DISSERTATION SUBMITTED FOR THE MASTER'S DEGREE

IN

MEDICAL PHYSIOLOGY

TITLE

"OCULAR & EXTRAOCULAR DISCOMFORT ASSOCIATED WITH EXTENDED DIGITAL SCREEN TIME IN YOUNG ADULTS"

SUBMITTED BY

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OCULAR & EXTRAOCULAR DISCOMFORT ASSOCIATED WITH EXTENDED DIGITAL SCREEN TIME IN YOUNG ADULTS

Thesis Submitted to

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Master of Science

In Medical Physiology

By

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This is to certify that the dissertation entitled **"Ocular and extra ocular discomfort associated with extended digital screen time in young adults"** is a Bonafide & genuine research work carried out by Dr. Nitya Mehrotra, under the guidance of **Prof. (Dr.) Khaleel Ahmad Manik,** Professor& head, Department of Physiology and under the co-supervision of **Dr. Ausaf Ahmad**, Associate Professor, Department of Community Medicine and **Dr. Khalida Sayeed,** Assistant professor, department of Ophthalmology, in partial fulfillment of requirement for the degree of Master of Science in Medical Physiology. The research methods and procedures described have been done by the candidate and result observed by the Guides periodically.

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This is to certify that Dr. Nitya Mehrotra, student of M.Sc. MEDICAL PHYSIOLOGY; Integral University has completed his dissertation entitled **"Ocular and extra ocular discomfort associated with extended digital screen time in young adults"** successfully. He has completed this work from the department of Physiology, Integral Institute of Medical Sciences and Research, Integral University under the guidance of **PROF. (DR.) KHALEEL AHMAD MANIK**. The dissertation was a compulsory part of his M.Sc. degree. I wish him good luck and bright future.

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I hereby declare that this dissertation entitled **"Ocular and extraocular discomfort associated with extended digital screen time in young adults"** is a bonafide & genuine research worked carried out by me under the guidance of Prof. (Dr.) Khaleel Ahmad Manik**,** Professor & Head, Department of Physiology and under the co-supervision of Dr. Ausaf Ahmad, Associate Professor, Department of Community Medicine and Dr. Khalida Sayeed, Assistant professor, Department of ophthalmology.

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Acknowledgement

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List of abbreviations

1. VDT : Visual Display Terminal

2. CVS : Computer Vision Syndrome

3. DE : Dry Eyes

4. DED : Dry Eye Disease

5. MGD : Meibomian Gland Dysfunction

Table of Content

Chapter - 1 INTRODUCTION

1.1 Introduction

Smartphone and tablet use in India and worldwide is reaching saturation levels and associated visual and ocular discomforts like headaches, eyestrain, dry eyes, sore eyes are widespread along with other extra-ocular symptoms like dizziness, neck pain and shoulder pain. Prolonged & continuous daily use of digital screens or visual display terminals (VDTs) has become the norm in occupational, educational & recreational settings.

Several mechanisms have been implicated in VDTs associated DE including: blink anomalies, damaging light emission from modern devices, inflammatory changes etc. [1,2]

The extent to which an individual may experience symptoms is largely dependent upon his/her visual abilities in relation to the visual demands of the task being performed. Many individuals in other highly visually demanding occupations will experience similar vision related problems. However, the unique characteristics and high visual demands of VDT work make many individuals susceptible to the development of eye and vision-related symptoms. Uncorrected vision conditions, poor VDT design and workplace ergonomics and a highly demanding visual task can all contribute to the development of visual symptoms and complaints. It is observed that vision problems experienced by VDT operators are generally only temporary and will decline after stopping VDT work at the end of the day. Supplementing to this longer duration of daily use of VDT is inversely proportional to the total sleep duration. Hence, finding the association of prolonged VDT use and ocular/extra-ocular discomfort and estimating the time duration of VDT use related to severity of discomfort would be beneficial for better understanding of impact and guiding precautions for better health. [3 – 7]

As technology becomes an increasingly integral part of modern society, the use of digital screens for work, entertainment, and communication is becoming more prevalent. However, extended usage of digital screens can lead to ocular and extraocular discomfort, which has become a major concern for both professionals and laypersons alike. Symptoms such as eye strain, dry eyes, blurred vision, headaches, and neck pain have been reported among individuals who spend prolonged periods in front of screens.

This thesis aims to investigate the ocular and extraocular discomfort associated with extended digital screen use, to identify the risk factors and potential interventions for the prevention and management of this emerging public health issue.

There are several recent clinical and research studies that have investigated the ocular and extraocular discomfort associated with extended digital screen use. Some of the notable findings are:

1. The American Academy of Ophthalmology (AAO) has reported that individuals who spend more than two hours per day in front of digital screens are at a higher risk of developing digital eye strain or computer vision syndrome (CVS).

2. A study published in the Journal of Occupational Health and Epidemiology reported that prolonged digital screen use was associated with increased neck and shoulder pain, which was attributed to poor ergonomic design of workstations.

3. A clinical trial involving 100 participants conducted by the University of Alabama concluded that computer users who wore blue-blocking glasses experienced less ocular discomfort and improved sleep quality, compared to those who did not wear the glasses.

4. A study published in the Journal of Optometry found that dry eye symptoms were more prevalent among individuals who used digital devices for more than 4 hours per day, compared to those who used it for lesser durations.

5. Research conducted by the University of California, Berkeley, found that the amount of time spent in front of screens was a significant risk factor for both myopia and hyperopia (nearsightedness and farsightedness, respectively).

In summary, the latest clinical and research data on this topic reveal that prolonged digital screen use can result in ocular and extraocular discomfort and potential long-term impacts on visual health. Several interventions, including ergonomic workstation design, blue-blocking glasses, and controlling the duration of digital screen use, have been found beneficial in minimizing the symptoms.

1.2 Hypothesis

Research Question:

Is there a correlation between Ocular & Extraocular discomfort with extended digital screen time usage in enrolled university students in young adults?

Hypothesis:

Null Hypothesis, H0:

There is no association between ocular & extraocular discomfort with extended visual display unit use.

Alternate Hypothesis, H1:

There is positive relation between ocular & extraocular discomfort & visual display unit use.

Chapter -2 Review of literature

- Alex Muntz, et al. (2021) conducted a study on the impact of extended screen time on dry eye in youth. The study aimed to identify the relationship between screen time and the prevalence of dry eye. The researchers found that elevated blink rate was observed in 24% of the participants, indicating that extended screen time has a significant impact on dry eyes. The findings were based on a survey of 456 participants who reported an average weekly screen time of almost 44 hours. Furthermore, 90% of the respondents qualified for dry eye disease, which highlights the severity of the issue. The study adds to the growing volume of research that identifies extended screen time as a significant contributor to dry eye disease, particularly in youth.[1]
- Shigeru Nakamura, et al. (2010) conducted a cross-sectional survey of 1025 office workers to investigate the prevalence of dry eye disease in visual display terminal (VDT) users. The study revealed that chronic reduction of tear secretion and impairment of the lacrimal gland function were the leading causes of dry eye disease. The findings also showed that VDT users are more prone to dry eye disease as they tend to blink less than regular intervals. The study emphasizes the importance of regular eye care and adherence to ergonomic guidelines for VDT users to prevent the onset of dry eye disease. The study provides valuable insights into the ocular manifestations of prolonged VDT use and highlights the need for more research in this area to develop effective preventive strategies.[2]
- Fenga, C., et al. (2008) investigated the relationship between meibomian gland dysfunction and ocular discomfort in video display terminal (VDT) workers. The study detected a statistically significant correlation between hours spent on VDT work and the symptoms of ocular discomfort in the total population with r=0.358, p=0.002 and 95% CI

0.13-0.54. It concluded that extended use of VDTs significantly increases the risk of meibomian gland dysfunction and resultant ocular discomfort. The findings emphasize the importance of developing preventive measures for individuals who are required to spend long hours in front of VDTs to maintain visual comfort.[3]

- A study by Saif H. Alrasheed, et al. (2020) titled impact of educational intervention using 20/20/20 rule in computer vision syndrome done on 40 young patients with CVS in Qassim university eye clinic revealed that patients complaining of dry eye symptoms showed significant changes after educational intervention and some limited changes for ocular surface integrity [4]
- Qolami M., et al. (2023) conducted a study on Prevalence of Computer Vision Syndrome Among Iranian Medical University Employees and Graduate Students in their Occupational Environment and concluded that prolonged use of digital screens can cause a set of visual and ocular symptoms known as Computer Vision Syndrome (CVS), which is a common health issue among computer users. This study aimed to estimate the prevalence of CVS among university employees and graduate students in their occupational environment in Iran. The total prevalence of CVS was 48.7% and the most frequent symptoms were eye redness (62.3%) and burning (56.5%). A significant positive correlation was found between the number of hours working with a computer and the total score of CVS (Pearson correlation coefficient = 0.248, P=0.02). [5]
- A study by Boadi – Kusi SB, et al. (2020) titled Association between Poor Ergophthalmologic Practices and Computer Vision Syndrome among University Administrative Staff in Ghana in the year 2020 concluded that of the 200 participants, 103 (51.5%) were found to have symptoms of CVS and Nine percent more males than females had CVS.[6]

- A study conducted by Sheppard AL, and Wolffsohn JS. titled Digital eye strain: prevalence, measurement and amelioration in year 2018 concluded that Use of social media and multitasking is particularly prominent among younger adults with 87% of individuals aged 20–29 years reporting use of two or more digital devices simultaneously. which included survey responses from over 10000 US adults, identified an overall self-reported symptom prevalence of 65%, with females more commonly affected than males (69% vs 60% prevalence). DES was reported more frequently by individuals who used two or more devices simultaneously, compared with those using just one device at a time, with prevalence of 75% and 53%, respectively. [7]
- A study published in investigative Ophthalmology & Visual Science September 2020, Vol.61, 42. by authors Daniel Ian Flitcroft, Elise N. Harb and Wildsoet CF concluded with a general agreement that the current myopia epidemic has developed too rapidly to reflect any genetic changes within the population and therefore must be primarily environmentally driven. Compared to the high prevalence of myopia seen in most industrial and post-industrial societies, very low rates of myopia (<5%) are found in indigenous communities retaining their traditional cultures, based in the natural environment, with relatively little or no formal education. Understanding what features of the modern indoor and urban environments promote myopia, and what features of the natural environment are protective may hold the key to new, more effective interventions. [8]
- A study published in state university of New York college of optometry by author Mark Rosenfield, and Portello JK in the year 2016. On The use of digital screens linked to an increase in ocular discomfort, including eye strain, dryness, and discomfort, among young adults Concluded that Computer vision syndrome, also known as digital eye strain, a combination of eye and vision problems associated with the use of computers and other

electronic displays. Today, many individuals spend large numbers of hours viewing these screens. However, the visual demands differ significantly from those presented by traditional printed materials, with the result that up to 80% of users report significant symptoms both during and immediately after viewing electronic screens. This paper reviews the principal ocular causes for this condition and discusses how the standard eye examination should be modified to meet today's visual demands. [9]

- A study by Tsubota, et al. (2017) concluded that Several factors, such as screen glare, reduced blink rate, and poor ergonomics, can contribute to increased ocular discomfort associated with digital screen use and gave a new definition of dry eye that Dry eye is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface. [10]
- Research titled, the association between visual display terminal use and dry eye by Fjaervoll H, et al. (2022) concluded VDT use is strongly associated with DED. VDT-associated DED is prevalent, but the exact prevalence needs to be further elucidated using standardized DED diagnosis criteria. Furthermore, a safe lower limit of daily VDT use has yet to be established. More research is needed on the effect of digitalization and digital transformation, which are particularly high during the time of the COVID-19 pandemic. [11]
- A research paper titled Computer Vision Syndrome and Associated Factors among Computer Users in Debre Tabor Town, Northwest Ethiopia by Dessie A, et al. (2018) concluded that, about 70 percent of computer users are suffered from CVS. Besides the health problems, CVS causes inefficiency at workplace and deteriorate quality of work. Multistage random sampling method was applied to select 607 study participants,

and the data were collected by using a structured questionnaire. Computer vision syndrome was measured by self-reported method. Bivariate and multivariable binary logistic regression analyses were performed using SPSS version 20. Significance level was obtained at 95% CI and value < 0.05. The prevalence of CVS was 422 (69.5%) with 95% CI of 65.60, 73.0%. Blurred vision, eyestrain, and eye irritation were the commonest reported symptoms of CVS with proportion of 62.60%, 47.63%, and 47.40%, respectively. [12]

- A study titled Effects of short-term VDT usage on visual functions by Qu XM, et al. (2005) Chinese journal of ophthalmology concluded that In comparison with pre-VDT use, amplitude of accommodation, were significantly decreased ($P < 0.05$), near point of convergence, near lateral exophoria were significantly increased after VDT use ($P < 0.05$). Total, high order, 4th and 5th order aberrations were significantly greater after VDT use ($P < 0.05$). i.e., Short-term VDT work does have a significantly greater temporarily effect on visual function, tear film quality and visual quality. [13]
- A research published in Pakistan journal of medical health sciences 2023 titled risk factors of computer vision syndrome & its prevention by Imran K, et al. (2023) a cross sectional research was conducted on 198 CMt students at Pakistan institute of medical sciences out of which 133 or 67.2 % had atleast one symptoms of computer vision syndrome i.e. headache , eye tiredness , blurring , burning and neck and shoulder discomfort and computer use time of 240 minutes / four hours was substantially correlated with eye tiredness and headache [14]
- Research by Wangsan K., et al. (2022) titled self-reported computer, a cross sectional study involving 527 students, a total of 516 students or 97.9 % students experienced atleast one symptoms of CVS and the most frequent symptom was eye pain and the most intense symptoms was the feeling of worsening eyesight [15]

- A study by Li R, et al. (2022) titled prevalence of self-reported symptoms of computer vision syndrome and associated risk factors in students in China during Covid pandemic involving 2363 students of 6 randomly selected schools, self-reported CVS symptoms occurred in three quarter of the students and non-compliance of 20-20-20 rule was associated with higher risk of CVS [16]
- A study titled computer vision syndrome in the Spanish population during COVID -19 lockdown by Galindo-Romero, et al. (2021) involving 730 participants, the main symptom reported was headache (36.7%) followed by dry eye (31.1 %), irritation (24.1 %) and blurred vision (21.2 %) concluding that participants who spent more time with electronic devices and less time outdoors reported more CVS related eye symptoms[17]
- A study titled computer vision syndrome and associated factors among medical and engineering students in Chennai by Logaraj M, Madhupriya V and Hegde SK, the prevalence of CVS was found to be 78.6% among engineering students while among medical students it was found to be 78.6% and students who used computer for 4.6 hours were at significantly higher risk of developing redness compared to those who used computer for less than 4 hours , significant correlation was found between increased hours of computer use and the symptoms of redness , burning sensation , blurred vision and dry eyes [18]
- A study by Reddy SC, et al. (2013) on computer vision syndrome: a study of knowledge and practices in university students involving 795 students aged between 18 to 25 years from 5 universities of Malaysia , the prevalence of symptoms of CVS was found to be 89.9 % , the most disturbing symptom was headache (19.7 %) followed by eye strain (16.4 %) and the use of radiation filter on the screen did not help in reducing the CVS symptoms and 90 % of university students experienced symptoms related to CVS which

was seen more often in those who used computer for more than 2 hours continuously per day [19]

- A study by Abudawood GA, Ashi HM and Almarzouki NK, titled Computer vision syndrome among undergraduate medical students in King Abdulaziz University, Jeddah, Saudi Arabia involving 651 participants, high prevalence of CVS was observed in which 95 % (558) reported atleast one symptom of CVS during studying using computers and female gender (54.3% (319) was observed to have higher risk of CVS and the most frequently reported ocular symptoms were excessive tearing (20.6%) , excessive dryness (20.3 %) , itching (18.9 %) , increased sensitivity to light (16.2 %) and redness of eye (15.1 %) while the most frequently reported extraocular symptoms were neck , shoulder , back pain , headache (39.7%) and numbness of the hands or fingers (14.8 %) [20]
- A study by Sitaula RK and Khatri A, titled knowledge , attitude and practice of computer vision syndrome among medical students and its impact on ocular morbidity on 236 students out of the total 299 students in which mean age of MBBS students was 21.38 years and the range was 19-22 years , 76.2 % were male and 23.8 % were females , the majority (37.2 %) spent 2-3 hours / day on the computer and had a higher risk of developing CVS . about 69 .5 % students used a computer at the level of the eye but there was a significant reduction in CVS among those who had computer screen below the level of eye. Association between taking breaks and frequent blinking during computer use and relief of symptoms was significant. among 80 medical students randomly selected for detail eye examination the prevalence of CVS was 71.6 % and the commonest ocular complaint was headache (50%) and dry eyes (45%). the study concluded that CVS is relevant among MBBS students but the knowledge, attitude, and practice of CVS among them is poor [21]

Chapter -3 AIM/OBJECTIVE

AIM: To identify if there is association between digital screen usage with ocular & extra-ocular discomfort.

OBJECTIVE:

- To collect details of digital screen usage, duration of usage and type of visual display terminal used with the help of questionnaire.
- To collect details of ocular and extra-ocular discomfort with the help of questionnaire.
- To look for association between digital screen usage with ocular and extra-ocular discomfort

Chapter -4 MATERIALS AND METHODS

4.1 Material and Method

TYPE OF STUDY: Cross sectional study

PLACE OF STUDY: The study was performed in Department of Paramedical Health sciences at Integral Institute of Medical Sciences and Research , Lucknow

DURATON OF STUDY: December 2022 to June 2023

4.2 Inclusion Criteria and Exclusion Criteria

INCLUSION CRITERIA:

1. >18 years of age
2. At least 1 Digital Device
3. Willing to give written informed consent

EXCLUTION CRITERIA:

1. NO Digital Device usage
2. Not willing to give written informed consent

4.3 Ethical approval

Ethical approval: The ethical committee of the institute gave its permission for the research project in question

4.4 Collection of Data/ Methodology

The methodology for the collection of data in a questionnaire-based research study on enrolled university students included the following steps:

- Designing the questionnaire: A detailed questionnaire was designed based on the research questions and objectives. The questionnaire was designed efficiently and in such a way that it covers all the aspects of the research topic.

- Participant Recruitment: The target population of potential participants were identified and invited to participate in the study after their academic classes in their respective academic departments and in departmental library.

- Obtaining Informed Consent: Before beginning the data collection process, informed consent from all participants was obtained.

- The participants were informed about the purpose of the study, the nature of the research, and how their information will be used to maintain their confidentiality and anonymity.

- The participants were explained of the benefits of the research study explaining correlation between the extended digital screen time and physical discomfort consequently affecting the quality of life and preventive measures that can be taken to prevent the same.

- Data Collection: The questionnaire was distributed to the participants via paper-based format to complete and return the questionnaire. Additionally, oral instructions were given to participants to improve the response rate.

4.5 Sample size estimation

Sample population is estimated using below details:

- **Confidence Level** = 95%
- **Margin of Error** = 10%
- **Population Proportion/Prevalence** = 42% (Wen-Hsin Hsu, et al. 2003)
- **Population Size** = 10000

$$n_0 = \frac{Z^2 pq}{e^2}$$

e	Margin of error
p	Population proportion
z	Use Z Table

Using above details, the sample size comes to 100.

4.6 Statistical analysis

Data will be statistically analyzed to answer following questions:

1. Is there any significant association between prolonged use of digital device and ocular discomfort?
2. What is the approximate duration of use of digital device above which the discomfort is observed?

To answer above questions, we are going to use below methods:

1. Non-parametric statistical test: Chi-Square test
2. Descriptive Statistics: Mean, Median, Mode, etc.

The analysis will be performed using Microsoft Excel.

Chapter – 5 Results & Discussions

Data analysis no. 1-To study for association between Gender & ocular discomfort

Hypothesis declared:

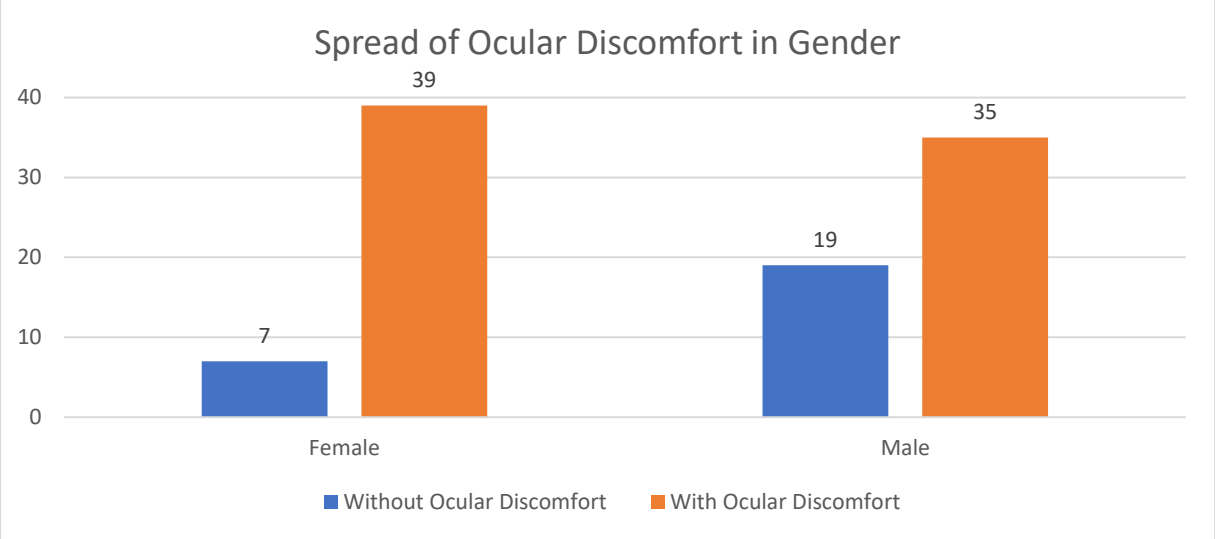
H0: There is no association between Gender & Ocular discomfort if present

H1: There is association between Gender & ocular discomfort if present

Table no. 1

	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
Female	7	39	**46**
Male	19	35	**54**
Grand Total	**26**	**74**	**100**

Graph no. 1



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma/Chi-Square	P-value	Degree of Freedom	Critical Value	Result
11.96	34.04	2.05698	0.7227	5.1476	0.05	1	3.841	**Reject H0**
14.04	39.96	1.7522	0.6156					

Result:

The data shows that out of the total 100 respondents, 46 were males and 54 were females. Among those who reported no ocular discomfort (26 respondents), 19 respondents (73%) were males, and 7 respondents (27%) were females. On the other hand, out of the 74 respondents who reported ocular discomfort, 35 respondents (47%) were males, and 39 respondents (53%) were females.

Discussion:

The data analysis reveals a higher proportion of females (54%) among the total respondents as compared to males (46%). The analysis also shows that while more males reported no ocular discomfort, a higher percentage of females reported ocular discomfort. The reasons for this gender disparity in ocular discomfort require further investigation.

Overall, the study highlights the need for gender-specific eye care interventions that can address the unique needs of male and female populations. The data can be used to inform the development of targeted education and outreach efforts aimed at reducing ocular discomfort and related eye conditions among both men and women.

Data analysis no. 2-to study for association between hours of daily sleep and ocular discomfort if present

Hypothesis declared:

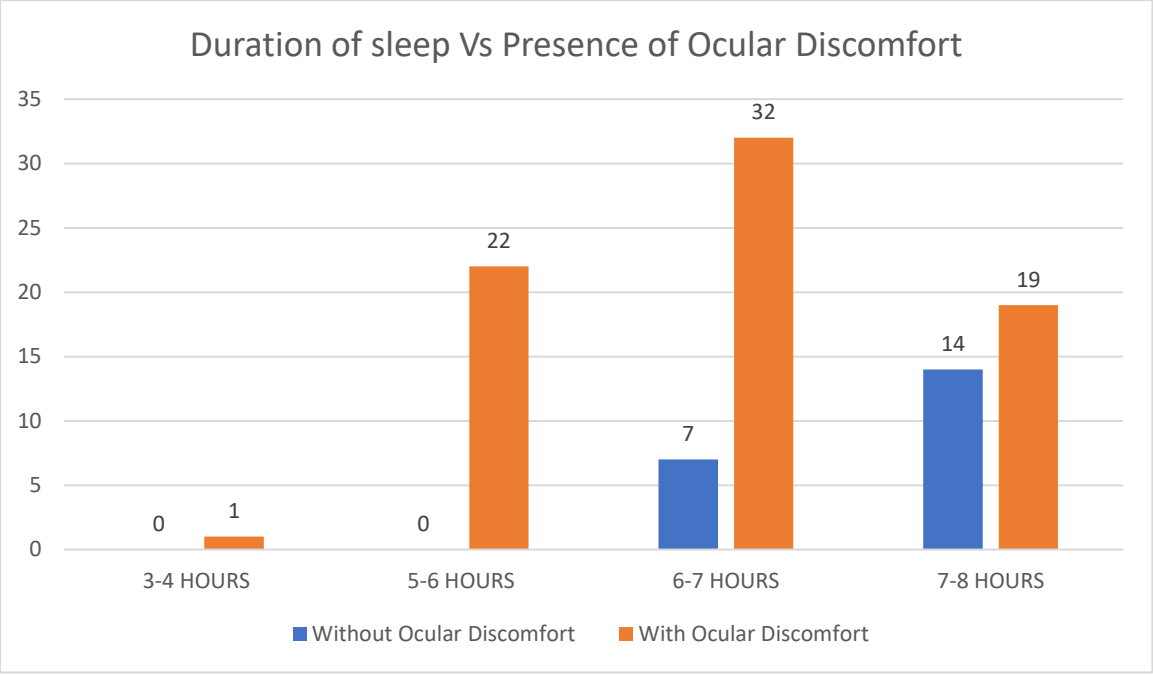
H0: There is no association between hours of daily sleep and ocular discomfort if present

H1: There is association between hours of daily sleep and ocular discomfort if present

Table no. 2

Hours of Daily Sleep	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
3-4 HOURS	0	1	**1**
5-6 HOURS	0	22	**27**
6-7 HOURS	7	32	**39**
7-8 HOURS	14	19	**33**
Grand Total	**26**	**74**	**100**

Graph no. 2



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/ Chi-Square	P-value	Degree of Freedom	Critical Value	Result
0.26	0.74	0.26	0.091	13.51634582	0.05	3	7.815	**Reject H0**
7.02	19.98	7.02	0.204					
10.14	28.86	0.972	0.341					
8.58	24.42	3.423	1.202					

Result:

The data shows that out of the total 100 respondents, 26 reported no ocular discomfort. Among those who reported no ocular discomfort, the majority had a daily sleep average of 6-7 hours (27%). Out of the 74 respondents who reported ocular discomfort, 32 respondents (43%) had a daily sleep average of 6-7 hours, and 19 respondents (27%) had a daily sleep average of 7-8 hours.

Discussion:

The data analysis reveals that most respondents who reported no ocular discomfort had a daily sleep average of 6-7 hours. In contrast, among those who reported ocular discomfort, respondents had a more varied sleep pattern, with a slightly higher percentage reporting a daily sleep average of 7-8 hours.

This association between ocular discomfort and sleep patterns could be related to factors such as eye strain or dryness caused by prolonged periods of screen use, which might disrupt sleep quality. Further research is needed to explore the links between sleep quality and ocular discomfort, as well as the potential impact of screen use and other factors on both sleep and eye health.

It is worth noting that the sample size for this study is relatively small, with only 100 respondents. Additionally, the study only collected self-reported data, which may be subject to bias or inaccuracy. Future studies with larger sample sizes and more objective measures of eye health and sleep quality would be useful in further exploring these potential connections.

According to the study conducted by Yoshioka E et al. (2008) [22] VDT work of 6 hours or more per day was significantly associated with insomnia and in particular caused problems with “total sleep duration” and “sleepiness during the day” among sleep-related symptoms.

Another study conducted by Giahi, O (et al.) [23] supports this where the researchers found the insomnia symptoms to be significantly higher in the participants having more than 6 hours of VDT usage.

Overall, this study suggests that there may be a relationship between sleep patterns and ocular discomfort, highlighting the importance of addressing both sleep and eye health in efforts to promote overall wellness.

Data analysis no. 3-To study for association between type of VDT used and ocular discomfort

Hypothesis declared:

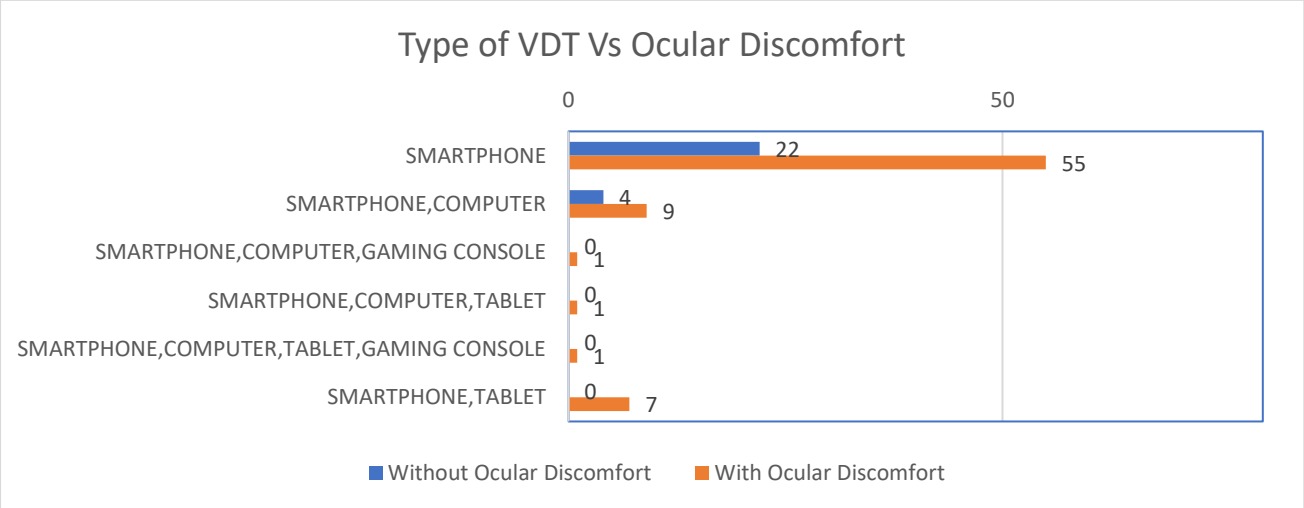
H0: There is no association between type of VDT used & ocular discomfort if present

H1: There is association between type of VDT used & ocular discomfort if present

Table no. 3

TYPE OF VDT USED	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
SMARTPHONE	22	55	**77**
SMARTPHONE,COMPUTER	4	9	**13**
SMARTPHONE,COMPUTER,GAMING CONSOLE	0	1	**1**
SMARTPHONE,COMPUTER,TABLET	0	1	**1**
SMARTPHONE,COMPUTER,TABLET,GAMING CONSOLE	0	1	**1**
SMARTPHONE,TABLET	0	7	**7**
Grand Total	**26**	**74**	**100**

Graph no. 3



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma / Chi-Square	P-value	Degree of Freedom	Critical Value	Result
20.02	56.98	0.195	0.068	3.931	0.05	5	11.07	**Reject H1**
3.38	9.62	0.113	0.039					
0.26	0.74	0.26	0.0913					
0.26	0.74	0.26	0.0913					
0.26	0.74	0.26	0.0913					
1.82	5.18	1.82	0.639					

Result:

The data analysis shows that a large percentage of the respondents (84%) used at least one VDT smartphone daily, while only 26% reported no ocular discomfort. On the other hand, 74% of respondents reported ocular discomfort, despite a slightly lower percentage (74%) using VDT smartphones daily.

Discussion:

This indicates that there may be other factors contributing to ocular discomfort beyond smartphone use alone. It also suggests that even those who do not use VDT smartphones regularly may experience ocular discomfort.

This finding highlights the importance of addressing the potential impact of other factors, such as lighting and screen quality, on eye health and comfort. It also emphasizes the need for individuals to be aware of and take steps to reduce eye strain, regardless of their frequency of smartphone use.

According to study conducted by M.Collins, et al. (1990)[24] where it was found that screen legibility significantly influenced the occurrence of symptoms of ocular discomfort and vertical head movements significantly affected the incidence of postural/headache symptoms.

Supplementing to this, another study conducted by U. Bergqvist et al. (1995)[25] With 353 participants concluded that among the VDT workers, the risk of eye discomforts increased among those who reported increased immobility and use of keyboards. Increased keyboards use also increased the risk of hand/wrist problems. On the other hand, it appeared that new keyboards alleviated the problems in some individuals as to neck, shoulder and upper arm problems.

Overall, the study's findings suggest that the relationship between VDT smartphone use, and ocular discomfort is complex, and that additional research is needed to fully understand the factors contributing to this condition.

Data analysis no. 4- Tostudy for relation between duration of VDT used daily & ocular discomfort

Hypothesis declared:

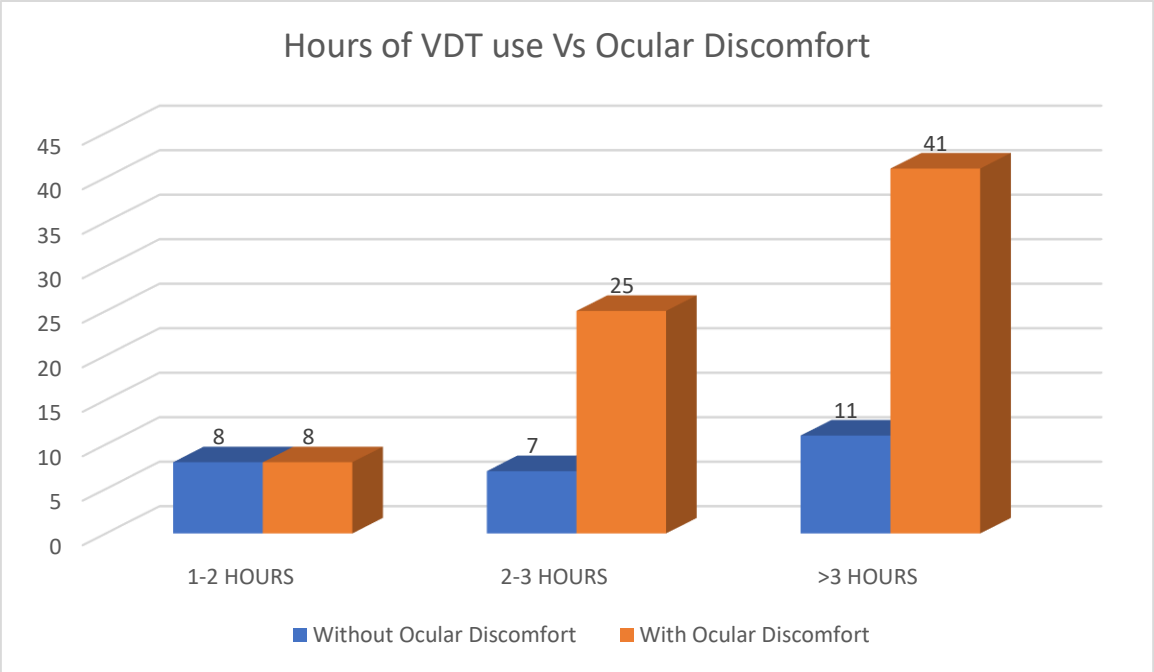
H0: There is no association between duration of VDT used daily and ocular discomfort if present

H1: There is association between duration of VDT used daily & ocular discomfort if present

Table no. 4

DURATION OF VDT USED DAILY	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
1-2 HOURS	8	8	**16**
2-3 HOURS	7	25	**32**
>3 HOURS	11	41	**52**
Grand Total	**26**	**74**	**100**

Graph no. 4



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/ Chi-Square	P-value	Degree of Freedom	Critical Value	Result
13.52	38.48	0.469	0.165	5.6835	0.05	4	9.488	**Reject H0**
4.16	11.84	3.544	1.223					
8.32	23.68	0.209	0.073					

Result:

The results indicate that a significant number of respondents (74%) experienced ocular discomfort after using VDT for more than 3 hours daily. However, it is also noted that a relatively high percentage (42%) of respondents did not experience any ocular discomfort even after prolonged VDT use. This suggests that there may be individual variations in susceptibility to ocular discomfort from VDT use, and that certain factors (such as age, eye health, and viewing habits) may influence this susceptibility.

Discussion:

The findings of this study have implications for workplace ergonomics and occupational health standards, particularly in jobs that require prolonged computer use. Employers may consider implementing measures to reduce eye strain and discomfort, such as regular breaks, proper lighting, and positioning of screens, and encouraging employees to seek eye exams and vision correction if necessary. Further research is needed to identify risk factors and effective interventions for ocular discomfort associated with VDT use.

This is in line with another study conducted by Knave BG, et al. (1985) [26] where the relationship between eye discomfort symptoms and working with VDT among 400n routine office workers was measured. It was observed that occurrence of eye discomfort increased as the extent of VDT work increased.

Another study conducted by Parihar JKS, et al. (2016)[27] also states on the similar lines of this research that the symptoms associated with VDT use like blur, dryness and asthenopia are significantly more when compared to similar tasks without using VDT's.

Data analysis no. 5- To study for relation between ocular discomfort & type of ocular discomfort

Hypothesis declared:

H0: There is no association between ocular discomfort if present & type of ocular discomfort

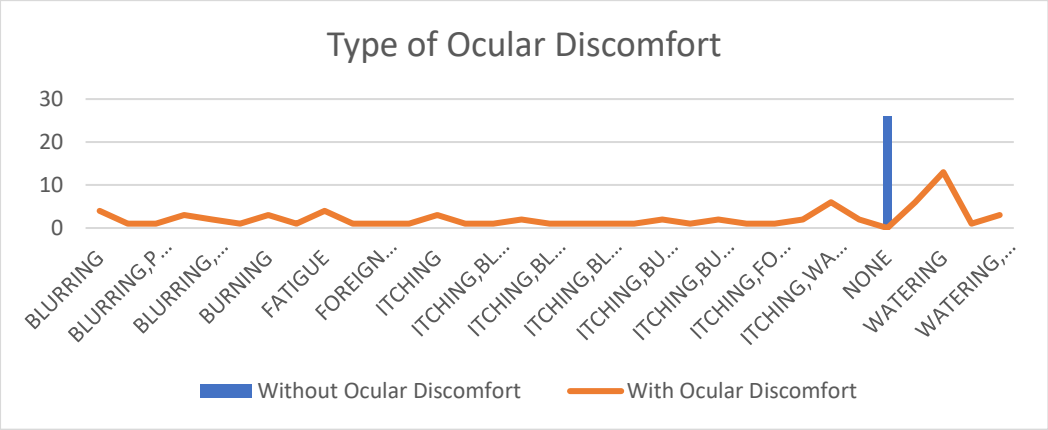
H1: There is association between ocular discomfort if present & type of ocular discomfort

Table no. 5

TYPE OF OCULAR DISCOMFORT	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
BLURRING	0	4	**4**
BLURRING,BURNING,WATERING	0	1	**1**
BLURRING,PAIN	0	1	**1**
BLURRING,WATERING	0	3	**3**

BLURRING,WATERING,PAIN	0	2	**2**
BLURRING,WATERING,PAIN,FATIGUE	0	1	**1**
BURNING	0	3	**3**
BURNING,WATERING	0	1	**1**
FATIGUE	0	4	**4**
FOREIGN BODY SENSATION,BURNING,PAIN	0	1	**1**
FOREIGN BODY SENSATION,FATIGUE	0	1	**1**
FOREIGN BODY SENSATION,PAIN	0	1	**1**
ITCHING	0	3	**3**
ITCHING,BLURRING,BURNING,PAIN	0	1	**1**
ITCHING,BLURRING,BURNING,PAIN,FATIGUE	0	1	**1**
ITCHING,BLURRING,BURNING, WATERING,PAIN,FATIGUE	0	2	**2**
ITCHING,BLURRING,FOREIGN BODY SENSATION,PAIN	0	1	**1**
ITCHING,BLURRING,PAIN	0	1	**1**
ITCHING,BLURRING,WATERING	0	1	**1**
ITCHING,BLURRING,WATERING ,PAIN,FATIGUE	0	1	**1**
ITCHING,BURNING	0	2	**2**
ITCHING,BURNING, PAIN,FATIGUE	0	1	**1**
ITCHING,BURNING,WATERING	0	2	**2**
ITCHING,BURNING,WATERING, FATIGUE	0	1	**1**
ITCHING,FOREIGN BODY SENSATION,FATIGUE	0	1	**1**
ITCHING,PAIN	0	2	**2**
ITCHING,WATERING	0	6	**6**
ITCHING,WATERING,PAIN,FATIGUE	0	2	**2**
NONE	26	0	**26**
PAIN	0	6	**6**
WATERING	0	13	**13**
WATERING,FATIGUE	0	1	**1**
WATERING,PAIN	0	3	**3**
Grand Total	**26**	**74**	**100**

Graph no. 5



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/Chi-Square	P-value	Degree of Freedom	Critical Value	Result
1.04	2.96	1.04	0.3654	99.9932	0.05	32	46.19	**Reject H0**
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.78	2.22	0.78	0.274					
0.52	1.48	0.52	0.1827					
0.26	0.74	0.26	0.091					
0.78	2.22	0.78	0.274					
0.26	0.74	0.26	0.091					
1.04	2.96	1.04	0.3654					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.78	2.22	0.78	0.274					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.52	1.48	0.52	0.1827					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					
0.52	1.48	0.52	0.182					
0.26	0.74	0.26	0.091					
0.52	1.48	0.52	0.182					
0.26	0.74	0.26	0.091					
0.26	0.74	0.26	0.091					

0.52	1.48	0.52	0.182	
1.56	4.44	1.56	0.548	
0.52	1.48	0.52	0.182	
6.76	19.24	54.76	19.24	
1.56	4.44	1.56	0.548	
3.38	9.62	3.38	1.187	
0.26	0.74	0.26	0.091	
0.78	2.22	0.78	0.274	

Result:

Based on the data provided, out of 100 subjects, 26 reported having no ocular discomfort while 74 reported experiencing ocular discomfort. Among those who reported discomfort, 17% complained of watering eyes, 8% complained of itching and watering eyes, and 5% complained of fatigue. The remaining respondents reported mixed ocular discomfort.

Discussion:

This data suggests that ocular discomfort is a common problem among individuals using digital devices for prolonged periods. The most frequently reported symptom was watering eyes, followed by itching and watering. Fatigue is another common symptom associated with prolonged digital device use, and a small proportion of respondents reported experiencing this symptom. The fact that many respondents reported mixed symptoms highlights the complexity of ocular discomfort associated with digital device use.

A study conducted by Shrestha GS, et al. (2011)[28] to evaluate visual problems, major symptoms, and their associations among VDT users in Nepal, Among 76 hospital attendees, assessment included visual acuity, retinoscopy, convergence, accommodation, fusional vergence and Schirmer's II. Subjects' symptoms were recorded in the structured 5-point intensity scale questionnaire concluded that accommodative infacility and tired eye were the most common abnormalities and symptom reported. Schirmer's test II was slightly correlated with some ocular, visual, and systemic symptoms.

Another study by Das A., et al. (2022)[29] in a cross sectional descriptive study on 319 VDT users in office settings in Kathmandu metropolitan concluded 89.4% of the respondents suffered from computer vision syndrome, more than 8 out of 10 study participants reported with at least one visual and musculoskeletal problem with tired eye 63.3%,dry eye 57.8% and headache 56.9% were the common visual symptoms reported.

These findings are consistent with previous research indicating that prolonged digital device use can lead to a range of ocular discomfort symptoms. Possible explanations for this discomfort include reduced blinking rate, increased dryness and exposure to blue light. Eye care professionals should be aware of these common symptoms and educate patients on methods of reducing digital device use or taking preventive measures such as properly adjusting screen brightness, taking frequent breaks, and using proper ergonomic posture.

Data analysis no. 6- Tostudy for association between duration of VDT used & severity of ocular discomfort

Hypothesis declared:

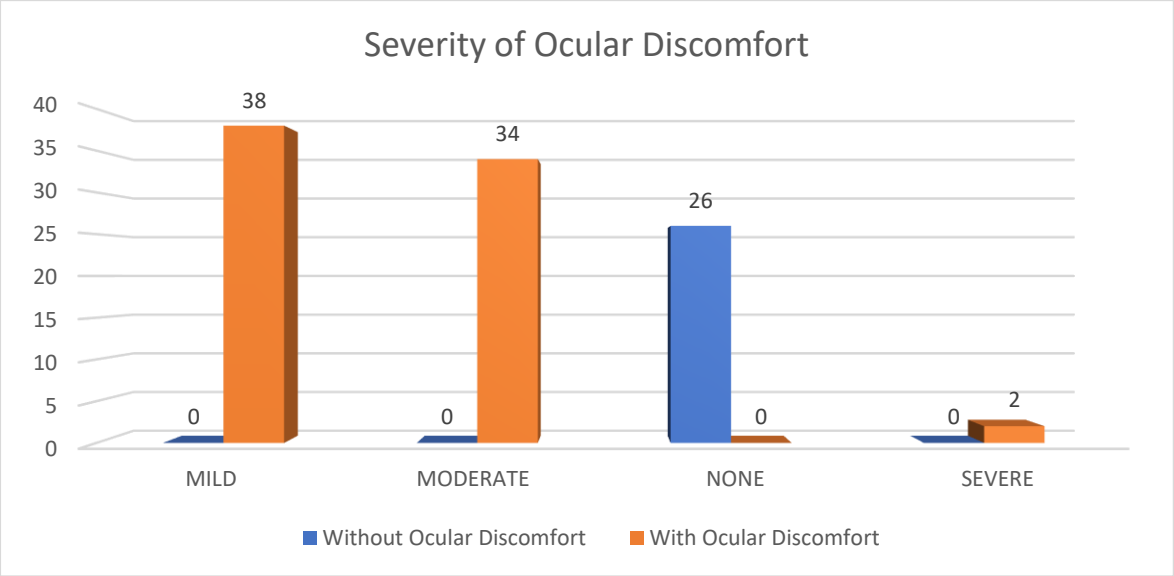
H0: There is no association between duration of VDT used and severity of ocular discomfort

H1: There is association between duration of VDT used and severity of ocular discomfort

Table no. 6

SEVERITY OF DISCOMFORT	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
MILD	0	38	**38**
MODERATE	0	34	**34**
NONE	26	0	**26**
SEVERE	0	2	**2**
Grand Total	**26**	**74**	**100**

Graph no. 6



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/ Chi-Square	P-value	Degree of Freedom	Critical Value	Result
9.88	28.12	9.88	3.471	99.998	0.05	3	7.815	**Reject H0**
8.84	25.16	8.84	3.105					
6.76	19.24	54.76	19.24					
0.52	1.48	0.52	0.182					

Result:

Based on the data provided, out of 100 subjects, 26 reported having no ocular discomfort while 74 reported experiencing ocular discomfort. Among those who reported discomfort, 51% had mild discomfort, 46% experienced moderate discomfort, and only 3% complained of severe discomfort.

This data suggests that ocular discomfort is a widespread problem among individuals using digital devices. The majority of respondents reported experiencing mild to moderate discomfort, which may interfere with daily activities and reduce overall quality of life. The low percentage of respondents reporting severe discomfort suggests that this may be a less common but potentially more severe manifestation of ocular discomfort associated with digital device use.

Discussion:

There are several potential explanations for the high prevalence of ocular discomfort associated with digital device use. Reduced blinking rate, increased dryness, exposure to blue light, and glare are among the most commonly cited causes. These factors can cause strain on the eyes and other uncomfortable symptoms, including headaches and neck pain.

Treatment options for ocular discomfort associated with digital devices include taking regular breaks, maintaining a proper distance from the screen, reducing screen brightness, and trying blue-light-filtering eyewear or software. Regular visits to an eye doctor can also help identify and address any underlying issues that may contribute to ocular discomfort.

In a study conducted by Collins M., et al. (1990)[30] that investigated the effects of a range of workstation factors upon the visual symptoms experienced by a group of 92 visual display terminal (VDT) users. Subjects in the study kept a diary over five consecutive working days in which they recorded the types of visual and postural symptoms which occurred, and the types of work tasks being performed. Each subject's workstation was analyzed for screen legibility and stability, discomfort and disability glare, and required head postures. Using multiple regression analysis techniques, we have considered the relative contribution of these factors to the symptoms reported by the users of these workstations. Screen legibility significantly influenced the occurrence of symptoms of ocular discomfort and vertical head movements significantly affected the incidence of postural/headache symptoms.

Another study by Fjærvoll H., et al. (2022)[31] concluded VDT use is strongly associated with DED or Dry Eye Disease. VDT-associated DED is prevalent, but the exact prevalence needs to be further elucidated using standardized DED diagnosis criteria. Furthermore, a safe lower limit of daily VDT use has yet to be established. More research is needed on the effect of digitalization and digital transformation, which are particularly high during the time of the COVID-19 pandemic.

In conclusion, ocular discomfort is a common problem among individuals using digital devices for prolonged periods. While most people experience mild to moderate discomfort, a small proportion may experience severe symptoms. It is important to take preventive measures and seek medical attention if the symptoms persist or worsen over time.

Data analysis no. 7- Tostudy for association between VDT used & extra ocular discomfort

Hypothesis declared:

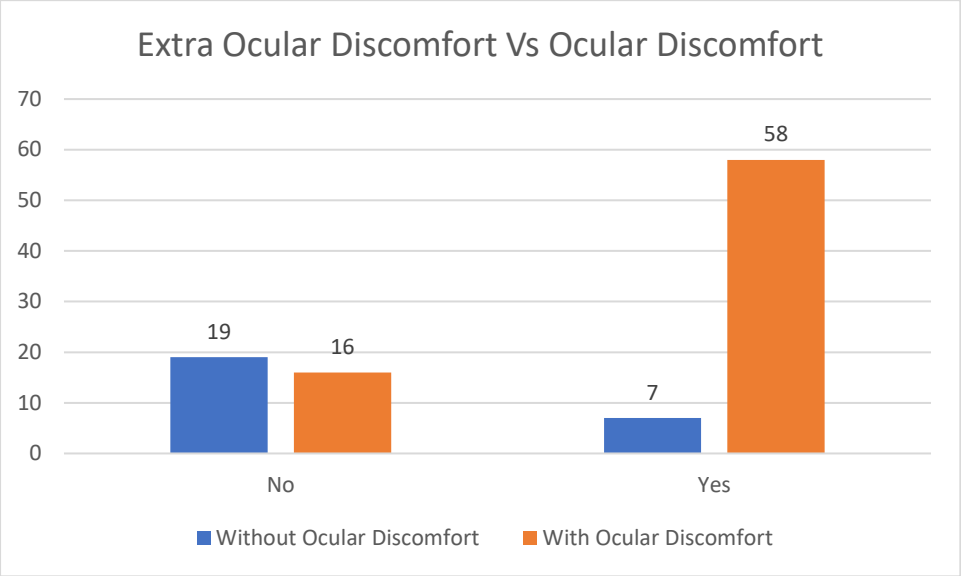
H0: There is no association between VDT used and extra ocular discomfort

H1: There is association between VDT used and extra ocular discomfort

Table no. 7

EXTRA OCULAR DISCOMFORT	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
No	19	16	**35**
Yes	7	58	**65**
Grand Total	**26**	**74**	**100**

Graph no. 7



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/ Chi-Square	P-value	Degree of Freedom	Critical Value	Result
9.1	25.9	10.77	3.784	22.39	0.05	1	3.841	**Reject H0**
16.9	48.1	5.799	2.037					

Out of total of 100 subjects, 26 respondents had no ocular discomfort, 7 subjects or about 26% subjects complained of extra - ocular discomfort, while out of 74 subjects who complained of ocular discomfort, 58 subjects or about 74% of the respondents complained of both ocular & extra-ocular discomfort.

Result:

Based on the additional data provided, we can see that out of the 26 subjects who had no ocular discomfort, 7 subjects or about 26% reported having extra-ocular discomfort. This suggests that even in the absence of ocular discomfort, individuals may still experience other types of discomfort or strain, such as headaches or neck pain, which may be associated with prolonged digital device use.

Discussion:

Among the 74 subjects who complained of ocular discomfort, a greater percentage (about 74%) reported experiencing both ocular and extra-ocular discomfort. This indicates that the discomfort associated with digital device use is not limited to the eyes, but may also affect other parts of the body, such as the neck, shoulders, and head.

It is important to note that the causes and treatments for ocular and extra-ocular discomfort may be different. For instance, while the main cause of ocular discomfort is often linked to issues with screen time and digital device use, extra-ocular discomfort may be caused by poor posture, lack of physical activity or exercise, or a combination of factors.

Therefore, treatment options for extra-ocular discomfort may involve lifestyle changes, such as posture correction, stretching exercises, and frequent breaks from sitting or standing in one position. Consultation with a healthcare professional may also be helpful in identifying potential underlying causes and developing a personalized treatment plan.

In a study conducted by Cheema MN, et al. (2019)[32], an institution based cross sectional study on 250 medical students of 4th year and final year of Islam medical and dental college Sialkot, Pakistan, within age group 21-25 years and who had used computers and digital devices in which 148 were females while 102 were males. It was calculated that headache was most common symptom among students almost 80% others were eye strain 48%, body pain 34%, epiphora 13%, back ache 60%, dryness 32%, photophobia 46% and slow refocusing 17%.

In another study conducted by Turkistani AN, et al. (2021)[33] on 690 participants, Neck /shoulder pain was found to be the most prevalent extra ocular symptom (85.2%) also, back pain and headache are frequently expressed (78% and 70% respectively). A significant

positive correlation was observed between CVS symptoms and time spent using the devices (P-value: 0.002).

In summary, the additional data suggests that extra-ocular discomfort is a common complaint among individuals using digital devices for prolonged periods and may be reported even in the absence of ocular discomfort. A comprehensive approach to addressing discomfort associated with digital device use may involve both ocular and extra-ocular considerations and may require a combination of preventive measures and medical interventions.

Data analysis no. 8- Tostudy for association between type of VDT used & type of extra ocular discomfort

Hypothesis declared:

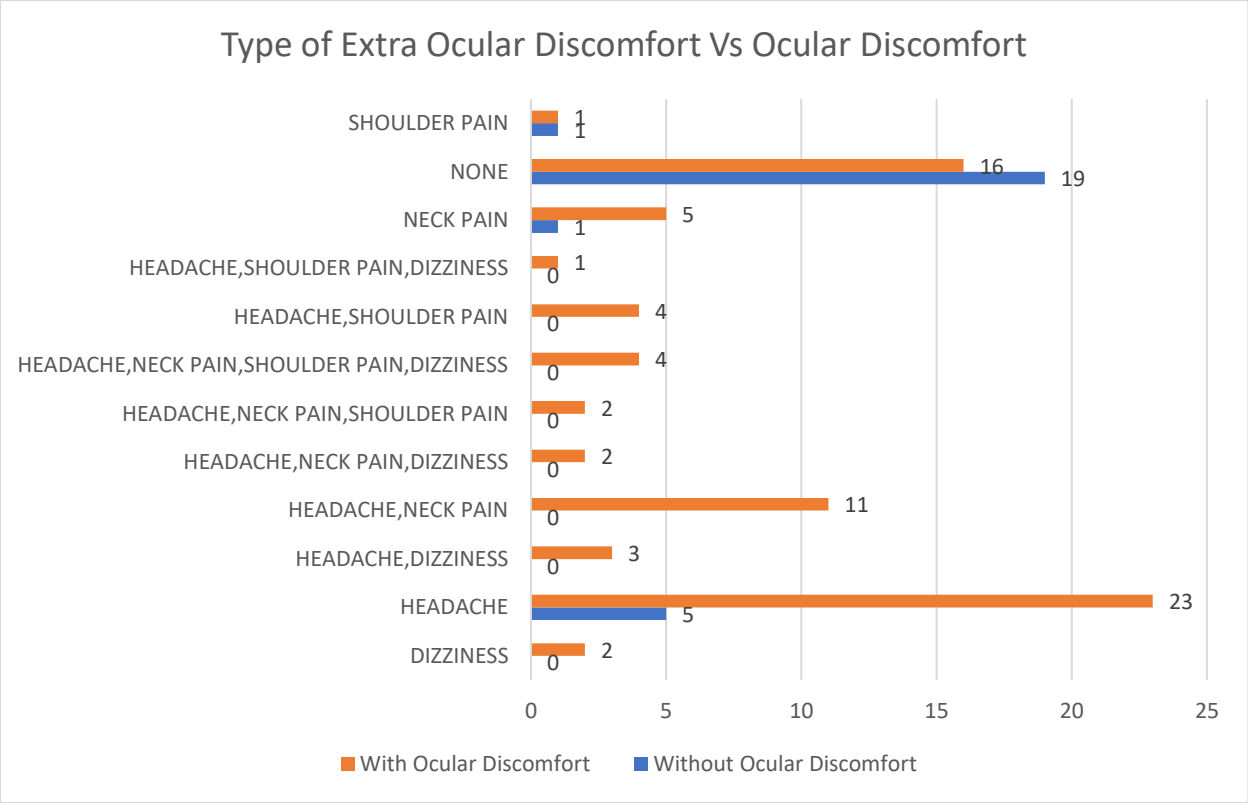
H0: There is no association between type of VDT used and type of extra ocular discomfort

H1: There is association between type of VDT used & type of extra ocular discomfort

Table no. 8

TYPE OF EXTRAOCULAR DISCOMFORT	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
DIZZINESS	0	2	**2**
HEADACHE	5	23	**28**
HEADACHE,DIZZINESS	0	3	**3**
HEADACHE,NECK PAIN	0	11	**11**
HEADACHE,NECK PAIN,DIZZINESS	0	2	**2**
HEADACHE,NECK PAIN,SHOULDER PAIN	0	2	**2**
HEADACHE,NECK PAIN,SHOULDER PAIN,DIZZINESS	0	4	**4**
HEADACHE,SHOULDER PAIN	0	4	**4**
HEADACHE,SHOULDER PAIN,DIZZINESS	0	1	**1**
NECK PAIN	1	5	**6**
NONE	19	16	**35**
SHOULDER PAIN	1	1	**2**
Grand Total	**26**	**74**	**100**

Graph no. 8



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/Chi-Square	P-value	Degree of Freedom	Critical Value	Result
0.52	1.48	0.52	0.1827	27.9287	0.05	11	0.553	**Reject H0**
7.28	20.72	0.714	0.25					
0.78	2.22	0.78	0.274					
2.86	8.14	2.86	1					
0.52	1.48	0.52	0.1827					
0.52	1.48	0.52	0.1827					
1.04	2.96	1.04	0.365					
1.04	2.96	1.04	0.365					
0.26	0.74	0.26	0.09					
1.56	4.44	1.56	0.07					
9.1	25.9	10.77	3.784					
0.52	1.48	0.443	0.1556					

Out of total of 100 subjects, 26 who didn't have ocular discomfort, 19 respondents or 73% respondents had no extra ocular discomfort but 5 respondents complained of headache and 1 each respondent complained for neck & shoulder pain, while out of 74 respondents who complained of extra – ocular discomfort, maximum 31% or 23 respondents complained of headache, 21% complained of ocular discomfort, 11 respondents or about 14% of respondents complained of headache & neck pain both, 5 respondents complained of neck pain, 4 respondents each for headache, neck pain, shoulder pain & dizziness.

Result:

Based on the additional data provided, we can see that among the 26 subjects who didn't have ocular discomfort, 19 respondents or 73% reported having no extra-ocular discomfort. However, 5 respondents complained of headache and 1 respondent each reported neck and shoulder pain. This suggests that even in the absence of ocular discomfort, individuals may still experience other physical symptoms like headaches and neck pain.

Moreover, among the 74 respondents who reported extra-ocular discomfort, the highest percentage of respondents (31%) reported having headaches. Other common complaints included neck pain (14%), ocular discomfort (21%), and dizziness (4%). This indicates that extra-ocular discomfort can manifest in a range of symptoms that affect different parts of the body.

Discussion:

It is worth noting that different underlying causes may contribute to different types of discomfort. For instance, headaches may be caused by prolonged screen time, dehydration, or improper posture. Neck and shoulder pain, on the other hand, may be linked to poor posture, muscle tension, or strain from holding a device at an awkward angle. Dizziness may also be caused by a range of factors, such as visual stress, lack of sleep, or vertigo.

Therefore, treatment options for extra-ocular discomfort may involve a combination of preventive measures and medical interventions tailored to the specific symptoms and underlying causes. This could include adjusting screen settings, taking more frequent breaks, practicing good posture, and engaging in stretching or relaxation exercises.

In a study conducted by Noreen K., et al. (2021)[34] on Computer Vision Syndrome (CVS) and its Associated Risk Factors among Undergraduate Medical Students in Midst of COVID-19 on 326 undergraduate medical students. Females were 228 (69%) and 98 (30%) were males. Age of the participants ranged between 17 to 25 years. Overall frequency of CVS was found to be 98.7%. Twenty nine percent students experienced extra ocular complaints and 71% had ocular symptoms. Symptoms of CVS were more commonly observed among those using desktop/laptop at less than forearm length ($p = 0.001$). Distance of < 12 inches from mobile phone was found to be associated with eye irritation and neck shoulder pain ($p = 0.001$). and study concluded that Health issues related to excessive use of digital devices has become alarmingly high during COVID-19 pandemic. Symptoms of CVS are significantly associated with distance from digital device and less frequent break intervals.

Another longitudinal study of VDT work and health by Bergqvist U., et al. (1992)[35] conducted with questionnaire data suggested that VDT use was related to the risk of developing eye discomforts and hand and wrist problems. For skin problems and headache, risks for VDT and non-VDT users were fairly similar, but indications of increased risks were found for certain groups and situations. The risks of developing neck, shoulder, shoulder joint, or upper arm problems were high for both VDT and non-VDT users, but there were, in this study, no convincing suggestions that these risks were higher for VDT users compared to nonusers.

The study involving 353 participants concluded that Eye discomforts and probably also hand/wrist problems were in general associated with VDT work.

Among the VDT workers, the risk of eye discomforts increased among those who reported increased immobility and use of keyboards. Increased keyboards use also increased the risk of hand/wrist problems. On the other hand, it appeared that new keyboards alleviated the problems in some individuals as to neck, shoulder and upper arm problems.

In summary, the additional data suggests that extra-ocular discomfort can manifest in a range of symptoms, including headaches, neck pain, shoulder pain, and dizziness. A comprehensive approach to addressing discomfort associated with digital device use may require a personalized approach that considers the individual's specific symptoms and underlying causes.

Another research paper published in medical journal of armed forces titled computer and visual display terminal VDT vision syndrome CVDTS by Parihar JK, et al. (2016)[36] concluded that Computer vision syndrome is an array of disorders, which encompass ocular, musculoskeletal, dermatological as well as psychological adverse effects among the users of Visual display units in either form. To summarize, appropriate refraction aids, use of higher frequency and higher resolution LED monitors, screen filters, improving the ambient lighting facility, modifying the ergonomic placement of monitors may ameliorate asthenopiccomponent; computer peripheral adjustments like forearm support. VDT use has been identified, emerged and implicated as a known influencing factor contributing toward developing dry eye disease (DED) affecting 10–70% of VDT users. An array of ocular complaints such as dry sensation, grittiness, burning, foreign body sensation, increased lacrymation, redness, tiredness, heaviness, and compulsion to blink frequently are reported by professional computer or VDT users and Musculoskeletal symptoms like neck pain, back

pain, and shoulder pain are frequently reported with use of computer with tendon related disorders (15%) and hand/wrist area (12%) as other most common disorder and most common affected area respectively. Nerve entrapment was reported in 4% of subjects.

Another study titled computer vision syndrome by Gowrisankaran S, et al. (2015) [37] concluded that Symptoms reported by computer users are classified into internal ocular symptoms (strain and ache), external ocular symptoms (dryness, irritation, burning), visual symptoms (blur, double vision) and musculoskeletal symptoms (neck and shoulder pain). The major factors associated with CVS are either environmental (improper lighting, display position and viewing distance) and/or dependent on the user's visual abilities (uncorrected refractive error, oculomotor disorders and tear film abnormalities).

Data analysis no. 9- Tostudy between type of VDT used & severity of extra – ocular discomfort

Hypothesis declared:

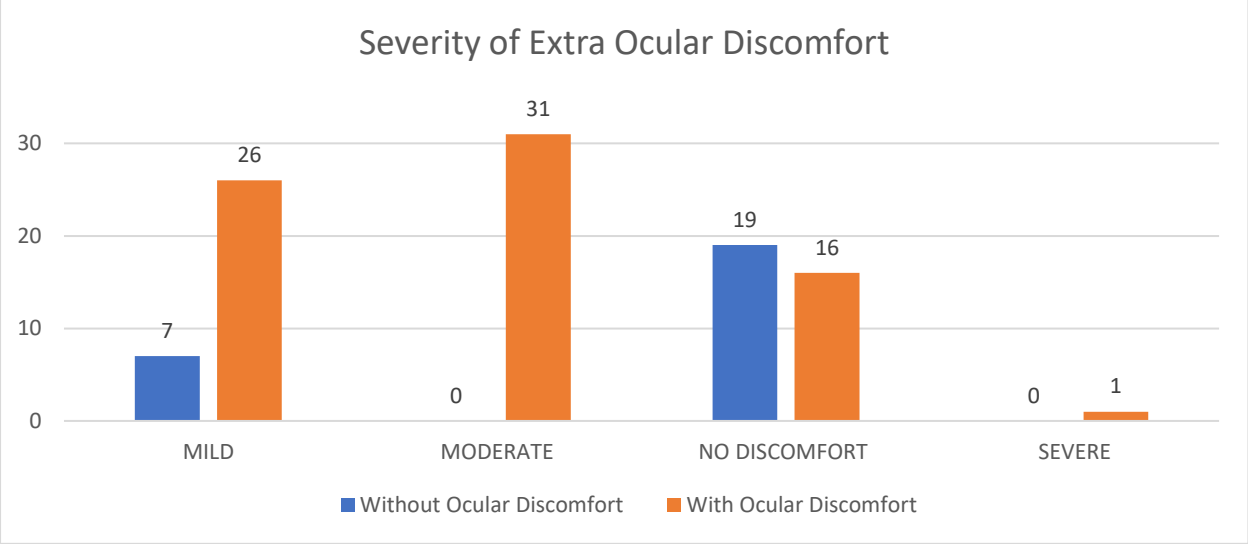
H0: There is no association between type of VDT used and severity of extra –ocular discomfort

H1: There is association between type of VDT used and severity of extra – ocular discomfort

Table no. 9

SEVERITY OF EXTRAOCULAR DISCOMFORT	Without Ocular Discomfort	WithOcular Discomfort	Grand Total
MILD	7	26	**33**
MODERATE	0	31	**31**
NO DISCOMFORT	19	16	**35**
SEVERE	0	1	**1**
Grand Total	**26**	**74**	**100**

Graph no. 9



Expected Value for N	Expected Value for Y	x(square) for N	x(square) for Y	Sigma(x-square)/ Chi-Square	P-value	Degree of Freedom	Critical Value	Result
8.58	24.42	0.29	0.102	26.188	0.05	3	0.878	**Reject H0**
8.06	22.94	8.06	2.831					
9.1	25.9	10.77	3.784					
0.26	0.74	0.26	0.091					

Out of total of 100 subjects, 74 subjects who complained of extra ocular discomfort, 31 subjects responded with moderate discomfort or about 41% while 26 subjects complained of mild and 1 subject complained of severe discomfort.

Result:

The data analysis shows that most of the subjects (74%) reported experiencing extra ocular discomfort. Out of these subjects, the majority (51%) reported moderate discomfort while only a small percentage (35%) reported mild discomfort and a negligible percentage (1%) experienced severe discomfort.

Discussion:

In a study conducted by Yamanishi R, et al. (2019) [38] on Analysis of the association between the severity of ocular and systemic pain on 41 participants concluded that that the ocular pain score was significantly associated with systemic pain score and participants with higher systemic pain scores have an increased risk of having ocular pain. Ocular pain is among the chief complaints of patients seeking ophthalmic medical help and is associated with a significant decline in the quality of life (QOL) due to anxiety, depression, and suicidal intentions. Neuropathic pain defined as pain arising as a direct consequence of a lesion or disease affecting the somatosensory system and can also occur in the cornea. The etiology of neuropathic ocular pain (NOP) may include ocular diseases including DED, infectious keratitis, herpetic keratitis, recurrent erosion syndrome, post-surgical pain, systemic disease, and post-traumatic stress disorders.

In another study by Sauter SL, et al. (1991)[39] on work posture, work station design and musculoskeletal discomfort in VDT use. Aspects of worker posture and workstation design were objectively assessed for 40 of the VDT users. Multiple regression analyses were used to examine the relationship between these ergonomic variables and musculoskeletal discomfort.

Effects of ergonomic factors on musculoskeletal discomfort were clearly evident in the analyses. Regression models explained up to 38% of the variance in discomfort at different body sites. In addition, arm discomfort increased with increases in keyboard height above elbow level, supporting arguments for low placement of the keyboard. Finally, high levels of neck and shoulder girdle discomfort observed in the study population suggest the need for further attention to the control of cervicobrachial pain syndromes in VDT work.

Another study titled Meibomian gland dysfunction and ocular discomfort in video display terminal workers by Fenga C, et al. (2008) [40] concluded that a total of 52 subjects out of 70 (74.3%) had MGD. A statistically significant correlation between the symptoms of ocular discomfort and hours spent on VDT work was observed in the total population (r=0.358; P=0.002; 95% CI 0.13–0.54) and in the group of subjects with MGD (r=0.365; P=0.009; 95% CI 0.103–0.58). Such correlation was not shown in subjects without MGD.

This study summarized that, the high prevalence of MGD among the subjects with symptoms of ocular discomfort suggesting that this diagnosis should be considered when occupational health practitioners encounter ocular complaints among VDT operators as it appears that MGD can contribute to the development of ocular discomfort in VDT users.

This information could be discussed in relation to potential causes and treatments for extra ocular discomfort. Factors such as screen time, environmental conditions, and underlying health conditions could be explored as possible contributors to discomfort. Additionally, the effectiveness of different interventions, such as eye drops or adjustments to screen settings, could be discussed considering these findings. Overall, this data provides important insights for understanding and addressing extra ocular discomfort.

Chapter – 6 Conclusion & Limitations

In conclusion, this questionnaire-based research paper titled "Ocular and Extra Ocular Discomfort Associated with Extended Digital Screen Time in Young Adults" examined the relationship between extended digital screen time and ocular and extra ocular discomfort in 100 university-enrolled students aged between 18 and 25 years and the study supports the declared hypothesis that there is a significant association between extended digital screen time and ocular and extra ocular discomfort among young adults.

The results of the study indicate that most of the participants reported experiencing ocular and extra ocular discomforts due to extended digital screen exposure. The study found that symptoms like headaches, eye strain, blurred vision, and dry eye were the most reported symptoms.

Limitations of the study include the use of a questionnaire which may not provide an accurate measurement of ocular and extra ocular discomfort compared to clinical evaluation. Also, the sample size was limited to university-enrolled students aged between 18 and 25 years of age, and the study did not consider other factors that may contribute to discomfort, such as lighting and workstation design.

This research paper provides valuable insight into the level of discomfort experienced by young adults due to extended use of digital screens. The findings of this study can help inform health professionals, educators, and policy makers on the importance of promoting healthy screen habits among young adults. Further research is needed to explore the causes, prevention, and management of ocular and extra ocular discomfort associated with extended digital screen time.

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QUESTIONNAIRE

1. NAME:

2. GENDER:

3. AGE:

4. ENROLLMENT NO.:

5. MOBILE NUMBER:

6. TYPE OF VDT USED: SMARTPHONE / COMPUTER / TABLET / GAMING CONSOLE

7. DURATION OF VDT USED DAILY: 1-2 HOUR / 2-3 HOUR / > 3 HOUR

8. OCULAR DISCOMFORT: Y/N

9. TYPE OF OCULAR DISCOMFORT (PLEASE TICK):

ITCHING / BLURRING / FOREIGN BODY SENSATION/ BURNING / WATERING / PAIN / FATIGUE

10. SEVERITY OF DISCOMFORT: MILD / MODERATE / SEVERE

11. EXTRAOCULAR DISCOMFORT: Y/N

12. TYPE OF OCULAR DISCOMFORT: (PLEASE TICK):

HEADACHE / NECK PAIN / SHOULDER PAIN / DIZZINESS

13. SEVERITY OF DISCOMFORT: MILD / MODERATE / SEVERE

14. HOURS OF DAILY SLEEP:

INFORMED CONSENT FORM

- I……. EXERCISING MY FREE POWER OF CHOICE, HEREBY GIVE MY CONSENT TO BE INCLUDED AS A SUBJECT IN THE CLINICAL STUDY ABOVE MENTIONED.
- I UNDERSTAND THAT I WILL BE EXAMINED IN DETAIL & I WILL BE INVESTIGATED IN DETAIL AS PER PROTOCOL OF THIS STUDY
- I HAVE BEEN INFORMED TO MY SATISTIFACTION THE PURPOSE OF THIS CLINICAL STUDY & THE NATURE OF THIS STUDY, INCLUDING ANY RELATED INVESTIGATIONS.
- I HAVE BEEN GIVEN A FULL EXPLANATION OF THE NATURE, PURPOSE & DURATION OF STUDY.
- I UNDERSTAND THAT THE RESEAERCHER MAY STOP THE STUDY OR MY PARTICIPATION IN THIS STUDY AT ANY TIME FOR ANY REASON WITHOUT MY CONSENT.
- I AM ALSO AWARE OF MY RIGHT TO OPT OUT OF THIS CLINICAL STUDY AT ANY TIME WITHOUT ASSIGNING ANY REASON THEREOF
- I HEREBY GIVE MY PERMISSION TO RESEARCHERS OF THIS STUDY TO RELEASE THE INFORMATION GATHERED AS A RESULT OF MY PARTICIPATION IN THIS STUDY TO NATIONAL OR INTERNATIONAL REGULATORY AUTHORITIES & GOVERNMENT AGENCIES & TO ALLOW THEM TO INSPECT ALL MY RECORDS

- I UNDERSTAND THAT MEDICAL RECORDS THAT REVEAL MY IDENTITY WILL REMAIN CONFIDENTIAL, EXCEPT THAT THEY WILL BE PROVIDED AS NOTED ABOVE OR AS MAY BE REQUIRED BY LAW.
- Signature (or Thumb impression) of the subject: ….....
- Name of the subject: ….....
- Date and place: ….....
- Name of the impartial witness: ….....
- Date and place: ….....
- Signature of the witness: ….....
- I conform that I have explained the nature, purpose and possible hazards of the above clinical study to Mr./Ms./Mrs.

  ……

- Signature of investigator: ….....
- Date and place: ….....

सूचितसहमति

- मैंयहघोषणाकरता/करतीहूँकिमैंनेइससहमतिपत्रकोपढ़लियाहै/ पढ़करसुनादियागयाहै।मेरीअपनीभाषामेमुझपरकिएजानेवालेशोधऔरपरीक्षणकेबारेमेभलीभा तिसमझादियागयाहैतथाइसविषयमेंकिसीप्रकारकीजानकारीप्राप्तकरने/ प्रशनकरनेकापूर्णअवसरप्रदानकियागयाहै।मैंभलीभातिअवगतहूँकिइसशोधमेंभागलेनाअथवान हींलेनापूर्णरूपसेस्वेक्षिकहैतथाकिसीभीसमयबिनाकोईकारणबताएअध्ययनसेअपनीचिकित्सकी यदेखभालअथवावैधानिकअधिकारोंकोप्रभावितनाहोतेहुएअलगहोसकता/ सकतीहूँ।
- मैंयहभलीभातिसमझता/समझतीहूँकिइसअध्ययनकोकरनेवाले, एथिक्सकमेटीअध्वाअन्यनियामकसंस्थानकोमेरीसहमतिकेबगेर, मेरीस्वास्थ्यसम्बधीअभिलेख, वर्तमानअधेयनोंतथाआगामीअन्यरिसर्चमेंउपयोगकियाजाएगा।मैंयेभीसमझता/ समझतीमेरेपहचानतथाअन्यसूचिनाएँकिसीतृतीयपक्षसेसांझानहींकिजाएगीयाप्रकाशितनहींकिया जाएगा।
- मेरेशोधसेवीरतहोनेकिदशामें, मैंअपनेसेसंबंधितसमस्तनतीजेजोइसशोधसेप्राप्तहोंगेउसकाउपयोगकेवलवेगयानिकप्रकाशनहेतु सहमतिप्रदानकरता/करतीहूँ।
- मुझेबतायागयाहैकिकिसीभीप्रकारकेपरीक्षणकिलिएमुझेकोईभूकताननहींकरनाहोगा।सभीभूक तानअध्ययनकर्ताद्वाराकियाजाएगा।
- मुझेबतायागयाहैकिअध्ययनमेंसम्मलितहोनेकेलिएसमस्तसावधानीबरततेहुएजांचइत्यादिसेहोनेवा लीजटिलताओंकोमुझेभलीभातिसमझादियागयाहै।
- मरीज़/ व्यक्तिकेअंगूठेकानिशान/ हस्ताक्षर:
- व्यक्तिकानाम: दिनांक:
- अध्ययनकर्ताकेहस्ताक्षर:
- अध्ययनकर्ताकानाम: दिनांक:
- गवाहकेहस्ताक्षर: दिनांक:

INSTITUTIONAL ETHICS COMMITTEE (IEC)

IIMS&R INTEGRAL UNIVERSITY, LUCKNOW

IEC/IIMS&R/2023/06

CERTIFICATE

This is to certify that research work entitled "**Ocular & Extraocular Discomfort Associated with Extended Digital Screen Time In Young Adults**" submitted by **Dr. Nitya Mehrotra** for ethical approval before the Institutional Ethics Committee IIMS&R. The above mentioned research work has been approved by Institutional Ethics Committee, IIMS&R with consensus in the meeting held on **30th December** 2022.

Dr.Q.S.Ahmed
(Member Secretary)
IRC/IEC
IIMS &R

Master Chart

Subject No 1-34, Page 1

sno.	enrollment no.	gender	age	type of vdt used	duration of vdt used daily	od	type of od	severity of discomfort	eod	type of eod	severity of discomfort	hours of daily sleep
1	2200103050	f	20	smartphone	2-3 hours	y	blurring	mild	y	headache	mild	7-8 hours
2	2200103045	f	18	smartphone	2-3 hours	y	blurring	moderate	y	headache	mild	7-8 hours
3	2200103031	m	18	smartphone	2-3 hours	y	blurring	moderate	n	-	-	6-7 hours
4	2200103008	m	22	smartphone	>3 hours	y	blurring	moderate	n	-	-	6-7 hours
5	2200100164	m	21	smartphone,computer,tablet	>3 hours	y	blurring,burning,watering	mild	y	headache,neck pain	mild	5-6 hours
6	2200102271	m	18	smartphone,tablet	>3 hours	y	blurring,pain	moderate	y	dizziness	moderate	7-8 hours
7	2200101249	m	18	smartphone,computer	>3 hours	y	blurring,watering	mild	y	headache	mild	5-6 hours
8	2200103061	f	18	smartphone	2-3 hours	y	blurring,watering	mild	y	headache,neck pain	mild	6-7 hours
9	2200103222	f	20	smartphone	1-2 hours	y	blurring,watering	mild	y	headache,neck pain	mild	6-7 hours
10	2200100781	m	20	smartphone	>3 hours	y	blurring,watering,pain	mild	y	headache,dizziness	mild	7-8 hours
11	2200102290	f	20	smartphone	>3 hours	y	blurring,watering,pain	moderate	y	headache,neck pain	moderate	6-7 hours
12	2200100348	f	19	smartphone	1-2 hours	y	blurring,watering,pain,fatigue	moderate	y	headache,shoulder pain	moderate	6-7 hours
13	2200100378	f	18	smartphone	2-3 hours	y	burning	moderate	y	headache	moderate	6-7 hours
14	2200103012	f	24	smartphone	2-3 hours	y	burning	mild	n	-	-	6-7 hours
15	2200100073	m	20	smartphone	2-3 hours	y	burning	moderate	n	-	-	7-8 hours
16	2200100112	f	20	smartphone	>3 hours	y	burning,watering	moderate	y	headache	moderate	6-7 hours
17	2200103241	f	23	smartphone	>3 hours	y	fatigue	mild	y	headache	mild	7-8 hours
18	2200100306	m	22	smartphone	2-3 hours	y	fatigue	mild	y	neck pain	mild	7-8 hours
19	2200103014	f	20	smartphone	2-3 hours	y	fatigue	mild	n	-	-	6-7 hours
20	2200102047	m	21	smartphone	2-3 hours	y	fatigue	mild	n	-	-	7-8 hours
21	2200103838	f	19	smartphone	>3 hours	y	foreign body sensation,burning,pain	mild	y	headache,neck pain	mild	5-6 hours
22	2200100062	f	25	smartphone	>3 hours	y	foreign body sensation,fatigue	moderate	y	headache,neck pain	moderate	7-8 hours
23	2200100548	f	18	smartphone,tablet	2-3 hours	y	foreign body sensation,pain	mild	y	headache	mild	6-7 hours
24	2200100191	f	25	smartphone	1-2 hours	y	itching	mild	y	headache	mild	7-8 hours
25	2200100470	m	28	smartphone,tablet	2-3 hours	y	itching	mild	y	headache	mild	6-7 hours
26	2200103498	f	19	smartphone	>3 hours	y	itching	mild	n	-	-	7-8 hours
27	2200102299	f	20	smartphone,tablet	>3 hours	y	itching,blurring,burning,pain	mild	y	headache	moderate	5-6 hours
28	2200100110	f	20	smartphone,tablet	>3 hours	y	itching,blurring,burning,pain,fatigue	moderate	y	headache,neck pain,shoulder pain	moderate	5-6 hours
29	2200100237	f	23	smartphone	>3 hours	y	itching,blurring,burning,watering,pain,fatigue	severe	y	headache,neck pain,shoulder pain,dizziness	moderate	6-7 hours
30	2200100121	f	20	smartphone,computer	>3 hours	y	itching,blurring,burning,watering,pain,fatigue	moderate	y	headache,neck pain,shoulder pain,dizziness	moderate	5-6 hours
31	2200102236	m	18	smartphone	>3 hours	y	itching,blurring,foreign body sensation,pain	moderate	y	headache,shoulder pain	moderate	6-7 hours
32	2200102245	m	19	smartphone	>3 hours	y	itching,blurring,pain	moderate	y	headache,shoulder pain	moderate	5-6 hours
33	2200100039	f	22	smartphone	>3 hours	y	itching,blurring,watering	mild	y	headache,shoulder pain,dizziness	moderate	7-8 hours
34	2200102976	m	20	smartphone	>3 hours	y	itching,blurring,watering,pain,fatigue	moderate	y	neck pain	mild	3-4 hours

Master Chart

Subject No 35-68, Page 2

sno.	enrollment no.	gender	age	type of vdt used	duration of vdt used daily	od	type of od	severity of discomfort	eod	type of eod	severity of discomfort	hours of daily sleep
35	2200100345	f	19	smartphone	2-3 hours	y	itching,burning	moderate	y	headache	moderate	6-7 hours
36	2200100058	m	23	smartphone	2-3 hours	y	itching,burning	moderate	y	headache,neck pain	moderate	5-6 hours
37	1900102505	f	21	smartphone	2-3 hours	y	itching,burning, pain,fatigue	mild	y	headache,neck pain,shoulder pain,dizziness	mild	5-6 hours
38	2200102273	f	20	smartphone	>3 hours	y	itching,burning,watering	moderate	y	headache	mild	5-6 hours
39	2200100553	m	20	smartphone	2-3 hours	y	itching,burning,watering	moderate	y	headache,neck pain	moderate	5-6 hours
40	2200100776	f	21	smartphone,computer	>3 hours	y	itching,burning,watering,fatigue	moderate	y	headache,neck pain,shoulder pain	moderate	5-6 hours
41	2200101112	f	23	smartphone	2-3 hours	y	itching,foreign body sensation,fatigue	mild	y	headache,dizziness	mild	6-7 hours
42	2200104165	f	22	smartphone	>3 hours	y	itching,pain	mild	y	headache	mild	5-6 hours
43	2200100691	m	19	smartphone,computer	>3 hours	y	itching,pain	moderate	y	headache,neck pain,dizziness	moderate	5-6 hours
44	2200102994	m	21	smartphone,tablet	2-3 hours	y	itching,watering	mild	y	headache	mild	6-7 hours
45	2200103013	f	20	smartphone	2-3 hours	y	itching,watering	mild	y	headache	mild	5-6 hours
46	2200100307	f	22	smartphone	>3 hours	y	itching,watering	mild	y	headache,neck pain	moderate	5-6 hours
47	2200100326	f	20	smartphone	1-2 hours	y	itching,watering	mild	y	headache,shoulder pain	moderate	5-6 hours
48	2200100531	m	20	smartphone,computer	>3 hours	y	itching,watering	severe	y	neck pain	severe	5-6 hours
49	2200103052	m	21	smartphone	>3 hours	y	itching,watering	moderate	n	-	-	5-6 hours
50	2200100458	f	19	smartphone,tablet	>3 hours	y	itching,watering,pain,fatigue	moderate	y	headache,neck pain,dizziness	moderate	6-7 hours
51	2200100857	f	18	smartphone,computer	>3 hours	y	itching,watering,pain,fatigue	moderate	y	headache,neck pain,shoulder pain,dizziness	moderate	5-6 hours
52	2200103842	m	22	smartphone	2-3 hours	y	pain	moderate	y	headache	moderate	7-8 hours
53	2200103207	m	20	smartphone	>3 hours	y	pain	moderate	y	headache	moderate	6-7 hours
54	2200100090	f	22	smartphone	2-3 hours	y	pain	moderate	y	headache	moderate	6-7 hours
55	2200102220	f	23	smartphone	2-3 hours	y	pain	mild	y	headache,neck pain	mild	6-7 hours
56	2200103524	f	18	smartphone	>3 hours	y	pain	mild	y	neck pain	moderate	6-7 hours
57	2200100038	m	24	smartphone,computer,tablet,gaming console	1-2 hours	y	pain	mild	n	-	-	5-6 hours
58	2200103059	f	18	smartphone	2-3 hours	y	watering	mild	y	headache	mild	6-7 hours
59	2200103281	m	19	smartphone,computer	>3 hours	y	watering	moderate	y	headache	moderate	6-7 hours
60	2200101211	f	19	smartphone	>3 hours	y	watering	mild	y	headache,dizziness	moderate	5-6 hours
61	2200100700	m	17	smartphone,computer,gaming console	2-3 hours	y	watering	moderate	y	headache,neck pain	moderate	6-7 hours
62	2200103963	m	24	smartphone	>3 hours	y	watering	mild	y	neck pain	mild	6-7 hours
63	2200103002	m	20	smartphone	1-2 hours	y	watering	moderate	n	-	-	7-8 hours
64	2200103009	m	17	smartphone	1-2 hours	y	watering	moderate	n	-	-	6-7 hours
65	2200102979	m	19	smartphone	1-2 hours	y	watering	moderate	n	-	-	7-8 hours
66	2200103238	m	21	smartphone	>3 hours	y	watering	mild	n	-	-	6-7 hours
67	2200100915	m	27	smartphone	>3 hours	y	watering	mild	n	-	-	7-8 hours
68	2200104455	m	23	smartphone	>3 hours	y	watering	mild	n	-	-	6-7 hours

Master Chart

Subject No 69-100, Page 3

sno.	enrollment no.	gender	age	type of vdt used	duration of vdt used daily	od	type of od	severity of discomfort	eod	type of eod	severity of discomfort	hours of daily sleep
69	2200104565	m	24	smartphone	>3 hours	y	watering	mild	y	headache	moderate	6-7 hours
70	2200100190	m	21	smartphone,computer	2-3 hours	y	watering	moderate	y	headache	moderate	7-8 hours
71	2200100209	m	23	smartphone,computer	>3 hours	y	watering,fatigue	mild	y	dizziness	mild	7-8 hours
72	2200100414	f	23	smartphone	>3 hours	y	watering,pain	mild	y	headache	mild	6-7 hours
73	2200101170	m	21	smartphone	>3 hours	y	watering,pain	moderate	y	shoulder pain	mild	7-8 hours
74	2200102990	f	18	smartphone	>3 hours	y	watering,pain	mild	n	-	-	6-7 hours
75	2200100161	m	25	smartphone	>3 hours	n	-	-	y	headache	mild	6-7 hours
76	2200100339	m	23	smartphone	>3 hours	n	-	-	y	headache	mild	5-6 hours
77	2200100192	m	25	smartphone	2-3 hours	n	-	-	y	headache	mild	7-8 hours
78	2200101632	f	23	smartphone	1-2 hours	n	-	-	y	headache	mild	5-6 hours
79	2200101222	f	19	smartphone	>3 hours	n	-	-	y	headache	mild	6-7 hours
80	2200100415	f	22	smartphone	1-2 hours	n	-	-	y	neck pain	mild	6-7 hours
81	2200100040	m	22	smartphone	1-2 hours	n	-	[redacted]	y	shoulder pain	mild	5-6 hours
82	2200102997	m	19	smartphone	2-3 hours	n	-	-	n	-	-	5-6 hours
83	2200100820	m	21	smartphone	>3 hours	n	-	-	n	-	-	7-8 hours
84	2200100158	f	18	smartphone	>3 hours	n	-	-	n	-	-	6-7 hours
85	2200103000	m	19	smartphone	1-2 hours	n	-	-	n	-	-	7-8 hours
86	2200103015	f	22	smartphone,computer	2-3 hours	n	-	-	n	-	-	7-8 hours
87	2200103097	m	20	smartphone	>3 hours	n	-	-	n	-	-	7-8 hours
88	2200102211	m	20	smartphone	>3 hours	n	-	-	n	-	-	7-8 hours
89	2200103010	m	21	smartphone	>3 hours	n	-	-	n	-	-	7-8 hours
90	2200102238	m	19	smartphone	>3 hours	n	-	-	n	-	-	7-8 hours
91	2200102228	m	19	smartphone	1-2 hours	n	-	-	n	-	-	7-8 hours
92	2200103032	m	18	smartphone,computer	2-3 hours	n	-	-	n	-	-	7-8 hours
93	2200102301	m	19	smartphone	2-3 hours	n	-	-	n	-	-	7-8 hours
94	2200102578	f	22	smartphone	2-3 hours	n	-	-	n	-	-	7-8 hours
95	2200103429	m	22	smartphone	1-2 hours	n	-	-	n	-	-	6-7 hours
96	2200103532	f	19	smartphone	1-2 hours	n	-	-	n	-	-	7-8 hours
97	2200103360	m	22	smartphone	>3 hours	n	-	-	n	-	-	7-8 hours
98	2200100958	m	22	smartphone	1-2 hours	n	-	-	n	-	-	6-7 hours
99	2200100778	m	22	smartphone,computer	2-3 hours	n	-	-	n	-	-	6-7 hours
100	2200100438	m	21	smartphone,computer	>3 hours	n	-	-	n	-	-	5-6 hours

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