

Impact of Dim Light Exposure during Study on Tear Film Break-Up Time (TBUT) in Medical Students

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ABSTRACT

Background: Tear Film Break-Up Time (TBUT) is a key parameter that is used for assessing the stability of tear film.

Objectives: To determine impact of exposure to dim light while studying on TBUT in medical students.

Methods: This cross-sectional analytical study was conducted on undergraduate medical students (18–26 years) at Al Tibri Medical College and Hospital, Karachi, over six months (Jan 2021–June 2021). Using non-probability consecutive sampling, students studying ≥ 2 hours/day were included. Lighting was measured with a lux meter (< 300 lux = dim, ≥ 300 lux = adequate). TBUT was assessed via fluorescein and slit lamp, and data were analyzed with SPSS using t-tests and chi-square tests ($p < 0.05$).

Results: From 357 students, 41.7% studied under dim light and 58.3% under adequate light. Mean TBUT was significantly lower in the dim light group (8.2 ± 2.1 sec) compared to adequate light (11.4 ± 2.6 sec, $p < 0.001$). Abnormal TBUT (< 10 sec) was more prevalent in dim light (69.8%) versus adequate light (29.8%), indicating a strong association between dim light exposure and tear film instability.

Conclusion: Dim light exposure during study significantly reduced TBUT and increased tear film instability in students. A future interventional or longitudinal research ought to be carried out for confirming causality.

Keywords: Tear Film, Dry Eye, Dim Light, Tear Film Break Up Time.

INTRODUCTION

With the ever-increasing academic demands amongst students, a prolonged duration is spent in near-work activities such as in using digital screens, reading and / or writing¹. Ocular health tends to be significantly affected by the study habits, influencing visual performances as well. A common finding among students is the sub-optimal conditions of lightning in which they study². Eye strain and vision related symptoms are, in the era of digitalization are termed as visual display terminals (VDTs) that include smartphones, computers and e-reading tablets³. Typical symptoms of eye strain include discomfort in the eye, dry eye (DE), excessive tearing, blurring of vision, and redness in eye, double vision and even transient color perception changes and rise in sensitivity of glare^{4,5}.

Typically a dim light is referred to as level of illumination below the standard recommendation light required for studying or reading⁶. Seldom late-night sessions of studying or resource-limited setting are a frequent cause. This leads to visual strain and alteration in pattern of blinking⁷. The tear film is pivotal not only for maintenance of ocular surface integrity, but also for optical clarity and lubrication of eye⁸. Composition of tear film includes mucin, aqueous and lipid layers. Tear film's stabilization is crucial for proper function and comfort in vision⁹. The Tear Film Break-Up Time (TBUT) is a key parameter that is used for assessing the stability of tear film¹⁰. It is defined as interval in-between a blink and first appearing of dry spot on cornea. A reduction in TBUT indicates instable tear film and predisposes to symptoms of dry eye (DE)¹¹.

The Asian Dry Eye Society (ADES) presented a diagnostic criterion for DE which enables diagnosing it using only subjective symptoms and reduced TBUT < 5 seconds¹². Tear evaporation also is influenced by the environment such as airflow, humidity and lighting influence. An increase in tear evaporation and reduction in rate of blinking occurs due to dim lightning¹³. Even concentrating for prolonged duration amid poor lighting could possibly be an exacerbating factor for stressing the ocular surface. An unstable tear film can lead to symptoms such as blurring of vision, dryness of eyes and irritation¹⁴. A combination of these can severely impair students' quality of life and academic performance. Identifying the modifiable risk factors in their early stage can help prevent DE¹⁵.

There is a paucity of data both locally and regionally regarding dim light exposure's effect on the stability of tear film among

students. Present researches have focused more on exposure to digital screen instead of the ambient conditions of lightning. Due to prolonged study hours and poor practices of ergonomics, students represent high-risk population for ocular problems¹⁶. TBUT is a non-invasive, simple and reliable indicator for early dysfunction of ocular surface¹⁷. The findings of this research might aid in supporting recommendations for optimum environments to study. The objective of this study was to determine impact of exposure to dim light while studying on TBUT in medical students.

MATERIAL & METHODS

This was a cross sectional analytical research carried out on medical students of Al Tibri Medical College and Hospital Karachi. The duration of study was six months after approval of research proposal Jan 2021 to June 2021. A comparative approach was taken to differentiate between groups of light exposure those studying in adequate light versus those studying in dim light. Using non-probability consecutive sampling, undergraduate medical students of either gender between 18 to 26 years of age were included. The study was conducted at Ophthalmology department of Al-Ibrahim Eye Hospital, Karachi which is a teaching hospital of Al Tibri Medical College and Hospital Karachi. Data collection was done in the classroom, hostel and library of the college.

Students with a regular habit of study, i.e. studying for at least 2 hours per day, willing to participate in the study by giving their informed consent and with no current ocular complaints at baseline were included in the study. Students with history of DE, any ocular trauma or surgery, currently using contact lenses or using a topical medication that affected production of tears were excluded from the research. Using a lux meter, lightning conditions were measured with < 300 lux being classified as dim light and > 300 lux as adequate light. For measuring TBUT, fluorescein dye and slit lamp examination was used. A TBUT < 10 seconds was regarded abnormal. For each eye, a mean of three readings were recorded for minimizing bias. A pre self-designed questionnaire was used for collecting the demographics, duration of study, conditions of lightning; environmental factors and screen time of students were recorded. All data was entered in SPSS v23.0. For TBUT values, mean and standard deviation was used after checking of data's normality using Shapiro Wilk test. For comparison of TBUT between

groups, independent t-test was applied while for categorical variables, chi-square test was used. A $p < 0.05$ was considered statistically significant.

RESULTS

From the total of 465 students currently studying at the college during the study time period, 357 were included in the research after taking informed consent. According to age groups, 142 (39.8 %) of students were between 18-21 years of age, 165 (46.2 %) were between 22 to 25 years of age and 50 (14 %) of students were in-between 26 to 30 years of age. Male students included 168 (47.1 %) while 189 (52.9 %) were females. Around 121 (33.9 %) students reported studying between 2 to 4 hours, 167 (46.8 %) students responded to study 5 to 7 hours per day while 69 (19.3 %) reported studying >7 hours per day. A screen time of >4 hours was reported in 214 (59.9 %) of students [Table I].

A total of 149 (41.7 %) of students were found to study in dim light whilst 208 (58.3 %) were observed to study in adequate light [Figure I].

From the students recorded to study in dim light, the mean TBUT was 8.2 ± 2.1 , while in students studying in adequate light, the mean TBUT was 11.4 ± 2.6 , with a significant difference of $p < 0.001$. In students with TBUT <10 seconds (abnormal), 104 (69.8 %) of students were reported to study in dim light while 62 (29.8 %) studies in adequate light. In students with TBUT >10 seconds (normal), 45 (30.2 %) students were found to study in dim light while 146 (70.2 %) studies in adequate light, with a significant association of $p < 0.001$ [Table II].

Table I: Baseline demographics of students included in the study (n=357)

| Variables | Frequency (%) | |
|--------------------------------|---------------|--------------|
| Age (years) | 18-21 | 142 (39.8 %) |
| | 22-25 | 165 (46.2 %) |
| | 26-30 | 50 (14.0 %) |
| Gender | Male | 168 (47.1 %) |
| | Female | 189 (52.9 %) |
| Study Duration per day | 2-4 hours | 121 (33.9 %) |
| | 5-7 hours | 167 (46.8 %) |
| | >7 hours | 69 (19.3 %) |
| Screen Time (>4 hours per day) | 214 (59.9 %) | |

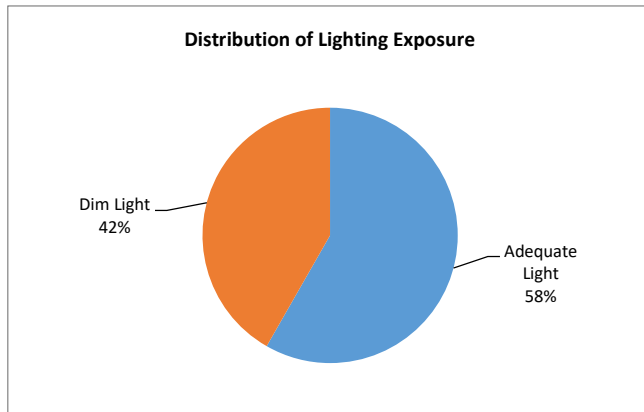


Figure I: Graphical representation of light exposure amongst included students (n=357)

Table II: Comparison of TBUT in-between the two study groups of students (n=357)

| Variable | Dim Light (n=149) | Adequate Light (n=208) | p-value |
|-----------------------------|-------------------|------------------------|------------|
| Mean TBUT (seconds) | 8.2 ± 2.1 | 11.4 ± 2.6 | $<0.001^*$ |
| TBUT <10 seconds (Abnormal) | 104 (69.8 %) | 62 (29.8 %) | $<0.001^*$ |
| TBUT >10 seconds (Normal) | 45 (30.2 %) | 146 (70.2 %) | |

DISCUSSION

This study demonstrated a response rate of 76.8 % (357 out of 465 students) were included in the research. Majority of students were between the 22 to 25 years age group (46.2 %). A pre-dominancy of female students was observed. Majority of students studies for 5 to 7 hours per day (46.8 %) with 59.9 % students having a screen time of >4 hours per day. Most students were found to have adequate exposure of light (>300 lux). Students with a TBUT of <10 seconds, majority (69.8 %) studied dim light. A significant association was observed in terms of dim light exposure with lower TBUT ($p < 0.001$).

In line with our study, a decrease in TBUT in dim light has also been reported in published literature, demonstrating that environmental factors tend to effect stability of tear films¹⁸. Likewise, studies also reported that rates of blinking decreased when studying in low illumination, thereby raising evaporation of tears and causing strain on the eye¹⁹. Studies also reported that academic performance and studying concentration was deeply affected due to dry eye, therefore an early preventive intervention might help in reducing complications to the ocular surface²⁰. In line with the recommendations of this study, an adequate lighting standard meant light between 300 to 500 lux. This highlights that lighting is a modifiable environmental risk factors for the health of ocular surface²¹.

An objective measurement of TBUT was one of the key highlights of this research. Moreover, an adequate sample size with high response rate was included in the study with comparison carried out in-between adequate and dim light exposure was done. However the study was not free from limitations, the cross sectional study design could not establish any causality. Furthermore, many demographics and screen time were self-reported by students which might have introduced recall bias. Moreover, a single centered research limited generalizability.

For future recommendations, an interventional or longitudinal research ought to be carried out for confirming causality. Including other ocular surface parameters such as ocular surface staining and Schirmer's test could strengthen the findings of this study. Lastly, assessing impact of lighting interventions can be done on academic performance and ocular health of students.

CONCLUSION

The study demonstrated that students exposed to dim light during study sessions showed significantly reduced Tear Film Break-Up Time (TBUT) compared to those studying under adequate lighting conditions. Dim light exposure was associated with a higher prevalence of tear film instability, highlighting the importance of optimal study lighting for ocular surface health in students.

Conflict of Interest: None declared.

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