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## Eye exercises are effective in managing digital eye strain among school students in selected Higher Secondary Schools, West Bengal: Quasi-experimental study

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### ABSTRACT

Background: Vision is considered the most dominant among the human sensory modalities. In recent years, there has been a significant rise in the use of digital devices—such as desktops, laptops, tablets, smartphones, personal access devices (PADs), televisions, and video games—particularly among students for educational activities, online learning, entertainment, and social engagement. One of the most prevalent adverse effects associated with prolonged use of such devices is Digital Eye Strain (DES). Common symptoms of DES include ocular discomfort, headaches, and blurred vision. Therefore, implementing appropriate preventive strategies is essential to mitigate the risk of digital eye strain and maintain visual health.

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### Introduction:

Vision is the most dominant of human senses. Sight is the biggest power to want to witness the beauty of the world and nature. We are swiftly moving into the digital world. Today's lifestyle and extensive use of digital devices are taking a heavy toll on the well-being of the eyes. This is the phase of essential development where technology is taking over every corner of life in running 21st century. Smartphones, laptops, and tablets are no more unknown words.

In the contemporary digital era, the human eye is continually exposed to electronic screens, ranging from smartphones and laptops to televisions. **Tanaya Dalvi (2023)** observed that prolonged screen exposure,



when compounded with factors such as age and hereditary predisposition, significantly contributes to visual health issues. Consequently, an increasing number of individuals are turning to **eye exercises** as a preventive and restorative strategy to maintain visual well-being.

Numerous studies from different regions have highlighted the global prevalence of **Digital Eye Strain (DES)**. A study conducted in China by **Wang et al. (2021)** among online learners revealed that **72.1%** of students reported symptoms of eye strain. Similarly, a **cross-sectional study** in Jordan by **Gammoh (2021)** indicated that **94.5%** of university students suffered from **Computer Vision Syndrome (CVS)**. In Peru, **Huyhua-Gutierrez et al. (2023)** reported that **87.6%** of nursing students exhibited symptoms of DES, further validating its widespread occurrence across academic populations.

In South India, **Motappa, Sachith, et al. (2023)** found that **85%** of students experienced moderate levels of stress associated with extended online class engagement. Supporting this, **Ranasinghe et al. (2016)** concluded that the use of digital devices such as mobile phones and tablets showed a statistically significant association with the occurrence of CVS.

Further, **Gammoh (2020)** reported a **94.5% prevalence** of CVS in a university-based cross-sectional study, with **tearing (59%)** being the most common symptom and **diplopia (18.3%)** the least. Notably, **55.5%** of participants used digital devices for more than **six hours daily**, and **30.7%** reported **musculoskeletal discomfort**, particularly in the fingers and wrists, due to mobile phone usage.

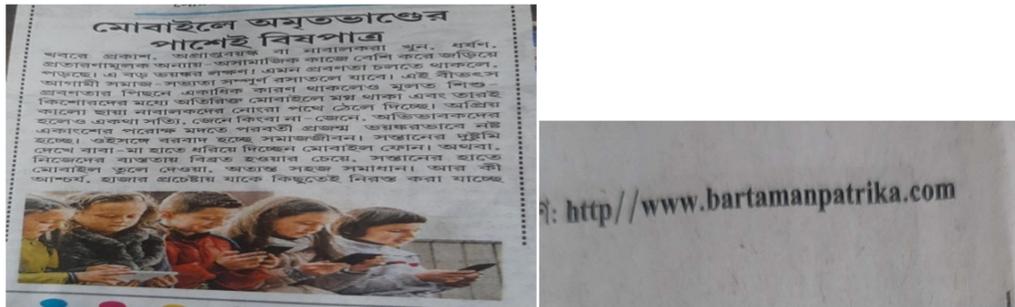
Lastly, a study by **Chawla, Yadav, and Chugh et al. (2021)** revealed that the **mobile phone** was the most commonly used digital device, with **88.02%** of participants ( $n = 485$ ) reporting at least one symptom of **ocular discomfort**, while **76.77%** ( $n = 423$ ) also experienced **non-ocular symptoms** such as neck or back pain.

**Alghamdi W, Alrasheed S (2020)** described that computer vision syndrome (CVS) the symptoms slightly reduced after intervention,  $9.00 \pm 3.03$  to  $8.35 \pm 1.89$  ( $p=0.38$ ). So significant increase after intervention (pre- $6.20 \pm 2.02$  and post- $8.55 \pm 2.84$ s) ( $p=0.005$ ). Educational intervention 20/20/20 rule induces significant changes in dry eye symptoms.

Eye exercise has been associated with better self-rated relaxation as well as with physiological relaxation. Diligent Yoga practice appeared to appease visual discomfort (Shirley Telles, K V Naveen, Manoj Dash, et al 2006) 10% of students were willing to take any measures to prevent the disease. Majority of Nursing students almost 66% obtained acceptable preventive measures score with respect to digital eye strain (S.K2022)



In order to enhance long-term productivity and reduce adverse health effects, there is a pressing need to raise awareness and improve understanding regarding the appropriate and balanced use of digital devices. Establishing a healthy interaction with technology is essential to safeguarding visual health while continuing to benefit from the convenience and functionality that these digital tools offer in modern life.



At 12.02 2024 in Bartaman paper it is published that engagement of students on mobile phone and effect of this in West Bengal.

Eye exercises, traditionally practiced as part of vision therapy, are designed to enhance the coordinated functioning of both eyes. Certain symptoms—such as visual discomfort, fatigue, and difficulty focusing—may suggest the potential benefit of such eye-strengthening practices. However, **limited empirical research** has been conducted to evaluate the effectiveness of eye exercises specifically in addressing **Digital Eye Strain (DES)**. A review of existing literature indicates a notable research gap concerning the prevalence and management of digital eye strain, particularly among school-aged students.

In light of this gap, the present study aims to investigate the challenges associated with the use of digital educational tools and to raise awareness about the potentially serious consequences of prolonged screen exposure. Furthermore, the development of **baseline data** is essential for planning and implementing effective awareness campaigns and preventive interventions.

Researcher felt that it would be beneficial to conduct a study among school students to assess the effectiveness of eye exercise on level of digital eye strain .The study also help the students to lower the digital eye strain and make their work easier, appropriate use of digital devices can progress of vision health. The study was designed to assess the effectiveness of eye exercise on digital eye strain among school students by using CVS-Q questionnaire.

### Methods

Permission has taken from Institutional Ethics Committee by Dean of Madhya Pradesh Global University Bhopal Madhya Pradesh after proper RDC at the presence of committee members and



Administrative permission was taken from Head Master of High secondary school Sutahata Jana kalyan Siskhya Niketan and Vivekananda Mission Ashram Sikhnikatan Sutahata East Midnapore. West Bengal.. Permission and Informed consent from Guardian for less than 18 yrs age students and Inform consent will be taken from respondents. Privacy and confidentiality will be maintained throughout the study. A written consent form was signed prior to conducting the study purposive sampling technique was employed in this study. Collected 40 samples are divided in two groups as Experimental and Control group with 20 in each group A semi-structured questionnaire was used to obtain socio-demographic data , a standardized rating scale questionnaire was used for measuring digital eye strain. Tools were developed & validated by using Cronbach's Alpha (.92) and the test re test r (.90) method. Each participant was responding using a questionnaire which include the demographic profile, hours of digital device /day and common DES related symptoms like headache, dry eyes etc.

They were also asked to indicate the grade of visual problem during or after digital device usage. Categories for different Digital eye strain were listed as follows: none, mild, moderate and severe. Participants were asked to answer 16 validated questions ,DES score in between none (0-5) between (6-12)was considered as mild ,moderate (13-18) and (19-32) was considered as severe.

### Statistical Analysis

All collected data were analyzed using both **descriptive and inferential statistical techniques**. Descriptive statistics were employed to summarize the data and were presented in terms of **frequencies, percentages, means, and standard deviations**. To determine the association between the **pre-test levels of digital eye strain** and selected **socio-demographic variables** among school students in both the experimental and control groups, the **Chi-square test** was utilized.

Furthermore, a **paired t-test** was conducted to evaluate the effectiveness of the intervention by comparing pre- and post-test scores within the experimental group. The **level of statistical significance was set at  $p < 0.05$** .

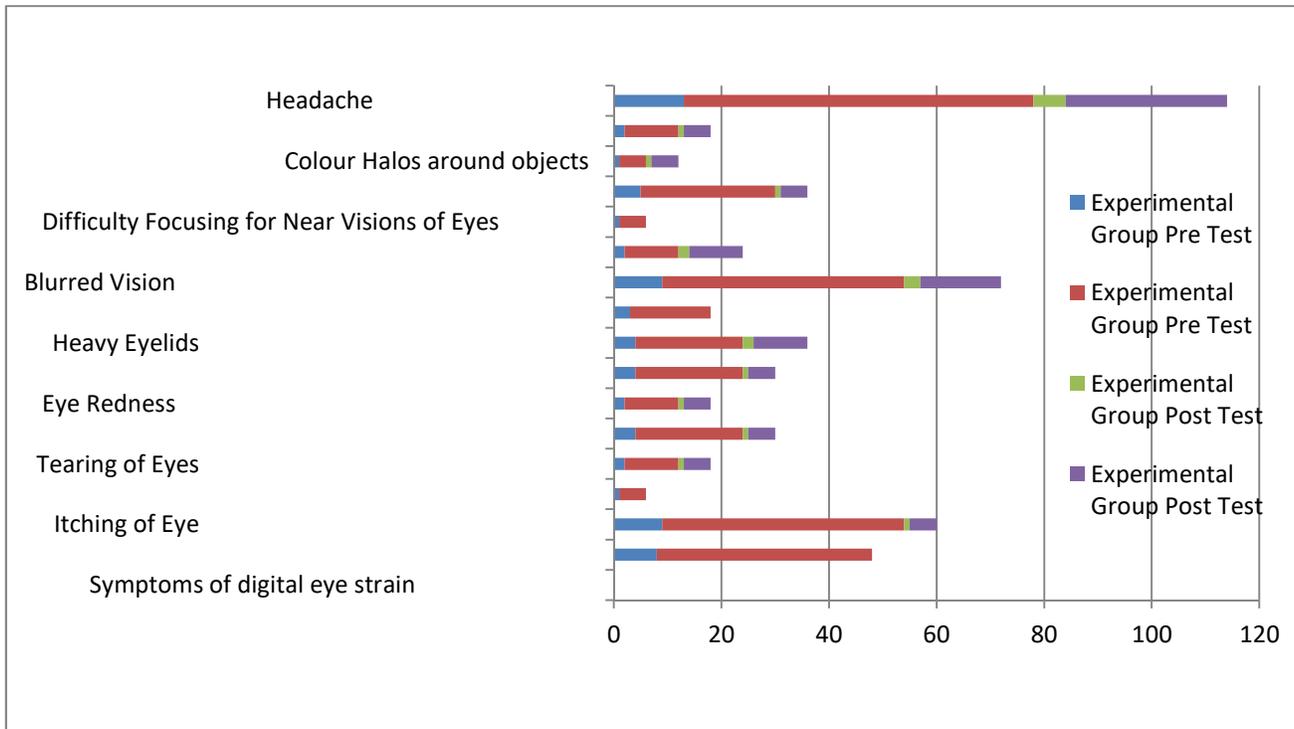
### Results

In the present study shows that among Experimental group that majority (55%) of students belonged to the age group of 13-16 years, and 45% belonged to the age group of 17-18 years. 65% students used digital device <2 yrs and 1-2 hrs/day.70% students spend leisure time with sports but 40% students engaged with mob games and 45% students were using phone day and night time kept mobile 10-18 inch distance . Control group- majority (100%) of students belonged to the age group of 13-16 years.,100%



students used digital device <2 yrs and 60% used mobile 1-2 hrs/day and 35% used mobile >3 hrs/day. Only 25% students spend leisure time with sports but 50% students engaged with mob games and 40% students were using phone day and 60% students night time 95% students kept mobile 10-18 inch distance . In both group (90%) students family income <20000 RS/month and 100% students used smart phone.

n=20



**Figure I:** Frequency and percentage distribution of school students as presence of digital eye strain2 shows that at pre-test in Experimental group among all the symptoms headache was the most common of experienced as 65% of participants .This was followed by blurred vision and itching of eyes (45%) ,burning of eyes (40%).tearing of eyes (66.6%).After post-test all of participants expressed that they had less symptoms. There was no burning of eyes,(30%) participants were experienced headache respectively.

**Table 1** Distribution of students in terms of Frequency and intensity of Digital eye strain. Experimental group n=20

Symptoms of digital eye strain	Total no of participants experience the symptoms	Occasionally moderate Intensity f(%)	Occurring Intense Intensity f(%)	Often/Always Moderate Intensity f(%)	Occurring Intense Intensity f(%)
Burning Eyes	8	-	8 (40)		
Itching of Eye	9	8(40)	-	1	-
Feeling of a Foreign Body in Eyes	1	1			
Tearing of Eyes	2		2	1	-
Excessive Blinking	4	4			-
Eye Redness	2				-
Eye Pain	4		2	2	-
Heavy Eyelids	4				-
Dryness of Eyes	3	3			-
Blurred Vision	9	9(45)			-
Double Vision	2	2			-
Difficulty Focusing for Near Visions of Eyes	1	1			-
Increased Sensitivity to Light	5	5(25)			-
Colour Halos around objects	1	1			-
Feeling Eye sight is Worsening	2	2			-
Headache	13	9(45)	2		2

\*Multiple responses included

The data presented in table 1 depicts that out of 20 participants majority 13(65%) of them 9(45%) occasionally experienced headache at a moderate Intensity. However, a small percentage (10%) of the



participants experienced occurring headache with Intense Intensity.(45%) of participants reported blurred vision with occasionally intense intensity , (25%) of participants having increased sensitivity of light.

Table 2 Mean, Median, Standard deviation (SD), mean percentage of digital eye strain among school students (pre-test and post-test), Experimental group)

n=20

Digital eye strain	Range of possible score	Range of obtained score	Mean	Median	SD	Mean Percentage
Pre test	0-32	0-10	3.7	4	2.69	23%
Post test	0-32	0-10	1.05	1	1.05	7%

The data presented in table 2 shows pre test the Digital eye strain score among school students ranged from 0-32, the maximum obtained possible score was 10, the mean digital eye strain score was 3.7 and the Median was 4 with SD 2.69. The mean percentage of digital eye strain was 23% In post test the digital eye strain score ranged from 0-32, the maximum possible score was 4, the mean digital eye strain score was 1.05 and the Median was 1 with SD 1.05. The mean percentage of digital eye strain was 07%

Table 3 Frequency and percentage distribution of school students according to grade of digital eye strain (pre-test and post-test), Experimental group

n=20

		Pre test		Post test	



Grades of digital eye strain	Range of score	Frequency	Percentage	Frequency	Percentage
None	0-5	18	90	20	100
Mild DES	6-12	02	10		
Moderate DES	13-18				
Severe DES	19-32				

Maximum possible score:32

Minimum possible score: 0

The data presented in table 3 shows that in pretest 90% of the participant did not any significant sign of digital eye strain. The prevalence of digital eye strain was 10%. Out of this majority (10%) of the participants were suffering from Mild grade digital eye strain and no participants were suffering from moderate to severe grade of digital eye strain.

In posttest that 100% of the participant did not any significant sign of digital eye strain.

Table 4: Mean, Median, Standard deviation (SD) mean percentage, and paired' t' of digital eye strain among school students (Pre &post-test) Experimental group)

n=20

Digital eye strain	Mean	Median	SD	Mean Difference	Paired t -test
Pre-test	3.7	4	2.69	2.65	2.9
Post test	1.05	1	1.05		

t=2.262with df=9 at 0.05 level of significance(p=0.0095)



From the table 4 it was observed that there were statistically significant difference in mean values between pretest & posttest digital eye strain score as the calculated value of  $t(2.9)$  was higher than table value  $t_s(2.26)$  with  $df 9$  at  $0.05$  level of significance. So, Eye exercise was effective and following hypothesis was accepted and null hypothesis was rejected.

H1- There will be a significant difference between the mean pre-test and post-test level of digital eye strain.

**Table 5:** Frequency and percentage distribution of students with the presence of digital eye strain

n=20

	Control Group			
	Pre Test		Post Test	
Symptoms of digital eye strain	Frequency	Percentage (%)	Frequency	Percentage (%)
Burning Eyes	8	40	7	35
Itching of Eye	0	-	0	-
Feeling of a Foreign Body in Eyes	0	-	0	-
Tearing of Eyes	0	-	0	-
Excessive Blinking	3	15	3	15
Eye Redness	3	15	3	15
Eye Pain	5	25	5	25
Heavy Eyelids	0	-	0	-
Dryness of Eyes	0	-	0	-
Blurred Vision	5	25	5	25
Double Vision	1	05	1	05
Difficulty Focusing for Near Visions of Eyes	0	05	0	-
Increased Sensitivity to Light	1	05	0	-
Colour Halos around objects	0	-	0	-
Feeling eyesight is worsening	4	20	1	05
Headache	15	75	13	65



\*Multiple responses included

The data presented in table5 shows that at pre test in control group among all the symptoms headache was the most common of experienced as 75% of participants .This was followed by blurred vision and eye pain (25%) ,burning of eyes (40%).

After post test all of participants expressed that they had headache was the most common of experienced as 65% of participants .This was followed by blurred vision and eye pain (25%) ,burning of eyes (35%) symptoms. Symptoms were Present in control group.

**Table 6** Mean, Median, Standard deviation (SD) mean percentage of digital eye strain score among school students(Pre test & Post test) Control Group

n=20

Digital eye	Range of	range of	Mean	Median	SD	Mean	percentage
		strain	Possible	obtained			
			score	score			
Pre test	0-32	0-7	2.25	1	2.14	14%	
Post test	0-32	0-6	1.9	1	1.8	12%	

The data presented in table 6 shows that in pretest the digital eye strain score ranged from 0-32, the maximum possible score was 7, the mean digital eye strain score was 2.25 and the Median was 1 with SD 2.14. The mean percentage of digital eye strain was 14% . that in posttest the digital eye strain score ranged from 0-32, the maximum possible score was 6, the mean digital eye strain score was 1.9 and the Median was 1 with SD 1.8. The mean percentage of digital eye strain was 12% . There was no significant change

**Table 7** Frequency and percentage distribution school students as grade of digital eye strain (pre and post test)test) Control Group

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n=20



		Pre test		Post test	
Grades of digital eye strain	Range of score	Frequency	Percentage	Frequency	Percentage
None	0-5	19	95	19	95
Mild DES	6-12	01	05	01	05
Moderate DES	13-18				
Severe DES	19-32				

Maximum possible score:32

Minimum possible score: 0

The data presented in table 7 shows at pre test and post test findings are no change. shows 95% of the participant did not any significant sign of digital eye strain. The prevalence of digital eye strain was 5%.Out of this (5%) of the participants were suffering from Mild grade digital eye strain.

### Discussion.

Bengi Demirayak et al. (2022) identified that the **average duration of continuous display use without a break** was **71.1 ± 36.02 minutes**, with an average daily screen exposure of **7.02 ± 4.55 hours**. Among the 568 participants in the study, **457 individuals (80.5%)** reported using digital devices for more than **30 minutes without taking a break**, and **430 participants (62.1%)** indicated that their **daily screen time exceeded 4 hours** during online learning sessions.

In the present study, it was observed that the **majority of students (65%)** in both experimental and control groups reported using digital devices for **1–2 hours per day**. A total of **332 participants (48.2%)** experienced **three or more symptoms** associated with digital eye strain. The most commonly reported symptoms were **headache (n = 361; 52.2%)**, **eye fatigue (n = 341; 49.3%)**, and **eye redness (n**



= **341; 49.3%**). The least frequently reported symptom was **double vision**, observed in **61 participants (8.8%)**.

**khan A , Jain R. et al (April-June 2019)** study result showed out of 120 participants ,mobile phones were the most commonly used digital device and 55.83% participants had symptomatic Digital Eye Strain. Headache was common symptoms experienced by 73.3% followed by Dry Eye experienced by 63.33% participants

According to Present study the symptoms headache was the most common of experienced as 65% of participants .This was followed by blurred vision and itching of eyes (45%) ,burning of eyes (40%).tearing of eyes (66.6%)

**Ganne, Sharma et al. (2020)** reported that **Digital Eye Strain (DES)** scores were significantly higher among students attending online classes ( $p < 0.0001$ ), those with pre-existing eye conditions ( $p = 0.001$ ), increased screen time ( $p < 0.0001$ ), screen distances less than 20 cm ( $p = 0.002$ ), individuals using devices in dark environments ( $p = 0.017$ ), and those taking infrequent or no breaks ( $p = 0.018$ ). In the present study, leisure time preferences varied between groups: **40%** of students in the **experimental group** reported mobile gaming as their primary activity, while in the **control group**, **50%** preferred internet browsing and **60%** opted for television watching. Across both groups, the majority (**65%**) used digital devices for **1–2 hours per day**.

**Issam R. and Touma Sawaya et al. (2020)**, in a study conducted at the **American University of Beirut**, found that **60.1% of students** practiced at least one preventive measure against DES—such as adjustable screens, ergonomic chairs, eye drops, antiglare filters, or regular breaks. Among these, **36.1%** reported taking regular breaks as the most common method.

**Alghamdi and Alrasheed (2020)** evaluated the **effectiveness of an educational intervention** using the **20-20-20 rule**. Participants were divided into an **intervention group** ( $n = 20$ ), which received an informative booklet on reducing Computer Vision Syndrome (CVS), and a **control group** ( $n = 20$ ), which was simply advised to increase water intake. Both groups were assessed using the **CVS-Q** and **Dry Eye Questionnaire-5 (DEQ-5)**. After 20 days, participants in the intervention group reported a **significant improvement** in dry eye symptoms (**pre-intervention mean =  $9.05 \pm 4.32$ , post =  $7.10 \pm 3.61$ ,  $p = 0.04$** ). Symptoms of CVS slightly reduced (**pre =  $9.00 \pm 3.03$ , post =  $8.35 \pm 1.89$ ,  $p = 0.38$** ). Notably, the overall awareness scores significantly improved (**pre =  $6.20 \pm 2.02$ , post =  $8.55 \pm 2.84$ ,  $p = 0.005$** ), indicating the **effectiveness of educational interventions** in managing digital eye strain.



**Dr. Muliani and Ked S. et al. (2017)** demonstrated that practicing **yogic eye exercises**—twice daily for eight weeks—significantly reduced **extraocular muscle fatigue** and improved **visual acuity**. Techniques included **eye focusing, movement control, visualization, and relaxation**.

In the **present study**, statistical analysis revealed a **significant difference** between **pre-test and post-test DES scores**, as the **calculated t-value (2.9)** exceeded the **critical value (2.26)** at **df = 9**, with a **significance level of  $p < 0.05$** . This result confirms the **effectiveness of eye exercises**, including **blinking, eye rolling, focus-shifting, palming, vertical and horizontal movements, warm compress application, and adherence to the 20-20-20 rule**.

Conclusion:

The findings of the current study indicate that although the **prevalence of digital eye strain** was observed to be **only 10%**, this may be attributed to the **limited sample size**. Importantly, no statistically significant association was found between **socio-demographic variables** and **pre-test DES scores**. However, the intervention demonstrated a **statistically significant reduction in digital eye strain** post-intervention, supporting the effectiveness of **structured eye exercises**. These findings have **practical implications for nursing education, administration, and research**, suggesting that eye health interventions should be incorporated into health education programs. Additionally, **limitations** of the current study were acknowledged, and **recommendations for future research** were proposed to facilitate more comprehensive and generalizable findings.

### **Ethical Clearance**

This study acknowledged ethical approval from Institutional Ethics Committee by Dean of Madhya Pradesh Global University Bhopal Madhya Pradesh after proper RDC at the presence of committee members and Guide. and administrative permission was taken from Head Master of High secondary school SutahataJanakalyanSiskhyaNiketan.Sutahata and Vivekananda Mission AsramSikshayatanChaitanayapur East Midnapore. West Bengal. also informed that contribution was voluntary and they could revoke consent at any time. All information was shared with administrators while still protecting the privacy of the data collected from the participants

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

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