international medical education

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A Web-Based Cross-Sectional Survey on Eye Strain and Perceived Stress amid the COVID-19 Online Learning among Medical Science Students

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Abstract: Due to the COVID-19 pandemic, educational institutions globally were forced to close, resulting in a transition to online learning. However, this transition increased screen time and made e-learners more vulnerable to biopsychosocial issues. This study aimed to assess the impact of online learning on the eyes and mental health of medical science students, including those pursuing MBBS, Nursing, Optometry, Pharmacy, and Veterinary degrees during the COVID-19 lockdown period. A cross-sectional quantitative study was conducted, collecting online data from 182 samples using a socio-demographic data sheet (SDVS), Computer Vision Symptom Scale (CVSS 17), and the Perceived Stress Scale (PSS 10). Results revealed that most students spent between 2 and 4 h and >7 h on electronic devices before and during COVID-19, respectively, with many reporting moderate mental stress and eye strain. A weak positive correlation (r = 0.204 at $p < 0.05$) was found between perceived stress and eye strain, with the 24–29 age group reporting higher mean scores for eye strain. Female participants in the study reported higher mean scores for both eye strain and perceived stress. Additionally, the study found significant associations between eye strain and the electronic devices used, the program of study, and perceived stress levels. The participants' ethnicity was also found to impact eye strain levels. The study concludes that the transition to online learning during COVID-19 caused moderate to severe levels of eye strain and mental stress, indicating the need for interventions for the student community.

Keywords: eye strain; perceived mental stress; the computer-vision symptom; COVID-19 transitional online learning; digital screen exposure

Citation: Victor, V.M.; Parsan, A.; Dookran, A.; Lulkool, A.; Ali, A.; Mahabir, A.; Marchan, A.; Monroe, A.; Ramharack, A.; Ekemiri, K.; et al. A Web-Based Cross-Sectional Survey on Eye Strain and Perceived Stress amid the COVID-19 Online Learning among Medical Science Students. *Int. Med. Educ.* **2023**, *2*, 83–95. https://doi.org/10.3390/ime2020008

Academic Editor: Hideki Kasuya

Received: 19 March 2023
Revised: 22 April 2023
Accepted: 10 May 2023
Published: 16 May 2023

1. Introduction

Lockdown and social distancing protocols came into force due to the unprecedented COVID-19 pandemic, which harmed globalization. To address the research question about the impact of COVID-19 on the triple bottom line (TBL) and identify potential research gaps in future support, a systematic review was conducted on the three key pillars of social, economic, and environmental sustainability in the aftermath of the pandemic. The study concluded that various sustainability researchers paid more attention and studied health care, human well-being, and education as the most critical social needs under social sustainability than other social issues [1]. The adverse impacts of COVIcould compromise

the global ability to achieve 12 of the 17 UN's SDGs within the 2030 agenda for Sustainable Development Goals [2]. The pandemic directly impacted health systems, population health, and well-being, while pandemic responses indirectly affected prosperity, education, global health, and food insecurity. COVID-19 has stymied progress on the SDGs [3].

In 2015, the General Assembly held by the United Nations established SDG 4 of 17, which prioritizes quality education as a crucial component for social sustainability within the 2030 Agenda for Sustainable Development [4]. As a fundamental human right for achieving peace and sustainable development, the UN emphasized and encouraged the active involvement of youth, students, teachers, leaders of schools and post-secondary institutions, their representative organizations, communities, parents, civil society, and academics at all levels. The UN questioned how learning systems must change to keep up with a rapidly evolving world that includes technological advancements, global integration, and climatic pressures [5]. COVID-19 lockdowns and closures disrupted education systems worldwide and presented new challenges for education systems and policymakers worldwide. The crisis prompted the revision of sustainable development principles and the integration of sustainability concepts into the education system structure [6]. The pandemic forced institutions to close and to facilitate innovative approaches that support remote teaching through various online platforms, allowing for continued education [7].

As the world shifts towards virtual learning due to the COVID-19 pandemic, some sectors and groups have faced challenges in providing their services to their stakeholders. Technology has become the primary mode of communication as human interactions have gone virtual [8]. To ensure quality education and support sustainable development, the UNESCO International Bureau of Education has proposed three key policies. These policies include utilizing technology to overcome learning difficulties caused by the pandemic, acknowledging community-driven support systems, and investing more in SDG 4 [9].

Before the COVID-19 pandemic, individuals were concerned about screen time, and many attempted to reduce their usage of digital devices to prevent eye strain. However, during the pandemic, electronic screens became the primary means of communication with family, teachers, and friends, leading individuals to shift their focus away from screen-time guilt. Hence, people spent their days watching TV for entertainment, keeping their computers open for online classes, and frequently using their unlocked phones to chat with friends [9]. Innovative technology helped individuals achieve their goals despite the restrictions of the pandemic, but this reliance on digital devices has negatively affected physical and mental health [10]. The pandemic significantly impacted education systems worldwide, disrupting the learning of approximately 1.6 billion students in over 190 countries; also, educational institution closures affected 94% of the world's student population. It sparked innovative approaches to education and training, improving education quality and increasing screen time [11]. Many studies have reported that the transition from face-to-face to online learning during the pandemic resulted in increased screen time and e-learners becoming more susceptible to multiple biopsychosocial problems, particularly visual and mental aspects, as evidenced in the literature reviewed [12–14].

The current research acknowledges the growing significance of technology while emphasizing the importance of examining the potential adverse effects of digital progress under Newton's second law. This fundamental principle highlights that any action results in an equal and opposite reaction, which also applies to technology and may harm individuals and the environment. Despite the known negative consequences of technology, it has significantly impacted how students are educated, with remote learning becoming the norm. This type of learning can cause ill effects on learners' physical and mental health due to reduced social interaction. Despite the potentially justifiable use of digital technology during the pandemic, conducting studies to determine the negative impacts and creating policies and measures to prevent harm to health and education sectors in each region is essential [15]. The present scientific study was designed to investigate the prevalence of eye strain and perceived mental stress among University of the West Indies students during the transition to online learning amid the COVID-19 pandemic. The study aims to

provide preliminary data that could inform the Ministries of Education and Health about the growing concern about eye strain and perceived stress among students in the context of online learning. The findings may contribute to developing new policies and budget allocations to address these issues effectively.

1.1. Literature on Online Learning and Eye Strain

Studies on online learning and visual impacts showed that visual problems, and various musculoskeletal problems, are known as digital eye strain (DES) or computer vision syndrome (CVS) [16]. Lockdown and online learning conditions during the pandemic warranted the public health to take responsibility for sustainable health problems due to the blue light emitted by digital screens, which causes ophthalmic and photoreceptor cell damage among learners [13]. The increased exposure to computer and phone screens creates a set of symptoms one may experience called digital eye strain (DES) [16]. Teachers and students are at risk for biopsychosocial problems due to long hours of digital screen dependency during online learning, which can cause digital eye strain, stress, and anxiety linked to the increased usage of electronic devices [15].

Many digital technology users may be aware of their pre-existing eye-related problems or may be unaware of them. It is imperative to bring awareness of the potential adverse effects of digital screens on the human body and mind among university graduates at this point of fully online learning. The prevalence of computer vision syndrome (CVS), also called digital eye strain (DES), in a community ranged between 22.3 and 39.8% [14]. Another study showed that out of 100 participants, 69% had computer vision syndrome, and 30% of the sample used computers for 4 to 6 h per day. The most distressing symptoms were eye strain and fatigue (59%), headache (57%), neck, shoulder, wrist, or back pain 51%), dryness of the eyes (37%), and blurred vision (35%). Only 11% of the participants knew about CVS [17].

Research on neuro biophysics and stress responses found that men and women exhibit different stress responses, with men having a 'fight-or-flight' response and women having a 'tend-and-befriend' response. Emotional stress responses differ between genders, but the neural networks involved remain unclear. Studies suggest stress- and gender-dependent neural activities and neural efficiencies are associated with varying stress feedback modalities [18–20].

A study surveyed 1046 college students during the COVID-19 outbreak in China to find a correlation between online learning and eye strain. Results showed that 72.1% of students experienced eye strain, with higher rates reported among females (74.6%) than males (68.4%). Female students also reported higher screen time exposure (>8 h/day) than males (<6 h/day). The study recommended protective measures to prevent eye strain and vision problems during online learning due to the positive correlation between screen time and eye strain [21].

A cross-sectional study in Jordan investigated digital eye strain among university students due to increased dependence on online education during COVID-19. Of 382 students surveyed, 94.5% had computer vision syndrome, with tearing being the most common symptom (59%). Double vision was the least reported (18.3%). Over half of the sample (55.5%) used digital devices for over 6 h per day, and 30.7% reported pain in fingers and wrists after using a mobile phone. Safe digital device use is recommended [22].

A study of 796 nursing students in Peruvian universities found that 87.6% experienced digital eye strain (DES), as assessed by the Computer Vision Syndrome Questionnaire (CVS-Q). The research recommended enhancing ergonomics, regulating screen brightness, setting screen time limits, and using eye-care measures such as wearing glasses to prevent DES spurred on by virtual learning [23].

1.2. Literature on Online Learning and Perceived Stress

The other domain affected by to digital life is mental well-being which increases daytime stress, anxiety, and depression levels and disrupts sleep [24]. A study found that

students were moderately satisfied with the online learning experiences, which affected their communication efficacy, and found a high prevalence of headaches [25]. A concept about stress and anxiety in the digital age due to daily exposure to digital rays described the dark side of technology as concrete evidence for the adult and student community. The top-five stressors are perpetual distraction, sleep dysregulation, work/life balance, fear of missing out, and delays in academic activities that need possible research-based solutions [26]. Before the pandemic, technology significantly impacted people's lives, particularly adolescents and young adults. The COVID-19 pandemic rapidly accelerated the use of technology [21]. Education was interrupted, resulting in remote learning.

A study that aimed to determine anxiety levels among university students in Malaysia during COVID-19 and the lockdown period found that 20.4%, 6.6%, and 2.8% of the sample experienced minimal to moderate, marked to severe, and most extreme anxiety levels. Financial constraints, remote online learning, and various uncertainties were the dominant stressors. An immediate, holistic policy to assess the psychological impact of COVID-19 or future pandemics on students should be recognized by all stakeholders in the education industry [27].

A descriptive cross-sectional study found an association between academic variables and stress levels between two groups of participants. Results showed that 46.1% preferred regular classes and showed severe stress levels while learning online, 20.3% agreed that "online learning was a burden", and the majority showed high-level anxiety and stress [28].

A cross-sectional study of 485 university students found that 53.1% reported worsening mental health due to COVID-19 compared to 38.5% reporting deteriorating physical health. Stress levels were highest due to social isolation, confinement, and remote learning. Female students had significantly worse mental health, but the reason was unclear. The study recommended low-threshold initiatives, such as counseling and mindfulness services, and emphasized considering gender-specific differences [29].

The latest study analyzed the emotional exhaustion of students in higher education, derived from the highly technology-related strain associated with the current COVID-19 pandemic called 'technostress' among a sample of 333 students in a public university in Spain, and selected two mediator variables, perceived stress and intrapersonal conflicts, to find their association in managing students' suffering. The statistical analysis showed a direct and significant relationship between technostress and emotional exhaustion. They were significantly associated with perceived stress and the level of intrapersonal conflicts in the sample students [30].

A cross-sectional study of 324 undergraduates from a medical college in South India used a perceived stress scale (PSS) and a questionnaire to investigate the association between stress and involvement in online classes during the pandemic. A total of 85% of students reported moderate stress, with the inability to focus (56.4%) and fear of exams (49.8%) as the main stressors. The study found a significant association between stress and involvement in online classes and recommended identifying various stressors and making online classes more student-friendly [31].

A study in Saudi Arabia investigated the relationship between digital learning during COVID-19, life satisfaction, perceived stress, defense mechanisms, and coping strategies among female students. The online survey-based study found that digital learning provided more flexibility in terms of time and cost than traditional learning. The study also reported a positive correlation between coping strategies, perception, and good academic scores. The findings suggest that a positive attitude can positively influence life satisfaction [32].

A randomized and controlled study design examined the efficacy of a digital intervention to change behavior among school children. The intervention included health education promoting exercise and ocular relaxation, as well as live streaming and peer sharing of activities to promote physical activity. The study aimed to reduce anxiety and digital eye strain in children during prolonged online schooling caused by the COVID-19 pandemic. The results showed a significant reduction in eye strain among the study group, while both groups had similar sleep quality [33].

At the University of Brunei Darussalam (UBD), a study investigated the shift to online teaching during the COVID-19 pandemic among 279 undergraduate students and 56 lecturers. Positive experiences reported by students included independence (72.8%) and adapting to online learning (67.4%), while lecturers learned new teaching techniques (50.0%), became more innovative (50.0%), and had more time for exercise (51.8%). However, students studying at home reported distractions (72.0%) and uncertainty toward exams (66.7%), with the majority missing extracurricular activities (64.9%). Both students and lecturers reported increased stress, and lecturers felt additional pressure due to deadlines, disruptions (44.6%), and concerns related to work, family, and self (39.3%) [34].

A study in Oman examined the impact of COVID-19-induced e-learning on stress levels among college students. Out of 966 participants, 96.9% reported experiencing stress ranging from moderate to high levels. The study found that students' academic achievement was negatively affected by perceived stress. The study strongly suggested that institutions should assess and improve their online course delivery methods to alleviate stress levels [35].

2. Materials and Methods

2.1. Design and Variables

A quantitative cross-sectional web-based survey design was used to assess the impact of the independent variable, online learning, on the dependent variables, which were eye strain and perceived mental stress during the COVID-19 lockdown period.

2.2. Population

This study aimed to investigate undergraduate students enrolled in medical science degree programs at the University of the West Indies (UWI), including Medicine, Nursing, Pharmacy, Optometry, and Veterinary. The total population size consisted of N = 2338.

2.3. Sample Size and Sampling Technique

The sample size was determined using the Rao-soft sample calculator [36] from the population size of 2338 at an error rate of 5%, confidence intervals of 95%, and response rate of 50%. Accordingly, the required sample size was 331. A purposive sampling method was used to select the sample based on the significant inclusion criteria of 18 years and over who were actively learning via online platforms. Unfortunately, the population's response rate was insufficient, and 180 people made up the final sample size.

2.4. The Research Tools

The study included three self-reported tools: the Perceived Stress Scale (PSS-10), the Computer-Vision Symptom Scale (CVSS-17), a rating scale with 17 questions designed to evaluate 15 distinct eye symptoms, and the Socio-demographic Data Sheet (SDDS), which comprised 12 categorical variables.

2.5. Ethical Considerations

Ethical approval was obtained from the UWI ethics board and permission from the University Registrar. An invitation was sent to the target population through Google Forms to obtain written consent. An email containing a Google link was dispatched to the participants' email addresses, which outlined the study's objectives, the option to withdraw, and guaranteed confidentiality.

2.6. Data Collection Procedure

The data were collected using the web-based self-reported method. A Google Form was constructed, in which the flyer, the consent form, and three research tools were built, and the link was disseminated to the target population through their email id. The responses of the 180 participants were received and analyzed.

2.7. Data Analysis

IBM SPSS Version 27 software was utilized for data analysis. Both descriptive and inferential statistics were employed. Pearson's correlation test was performed to examine the correlations between perceived stress and online learning, eye strain and online learning, and perceived stress and eye strain. The one-way ANOVA test was used to compare the four schools of medical science students as an independent group, while the independent *t*-test was used to compare the age groups and gender. In addition, the Brown–Forsythe (BF) test was performed to determine the differences between the ethnic groups concerning eye strain and perceived stress.

2.8. Data Protection

All collected data were securely encrypted and stored in a password-protected electronic format. The primary researcher was granted access to the data for research purposes. Furthermore, the data file will be securely deleted after five years to safeguard the participants' confidentiality. This protocol was established to adhere to ethical standards and protect the participants' privacy rights.

2.9. Limitations to Methodology

The sample size was insufficient in comparison to the population size. The data were collected online rather than in person, which lacked self-motivation among participants to increase their response rate in the study. An added formal ophthalmological exam rather than relying on self-reported responses to the given questionnaire could have validated the collected data and improved the results.

3. Results

The socio-demographic variables showed that the study sample was primarily composed of females (152) in the 18–23 age group who had been using prescription glasses for myopia since school. Before the COVID-19 lockdown, most participants reported spending 2–4 h daily on electronic devices for learning purposes. However, during online learning, this time duration increased significantly to over 7 h, as shown in Table 1. The analysis of the main study variables revealed that all participants experienced eye strain at different levels. Specifically, 56.1% reported moderate eye strain, 30.6% reported severe eye strain, and 3.3% reported mild eye strain. The average mean level of eye strain was $\bar{x} = 55.2$ (Table 2 and Figure 1). Similarly, most (68.9%) participants reported moderate perceived stress, while 1.1% reported mild perceived stress, with an average mean score of $\bar{x} = 24.8$ (Table 3 and Figure 1). There was a weak, positive, and significant correlation (r = 0.204) found between perceived stress and eye strain at a *p*-value> 0.05 (Table 4). The 18–23 and 24–29 age groups differed significantly ($t = -4.213$ at $p < 0.05$) only in eye strain levels, while males and females differed significantly ($t = -3.28$) in eye strain and perceived mental stress levels ($t = -3.021$). Differences in eye strain were found among ethnic groups (BF $t = 11.16$ at $p = 0.05$) but not in perceived stress. On an association, the electronic devices used for online learning were significantly associated with eye strain (F = 2.783). In contrast, the program of study was significantly associated with both eye strain (F = 15.037) and perceived stress (F = 2.769) at the $p < 0.05$ levels.

Table 1. The Socio-demographic Characteristics of Participants Illustrated Using Frequency and Sample Percentage.

Socio-Demographic Variables		Frequency (f)	Percentage (%)
Gender	Male	28	15.6%
	Female	152	84.4%
	Total	180	100.0%
Age Group	18–23 years	113	62.8%
	24–29 years	67	37.2%
Enrolled Program	Dentistry	12	6.7%
	Medicine	75	41.7%
	Nursing	28	15.6%
	Optometry	30	16.7%
	Pharmacy	21	11.7%
	Veterinary	14	7.8%
Ethnicity	African	24	13.3%
	Asian	19	10.6%
	East Indian	118	65.6%
	Mixed	19	10.6%
Presence of Congenital Eye Condition	No	168	93.3%
	Yes	12	6.7%
Prescribed Eye Device	No	87	48.3%
	Yes	93	51.7%
Type of Vision	Normal	86	47.8%
	Short-sight	85	47.2%
	Long-sight	9	5.0%
Device Worn	NA	86	47.8%
	Spectacles	93	51.7%
	Contact lenses	1	0.6%
Period When Started Wearing Eye Device	After entering university	10	5.6%
	After starting school	24	13.3%
	From childhood	14	7.8%
	NA	86	47.8%
	While studying in secondary school	46	25.6%
Average Hours Spent on Electronic Devices Daily BEFORE Start of Online Learning	2−4 h	111	61.7%
	4–6 h	54	30.0%
	>7 h	15	8.3%
Average Hours Spent on Electronic Devices Daily AFTER Start of Online Learning	2–4 h	30	16.7%
	4–6 h	39	21.7%
	>7 h	111	61.7%
Electronic Devices Used for Online Learning	Mobile Phone	19	10.6%
	Tablet	32	17.8%
	Laptop	112	62.2%
	Computer	17	9.4%

Table 2. Illustrates the Frequency and Percentage of Levels of Eye Strain with the Mean and Standard Deviation of the Sample.

S. No.	Level of Eye Strain with Scores	Frequency (f)	Percentage (%)	Mean & Std. Deviation
1	No Eye Strain (1–20)	0.00	0.00	$\bar{x} = 55.2$ $\sigma' = 13.7$
2	Mild Eye Strain (21–40)	24	13.3	
3	Moderate Eye Strain (41–60)	101	56.1	
4	Severe Eye Strain (61–80)	55	30.6	
	Total	180	100.0	

Table 3. Illustrates the Frequency and Percentage of Perceived Stress Levels with the Mean and Standard Deviation of the Sample.

S. No	Perceived Stress Levels with Scores	Frequency (f)	Percentage (%)	Mean & Std. Deviation
1.	Mild Stress (0–13)	2	1.1	$\bar{x} = 24.8$ $\sigma' = 5.54$
2.	Moderate Stress (14–26)	124	68.9	
3.	Severe Stress (27–40)	54	30.0	
	Total	180	100.0	

Table 4. Shows the Correlation of Perceived Stress Scores with Eye Strain Among the Sample.

Study Variables	Perceived Stress	Eye Strain	*p*-Value
Perceived Stress	1	r = 0.204 **	0.006
Eye Strain	r = 0.204 **	1	

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

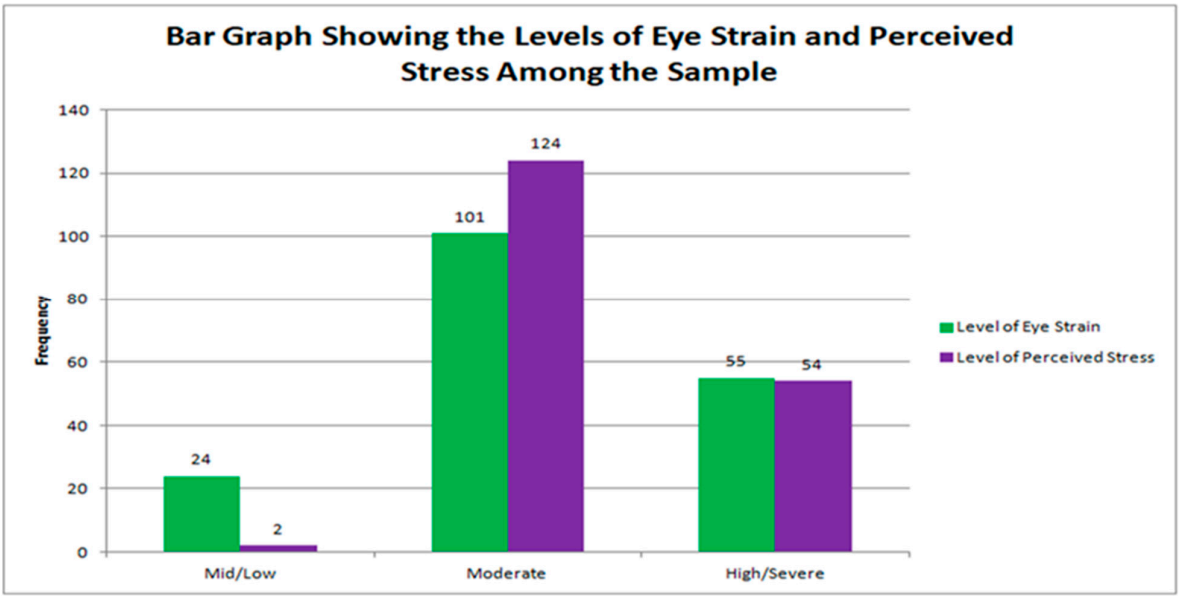

Figure 1. Shows the levels of eye strain and perceived stress experienced by the study participants during online learning.

4. Research Findings and Discussion

University students attend lectures, read, comprehend, recall, and think critically to apply concepts in the laboratory and clinical learning areas. Medical sciences students spend most of their time in classrooms, libraries, or private study rooms to perform these higher mental and psychomotor functions. During the pandemic, remote learning replaced in-person instruction, forcing learners to attend lectures via digital screens in monotonous home environments, resulting in a lack of visual stimulation. Campus learning gives students a chance to interact with classmates and teachers as well as engage in psychomotor activities that cause the release of positive biochemicals in the brain. These chemicals help students concentrate, move more efficiently, and unwind after studying, reducing their screen exposure. The study critically assessed the findings of the results with the pieces of reviewed evidence to determine the commonalities and contrasts for unanswered questions about the best course of action for future research on the study variables.

4.1. Findings on Socio-Demographic

Females made up 84.4% of the participants in the research. This majority was contributed by samples from the nursing school's female profession. Many (57%) also had short and long sight and used glasses since elementary school, which may be related to genetics, diet, or technology usage. Most females were found to be more often impacted by digital eye strain than men, according to research by Sheppard and Wolfson and Kumar and Sharma [16,17], confirming the present findings. Most of the sample (61.7%) spent 2–4 h before COVID-19, but it increased to >7 h (61.7%) after online learning was initiated. This advanced screen time evidence is aligned with the studies of Lakshmi and Wang Shuo et al. The subsequent finding was that the most used devices for online learning were laptops (62.2%) and desktops (9.4%), which contradicted Lakshmi's study, which reported that smartphones were used more [29,31]. Handsets are assumed to be affordable and easy to use anywhere for the students as passive listeners to the online lecture classes.

4.2. Findings on Eye Strain

The findings of the current study revealed that all participants experienced varying degrees of eye strain, ranging from mild to severe, which is consistent with numerous studies in the literature, including those conducted by Mishra, Sanodiya, Wang Shuo et al., Gammoh, and Huyhua Sonia et al. [31,32,35,37,38]. The prolonged use of digital screens, particularly in the context of university-level education, has been identified as a significant contributing factor to eye strain. It was attributed to the increased reading and computer use associated with online learning and digital screens for recreation to cope with boredom. Eye strain has been identified as a prevalent issue among university students, particularly during the COVID-19 pandemic. Wang Shuo et al., Gammoh and Huyhua, and Sonia et al.'s studies have reported a high prevalence of eye strain symptoms such as tearing eyes, headache, and dry eyes. Additionally, it is essential to highlight that musculoskeletal pain resulting from online learning was not addressed by many reviewed studies or the present study, as evidenced by the survey conducted by Abou et al. [24].

4.3. Findings on Perceived Stress Levels

Based on the current study, all participants experienced varying levels of mental stress, ranging from mild to severe, which could be attributed to the challenges of adapting to online schooling, being isolated due to COVID-19, and sitting alone for extended periods. These findings are consistent with previous studies by Abdulghani et al., Sheppard and Wolffsohn, Isabel et al., Motappa et al., and Idris et al. [16,21,26,31,39]. However, the studies by Abdulghani et al. and Gewalt et al. specifically identified increased anxiety levels as a stressor during online learning [26,28], which was not focused on in the present study. On the other hand, Mabrouk, Fatma et al. reported positive outcomes of online learning, such as flexibility in learning and cost-effectiveness, and Idris et al. found that virtual learning enhanced students' independence and facilitated innovative teaching methods

for lecturers [33,39]. The present study did not investigate the positive effects of online teaching and learning.

4.4. Findings on the Correlation between Eye Strain and Perceived Stress

The current study discovered a weak but significant positive correlation (r = 0.204). The research paper found a correlation of 0.204 between the perceived stress and eye strain levels of the participants undertaking online learning during the COVID-19 pandemic. This finding was supported by previous studies conducted by Hyon and Yang, Han et al., and Sabel et al. [19,40]. Isabel et al.'s study also highlighted a significant relationship between technostress and emotional exhaustion, which was associated with perceived stress [19]. Conversely, Mabrouk, Fatma et al.'s research demonstrated a positive correlation between online learning, coping strategies, perception, and good academic performance [33]. Furthermore, Malik and Javed's study indicated that stress perception adversely affected students' academic achievement [36]. Notably, the present study did not evaluate the impact of the online learning mode on coping strategies or academic performance.

4.5. Findings on the Association of Selected SDVs with Eye Strain and Perceived Stress

The results indicated higher eye strain levels in the 18–23 age group compared to 24–29, possibly due to younger generations' reliance on electronic devices. Females also exhibited higher levels of eye strain and mental stress than males, supported by previous studies (Abdulghani et al., Sheppard and Wolfson [16,26]). The above could be attributed to females' different hormonal systems and the challenges of managing multiple roles in their daily lives, resulting in heightened emotional reactivity and quicker exhaustion, as evidenced in Verma, Rohit et al., Goldfarb, Elizabeth, et al., and Nuamah, Joseph et al. [18,19,41].

The study revealed a significant mean difference of 11.44 in eye strain levels between participants of East Indian and African descent, possibly attributable to genetics or diet variations. This finding is supported by Prince Kwaku Akowuah et al. [39], who found that among African participants, the prevalence of Computer Vision Syndrome was 64.36%, with eye strain being the most common symptom. In contrast, a study conducted in Central India reported 89.5% of participants experiencing digital eye strain [38], confirming our research findings that eye strain may be more prominent in individuals of East Indian descent compared to Africans. The study found a significant difference in mean eye strain among the five programs (excluding Optometry), possibly due to differences in online class duration and screen time. Additionally, those who used tablets had significantly higher eye strain levels than those who used computers, potentially due to screen size, brightness, and angle. There was a significant difference between the six programs regarding perceived stress, potentially due to varying workloads or personal issues. These findings align with [24]. Abou Hashish et al. found a higher stress prevalence in pharmacy students compared to medicine and dentistry students [24].

The systematic review conducted by Radtke et al. and the study conducted by Jaafar et al. underscore the significance of ergonomic knowledge among university students. Several studies have revealed low awareness of ergonomic practices among medical and engineering students, and improper computer usage has been linked to health issues such as musculoskeletal disorders. These findings emphasize the need for preventive measures among students who rely on computers for online learning [42,43].

Despite limited intervention-based research on reducing eye strain or perceived stress among adult online learners, Zheng et al. conducted an experimental study involving a digital intervention for school children during prolonged online schooling due to COVID-19. The intervention included health education on exercise promotion, ocular relaxation, live streaming, and peer-sharing activities to reduce eye strain and anxiety, and the results showed a significant reduction in eye strain but similar sleep quality in the study group [33]. The research on the impacts of excessive screen time on adults' health is limited; evidence suggests that online learning or prolonged digital screen exposure can have negative consequences, such as digital eye strain, technostress, poor academic performance, poor sleep,

and worsened mental health (perceived stress and anxiety). Digital detox interventions, which involve voluntary abstinence from social media and technology, have been shown in previous studies to significantly reduce stress, improve sleep hygiene, and enhance overall mental health [42].

5. Recommendations and Conclusions

This research paper recommends a large-scale longitudinal–observational study in Trinidad and Tobago to investigate the impacts of online learning on mental health and ophthalmic health. The Ministry of Education and Ministry of Health's involvement is crucial to integrating findings into student well-being policies. Proposed strategies include eye care, stress management, and hybrid classes based on preventive and promotive healthcare. Intervention-based research is needed to mitigate eye strain and musculoskeletal damage among online learners. Assessing students' digital wellness quotient and existing policies can refine global health and education systems. Given COVID-19's disruption of Sustainable Development Goals, this research must be conducted as a national project to address pandemic challenges and ensure student well-being.

In conclusion, it is crucial to implement interventions such as educating students on computer ergonomics, utilizing digital behavior modification, and promoting digital detoxification in transitional learning platforms during COVID-19 lockdowns to reduce eye strain and mental stress. Policies mandating routine medical eye examinations and incorporating yoga classes focusing on pranayama and relaxation techniques are recommended to tackle these issues in educational institutions and public health settings, considering the pervasive reliance on digital technologies today.

Author Contributions: Conceptualization: V.M.V., A.P., A.D., A.L., A.A., A.M. (Amethyst Mahabir), A.M. (Amanda Marchan), A.M. (Ambernique Monroe), A.R., K.E., N.E. and E.D.; methodology: V.M.V.; software: A.P.; validation: V.M.V., K.E., N.E. and E.D.; formal analysis: A.P., A.A., A.D., A.L., A.M. (Amethyst Mahabir), A.M. (Amanda Marchan), A.M. (Ambernique Monroe), A.R.; investigation: V.M.V., A.P., A.D., A.L., A.A., A.M. (Amethyst Mahabir), A.M. (Amanda Marchan), A.M. (Ambernique Monroe), A.R.; resources: A.P., A.D., A.L., A.A., A.M. (Amethyst Mahabir), A.M. (Amanda Marchan), A.M. (Ambernique Monroe), A.R.; data curation: V.M.V.; writing—original draft preparation: A.P., A.D., A.L., A.A., A.M. (Amethyst Mahabir), A.M. (Amanda Marchan), A.M. (Ambernique Monroe), A.R.; writing—review and editing: V.M.V., K.E., N.E. and E.D.; visualization: K.E., N.E. and E.D.; supervision: V.M.V.; project administration: V.M.V.; funding acquisition: self-funded study, V.M.V., A.P., A.D., A.L., A.A., A.M. (Amethyst Mahabir), A.M. (Amanda Marchan), A.M. (Ambernique Monroe), A.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of the university of the West Indies, St Augustine (reference code CREC-SA-0669/01/2021, dated 29/01/2021) as well as the assurance was given by the campus Registrar; on 16 March 2021. (Copies of the letters submitted).

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

Conflicts of Interest: The authors declare no conflict of interest.

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