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Prevalence and Predictors of Digital Eyestrain among undergraduates in Universities, Rivers State Nigeria

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Abstract- ***The extensive reliance among undergraduates on digital electronic devices for leisure, academic and non-academic purposes and the recent diagnosis of age related ocular disorders among youths necessitated this study which investigated the prevalence and predictors of digital eyestrain (DES) among undergraduates in universities, Rivers state Nigeria. Eight (8) objectives, eight(8) research questions and seven (7) hypotheses were raised and tested. This investigation adopted a descriptive clinic based study design using a sample size of 425 student derived using Fischer formula from a two-stage sampling procedure. The instrument for data collection includes standard ophthalmic equipment while data collection was done by licensed eye care practitioners. Data collected were analyzed using Statistical Product for Service Solution (SPSS) version 20.0. The result of the study showed that 111 (26.1%) students did not experience any DES symptoms, 188 (44.2%) experienced mild DES, 73 (17.2%) experienced moderate DES while 53 (12.5%) experienced severe DES symptoms thus aggregating to an overall DES prevalence of 73.9%. In regards to predictors for DES, the study reported that 32.3% of DES symptoms can be predicted from family ocular history,0.5% of DES symptoms can be predicated on the nature of digital device, 44.6% of DES symptoms from screen time 64.2% of DES was predicated on preexisting eye defect of the subject, 2.7% of DES on age while 1.2% of DES attributed to gender. In addition, correlation analysis at 0.05 level of significance ($p < 0.05$) revealed a statistically significant association between family oculr history ($r = -0.176$, $p = 0.000$, $df = 423$), screen time ($r = -0'576$, $p = 0.000$, $df = 423$) , preexisting eye defect ($r = -0.256$, $p = 0.000$, $df = 423$), age ($r = -0.166$. $p = 0.001$, $df = 423$) as well as gender ($r = 0.133$, $p = 0.005$, $df = 423$) and DES related symptoms among undergraduates in universities Rivers state Nigeria.. However, there was no statistically significant relationship between the type of digital device ($r = 0.068$, $p = 0.163$. $df = 423$) or course of study ($r = 0.058$, $p = 0.153$, $df = 423$) and DES related symptoms among undergraduates in universities Rivers state Nigeria, The study concluded that the combined prevalence of digital eyestrain was 73.9% while about 26.1% of the subjects did not experience any remarkable DES symptom,. The study concluded that the dominant predictors of DES were family ocular history, screen time, preexisting eye defects while, age, gender, type of preferred digital device and course of study contributed less significantly and recommends that undergraduate students should prioritize their ocular health by reducing screen time, correcting visual defects and periodic eye examination.***

Keywords: Digital, Disorders, Electronic, Eye-strain, Predictors, Prevalence, Undergraduates

I. INTRODUCTION

The introduction electronic digital devices in data processing, storage, communication and task execution has greatly improved the quality of life but these gadgets is fast becoming a potential domestic and occupational hazard that poses a threat to some vital sense organs. One of such sense organs threatened by the prolong use of digital devices is the eye, the principal organ for vision as it is a window to the body, be it physical or spiritual. Technology indeed has transformed every realm of human endeavors in the current information age spanning healthcare to education, engineering, astronomy, banking, research, e and many more. Similarly, the recent outbreak of the novel Corona virus disease (COVID-19) resulted to an upsurge in the usage of digital device for longer periods predicated on virtual learning and jobs. Many persons who hitherto seldom employ electronic devices for their daily task were compelled to do so as the last resort with some negative health effects majorly impacting on the eyes.

The American Optometric Association (2021) defined digital eye strain (DES) as an entity encompassing visual and ocular symptoms arising from the prolonged use of digital electronic devices. Thus digital eye strain encompasses a cluster of ocular and vision-related problems attributed to prolonged usage of desktops, laptops, mobile phones, tablets, e-readers, and storage devices. Similarly, the AOA claimed that the usage of digital devices continuously for two hours is adequate to bring about digital eye strain. Eyestrain is a common condition that occurs when the eyes get tired from intense use, such as while driving long distances or staring at

computer screens and other digital devices. The Vision Council (2016) carried out a digital eyestrain survey in the United States of America. In their digital eyestrain Report of 2016 arising, they included survey responses from over 10,000 adults from the U.S.A. where they identified an overall self-reported` DES prevalence of 65%, with females more commonly affected than males (69% vs. 60% prevalence). They were of the view that its pathophysiology is multifactorial, with several contributing factors such as reduced contrast level of letters compared to the background of digital screens, screen glare and reflections, wrong distance and angle of viewing digital screens, poor lighting conditions, improper posture during usage, and infrequent blinking of eyes.

Nemeth et al., (2021) opined that the eye focusing and ocular movements required for better visibility of digital screen place additional demand on an intricate balance between accommodation and convergence mechanisms, thus making people with uncorrected or under-corrected refractive errors even more susceptible to DES. Usgaonkar et al, (2021) explained that this condition can cause an array of symptoms including eye pain, tearing , headache, tired eyes, burning sensation, red eyes, irritation, dry eye, foreign body sensation, blurred vision at near, and double vision.

Age is one of the demographic predictors of digital eyestrain because as one advance in age, there is deterioration of ocular tissues that predisposes one to ocular disorders and visual anomalies such as digital eyestrain (DES). It could be plausible that the frequency of eyestrain could be on the increase as one advance in age. Ichhpujani et al. (2019) reported that a sizeable proportion of people over the age of 17years who spend prolong periods focusing on digital screen had an eyestrain prevalence of about 50%. Sharma et al. (2023) reported that the prevalence of eyestrain among students were high among those aged over 21 years accounting to 45.5% of which 52.8% were females and 47.25 males. Jakhar et al. (2023) indicated that university students over 23 years reported a DES prevalence of about 97.9% which was significantly associated with age. Empirically, studies of Aidarrab et al. (2022) indicated that older age, female gender and using digital devices for more than 6 hours were the independent and significant predictors of digital eyestrain syndrome among college students

Duration of screen viewing time could contribute to the occurrence of DES. The extent to which they are exposed to digital screen devices could determine the occurrence of eyestrain and other eye related problems. Studies of Jakhar et al. (2023) added that the prevalence rate of 88.1% of the participants were exposed to screening viewing time for more than 4 hours per day based on the duration of view time. Recent findings of AlHarkan et al. (2023) gave an illustration that students with spectacles, those with more than 4 h daily screen time or who position devices 25 cm or less from their eyes, and those attending virtual class for more than 4 houurs a day were found to have significantly severe digital eyestrain syndrome. Gammoh (2021) reported that students who view screen times for more than 6 hours per day had 55.5% prevalence rate of digital eyestrain.

Presence of eye disorders could determine eyestrain among students and thus could constitute a predictor of eyestrain. Ganne et al. (2021) affirmed that there was a statistically significant relationship between eye disorders ($p = .001$) and eyestrain. Sharma et al. (2023) revealed that existing eye disorders were 45.5 times more significantly associated with eyestrain among patients. Current findings of Bhatnagar et al. (2024) indicated that there was significant association ($P < 0.05$) of visual strain was found with increased duration of digital device usage, refractive errors, use of glasses or contact lens, preexisting dry eye disease. Gammoh (2021) reported that prevalence of CVS was 94.5%, with tearing being the most prevalent symptom (59%), while double vision was least reported by students (18.3%). Jakhar et al. (2023.) recently reported that headache is the most commonly reported symptom followed by neck pain, tearing, eye pain and burning sensation. It is plausible because students with recurrent eye problems could likely report symptoms of eyestrain.

II. OBJECTIVES OF THE STUDY

The aim of this study was to investigate the prevalence of digital eyestrain and ascertain the level of involvement of selected predictors with a view to proffering evidence base preventive measures. In specific terms, this study sought to;

1. determine the prevalence of digital eyestrain among undergraduates in universities, Rivers state Nigeria.

2. ascertain the extent family history can predict digital eyestrain symptoms among undergraduates in universities, Rivers state Nigeria.
3. find out the extent nature of preferred digital device can predict digital eyestrain symptoms among undergraduates in universities, Rivers state Nigeria.
4. determine the extent duration of using devices could predict digital eyestrain among undergraduates in universities, Rivers state Nigeria.
5. ascertain the extent preexisting eye defects/ disorder could predict digital eyestrain among undergraduates in universities, Rivers state Nigeria.
6. find out the extent age could predict digital eyestrain among undergraduates in universities, Rivers state Nigeria
7. investigate the extent at which gender could predict the occurrence of digital eyestrain among undergraduates in universities, Rivers state Nigeria.
8. ascertain the extent one's course of study\ could predict digital eyestrain among undergraduates in universities, Rivers state Nigeria

III. METHODOLOGY

Area and scope of the Study

This study took place from October 2024 to March 2025 and focused on the prevalence and predictors of digital eyestrain among undergraduates in universities, Rivers State. Rivers State is one of the thirty-six states in Nigeria with its capital in Port Harcourt city. The state which is the nerve center of the petroleum industry in Nigeria has twenty-three Local Government Areas and three senatorial district- Rivers west, Rivers East and Rivers South East senatorial districts. Rivers state shares boundaries with Anambra and Imo tothe North, Abia and Akwa-Ibom to the East, and Bayelsa and Delta to the west. Rivers state contains vast mangrove swamp, tropical rain forests and many rivers. Fishing and farming are the principal occupation of the region. The economy of Rivers state is dominated by the states booming petroleum industry which is the main stay of the Nigerian economy which has led to an influx of job seekers, business men and service providers and concomitant population increase and urbanization.

Currently, the state play host to several tertiary institutions including five functional universities comprising of one federal university, two state owned universities and two privately owned university while the recently approved Federal university of environment is yet to commence operation. All the universities in Rivers state have functional health centers but the level of utilization among undergraduates is relatively low due to perception, cost implication and lay referral system. The study investigated some predictors of digital eyestrain such as family history, nature of device, duration of using devices, preexisting eye disorder, age, gender and course of study.

Research Design and Sampling Techniques

This investigation adopted a descriptive clinic base study design which involves direct assessment of the subjects from case history to simple ocular examination using mobile ophthalmic equipment and conclusive diagnosis by licensed eye care practitioners. A similar design was used by Adane, et al. (2022) to investigate the computer vision syndrome and predictors among computer users in Ethiopia hence, it was considered appropriate and applicable to the current study in line with its aim and objectives.

The sample size for this study was 425 students. However the working population / sample size was calculated as below using the Fischer formula which states that $n=z^2\ p\ q/\ r^2$.

Where z=the standard normal deviation (p less than 0.05) and is given as 1.96

p=estimated proportion or prevalence of Eyestrain in Nigeria (Ayaki et al. 2023) where p= 80% (p=0.80).

q= 1- p = 1- 0.90 q= 0.1

r = absolute error which is 0.05

Therefore sample size used was $n= (1.96)^2 X\ 0.80\ X\ 0.1/(0.05)^2$

n= 3.8416 X 0.08 / 0.0025

n= 0.707328/ 0.0025

n= 282.9 approximately 283.

50% attrition rate 142 was added to the initial sample 283 to give 425 as the substantive sample size.

A two-stage sampling procedure was used to select the sample size. The first stage involved the use of Simple random sampling technique to select the four universities in Rivers State which are University of Port Harcourt, Rivers State University, Ignatius Ajuru University of Education and Madonna

University. The second stage involved the use of proportionate sampling to select 150 students from University of Port Harcourt, 120 students from Rivers State University, 90 students from Ignatius Ajuru University of Education and 65 students from Madonna University.

Table 1: Distribution of subjects selected for this study

S/N	Universities Selected	Sample Selected
1	University of Port Harcourt	150
2	Rivers State University	120
3	Ignatius Ajuru University of Education	90
4	Madonna University	65
	Total	425

Instrument for Data Collection

The instrument for data collection employed in this study includes;

i) Snellen's visual acuity (VA) chart for assessment of vision (V.A) of each subjects. VA assessment is a prerequisite for all ocular examination for diajgnostic and reference purposes.
ii) Pen light for external examination of the eyes to check for ocular surface anomalies
iii) An Ophthalmoscope to check for internal (funduscopic) examination of the internal structures (fundus) of the eyes.
iv) A Retinoscope to assess the objective refractive status of the eyes
v) Structured data collection Sheet.

Reliability and Validity of the Instrument

The instruments employed in this study are prototypes of those approved for professional eye care practice by the World Council of Optometry (WCO) as well as the Optometrist and Dispensing Opticians Registration Board of Nigeria (ODORBN) for professional optometric practice in Nigeria. The validity of the powered ophthalmic instrument was ascertained by two consultant ophthalmologist and one optometrist from Madonna University Teaching Hospital, Elele Rivers state Nigeria. The instruments did not undergo any specific reliability testing due to their repeatability and regular employment in professional employment in professional eye care practice globally.

Method of Data Collection

A letter of introduction was obtained from the Head, Department of human kinetics health and safety studies IAUE and handed to the medical directors of the health facilities involved in the study. Approval was also obtained from the Dean of Student Affairs of the educational institutions following and the Medical Directors of the Health facilities within the various campuses. Examination of subjects/ collection of data were conducted by qualified (licensed) Optometrist at the health facilities located in the universities guided by the objectives of the study. The final data collection involved direct assessment of the subjects commencing with case history, simple visual and ocular examination and diagnosis by professional eye care practitioners (Optometrist)

Diagnostic criteria for Digital Eyestrain (DES)

DES as defined by the American optometric Association (2021) is an entity encompassing ocular signs and visual symptoms resulting from the prolong use of digital devices such as smart phones, Laptop Computers, Television sets, Video games monitors, e.t.c. Visual symptoms associated with DES include; blurry vision, dry eyes, eye ache, heavy eyes, headaches, itchy eyes, heavy/ tired eyes, neck ache, tearing, etcetera.. Some of the signs associated with DES include; mildly swollen lids and dilated conjunctiva blood vessels,

The current study adopted the following DES diagnostic criteria:

Table 2: Diagnostic Criteria for Digital Eyestrain (DES)

Diagnosis	Observation/ Presentation

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1	No DES	Zero symptoms or signs
2	Mild DES	One symptom and/ or one sign
3	Moderate DES	Two symptoms and/ or one sign
4	Severe DES	Three or more symptoms and/ or on sign or more

Method of Data Analysis

Data collected were analyzed using Statistical tools of the Product for Service Solution (SPSS) version 25.0. Statistical tools employed are percentages, regression model and bi-variate correlation analysis. Percentage (%) and regression model was used to answer the research questions (DES predictors) while bi-variate correlation was used to test the hypotheses at 0.05 level of significance

IV. RESULTS

The results of this study were presented based on the data collected from the sample

Prevalence of Digital Eyestrain

Research Questions 1: What is the prevalence of eyestrain among students in tertiary educational institutions in Rivers State?

Table 3: The prevalence of digital eyestrain among students in tertiary institutions in Rivers State

Diagnosis of Digital Eyestrain (DES)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No DES	111	26.1	26.1	26.1
	Mild DES	188	44.2	44.2	70.4
	Moderate DES	73	17.2	17.2	87.5
	Severe DES	53	12.5	12.5	100.0
	Total	425	100.0	100.0	

Table 3 indicates that 111 (26.1%) have normal ocular status (No DES), 188 (44.2%) experienced mild DES, 73 (17.2%) experienced moderate DES while 53 (12.5%) experienced severe DES. Thus a combined total of 74.1 % of undergraduates experienced some form of digital eyestrain while 26.1% experienced no remarkable symptom after using their digital devices for varying length of time.

Family Ocular History and Digital Eyestrain

Research questions 2: To what extent does family ocular history predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria?

Table 4a: Regression analysis on the extent does family ocular history predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria.

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.177[a]	.323	.298	.940	1.625

a. Predictors: (Constant), Type of Family Eye Defect

b. Dependent Variable: Diagnosis of Digital Eyestrain

In regards to what extent family ocular history predicts digital eyestrain, it can be observed that the R-value is 0.177 and R-square value is 0.032. The R-value of 0.323 implies that 32.3% of the variance in digital eye strain symptoms can be predicted by family ocular history as shown in table 4a above

Association between family ocular history and digital eyestrain

H_{01}: There is no significant association between family ocular history and digital eyestrain among undergraduates in universities, River's state Nigeria.

Table 4b: Correlation analysis on the association between family ocular history and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

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		Diagnosis of Digital Eyestrain	Type of Family Eye Defect
Diagnosis of Digital Eyestrain	Pearson Correlation	1	-.176**
	Sig. (2-tailed)		.000
	N	424	423
Type of Family Eye Defect	Pearson Correlation	-.176**	1
	Sig. (2-tailed)	.000	
	N	423	424

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient between family ocular history and digital eyestrain is -0.176 while the significance level is 0.000 which indicates that there is a statistically significant association between family ocular history and diagnosis of digital eyestrain at the 0.01 level as shown in Table 4b above

Nature of Device and Digital Eyestrain

Research questions 3: To what extent does nature of devices predict digital eyestrain among undergraduates in universities, Rivers State Nigeria?

Table 5a: Regression analysis on what extent does preferred digital device predicts digital eyestrain among undergraduates in universities, Rivers State Nigeria.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	069[a]	.005	002	952	1.556

a. Predictors: (Constant), Preferred Digital Device

b. Dependent Variable: Diagnosis of Digital Eyestrain

In regards to what extent type of device could predict digital wywstrain, it can be observed that the R-value is 0.068 and R-square value is 0.005. The R-value show that there is association while the R-square value 0.005 implies that 0.5% of the variance in digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria can be predicted by the nature of preferred device as shown in table 5a above.

Association between types of preferred digital devices and digital eyestrain

H_{02}: There is no significant association between type of preferred digital devices and digital eyestrain among undergraduates in universities, Rivers state Nigeria.

Table 5b: Correlation analysis on the association between preferred digital devices and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

		Diagnosis of Digital Eyestrain	Preferred Digital Device
Diagnosis of Digital Eyestrain	Pearson Correlation	1	.068
	Sig. (2-tailed)		.163
	N	424	424
Preferred Digital Device	Pearson Correlation	.068	1
	Sig. (2-tailed)	.163	
	N	424	425

The correlation coefficient between types of preferred digital device and digital eyestrain is 0.068 while the significance level is 0.163 which indicates that there is no statistically significant association between the type of preferred digital device and

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diagnosis of digital eyestrain at the 0.01 level as shown in table 5b above.

Screen Time and Digital Eyestrain

Research questions 4: To what extent does duration of using devices predict digital eyestrain among undergraduates in universities, Rivers State Nigeria?

Table 6a: Regression analysis on the extent to which duration of using devices predicts digital eyestrain among undergraduates in universities, Rivers State Nigeria

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.215[a]	446	.443	932	1.585

a. Predictors: (Constant), Average daily screen time (hours)

b. Dependent Variable: Diagnosis of Digital Eyestrain

In reference to what extent the average daily duration of using digital device can predict digital eyestrain, it can be observed that the R-value is 0.215 and R-square value is 0.443. The R-square value (0.446) implies that 44.6% of the variance in digital eyestrain among undergraduates in universities, Rivers State Nigeria can be predicted by the nature of preferred digital device as shown in Table .6

Association between duration of using digital devices and digital eyestrain

H_{03}: There is no significant association between duration of using devices and digital eyestrain among undergraduates in universities, Rivers state Nigeria.

Table 6b: Correlation analysis on the association between duration of using devices and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

		Diagnosis of Digital Eyestrain	Screen time duration
Diagnosis of Digital Eyestrain	Pearson Correlation	1	-.576**
	Sig. (2-tailed)		.000
	N	424	423
Type of Family Eye Defect	Pearson Correlation	-.576**	1
	Sig. (2-tailed)	.000	
	N	423	424

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient between screen time duration and digital eyestrain is -0.576 while the significance level is 0.000 which indicates that there is a statistically significant association between screen time and diagnosis of digital eyestrain at the 0.01 level as shown in Table 6b above

Preexisting Eye Defect and Digital Eyestrain

Research questions 5:To what extent does preexisting eye disorder predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria?

Table 7a: Regression analysis on the extent to which subject's ocular disorder predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.257[a]	..642	.641	.922	1.628

a. Predictors: (Constant), Nature of Subject's Eye Defect

b. Dependent Variable: Diagnosis of Digital Eyestrain

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With reference to what extent preexisting eye defects predicts digital eyestrain,, it can be observed that the R-value is 0.257 and R-square value is 0.064. The R-square value 0.642 implies that 64.2% of the variance in digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria can be predicted by nature of eye defect as shown in Table 7a

Association between preexisting eye defect of the subjects and digital eyestrain

H_{04}: There is no significant association between preexisting eye defects and digital eyestrain among undergraduates in universities, Rivers State Nigeria.

The correlation coefficient between preexisting eye defects and digital eyestrain is -0.256 while the significance level is 0.000 which indicates that there is a statistically significant association between preexisting eye defect and diagnosis of digital eyestrain at the 0.01 level as shown in table 7b below

Table 7b: Correlation analysis on the association between subject's preexisting eye defects and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

		Diagnosis of Digital Eyestrain	Subject's Eye Defect
Diagnosis of Digital Eyestrain	Pearson Correlation	1	-.256**
	Sig. (2-tailed)		.000
	N	424	424
Subject's Eye Defect	Pearson Correlation	-.256**	1
	Sig. (2-tailed)	.000	
	N	424	425

**. Correlation is significant at the 0.01 level (2-tailed).

Age and Digital Eyestrain

Research questions 6: To what extent does age predicts digital eyestrain among undergraduates in universities, Rivers State Nigeria?

Table 8a: Regression analysis on the extent does age predict digital eyestrain among undergraduates in universities, Rivers State Nigeria

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.164[a]	.027	.025	.941	1.597

a. Predictors: (Constant), Age of Subject (years)

b. Dependent Variable: Diagnosis of Digital Eyestrain

Analysis in reference to what extent does age predicts digital eyestrain it can be observed that the R-value is 0.164 and R-square value is 0.027. The R-square value 0.027 implies that 2.7% of the variance in digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria can be predicted by age as shown in Table 8a above

Association between age and digital eyestrain

H_{05}: There is no significant association between age and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Table 8b: Correlation analysis on the association between age of undergraduates and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

	Diagnosis of DigitalEyestrain	Age of Subject (years)

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Diagnosis of Digital Eyestrain	Pearson Correlation	1	-.166**
	Sig. (2-tailed)		.001
	N	424	423
Age of Subject (years)	Pearson Correlation	-.166**	1
	Sig. (2-tailed)	.001	
	N	423	424

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient between age and digital eyestrain is -0.166 while the significance level is 0.000 which indicates that there is a statistically significant association between age and diagnosis of digital eyestrain at the 0.01 level as shown in table 8b above

Gender and Digital Eyestrain

Research questions 7: To what extent does gender predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria?

Table 9a: Regression analysis on the extent does gender predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.112[a]	.012	.010	.948	1.560

a. Predictors: (Constant), Gender

b. Dependent Variable: Diagnosis of Digital Eyestrain

In regards to what at extent does gender predicts digital eyestrain among undergraduates in universities, it can be observed that the R-value is 0.112 and R-square value is 0.012. The R-square value 0.012 implies that 1.2% of the variance in digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria can be predicted by gender as shown in Table 9a

Association between gender and digital eyestrain

H_{06}: There is no significant association between gender and digital eyestrain among undergraduates in universities, Rivers state Nigeria.

Table 9b: Correlation analysis on the association between gender and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

		Diagnosis of Digital Eyestrain	Gender
Diagnosis of Digital Eyestrain	Pearson Correlation	1	.136**
	Sig. (2-tailed)		.005
	N	424	423
Gender	Pearson Correlation	.136**	1
	Sig. (2-tailed)	.005	
	N	423	424

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient between age and digital eyestrain is -0.136 while the significance level is 0.005 which indicates that there is a statistically significant association between age and diagnosis of digital eyestrain at the 0.01 level as shown in table 9b above.

Course of Study and Digital Eyestrain

Research questions 8: To what extent does course of study predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria?

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Table 10: Regression analysis on the course of study predicts digital eyestrain among undergraduates in universities, Rivers state Nigeria

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.024[a]	.001	-.002	.73239

a. Predictors: (Constant), course of study
b. Dependent Variable: Diagnosis of Digital Eyestrain

From Table 10 above, it can be observed that the R-value is 0.024 and R-square value is 0.001. The R-square value 0.001 implies that 0.1% of the digital eyestrain among undergraduates in universities, Rivers State Nigeria can be explained by course of study.

Association between course of study (department) and digital eyestrain

H_{07}: There is no significant association between course of study and digital eyestrain among undergraduates in universities, Rivers state Nigeria.

Table 10b: Correlation analysis of the association between course of study (department) and digital eyestrain among undergraduates in universities, Rivers State Nigeria

Correlations

		Diagnosis of Digital Eyestrain	Preferred Digital Device
Diagnosis of Digital Eyestrain	Pearson Correlation	1	.058
	Sig. (2-tailed)		.153
	N	424	424
Preferred Digital Device	Pearson Correlation	.068	1
	Sig. (2-tailed)	.163	
	N	424	425

The correlation coefficient between course of study and digital eyestrain is 0.058 while the significance level is 0.153 which indicates that there is no statistically significant association between course of study and diagnosis of digital eyestrain at the 0.01 level as shown in table 10b above.

V. DISCUSSION

The results of this study were discussed below:

Prevalence of eyestrain among students

The current study observed that 111 (26.1%) undergraduates have normal ocular status (No DES), 188 (44.2%) experienced mild DES, 73 (17.2%) experienced moderate DES while 53 (12.5%) experienced severe DES. Thus a combined total of 73.9% of undergraduates experienced some form of digital eyestrain while 26.1% experienced no remarkable symptom after using their digital devices for varying length of time. The result of this study is expected because of the relatively high proportion of undergraduates and other sub group of youths who spend an appreciable length of their daily routine on digital electronic devices resulting in various oculovisual complaints like photophobia, glare and blurry vision. The outcome of this study is in credence with findings of AlQarni et al. (2023) which affirmed that the overall prevalence of digital eyestrain symptoms in the sample was found to be 68.53% with largest proportion of students were found to have mild digital eyestrain symptoms (43.20%), and only 11% had severe digital eyestrain symptoms. Ayaki et al. (2023) reported that prevalence of each symptom was 31.8% for eye strain, 22.5% for blurred vision and 16.0% for photophobia. Similar studies of Almudhaiyan et al. (2023) conducted among students reported that a significant proportion of university students (84.6%) were using digital devices for five hours or more with an overall prevalent rate of 76.1% among students population. AlDarrab et al. (2022) affirmed that the prevalence of digital eyestrain among young people was 95% indicating that almost the entire population had one or more symptoms of visual disorders.

AlHarkan et al. (2023) carried out a study on the prevalence of eyestrain among university students which reported that 59.4% of the sample population suffered for severe eyestrain of which 14.5% had deteriorated vision. Ganne et al. (2021) had it in their comparative study that the prevalence of eye strain was higher among students taking online classes compared to the general public (50.6% vs 33.2%). It is plausible that students in universities are more likely to offer online courses and programme that may expose them eye-related problems including eyestrain. No contrary studies were reviewed at the time of the present study, therefore, the prevalence of digital eyestrain as reported could best be described as significant.. The concordance between the findings from this study and the studies reviewed in the process may be attributed to similarity in the population of the study as both studies focused on university students.

Family Ocular History predict Digital Eyestrain

The result of this study pertaining to the relationship between family ocular history and digital eyestrain illustrated a R-value of 0.032 which implies that 3.2.% of the variance in presented cases of digital eyestrain were traceable to family history among undergraduates in universities, Rivers State Nigeria. It was also observed that the correlation coefficient was -.176 at 0.000 level of significance and 423 degrees of freedom which indicated that there was a statistically significant association between family history and digital eyestrain among undergraduates in universities, Rivers State Nigeria since the level of significance (0.000) is less than 0.05. This finding could be attributed to the fact that heredity/ genetic predisposition play a significant role in health outcomes. This predisposition may have been amplified by a sedentary lifestyle and increased screen time observed among today's undergraduates This finding is in agreement with findings of Al-Qarni et al. (2023) which revealed that overall prevalence of eyestrain in the sample was found to be 68.53% with previous cases of eye defects. Ayaki et al. (2023) in their study illustrated that the prevalence of each symptom was 31.8% for eye strain, 22.5% for blurred vision traceable the eye defect syndrome. Empirically, Almudhaiyan et al. (2023) and AlDarrab et al. (2022) whose studies identify the family history as 8times more likely to determine eyestrain based on development defects. Due to advancement in technology and computerization, the use of digital screen and devices were paramount among productive youths and others which progressively leads to eye defects. It is pertinent to note that this current dispensation of youths as well as students depend and get addicted to the use of digital devices including cellphone, Video games, Laptop computers, etc which have significant effect on the ocular health of the individual leading to eyestrain and associated complaints.

Nature of devices and Digital Eyestrain

The result of this study pertaining to the relationship between type of preferred digital device and digital eyestrain showed an R-square value of 0.005 indicating that 0.5% of the variance in DES symptoms could be attributed to the nature of preferred digital devices. Similarly, in regards to the association between nature of preferred digital devices and digital eyestrain symptoms among undergraduates in universities, River's state Nigeria, the study observed a correlation coefficient of-068at .163 level of significance and424 degrees of freedom. This indicates that there was no statistically significant association between nature of preferred digital device and digital eyestrain symptoms among undergraduates in universities, River's state Nigeria.This finding is not unexpected as modern digital devices present similar features like adjustable brightness, contrast, font sizes and flicker display all of which are factors of DES (Blehm, 2005). This finding concurs with findings by Rechichi et al. (2017) which reported that students that preferred the use of video game digital devices and other gadgets such as televisions, computers, tablets, and smart phones are 5.6 times more likely to develop symptoms of eyestrain. Moon et al. (2014) also reported that smartphones use was more common in the dry eye disease group (71%) which is symptomatic to digitaleyestrain.Gammoh (2021) added that students who spent more than 6 hours per day had 55.5% prevalent rate of eyestrain. In accordance, Mohan et al. (2021) reported that 118 (49.8%) who were attending online classes for >2 h per day had a DES prevalence rate of 50.23%. It was deduce that digital devices have different level of brightness which may affect the eye.

Digital Eyestrain symptoms and screen time (duration)

Result from this study showed an R-square value 0.446 which implies that 44.6% of the variance of digital eyestrain symptoms can be predicted based on duration of using devices among undergraduates in

universities, Rivers State Nigeria. Similarly, the association between duration of using devices and digital eyestrain among undergraduates in universities, Rivers state Nigeria showed a correlation coefficient of -0.576 at 0.000 level of significance and 423 degrees of freedom which implies that there was a statistically significant association between screen time and digital eyestrain among undergraduates in universities, Rivers State Nigeria . This finding could be attributed to the accommodative efforts exerted by the eye's focusing mechanism (crystalline lens, ciliary muscles and zonules) during near work such as viewing digital devices. The sustained strain on the cilliary muscles over time results to fatigue which manifest in various ways/ symptoms described as digital eyestrain This outcome is in line with findings ofJakhar et al. (2023) which reported a DES prevalence rate of 88.1% among subjects exposed to screen viewing time for more than 4 hours per day.

Recent findings of AlHarkan et al. (2023) gave an illustration which support the current study that students with spectacles, those with more than 4 hour daily screen time or who position devices 25 cm or less from their eyes, and those attending virtual class for more than 4 h a day were found to have significantly severe digital eyestrain syndrome. Studies of Gammoh (2021) affirmed that students who view screen times were more than 6 hours per day had 55.5% prevalent rate of eyestrain. Mohan et al. (2021) reported that one hundred and eight children (49.8%) were attending online classes for >2 h per day had a prevalent rate of 50.23% eyestrain. This is plausible because the length of time spent on visual display digital devices expose them to eye problems such as digital eyestrain. Undergraduate students in Rivers state like their peers in the world are within the active or digital age groups which spend ample time on digital devices with little or no emphasis on preventive strategies.

Preexisting Eye Defects and Digital Eyestrain

Pertaining to relationship between preexisting ocula defects and digital eyestrain, this study reported an R-square value of 0.642 which implies that 64.2% of the variance in digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria can be predicted from preexisting eye disorders. Similarly, in regards to association between preexisting eye defects and digital eyestrain, this study observed a correlation coefficient of -0.256 at 0.000 level of significance and 424 degrees of freedom which implies that there was a statistically significant association between duration of using devices and digital eyestrain among undergraduates in universities, Rivers state Nigeria. This could be attributed to the nature of the visual mechanism and how images are perceived and formed on the retina as those whit eye defects exerts more efforts in an attempt to see clearly unlike those without visual defects whose images are formed precisely on the retina. This outcome is in consonance with findings of Ganne et al. (2021) which affirmed that there was a significant relationship in eye diseases ($p = .001$) in regards to eyestrain. Sharma et al. (2023) revealed that existing eye disorders were 45.5 times more significantly associated with eyestrain among patients.

Recent findings of Bhatnagar et al. (2024) buttressed that there was a statistically significant association ($p < 0.05$) between visual strain and increased duration of digital device usage, refractive error, wearing of glasses or contact lens, preexisting dry eye disease. Gammoh (2021) reported that prevalence of CVS was 94.5%, with tearing being the most prevalent symptom (59%), while double vision was least reported by students (18.3%). Current studies of Jakhar et al. (2023) recently reported that headache is the most commonly reported symptom followed by neck pain, tearing, eye pain and burning sensation. This is plausible because students with preexisting eye defects unattended to, are bound to exert more visual effort per target and probably report worse symptoms of eyestrain.

Digital Eyestrain and Age

In regards to the extent to which age predicts digital eyestrain, the study showed a R-square value of 0.027 which implies that 2.7% of the digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria could be linked to age. Similarly, the correlation coefficient was -0.166 at 0.001 level of significance which indicated that there was a seismically significant association between age and digital eyestrain among undergraduates in universities Rivers state Nigeria. This observation could be attributed to age related decline in the anatomy, physiology and functionality of ocular tissues. This finding is in accordance with findings of Ichhpujani et al. (2019) which reported that good proportion of subjects over the age of 17 years with

prolong screen time had a prevalence of eyestrain of about 50%. Sharma et al. (2023) in their study reported that the prevalence of eyestrain among students was high among those aged over 21 years accounting to 45.5% of which 52.8% were females and 47.25 males. Study of Jakhar et al. (2023) buttressed that university students over 23 years reported a DES prevalence of97.9% which was significantly associated with age. Studies of Al-Darrab et al. (2022) indicated that older age, female and using digital devices for more than 6 h were the independent and significant predictors of digital eyestrain syndrome among college students. Mohan et al. (2021) conducted a multivariate analysis which revealed that age >14 years (p = 0.04) and male gender (p = 0.0004) were significantly associated with digital eyestrain among students in tertiary institutions.

Digital Eyestrain and Gender

Pertaining to the extent gender could predict digital eyestrain, the study observed a R-square value of 0.012 which implies that 1.2% of the variance in digital eyestrain symptoms among undergraduates in universities, Rivers State Nigeria can be predicted by gender. In addition, the association between gender and digital eyestrain among undergraduates in universities, River's state Nigeria showed a correlation coefficient of 0.136 at 0.005 level of significance and 423 degrees of freedom. From the table, the F-value is 5.351 with 0. 021 level of significance and 424 degrees of freedom. Becaue the level of significance (0.005) is less than .05,therefore there is a statistically significant association between gender and digital eyestrain ,symptoms among undergraduates in universities, River's state Nigeria. This finding concurs with that of Sharma et al. (2023) which in their study reported that the prevalence of digital eyestrain among students was high among those aged over 21 years accounting to 45.5% of which 52.8% were females and 47.25 males. Study of Jakhar et al. (2023) buttressed that university students over 23 years reported a DES prevalence of97.9% which was significantly associated with age. Studies of Al-Darrab et al. (2022) indicated that older age, female and using digital devices for more than 6 h were the independent and significant predictors of digital eyestrain syndrome among college students. Mohan et al. (2021) conducted a multivariate analysis which revealed that age >14 years (p = 0.04) and male gender (p = 0.0004) were significantly associated with digital eyestrain among students in tertiary institutions.

Digital eyestrain and Course of Study

The result from this study in regards to what extent course of study could predicts digital eyestrain showed a R-square value of 0.001 which implied that 0.1% of the digital eyestrain among undergraduates in universities Rivers State Nigeria could be predicted from the course of study. However, the correlation coefficient for both variables was 0.058 at .153 level of significance and 424 degrees of freedom which implies that there is no statistically significant association between course of study and digital eyestrain. This finding is not unexpected because the current undergraduates regardless of their course of study spend an appreciable length of time on digital devices and are likely to experience similar complaints The observation is in consonance with findings of Shantakumari et al. (2014) and Ichhpujani et al. (2019) whose studies revealed that university programmes (courses) offered by students has nothing to do with developing eye problems. However, Wang et al. (2023) reported that undergraduate (p <0.001, medical: p = 0.0015) medical students with increasing usage of computed devices is significantly associated with digital eyestrain..

VI. CONCLUSION

The result of this study concluded that the combined prevalence of digital eyestrain (DES) among undergraduates, Rivers state Nigeria was 73.9% with those experiencing mild DES (44.2%) constituting the largest proportion. However, 26.1% of undergraduates in Rivers state experienced no remarkable digital eyestrain symptoms regardless of the length of time spent on digital devices. The major factors of digital eyestrain among undergraduates, Rivers state Nigeria were; screen time, preexisting oculovisual disorders, preexisting ocular disorders, age and gender while the less significant contributors to digital eyestrain among this sub group were course of study and the nature of digital devices employed.

VII. RECOMMENDATIONS

In the light of this study, the following recommendations were made:

1. University management should include comprehensive eye examination by professional

eye care practitioners as a component of the basic pre admission medical screening for newly admitted students. This will help identify undetected ocular and visual disorders that could impact negatively on the wellbeing and academic life of the students during their stay on campus

2. Students should prioritize their general and ocular health by visiting healthcare facilities with professional practitioners whenever they observe an unusual sign or symptom that is intermittent, recurrent or sustained. This will aid early detection and prompt management of underlying ocular and visual problem, avert needless visual stress and prevent avoidable deterioration of vision
3. Professional eye care practitioners should collaborate with university authorities to organize ocular health education particularly on harmful effects of some visual habits/ practices such as prolong screen time..This will avail undergraduate students with vital information on visual hygiene and other beneficial health practices that could enhances ocular health and optimal visual performance to face the visual demands of university education
4. University management should provide subsidized eye care services for students and staff to encourage regular eye checks that would have been made impossible by the cost of hospital registration, consultation and optical/ ophthalmic products which may be out of reach particularly for undergraduates.
5. Students should reduce the time spent on visually displaying digital devices particularly for less productive activities like social media, video gaming and movies and much more. They should as well employ ocular preventive measures such as making use of screen filters, blue light blocking lens coating and/ or observing the 20-20-20 rule which means that for every 20 minutes of sustained viewing of digital screens/ monitors at close range, one should observe a 20 second break by looking at a target 20 feet away. This will help relax the eye's focusing mechanism (accommodation) and prevent undue strain
6. Parents and guardians should inculcate early in their children and wards healthy visual habits and also advise/ caution the children who are of age on the need to reduce screen time and other addictive practices common among youths and teenagers

CONTRIBUTION TO KNOWLEDGE

This study was important to improve the knowledge of the population because it revealed the pattern of symptoms of digital eyestrain as well as the dominant and less significant predictors among undergraduate students. This study identified family ocular history, duration of device use (screen time), preexisting ocular disorder, age and gender as the dominant predictors while course of study and nature of digital device employed are less significant predictors of digital eyestrain among undergraduate students. Hence, this study successfully unraveled the problem that informed its findings.

VIII. LIMITATIONS OF THE STUDY

In the course of the study, the researcher encountered difficulty in getting the nod early from a few of the heads of the medical centers and the Dean of Student Affair in some of the universities where the study took place. This difficulty was surmounted after meeting all approval requirements as demanded by the relevant officials resulting to a slight delay in the commencement of the study's data collection procedure..

ETHICAL CONSIDERATIONS

Ethical clearance was obtained from the medical advisory committee of Madonna University Teaching Hospital (MUTH), Elele Rivers State Nigeria. The ethical clearance letter from MUTH and the introductory letter from the Head of Department of Human Kinetics, Health and Safety Studies Ignatius Ajuru University Port Harcourt Rivers State were handed to the Medical Directors in-charge of the health facilities where data collection took place within the four university campuses

The following ethical guidelines were observed in course of this study;

i) The aim and the nature of the study was made clear to the subjects and verbal consent duly obtained
ii) The participation was made voluntary, the subjects were treated with dignity and privacy was maintained.

Confidentiality was ensured as all information generated from the study were used strictly for academic purposes and case files are domiciled with

the records unit of the senior clinic department of optometry, Madonna University, Elele campus Rivers State Nigeria which is the base of the researcher

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CONFLICT OF INTEREST

The researchers hereby declare that there was no conflict of interest in the study and its reported findings

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