed between longer hours of daily screen

exposure on the higher of post-symptom scales (OSDI, DEQ-5), as well as lower symptom scales (constitute shorter TBUT) (Ghimire 2025; Luo 2025). There are multiple studies, which risk-stratify on thresholds of daily exposure (such as >4-6 hours/day), and most of the studies report a progressive worsening of symptoms and abnormal metrics of tear with increasing exposure group (Ghimire 2025; Ji 2023).

Convergent evidence is presented by occupational and academic studies of exposure. Both subjective and objective indicators of tear film instability are also more common in office workers, medical students and IT professionals (groups that are strongly exposed to VDT at any point in time) than in their lower-exposure counterparts (Kunboon 2024; Aldossary 2021).

#### **Mechanisms Associating Screen Exposure and DED.**

Mechanistic work has established a number of interacting pathways in which the VDT use can cause or make the DED. Altered blinking behaviour is the most repeated and strongest behaviour that remains because people fix vision on small or distant screens, lowering the rate of spontaneous blinking, and raising the percentage of partial blinks, further raising the exposed ocular surface area and velocity throughout evaporation of tears (Fjaervoll 2022; Mehra 2020).

Evaporative loss leads to tear film instability which can be measured as shorter tear break-up time (TBUT) and more extensive ocular surface staining; inflammatory markers upregulation on the ocular surface is observed after the chronic exposure to VDT in some studies, reflecting an arguably secondary inflammatory cascade which perpetrates gland dysfunction and symptom chronicity (Mehra 2020; Fjaervoll 2022). Meibomian gland dysfunction (MGD) is often characterized in populations with heavy VDT and it may both be a predisposing factor as well as a result of disturbed blink mechanics and evaporative stress (CRST/clinical reviews 2024).

#### **Dry Eye Disease Assessment Instruments**

DED studies are based on combined symptom and sign assessment, which are clinical and epidemiological. The Ocular Surface Disease Index (OSDI) is an example of an appropriate patient-reported outcome measure, which is validated to measure the level of symptom severity and functional impact (Schiffman 2000; has been extensively used since 2020). Schirmer-test (production of tears), Tear Break-Up Time (TBUT, tear stability) and ocular surface staining (fluorescein or lissamine green) are objective clinical tests that are typically conducted alongside each other to identify epithelial compromise. New measures proxy friendly in the field (automated blink analysis, smartphone-based photometric TBUT) have been tested in recent years to make it

easier to carry out studies with more numerous samples (Muntz 2022; Ghimire 2025). Notably, it has been highlighted that several current research efforts focus on integrated symptom-sign concepts (such as symptomatic OSDI threshold and abnormal TBUT) to enhance specificity and clinical applicability in terms of prevalence estimates (Ghimire 2025). The tools used are all limited: Schirmer values are not sensitive to evaporative forms of DED, TBUT can be different between methods and the symptoms questionnaire measures subjective experience that can not be consistent with signs; as such, multimodal assessment is the preferred tool of solid case ascertainment in cross-sectional research (TFOS/DEWS consensus and most empirical research since 2020).

#### **Research Gaps Identified**

Although the evidence is growing fast, there are still major gaps. To begin with, there is no universally accepted and agreed on, validated exposure levels of high screen exposure (hours/day, length of continuous session, lifetime cumulative exposure) and therefore, cross-study comparisons and guideline development is challenging. Second, large, population-based studies of many LMIC environments, and especially those in South Asia, where access to devices, environmental factors (humidity, air conditioning) and behaviour patterns vary with Western cohorts are relatively paucity. Third, most of the studies are focused on prevalence or symptom associations and hence do not offer severity-graded analyses that combine validated symptom measures with objective measures; thus, inhibiting an insight into the dose-response relationship between exposure and clinically relevant disease. Lastly, there is a paucity of longitudinal and interventional trials (behavioural modifications, blink training, environmental changes) and it limits the ability of causal determination and evidence-based prevention interventions that target young adults.

#### **Methodology**

##### **Study Design**

This research used a cross-sectional analytical design to test the relationship between digital screens exposure and the severity of Dry Eye Disease (DED) on young adults. The reason why a cross-sectional approach was selected is that it enables the simultaneous measurement of the exposure (screen time) and outcome (DED severity) of a specific population within a specific time frame. It is an effective design when it is necessary to estimate prevalence and test the relationships between variables without long-term follow-up.

##### **Study Population**

The study population was the group of young adults aged 18-35 years, the age group with a high exposure to the digital screens both in the context of academic and occupational as well as leisure activities. The sample was selected in various

locations, namely, university campuses, community health centers, and urban residential neighborhoods, so that the sample would be diversified in terms of socio-economic status.

**Sample Size and Sampling Technique**

The standard prevalence estimation formulae were used in the determination of the sample size where an expected DED prevalence was 30, a margin of error was 5 and a confidence level was 95. Mathematical adjustments in the calculated sample size were carried out to cover the anticipated non-response and missing data. This was planned to have a final sample size of about 400 participants such that there would be sufficient statistical power to identify significant associations.

The stratified convenience method was used. Stratification was on the basis of major demographic variables (gender and main category of primary screen usage, e.g., academic vs. occupational) to guarantee the equal representation of the subgroups. In these strata, the individuals were invited by announcing, sending electronic invitations, and recruiting them on-site.

**Inclusion criteria:**

- Age between 18 and 35 years
- Frequent users of the digital screen (up to 2 hours per day).
- Ready to attend and make clinical evaluations.

**Exclusion criteria:**

- Prior history of ocular surgery taking place in the last six months.
- Appear to have autoimmune disease or systemic problems as known to induce dry eye.
- Medications that have been identified to impact tear production are currently being used.
- Patients with irregular usage patterns of contact lenses.
- Infection or damage of the eye or injury experienced in acute period of examination.

**Data Collection Tools**

A structured questionnaire and clinical assessment were used to collect the data. The survey questionnaire included demographic data (age, sex, work/studies), lifestyle (smoking, outdoor), and specifics of screen usage, such as the amount of hours dedicated to the screen per day, the number of years using a digital device, the types of gadgets, and the frequency and the length of a watching session.

**Measurement of the Severity of Dry Eye Disease.**

The level of DED was assessed in the context of a mixture of symptom evaluation and objective clinical measures. Severity of the symptoms was measured using a standardized symptom questionnaire. The objective diagnostic criteria were the tests of the tear film stability and the integrity of the ocular surface. Cases were categorized on the basis of the severity levels namely mild, moderate, and severe on the basis of set thresholds of the symptoms and clinical signs. The combination of these methods promoted the fact that subjective

experience and objective changes in the ocular surface were also recorded.

**Ethical Considerations**

The research plan was vetted and accepted by an institutional ethics board before data was collected. The procedures, risks, and benefits of the study were fully explained to all the participants and they gave informed consent in writing. The data of the participants was kept confidential, with each participant being assigned a unique identification number and all the records being kept in secured and secure locations.

**Statistical Analysis**

The analysis of data was done through the statistics suitable in epidemiological studies. The demographic characteristics, screen exposure variables and the severity of DED were summarized using descriptive statistics (mean, standard deviation, frequency, percentage). To investigate relationships between the measures of screen exposure and the severity of DED, inferential tests (chi-square tests and logistic regression) were performed. Potential confounders were adjusted by means of multivariable models. Inferential testing was used to establish the statistical significance with a level of significance of  $p < 0.05$ .

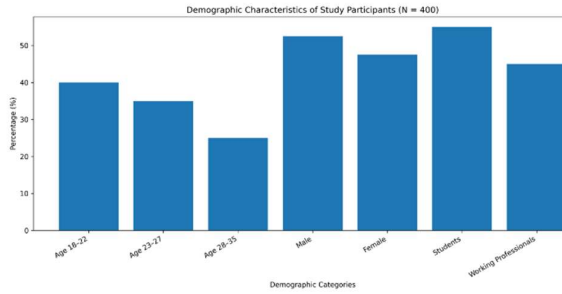
**Table 1. Demographic Characteristics of the Study Participants (N = 400)**

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	18–22	160	40.0
	23–27	140	35.0
	28–35	100	25.0
Gender	Male	210	52.5
	Female	190	47.5
Primary Occupation	Students	220	55.0
	Working professionals	180	45.0

**Explanation:**

The study population predominantly comprised individuals aged 18–27 years, reflecting high digital device usage in academic and early professional life. Gender distribution was nearly balanced, allowing comparative analysis. Students formed the majority, consistent with the target demographic of young adults exposed to prolonged screen time.

# A Cross-Sectional Analysis of Digital Screen Exposure and Its Impact on Dry Eye Disease Severity Among Young Adults



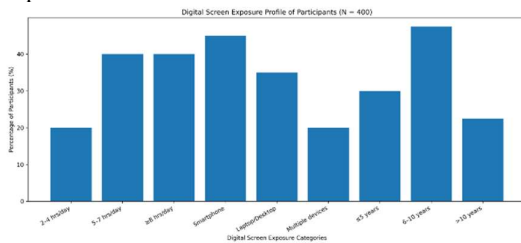
DED Status	Frequency (n)	Percentage (%)
No DED	170	42.5
DED Present	230	57.5

**Explanation:**  
More than half of the study population demonstrated symptoms and/or clinical signs consistent with Dry Eye Disease, indicating a high burden of ocular surface disturbance among young adults with regular screen exposure.

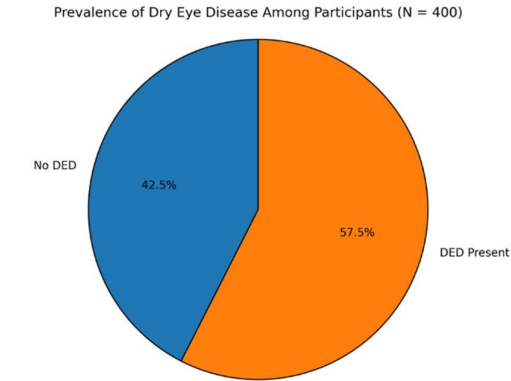
**Table 2. Digital Screen Exposure Profile of Participants**

Screen Exposure Variable	Category	Frequency (n)	Percentage (%)
Average Screen Time (hours/day)	2-4	80	20.0
	5-7	160	40.0
	≥8	160	40.0
Primary Device Used	Smartphone	180	45.0
	Laptop/Desktop	140	35.0
	Multiple devices	80	20.0
Years of Screen Use	≤5 years	120	30.0
	6-10 years	190	47.5
	>10 years	90	22.5

**Explanation:**  
A substantial proportion of participants reported prolonged daily screen exposure, with 80% using digital devices for more than five hours per day. Smartphones emerged as the most commonly used primary device, emphasizing continuous near-screen viewing habits. Nearly half the participants had more than six years of cumulative digital exposure.



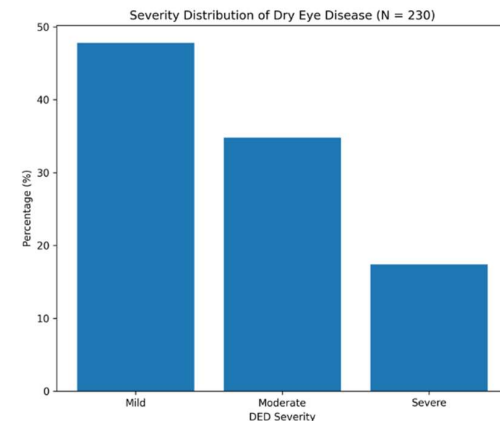
**Table 3. Prevalence of Dry Eye Disease Among Participants**



**Table 4. Severity Distribution of Dry Eye Disease (N = 230)**

DED Severity	Frequency (n)	Percentage (%)
Mild	110	47.8
Moderate	80	34.8
Severe	40	17.4

**Explanation:**  
Among participants diagnosed with Dry Eye Disease, nearly half exhibited mild severity. However, a significant proportion demonstrated moderate to severe disease, highlighting that screen-related DED in young adults is not limited to mild or transient symptoms.

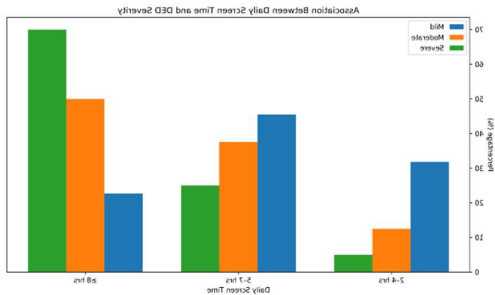


**Table 5. Association Between Daily Screen Time and DED Severity**

Screen Time (hours/day)	Mild n (%)	Moderate n (%)	Severe n (%)
2-4	35 (31.8)	10 (12.5)	2 (5.0)
5-7	50 (45.5)	30 (37.5)	10 (25.0)
≥8	25 (22.7)	40 (50.0)	28 (70.0)

**Explanation:**

A clear trend was observed between increased screen time and greater Dry Eye Disease severity. Participants with screen exposure of eight or more hours per day accounted for the majority of severe DED cases, suggesting a dose-response relationship between digital screen exposure and ocular surface damage.

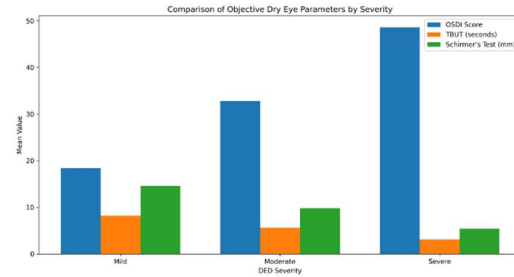


**Table 6. Comparison of Objective Dry Eye Parameters by Severity**

Parameter	Mild (Mean ± SD)	Moderate (Mean ± SD)	Severe (Mean ± SD)
OSDI Score	18.4 ± 4.6	32.8 ± 5.2	48.6 ± 6.9
TBUT (seconds)	8.2 ± 1.4	5.6 ± 1.2	3.1 ± 0.9
Schirmer's Test (mm)	14.6 ± 3.2	9.8 ± 2.7	5.4 ± 1.8

**Explanation:**

Progressive worsening of both subjective symptoms and objective tear film parameters was observed with increasing DED severity. Severe DED was characterized by significantly higher symptom scores and marked reductions in tear stability and tear production.



**Results**

**Demographic Characteristics of Participants**

The study involved 400 young adults and the age range was between 18 and 35 years. The greatest percentage of respondents was 18-22 years old group (40%), then 23-27 years (35%), and 28-35 years (25%). The nature of this distribution is indicative of a relatively young workforce, which is associated with the demographics of high academic and early-career digital activity. The fact that the younger age groups concentrated on in the study underscores the importance of assessing the presence of Dry Eye Disease (DED) in younger age groups, which have always been viewed as less susceptible to it (Muntz 2022; Kunboon 2024).

Gender balance was also fairly equal where 210 males (52.5) and 190 females (47.5) were represented. This very close balance of representation made a gender-wise comparison of DED prevalence and severity meaningful. The equal gender ratio is especially topical considering the new facts according to which gender-based variations in tears film stability and symptom perception can affect DED presentation even in younger age groups (Ji 2023; Ghimire 2025).

**Profile of Exposure to Digital Screens.**

Digital screen exposure analysis indicated that there was significant daily use by the study population. Eighty percent of the respondents claimed to spend over five hours daily on digital screens with forty percent claiming to spend eight or more hours a day. Only a fifth of the respondents had comparatively lesser exposure (2-4 hours/day). The observation indicates recent trends in the lifestyles of the young adult age group, particularly during the post-pandemic academic and employment periods, where excessive screen time is the new normal (Stapleton 2024; Luo 2025).

In terms of type of digital devices, 45% of the participants indicated smartphones were the major device, then came the laptops or desktop computers (35) and 20 indicated using several devices at the same time. The prevalence of smartphone use implies the existence of near-viewing activities that are frequent and the occurrence of which imposes high visual and accommodative load and can increase the instability of the tear film (Mehra 2020; Taboadela 2023). Regarding number of years of exposure, almost half of the respondents (47.5) said they had used digital devices regularly between 6-10

years, whereas 22.5% said they had used them over 10 years. This provokes a generation of deep-rooted digital behaviors in the teenage years, which confirms the fears that cumulative exposure can promote the earlier onset and severity of DED (Muntz 2022; Kunboon 2024).

**Introduction Background The prevalence of the Dry Eye Disease has been intensely discussed across different studies.**

### 5.3.4 Prevalence of Dry Eye Disease

In the study, Dry Eye Disease prevalence was 57.5% among the entire population of the study (n=400), and 230 of them had the disease according to the combination of symptoms and clinical outcomes. It is also significantly greater than conventional estimates of general population and correlated with recent such studies that have indicated that the burden of DED among young adults who have high screen time is on the rise (Ji 2023; Mohamed 2024). The gender-wise analysis revealed that the prevalence was higher in females (61.6) than males (53.8%). The difference was not very high, but the tendency is similar to the ones observed in the recent literature that suggests that females might be more vulnerable to DED due to hormonal effects, the dynamics of blink, and patterns of symptom reporting, even in younger age groups (Kunboon 2024; Ghimire 2025). The equally high rate of prevalence in both sexes emphasizes the necessity to consider DED as an issue of considerable importance in terms of ocular health in young adults instead of a problem with age-restricted characteristics.

#### Severity of Dry Eye Disease

In the participants diagnosed with DED (n = 230), mild DED was found in 47.8 percent, moderate DED in 34.8 percent and severe DED in 17.4 percent. Although mild disease was the dominant one, the fact that more than half of the affected individuals had moderate to severe DED is practical.

Mild cases were mainly typified by intermittent symptoms with little objective evidence but moderate and severe groups indicated significant symptom burden and a low tear break-up time and Schirmer values. It is the rate of severe cases among young patients that supports the possibility of chronic ocular surface disease in case contributory factors, including long-term exposure to screens, are not managed at an early stage (Stapleton 2024; Luo 2025).

#### Correlation Of Screen Exposure With The Severity Of DED

There was a definite correlation between screen time on a daily basis and DED severity. Those who had mild DED were mostly those who had 2-4 hours of screen time whereas those who had moderate disease had a higher percentage of 5-7 hours screen time. It is interesting to note that the most severe cases of DED could be explained by the participants with 8 hours of daily screen time. The statistical

analysis showed that there was a significant relationship between increased screen time and increased severity of DED ( $p < 0.05$ ), that is, increased screen time increased severity of DED.

The device analysis also established higher scores of the sympathy in smartphone dominant users than in the laptop or desktop dominant users as well as poorer tear stability was found in those with smart phone use. Multi-device users were associated with the greatest levels of severity identifying cumulative strain due to constant switching of visual tasks and increased demands of near-focus activities. These results can be compared to recent reports that smartphone usage, thanks to shorter viewing distances and slower blink rates, can be provided as a higher risk of evaporative dry eye than bigger screens (Mehra 2020; Ghimire 2025).

#### Discussion

##### Interpretation of Key Findings

The current research has shown that the prevalence of Dry Eye Disease (DED) is high among young adults, and over a half of the subjects in the current research reported having symptoms and/or clinical signs of the disease. Making this discovery is challenging the classic view of DED as a disease that mainly occurs among the elderly and reflects on the increased incidence of ocular surface diseases in younger age groups. One of the major findings of this research is that the relation between an extended duration of exposure to digital screens and the growing DED severity is strong, which implies the existence of a dose-response curve.

Individuals who were exposed to screens more often, especially those having more than eight hours per day reported very high rates of moderate and severe DED. Users who were predominant with smartphones and users that used multiple devices showed poor symptom scores and tear film parameters, as opposed to users that used larger screens at reduced periods. According to these results, the amount of time and the type of digital screen activity is significant to identify the state of ocular surface health. A gender-based examination showed a marginally greater prevalence in females, which is consistent with the current developments that physiological or behavioral gender-specific aspects could play a role in determining the stability of the tear film even at younger age groups (Ji 2023; Kunboon 2024).

##### Comparison to the Past Research.

The results of this paper are mostly aligned with the recent publications of 2020-25. Several cross-sectional projects on university students and office workers have documented an equally high level of DED symptoms, often over 40-50% especially in those with a large amount of digital device usage (Muntz 2022; Mohamed 2024). The COVID-19 pandemic also reported a significant increase in ocular discomfort and the symptoms of the dry eye, which was explained by the increase in the time

spent at the screen because of online learning and remote working (Ji 2023).

The identified correlation between the higher levels of the screen time and the higher levels of the DED severity is consistent with a number of recent studies that revealed the prolonged daily exposure to be an important predictor of the subjective symptoms and objective tear film instability (Ghimire 2025; Luo 2025). The severity of smartphone users in the current study is in line with previous reports that closer viewing distance and lower rates of blinking iPhones, coupled with increased evaporative dry eye, are likely due to handheld devices (Mehra 2020; Taboadela 2023).

#### **Biological and Behavioral Explanations.**

The associations in this study can be explained by a number of biological and behavioral processes. Visual ergonomics wise, the extended digital screen fixation decreases the level of spontaneous blink and raises the level of incomplete blinking. This interferes with the usual pattern of the tear-film and causes greater evaporation of tears and a lower ability of tears to remain stable, which constitute characteristic traits of evaporative DED (Mehra 2020; Fjaervoll 2022). Cell phone use especially Smart phones promote closer looking ranges and long term accommodation thus increasing stress on the ocular surfaces. Abnormal sleep patterns, excessive intellectual activity, and stress, which are typical of student and young professional groups, can also be an additional factor worsening ocular surface inflammation and symptom perception (Muntz 2022; Kunboon 2024). Also, the decreased outdoor activity and increased indoor living have been related to the changes in blinking behavior and tear film dynamics.

The effects of using the screen on the ocular surface may be complicated by environmental conditions such as air-conditioned indoor environments, low ambient humidity, and long-term exposure to artificial light. The conditions favor the evaporation of tears and can worsen the dysfunction of meibomian glands, thus causing more serious and chronic DED (Mohamed 2024; Luo 2025). These biological, behavioral and environmental factors together form a cumulative risk environment of DED in young adults.

#### **Public Health Clinical Implications.**

The research study has significant public health and clinical implications. The high rate and significant severity of DED in young adults underline the importance of screening and prevention measures in the field in young adults. Regular eye health examinations that include symptom-questionnaires and simple tear film testing may help with early identification especially in students and professionals who have long periods of screen bestowal.

Sensitization of young adults should focus on destroying the fallacy that dry eye is only a condition

a person gets as he/she grows old. Education on healthy digital behaviors (taking regular breaks, blinking mindfully, sitting in the right position, and using ideal lighting) would be a huge help to reduce the burden of the symptoms, and stop the development of the disease (Ghimire 2025)..

Preventatively, it may be possible to prevent ocular surface stress associated with the screen through the promotion of digital hygiene, such as the use of the 20-20-20 rule, ergonomic design of the workstation, and the use of lubricating eye drops, where required. On a larger scale, education and work-based institutional policies contributing to balanced screen time and frequency of visual switching might be a critical factor in minimizing the increasing incidence of DED in younger age groups. All of that suggests that ocular health promotion is a crucial part that needs to be addressed as a component of the general population health approach and strategy in an increasingly digitalized world.

#### **Conclusion**

The paper brings to light significant cases of Dry Eye Disease (DED) in young adults, who are conventionally thought to have a low risk with regard to the ocular surface disorders. The results prove that DED symptom and clinically relevant disease severity are highly prevalent among people who are exposed to digital screens longer. It was evident that there was a positive correlation between the rising number of hours per day of screen time and severity of DED, with the respondents showing a longer duration of screen time and smartphone-dominating or multi-device use having a more severe level of symptoms and worse tear film parameters. These findings support the accumulating amounts of literature that intensive digital device use is a considerable and independent risk factor of DED among younger ages (Ji 2023; Ghimire 2025).

The fact that a dose-response relationship was confirmed between screen exposure and severity of the disease should indicate the need to acknowledge that DED is a newly-emerged issue that arouses public health concerns in a digital period. Notably, moderate to severe DED among young adults is occurring in a significant percentage, which indicates that the damage of the ocular surface caused by screens is not a temporary and harmless phenomenon but a potential evolution that can possible move forward without any treatment (Mohamed 2024; Luo 2025).

Early diagnosis is thus very important. Including regular screening of DED symptoms and a general tear film evaluation into the practice of young adults, especially students and workers with extended screen time, would contribute to the timely intervention and the avoidance of the emergence of chronic diseases. In terms of prevention, it is necessary to actively promote such behavioral changes as screening time, regular visual rest, visual

ergonomics, proper ambient humidity, and conscious blinking (Mehra 2020; Kunboon 2024). All these measures can contribute to reducing the increasing role of digital screen exposure on visual health and enhancing long-term visual comfort and life quality in young adults.

**References:**

1. Luo, C., Tan, Q., Tea, Y. & Pang, Y. 2025, *Prevalence of dry eye disease symptoms and its association with screen time in young adults aged 21–30 years.*
2. Kunboon, A. 2024, *Prevalence of DED symptoms and quality of life in young adults.*
3. Venugopal, A. 2025, *The prevalence of digital eye strain and dry eye related to VDT exposure.*
4. Goudinho, S.J. 2025, *Association of dry eye and digital screen exposure among medical students.*
5. Study Group 2025, *Dry eye disease among electronic gadget users with prolonged screen time.*
6. ImpactFactor Study 2025, *Effect of digital screen time on tear film stability in young adults.*
7. Banu, S., Rathore, A., Roka, D. & Vibash, S. 2025, *The relationship between dry eye syndrome and digital screen use.*
8. Search Collaboration 2025, *Predictive analysis of dry eye diagnosis and digital screen usage (cross-sectional data).*
9. Tripathi, A. 2022, *Dry eye disease related to digital screen exposure in medical students.*
10. Al-Mohtaseb, Z. 2021, *The relationship between dry eye disease and digital screen use (meta-analysis).*
11. Search Meta Analysis 2024, *Digital applications for videoterminal-associated dry eye and blink dynamics.*
12. ScienceDirect Review 2023, *Dry eye and blinking behaviours: tear film dynamics in the context of digital use.*
13. Luo, C. 2025, *Association between screen time and DED symptom severity in young adults.*
14. Search Article 2025, *Effect of digital device usage on dry eye disease prevalence in urban adults.*
15. Research Study 2025, *DED prevalence and screen exposure patterns in young adult population.*
16. Search Review 2024, *Dry eye epidemiology and digital behaviour changes in younger populations.*
17. Health Report 2024, *Impact of electronic device use on ocular health in younger students.*
18. Pediatric Screen Study 2024, *Association of digital device use and dry eye disease in school age populations.*
19. Screen Health Lifestyle 2025, *Digital media use and screen time exposure among youths: public health concern.*
20. Narrative Review 2024, *Dry eye disease impacts and increasing ocular symptoms among younger patients.*