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Effect of Digital Devices on Ocular Surface and Tear Film of Eye during Covid-19 Pandemic

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Abstract
Objective: *To assess the effect of digital devices on ocular surface and tear film of eye.*
Material and Methods: *A cross sectional study involving patients using digital devices for more than 2 hours/day, visiting Ophthalmology OPD was conducted. Dry eye evaluation was done subjectively by SPEED score and objectively by Schirmer's test, F-BUT, Corneal fluorescein staining and Tear meniscus height. Dry eye diagnosis was made by Asia Dry Eye Society/JDES criteria*
Results: *Total of 100 patients (200 eyes) were enrolled in the study. The mean age was 26.8 ± 5.142 (range 17-46) years with male preponderance. Mean duration of digital devices usage was 9.19 ± 2.163 hours/day (range 5–15 hours). Laptop/computer was the most common digital device used by patients and caused maximum dryness. Dryness was diagnosed by F-BUT in 100%, by Tear meniscus height in 28%, by Schirmer's Test in 19% and by SPEED score in 100% patients. Corneal staining was present in 61% patients.*
Conclusion*: There was statistically significant increase in SPEED score with increasing duration of usage. F-BUT and SPEED score were most reliable amongst all the parameters in diagnosing dry eye. This study findings stress the need to spread awareness about decreasing the usage of digital devices and increasing the awareness regarding how to prevent damage caused by digital devices on ocular surface.*
Key words*: Dry eye, F-BUT, SPEED Score, Digital device*

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I. Introduction

Covid-19 saw a dramatic increase in use of internet and electronic devices. There has been 55% increase in time spent on social media and 45% increase in time spent on smartphones. Average time spent on screens in a day has increased from an average of 5.5 hours in March 2020 to 6.9 hours since April 2020. [1], [2.] This study therefore aims to evaluate the influence of digital screens on ocular health and to see if there is an association between prolonged hours of usage of the digital screens and the occurrence of dry eye.

II. Methodology

A cross sectional study was conducted at a tertiary eye centre from August 2020 to March 2021. Patients between the age group of 10to 60 years who are using digital devices for more than 2 hours per day were included. Patients who had already been diagnosed with dry eyes because of other ocular conditions like meibomian gland dysfunction, ectropion, entropion, trachoma, bell's palsy, patients on topical anti glaucoma agents were excluded from the study. Those with systemic diseases that affect tear film stability like diabetes, connective tissue disorders, hypertension, systemic medications that are known to cause dry eye, those who had undergone any intraocular surgeries and contact lens users were also excluded.

All the participants were explained about the purpose of the study and made to sign an Informed Consent Form before starting data collection. The study protocol was adhered to the tenets of the Declaration of Helsinki on research involving human subjects. A self-administered questionnaire was used to collect socio-demographic data, symptoms of Digital Eye Strain (DES), and details of digital device usage. Questions on symptoms of DES were adapted from the Standard Patient Evaluation of Eye Dryness (SPEED) questionnaire. It is composed of 8 items that access frequency and severity of symptoms consistent with DES.

Subjects underwent a detailed ophthalmic examination, including best-corrected visual acuity, anterior segment examination with a slit-lamp biomicroscope. Following this, subjects underwent objective tests for evaluation of dry eye including fluorescein break-up time (F-BUT), Tear meniscus height (TMH), corneal fluorescein staining and Schirmer's type 1 test.

F- BUT was repeated three times on both eyes. A F-BUT of less than 10 seconds was considered as dry eye and it was further graded into mild (6-9 sec), moderate (1-5 sec) and severe (0 sec). TMH < 0.3 mm was considered as having dryness. Corneal fluorescein staining was assessed and recorded as present or absent. Schirmer's type 1 test was performed. 5 min wetting < 10 mm was considered as dry eye and it was further graded into mild (7-10 mm), moderate (4-6 mm) and severe (0-3 mm).

We used ADES/JDES (Asia Dry Eye Society/Japanese Dry Eye Society) criteria to diagnose dry eye in study population and it includes presence of subjective symptoms plus F-BUT < 5 sec. [3]

The data was analyzed with the SPSS software version 15. Continuous variables were compared using Student's t-test, and non-continuous variables were compared by the chi-square test. p values of < 0.05 were considered significant.

III. Results

This study included 100 patients, 61 males and 39 females, aged between 17-47 years. The mean age was 26.8 ± 5.142 years. Digital device used by study population include television, mobile phone and laptop/computer. Amongst them, usage of laptop/computer was found to be the maximum.

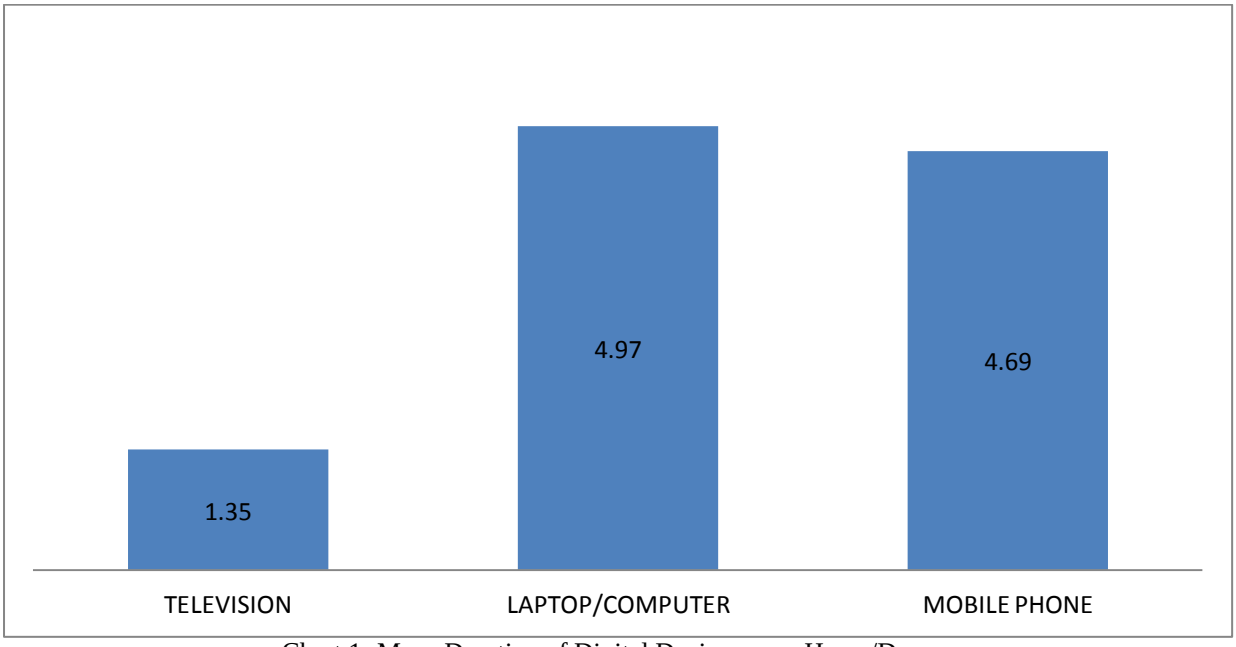


Chart 1**:** Mean Duration of Digital Device usage Hours/Day

Chart 2 shows Laptop/computer caused maximum dryness according to ADES/JDES criteria.

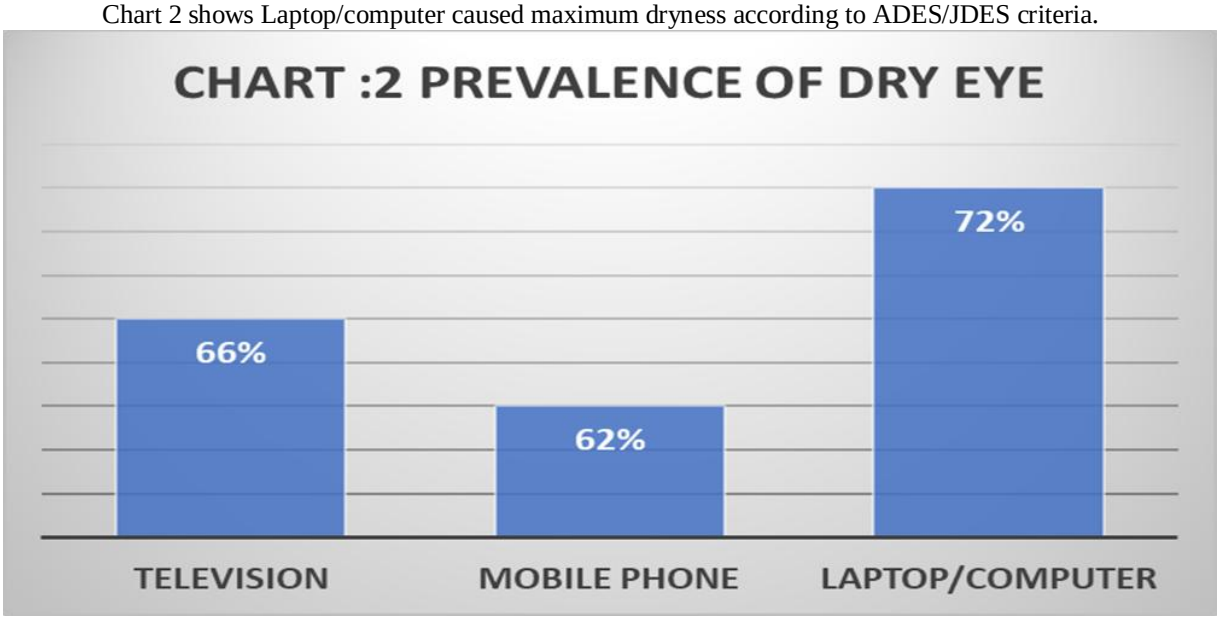


Chart 2: Prevalence of Dry eye

Mean duration of digital device usage was 9.19 ± 2.163 hours/day (range 5–15 hours). Males have higher mean usage (9.69 hours versus 8.41 hours) though difference between the two was not found to be significant (p=0.968).

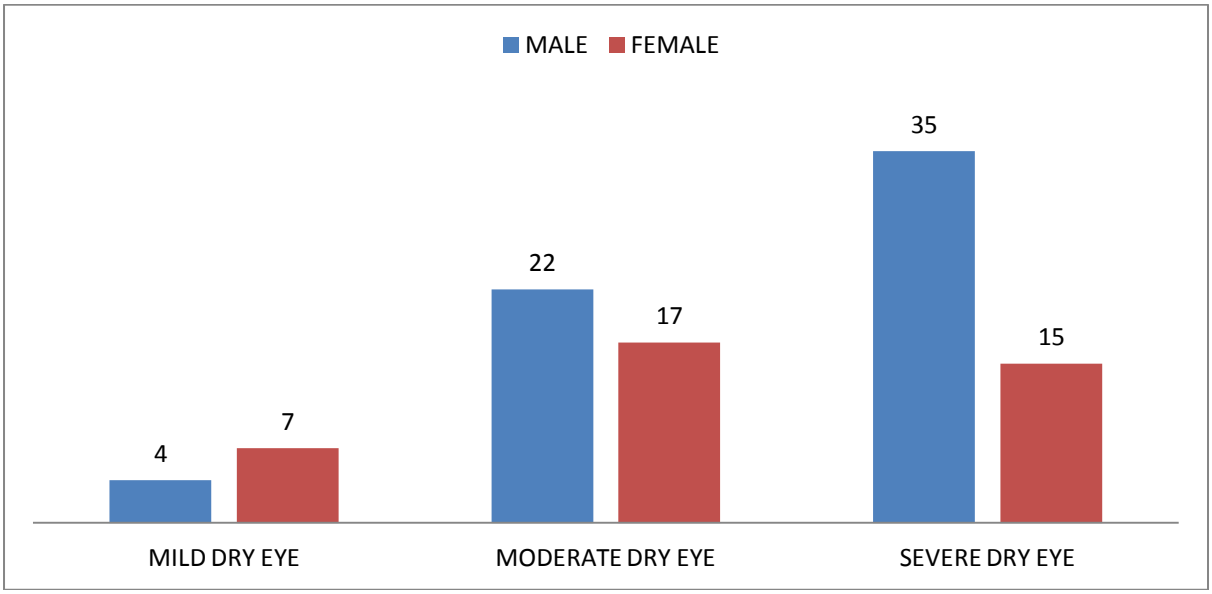
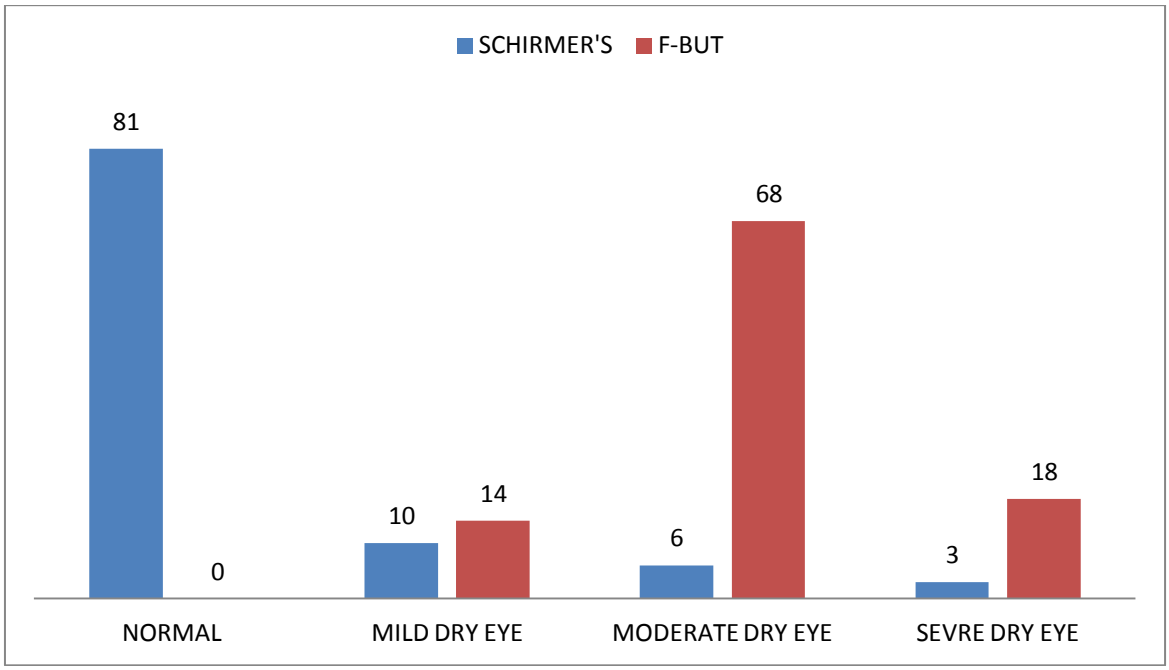


Chart 3: Gender Distribution of Dry Eye According to Speed Score

Chart 3 shows that 50% patients had severe, 39% had moderate, 11% had mild dry eyes. Male shave significantly higher tendency to have moderate and severe score as compared to females (P=0.0006).



Char 4: Comparison between result of Schirmer's and F-BUT on Dry Eye

Chart 4 shows that Schirmer's test detected 81% patients having no dry eye while no patient was detected normal through F-BUT. To assess effect of duration of digital device usage, we divided patients in two groups according to duration of digital device usage: Group 1 with less than 10 hours exposure and Group 2 with more than 10 hours exposure (Table 1).

PARAMETERS	DURATION OF DIGITAL DEVICE USAGE		P VALUE
	GROUP 1 (< 10 HOURS)	GROUP 2 (>10 HOURS)	
Age(in years)	25.91±4.94	27.89±5.22	0.0550
Schirmer's test (mm)	15.05±5.70	14.64±4.98	0.7060
F-BUT (sec)	4.51±2.35	2.91±2.06	0.0006
Tear Meniscus Height (mm)	0.4±0.15	0.3±0.15	0.0908
Corneal Staining present	58%	64%	0.4080

Table 1 : Relation of duration of digital device usage on various parameters.

Table 1 shows that F-BUT is significantly lower in group 2 (2.91±2.06, P = 0.0006) among all objective tests in the study. SPEED score was significantly higher in group 2(8.40±2.41,P=0.0070). Occupation and refractive status of the eyes did not show any significant difference between the two groups.
TMH was decreased in 28% of patients. Corneal staining was present in 61% of patients.
According to the ADES/JDES criteria, 70% patients had dry eyes with significant male preponderance (43% males, P=0.0069).

IV. Discussion

87% of the patients were in the age group less than 30 years with higher prevalence in males. This is in contrast to Mehra et.al study according to which the frequency of the disease ranged from 22% to 27% among males and 36% to 48% among females in Japan. [4]
Mean duration of digital device usage was 9.19 ± 2.163 hours/day (range 5–15 hours). This was found to be consistent with Bahkir et.al study where the total usage per day was found to be 8.65 ± 3.74 hours. [5]
Prevalence of dry eye is maximum in laptop/Computer user (72%) which corroborates with C-Talens -Estarelles et.al. in which 31 healthy individuals ranging in age from 20 to 26 years (mean ± standard deviation, 21.26 ± 1.73 years) were included and it was found that computer produced the highest disturbance on the ocular surface and tear film whereas smartphones produced the least disturbance. [6]
The prolonged usage of digital devices is significantly associated with increase in prevalence of dry eye. Prevalence of dry eye was 65% and 84% respectively in Group1 and 2 as classified previously. This is in

accordance to the two previous studies of Ranasinghe P et. al and Mehak Muftil et. al. [7,8] Study by Titiyal JS et al have found 4 or more hours of usage of video display terminals associated with 89.9% of dry eye cases. [9] Studies by Bali et.al and Chakrabarti M have showed that the usage of computer for even 3 hours daily is linked to increased risk of CVS. [10, 11]

SPEED score significantly correlates with corneal staining (P= 0.001) and duration of digital device usage. This can be interpreted as patients with presence of ocular surface damage are more symptomatic.

F-BUT was < 5 sec in 70% patients and it is significantly associated with presence of corneal staining (P=0.0001) and duration of digital device usage (P= 0.0006).

Schirmer's test was more than 10mm in 81% patients, Lucca et al and Farris et al also reported low sensitivity of Schirmer's tests in their studies. [12, 13]. DEWS 2 also reported high variability in specificity, sensitivity and repeatability of Schirmer's test and they did not mention Schirmer's test in their proposed diagnostic battery of tests. [14]

Tear meniscus height was normal in 72% patients and did not correlate with any variable in the study.

As per ADES/JDES criteria 70% had dry eyes, whereas according to SPEED Score alone 89% had moderate to severe dry eyes.

Absence of inclusion of tear film osmolarity is a limitation of our study.

V. Conclusion

SPEED score has high sensitivity and can be used as a screening method for dry eye diagnosis even by para-medical personnel. This study findings stress the need to spread awareness about decreasing the usage of digital devices as well as measures to prevent dryness while using the devices such as smartphones, laptops and computers in order to decrease dry eyes and to prevent damage caused to the ocular surface.

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