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Original Research Article

An Analytical Study of Dry Eye Disease Prevalence and Risk Factors Among Medical Students Using Digital Devices

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Conflict of interest: Nil

Abstract:

Background: Dry Eye Disease (DED) is a multifactorial disorder of the ocular surface that includes instability of the tear film, causing discomfort, visual impairment, and possible destruction of the ocular surface. The rising prevalence of DED is greatly attributed to the growing use of digital devices among medical students.

Aim: To analytically assess the prevalence and associated risk factors of dry eye disease among medical students using digital devices.

Methodology: The research was carried out in the Department of ophthalmology, Shree Narayan Medical institute and hospital, Saharsa, Bihar, India. 120 medical students at Shree Narayan Medical Institute and Hospital participated in the cross-sectional analytical study. The Ocular Surface Disease Index (OSDI) symptoms, digital device use, and demographic data were all gathered using a standardized questionnaire. Tear Break-Up Time (TBUT) and the Schirmer test were used in clinical testing. The statistical analysis was carried out using SPSS version 25.

Results: The incidence of the dry eye disease was 48.3%. The prevalence was more in students who spend over 6 hours/day with digital devices (62.1%). Among the major risk factors, there were also the duration of exposure to the screen, low blinking rate, low light conditions, and absence of breaks during using the device ($p < 0.05$).

Conclusion: Medical students are among the most affected by dry eye disease which is majorly caused by the overuse of digital devices. Screen breaks, ergonomic practices and awareness programs are very necessary as preventive measures.

Keywords: Dry Eye Disease, Digital Devices, Medical Students, OSDI, Tear Film, Risk Factors.

Introduction

Ocular pain, visual disruption, dryness, burning feeling, foreign body sensation, and fluctuating vision are all symptoms of (DED), a complex ocular surface illness characterized by loss of tear film equilibrium [1]. The tear film is a very vital part of the ocular surface integrity, lubrication, nutritional and defense against the environmental insult [2]. Any instability or change in its balance and structure may result in inflammation, injury in epithelia, and neurosensory defects, thus, dramatically influencing the quality of vision and everyday life [3]. Over the past years, DED has become a significant public health issue because of its growing prevalence, chronicity, and high impact on the quality of life and productivity [4].

The high rate of growth of the digital technology has radically changed education and lifestyle trends, especially among medical students [5]. Academic learning, virtual lectures, researches, and recreational activities on smartphones, laptops, tablets, and desktop computers have contributed to the long screen exposure [6]. This prolonged contact with the screens is strongly associated with the low blink rate and higher rates of incomplete blink that disrupts the tear film distribution and rapid tear evaporation [7]. Also, long screen time results in accommodative stress and ocular fatigue, which are all causes of digital eye strain and dry eye disease [8].

Medical students are a high-risk group to DED due to their rigorous academic schedules, hours of study, and increased use of digital channels to study. Screen time, which was already increased due to the transition to e-learning, particularly by 2020, was further increased [9]. Additionally, learners tend to study indoors in a controlled, air-conditioned, low humidity, and artificial light environment, which is also a cause of tear film instability. Behavioral problems such as bad posture, reduced screen distance and lack of frequent breaks also contribute to the risk [10].

Studies carried out in and around 2020 reveal that the incidence of dry eye disease in the young adults is estimated to be between 30 and 60 percent with higher levels of incidence reported among those who spend too much time on digital devices [11]. These results illustrate a worrying pattern, especially among academic groups, with the aggregate of environmental and behavioral risk factors [12]. These differences in prevalence between studies could be explained by variations in diagnostic criteria and assessment instruments, like the (OSDI), and the study populations [13].

DED has been developed through a number of risk factors both intrinsic and extrinsic [14]. The intrinsic ones are age, sex, hormonal, and systemic factors and the extrinsic factors are exposure to the environment, contact lens use, medication and lifestyle habits. One of them is the length of a screen time, which is now the most significant and alterable threat factor in a modern setting. Other factors are due to poor lighting, improper ergonomics, reduced blinking, psychological stress and sleep deprivation that exacerbates the situation.

Clinical implications of dry eye disease are not limited to the eye pain, which, in turn, can affect the performance at school, diminish focus, and adversely influence mental health. The chronic symptoms can result in a reduction in productivity and higher healthcare use. DED is a widespread ailment, but has been misdiagnosed and undertreated, particularly in younger individuals who may ignore the symptoms or label them as not important.

Given the rise in both digital technology use and dry eye illness, it would be wise to conduct analytical study on the disease's prevalence and the variables that put people at risk for it. Such a study is crucial in identifying vulnerable groups, variables involved and developing special preventive and management programs. [15] That is why the present study is aimed at providing an analytic evaluation of the occurrence of the disease of dry eyes among medical students who use digital devices with a focusing on the discussion of the primary risk factors and the following recommendations on early actions that should be undertaken to preserve the eye health.

Methodology: The study design was systematic that provided a reliable and valid assessment of prevalence of dry eye disease and risk factors among medical students who use digital devices. To provide the information in detail about the condition, a systematic approach combining subjective and objective analysis methodology was used. To enhance the quality of the results and make them reproducible, standardized diagnostic tools and statistical analysis were employed and the inclusion and exclusion criteria were very rigorous to minimize bias and confounding factors.

Study Design: The purpose of this cross-sectional analytical study was to identify the frequency of dry eye disease (DED) and the variables that put medical students at risk for developing the condition when using electronic devices. The reason why a cross-sectional approach was chosen is that it would enable simultaneous measurement of exposure (use of digital device and factors surrounding it) and outcome (presence of DED) at a certain group of people at a given time. The design is especially appropriate when it is necessary to estimate the disease burden and assess the relationships between variables in an academic environment.

Study Area: The research was carried out in the Department of ophthalmology, Shree Narayan Medical institute and hospital, Saharsa, Bihar, India.

Study Duration: The experiment was conducted during one year.

Study Participants: The population used was undergraduate medical students, and they were registered in the institution during the study. The predefined inclusion and exclusion criteria were used to select participants to guarantee homogeneity and reduce confounding factors.

Inclusion Criteria:

- Medical students aged 18-30 years old.
- Students who have had access to digital devices (smartphones, laptops, tablets, or computers) at least 2 hours a day.
- Those students who gave informed consent and would have liked to take part in the study.

Exclusion Criteria:

- Students having ocular surface diseases or diagnosed with dry eye disease.
- Contact Lenses users, as they are independently related to changes in tear films.
- Previous ocular surgery or trauma.
- Existence of systemic diseases that can cause tear production (e.g., autoimmune disorders, diabetes mellitus, thyroid disorders)
- Use of drugs that may affect secretion of tears.

Sample Size: A total of 120 medical students who met the inclusion criteria were included in the study. The sample was selected according to the feasibility, availability of participants and previous prevalence estimates reported in similar studies that have been carried out approximately in 2020. Participants of varying years of study were also included in an effort to have variability in exposure to digital devices.

Procedure: Systematic and standardized data collection was done. Informed consent was obtained and then the participants were subjected to both subjective and objective testing.

An already tested and validated structured questionnaire was used to gather data on:

- Demographic attributes (age, gender, academic year)
- Time and patterns of using the digital devices (hours per day, device type)
- Environmental (lighting conditions, distance to the screen, air conditioning)
- Behavioral aspects (number of breaks, blinking, posture)
- Existence and intensity of eye symptoms.

In order to subjectively evaluate the symptoms of dry eye, we utilized the Ocular Surface Disease Index (OSDI), a widely used and validated tool for evaluating the severity of symptoms and how they impact everyday activities.

Objective clinical evaluation included:

- Schirmer Test: This test is done to evaluate the basal and reflex tear secretion. A lower value of less than 10 mm within 5 minutes was deemed to be the indicator of low production of tear.
- (TBUT): Tear film stability was measured with the help of fluorescein dye. TBUT was considered abnormal when the value was less than 10 seconds.

The combination of symptom score (OSDI) and clinical test results was used to classify the participants as having dry eye disease in order to make a thorough and correct diagnosis.

All the operations were done under standardized conditions to reduce variability. The privacy of the participants data was highly secured and ethical issues were observed during the research.

Statistical Analysis: Statistics for the Social Sciences (SPSS) version 25.0 was used to examine the coded and keyed data. We calculated descriptive statistics (frequency and percentage for categorical variables, and mean and standard deviation for continuous variables) to summarize the data.

We used inferential statistics to find out which risk variables were associated with dry eye disease. A chi-square test was employed for categorical variables, along with any required parametric or non-parametric tests. To identify factors that could be used as independent indicators of dry eye illness, the researchers used multivariate analysis.

There is a statistically significant correlation between the variables since the p-value was considered to be 0.05 or less. In order to facilitate and improve comprehension, the results were presented in a tabular and graphical fashion.

Results

Table 1 displays the demographic information of the 120 study participants. The age bracket of 18–21 years comprised 41.7% of the total, with 37.5% falling into the 22–25 year bracket and 20.8% in the 26–30 year bracket.. The gender distribution was more or less equal with a dissimilarity of 54.2 and 45.8 percent of males and females respectively, which represents a fairly equal representation of both genders in the study population.

Table 1: Profile of the Participants: Demographics

Parameter	Category	Frequency (n)	Percentage (%)
Age (years)	18–21	50	41.7
	22–25	45	37.5
	26–30	25	20.8
Gender	Male	65	54.2
	Female	55	45.8

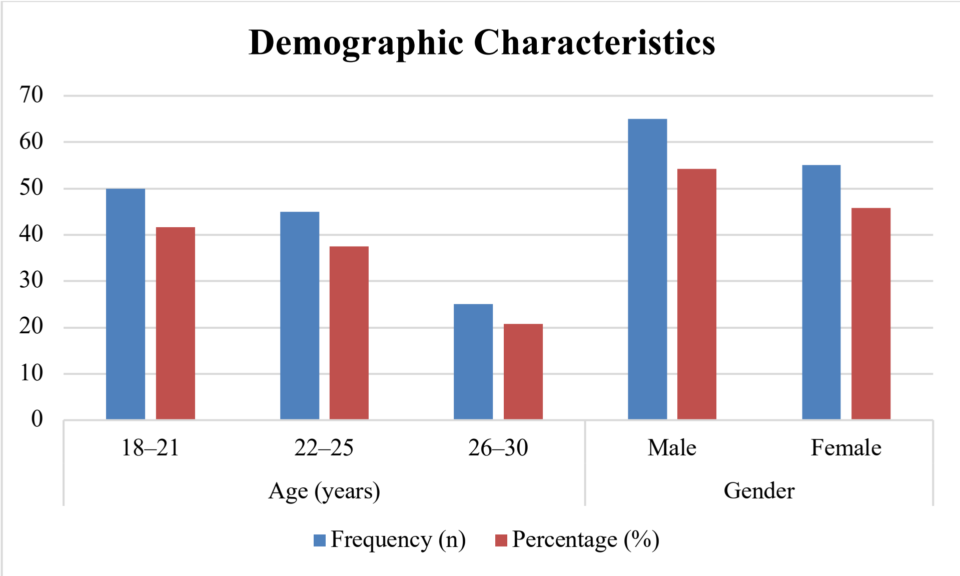

Figure 1: Graphical Representation of Demographic Characteristics of Participants

The distribution of the age and male gender of the participants are visually depicted in figure 1. As can be observed in the graphical analysis, the largest number of participants is concentrated in the 1821 years group, and the 2225 years group, with a relatively small number of participants in the 2630 years group. The gender representation is also slightly skewed towards male participants over female participants, although the ratio is also quite balanced. This sample is representative of the entire population of medical students, and therefore, the study results are reliable.

The incidence of dry eye disease among the study subjects was determined, on the basis of clinical assessment and symptom rating. Table 2 shows the distribution of participants with and without dry eye disease.

Table 2: Dry eye disease prevalence

Category	Frequency (n)	Percentage (%)
DED Present	58	48.3
DED Absent	62	51.7

Out of the 120 medical students used in the study, 58 (48.3) were found to have a dry eye disease with 62 (51.7) not having it. These results suggest that almost half of the population of the study has the disease of dry eye. Figure 2 graphically expresses the prevalence of the dry eye disease among the participants providing a clear visual comparison of the prevalence of the disease in the students who had the dry eye disease and the students who did not have the disease. The number denotes the ratio of the afflicted to the unafflicted, which makes the pattern of prevalence of the study population easier to interpret. This figure of speech is used to supplement the tabulated data and highlights the relatively high prevalence of the dry eye disease in medical students.

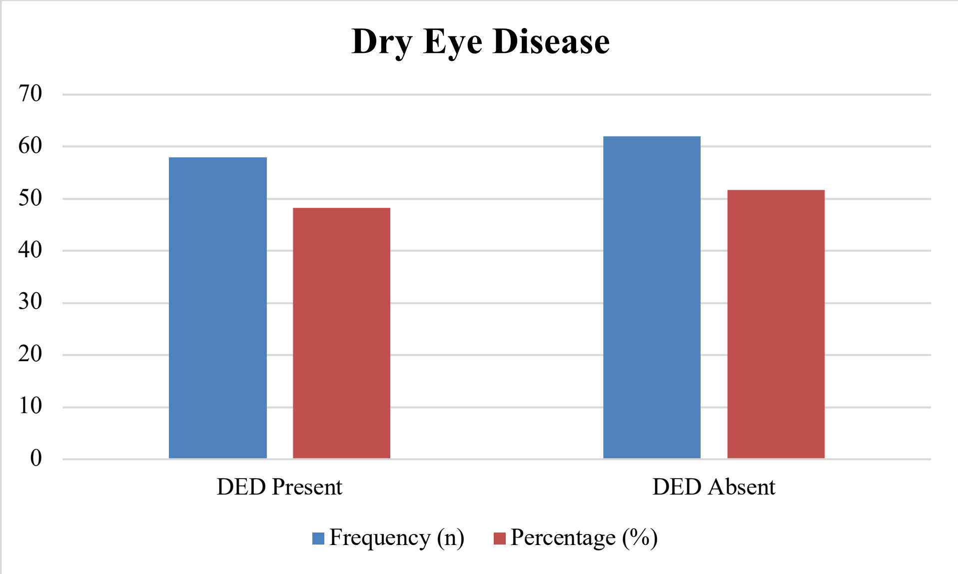

Figure 2: Graphical Representation of Prevalence of Dry Eye Disease

The figure depicts an almost equal ratio between those with and without dry eye disease with a slight majority of the non-affected persons. The frequency of digital device use by the participants of the study was examined to determine the level of screen time. Table 3 shows the distribution of participants according to the number of hours that they spend using the digital devices per day.

Table 3: Digital Device Usage Pattern

Usage Duration	Frequency (n)	Percentage (%)
<3 hours/day	20	16.7
3–6 hours/day	45	37.5
>6 hours/day	55	45.8

A significant percentage of students (45.8) were found to spend over 6 hours using digital devices daily and this was followed by 37.5% who spent between 3 and 6 hours on the devices. Only 16.7% of the respondents said that they spend less than 3 hours a day on screen. These results suggest that there is an extensive digital screen exposure amongst the study group.

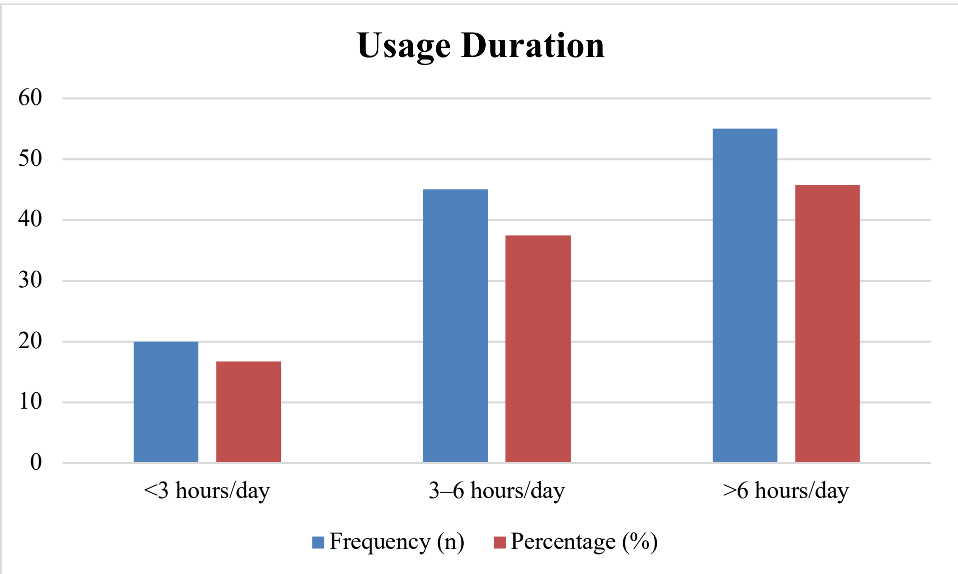

Figure 3: Graphical Representation of Digital Device Usage Pattern

The figure shows that most participants are in the higher screen time category (>6 hours/day), then moderate usage (3-6 hours/day), and a smaller proportion of participants is in the lower usage category (<3 hours/day). Such distribution indicates that among medical students, there is a tendency to spend more time on digital devices. The relationship between the time spent on digital devices and the incidence of the disease of dry eyes was examined to reveal how long-term screen time affects the disease. The prevalence of dry eye disease cases broken down by screen time category is shown in Table 4.

Table 4: Screen Time and the Risk of Dry Eye Disease

Usage Duration	DED Present (n)	DED Absent (n)
<3 hours/day	5	15
3–6 hours/day	17	28
>6 hours/day	36	19

The prevalence of cases of the disease of dry eye was higher among the participants who had more than 6 hours of screen time (36 cases), than those with moderate (17 cases) and low screen exposure (5 cases). On the other hand, there were more participants of the lower and moderate usage groups who did not have dry eye disease. These results show a definite tendency towards the rising prevalence of dry eye diseases with the extended use of digital devices. Figure 4 shows the graphical depiction of the relationship between screen time and dry eye disease, with a slight difference in the cases of DED occurrence by various types of usage.

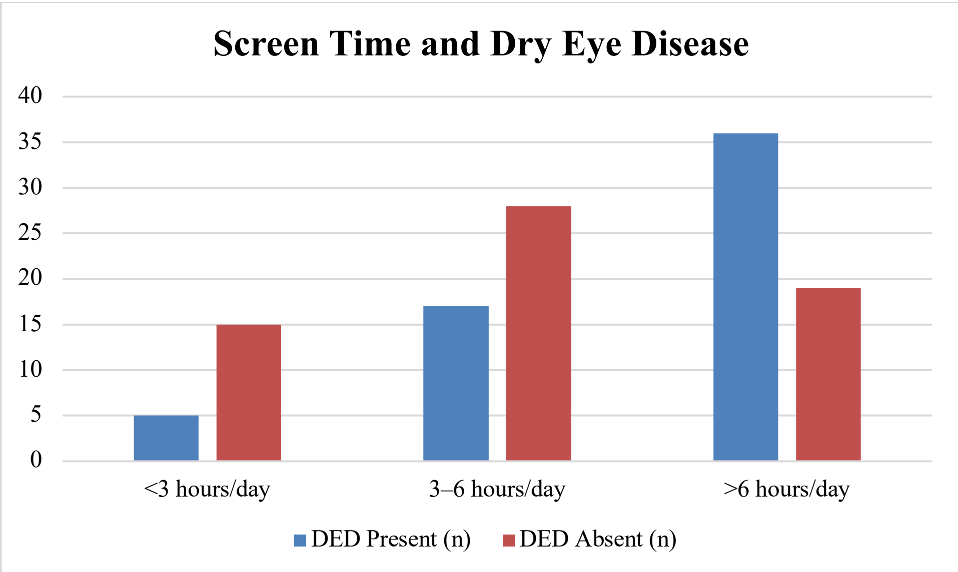

Figure 4: Graphical Representation of Association Between Screen Time and Dry Eye Disease

The figure shows clearly that participants who have greater exposure to the screen (more than 6 hours/day) exhibit more cases of the dry eye disease than those with shorter usage time. Conversely, the respondents who have less screen time have fewer incidences of dry eye disease, which means that there is a positive relationship between excessive screen exposure and incidence of dry eye disease. Researchers assessed how often various dry eye disease risk factors were among the people who took part in the study. All of the identified risk factors are displayed in Table 5 along with their percentages and frequencies.

Table 5: Potential Causes of Dry Eye Disease

Risk Factor	Frequency (n)	Percentage (%)
Prolonged screen time (>6 hrs)	36	62.1
Reduced blinking	30	51.7
Poor lighting	28	48.3
Lack of breaks	32	55.2
Sleep deprivation	25	43.1

The most common risk factor was the high number of hours spent in front of the screen (>6 hours/day) (62.1%), then the absence of breaks (55.2%), and poor blinking (51.7%). Other frequently reported factors were environmental (poor lighting 48.3) and behavioral (sleep deprivation 43.1) factors. These results indicate that behavioral and environmental factors are important in the development of the dry eye disease among medical students. Figure 5 shows the graphical representation of the distribution of risk factors related to dry eye disease.

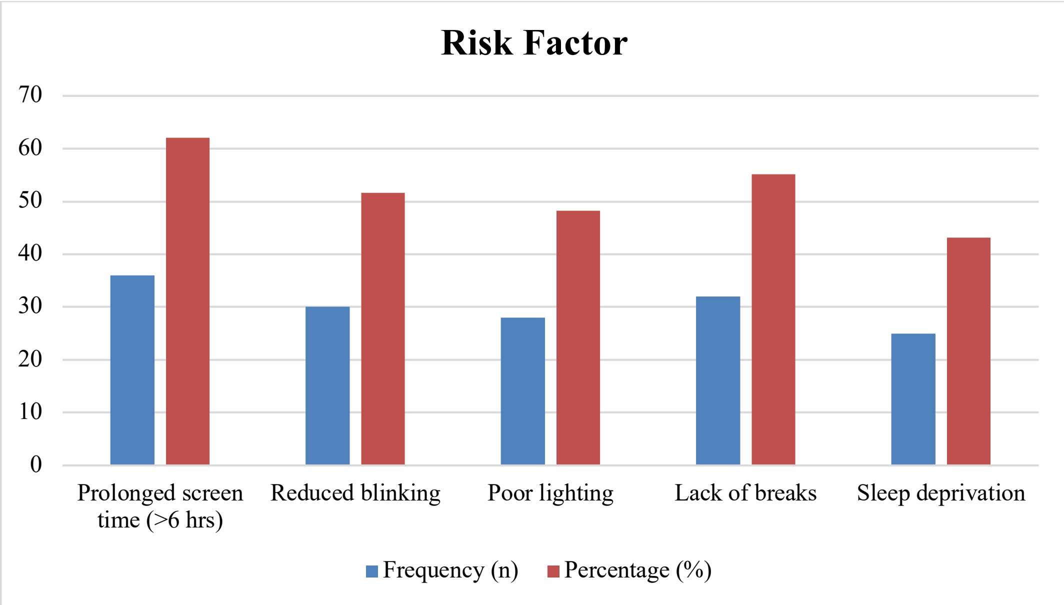

Figure 5: Graphical Representation of Risk Factors Associated with Dry Eye Disease

The most apparent risk factor, as seen in the figure, is the long screen time followed by the lack of breaks and less blinking. There are other factors such as inadequate lighting and sleep deprivation that are also quite important, which justifies the multifactorially of the dry eye disease.

For clinical evaluation of dry eye disease, standard diagnostic procedures were utilized, such as the Schirmer test and (TBUT). As shown in Table 6, the distribution of the aberrant findings is detailed.

Table 6: Clinical Findings among Study Participants

Test	Abnormal (n)	Percentage (%)
Schirmer's Test (<10 mm)	40	33.3
TBUT (<10 sec)	45	37.5

In 37.5 percent of the participants, Abnormal Tear Break-Up Time (TBUT) was observed and this indicates that tear film instability is more common compared to tear secretion reduction. The test conducted by Schirmer demonstrated the fact that 33.3 percent of the participants had reduced tear production. These results indicate that aqueous deficiency is a little less prevalent than tear film instability in the study population. Figure 6 presents the clinical results in the form of a graph, comparing the abnormal test results with each other.

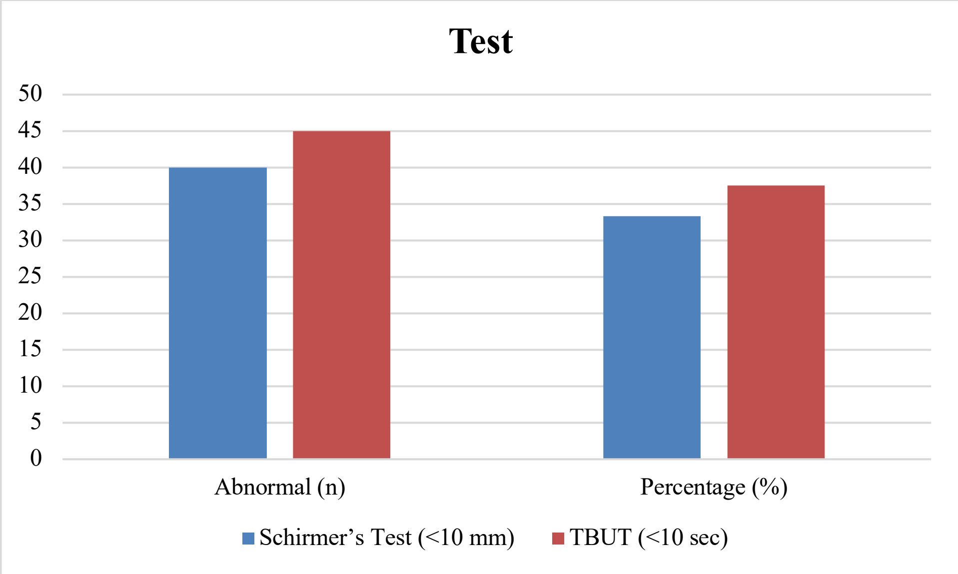

Figure 6: Graphical Representation of Clinical Findings

The figure shows that the abnormal values of TBUT are a bit more common than the abnormal values of Schirmer test results, which means that the instability of tear film is a more noticeable clinical symptom of dry eye disease in this group.

Discussion

This research analyzes the frequency and causes of (DED) in students of medicine who use electronic devices. The incidence of DED was determined to be 48.3 in general, that is, about half of the sample used in the study had the DED (Sawaya et al., 2020) [16]. This finding is consistent with previous studies conducted on young adults and more so those who have been exposed to prolonged exposure on digital screens.

The majority of the participants were aged 1821 years and this meant that they were mostly in the age group that is actively engaged in academic activities which greatly rely on the digital platform (Sidhu et al., n.d.) [17]. A large percentage of students (45.8) indicated that they spend over 6 hours a day on digital devices. The study has clearly indicated that long screen time is highly correlated with dry eye disease incidence with the highest incidence being reported in the >6 hours/day. This supports the existing reports that prolonged screen time reduces the speed of blinking and enhancement of tear evaporation (Skoblina et al., 2020) [18].

Among the identified risk factors, the longest screen time was the most important risk factor followed by the lack of breaks, reduced blinking and unfavorable lighting and sleep deprivation. The results emphasize the multifactorial character of DED, which is affected by behavioral and environmental factors (Thatte & Choudhary, 2020) [19].

Clinical observation revealed that abnormal TBUT (37.5) was slightly higher than low tear production (33.3) according to the Schirmer test that reveals that tear film instability (evaporative dry eye) is the predominant process among them.

Nevertheless, there are some limitations of the study (Xu et al., 2019) [20]. It is a cross-sectional study and thus causal relationships cannot be conclusively made. Secondly, the study was conducted in a single institution and a relatively small sample, which might be a limitation on external validity.

In general, the evidence underlines the importance of preventative measures (e.g., screen time reduction, regular breaks, and ergonomic and environmental adjustments) to help decrease the incidence of the dry eye disease in medical students.

Conclusion

The majority of all medical students suffer from dry eye illness, according to the current study. The results make it clear that the most important contributory factor is prolonged use of digital devices, especially more than 6 hours a day.

Other risk factors that can be altered such as reduced blinking, absence of breaks, inadequate lighting and sleeplessness are also critical in the development of the condition in addition to screen time. There is also clinical evidence that tear film instability is eminent when compared to tear deficiency, which implies evaporative dry eye is predominant.

In totality, the study indicates that behavioral and environmental influences that accompany the new digital way of life are the key contributors to development of dry eye disease in medical students. Preventative measures, such as controlled use of screens, ergonomics, and creation of awareness should be implemented early to lessen the burden of diseases and enhance ocular health.

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