ORIGINAL RESEARCH

High Prevalence of Symptomatic Dry Eye Disease Among University Students During the COVID-19 Pandemic in University of West Indies, Trinidad and Tobago

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Background: The Covid-19 pandemic lockdown obligated higher education students to attend online courses, leading to prolonged exposure to digital displays. Excessive time on digital devices could be a risk factor for ocular problems, including symptomatic dry eye. There are limited evidences to show the magnitude of symptomatic dry eye disease and its associated factors during COVID-19 pandemic. This study aimed to fill this gap, among university students in Trinidad and Tobago.

Methods: An institutional-based cross-sectional study was conducted among undergraduate students attending the University of West Indies, Saint Augustine Campus from October 2020 to April 2021. The standardized ocular surface disease index questionnaire, descriptive statics and binary logistic regression were used to assess the prevalence and associated factors of dry eye diseases. Variables with a p-value of less than 0.05 were considered to be statistically significant.

Results: Four hundred (96.3%) participants completed the questionnaire. Among all, 64.8% were female and 50.5% were east Indians. About 48% were using visual display units for average of 10–15 hours/day. The prevalence of symptomatic dry eye disease was 84.3% (95% CI = 80.8–87.5%) with OSDI score ≥13. Lack of education about dry eye 2.69 (95% CI: 1.41–5.13), use of the reading mode of computer 3.92 (95% CI: 1.57–9.80), refractive error 3.20 (95% CI: 1.66–6.20), previous systemic medications 2.80 (95% CI: 1.15–6.81), and average hours of visual display unit use/day (p<0.001) were significantly associated with symptomatic dry eye disease.

Conclusion: Symptomatic dry eye disease was a prominent problem among students at the University of West Indies. Average of >4 hours of visual display unit use/day, refractive error, positive history of systemic medication, lack of education about dry eye, and using computers in reading mode were associated factors.

Keywords: symptomatic dry eye disease, prevalence, associated factors, West Indies, Caribbean

Introduction

The ongoing COVID-19 pandemic and associated lockdowns required online university educations, which resulted in excessive use of electronic devices like phones, tablets, laptops, and computers. This excessive time spent using electronic devices led to an increased risk of ocular problems, including eye diseases like dry eye.[1]

Symptomatic dry eye disease (SDED) is a multi-factorial ocular surface condition that is manifested by symptoms of ocular pain, burning, visual disturbance, eye fatigue, dryness, grittiness, soreness, irritation, photophobia, and tearing.[2–6] It occurs because of a disturbance in tear film layers (the inner mucous, middle aqueous, and outer lipid layer), especially in the outer lipid layer.[7] SDED frequently affects quality of life by disturbing crucial daily activities like reading, using Visual Display Units (VDUs), watching television, recognizing friends, and driving.[5,8–10] Studies confirm that the

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economic burden of SDED is very high.[8,11–15] The United States healthcare system reported an overall annual burden of $59.24 billion due to SDED.[9]

Factors affecting SDED include age,[3,16,17] sex,[2,3,13,18,19] contact lens wear,[18,20–22] VDU use,[18–20,23] topical ophthalmic medication,[2,22] allergies,[2,24] current smoking,[8,25] systemic health conditions,[4,8,24,26] ocular surgery[27] and systemic medications.[26,28,29]

The prevalence of SDED reported among students varies in different geographical locations. For example, it was estimated in Japan (21.6% to 32.3%),[20] China (18.7% to 23.7%),[23] Ghana (48.1%),[2] Turkey (52.8%),[19] Mexico (56%),[30] Spain (51.8),[31] and Saudi Arabia (62.4%).[17] Since the COVID-19 pandemic, ophthalmic clinic visits due to SDED have increased.[32] The prevalence of SDED increased from 48.1% before the COVID-19 pandemic to 62.4% during the pandemic, especially among those who are Visual Display Unit (VDU) users and other long-time near activity workers like students (high school and university), administrative and bank workers.[30,33]

Generally, although there are so many studies done about SDED in many parts of the world before and during the pandemic,[2,13,20–22,34] due to the lack of evidence pertaining to the effect of COVID-19 epidemic on the population of Trinidad and Tobago, this study was aimed assessing the prevalence and associated factors of SDED among undergraduate students of the University of West Indies. This study also provides an insight into the effects of the COVID-19 pandemic on the Caribbean population.

Methods and Materials

An institutional-based cross-sectional study was conducted among undergraduate students attending the University of West Indies (UWI), Saint Augustine Campus, Trinidad and Tobago from October 2020 to April 2021. The university has approximately 17,035 students and eight faculties including Medical Sciences, Science and Technology, Engineering, Sports, Humanities and Education, Food and Agriculture, Social Sciences, and the Faculty of Law.[35]

All undergraduate students at UWI Saint Augustine campus made up the study population. All undergraduate students attending the UWI Saint Augustine campus who are between the ages of 18–35 years and gave their consent to take part were included as the study population. But the study excluded students who have not stayed up to a semester as UWI students.

Sample size calculated with Raosoft software considering a population of 17,035 and 95% confidence interval with a 5% margin of error using the formula below: x=Z(c/100)2r(100-r) n=N x/((N-1)E2 + x) E=Sqrt[(N - n) x/n(N-1)] Where n is the sample size, E is the margin of error, N is the population size, r is the fraction of responses that you are interested in, and Z(c/100) is the critical value for the confidence level c. Using the above formula, the calculated sample size was 376. By considering a 10% non-response rate, it increased the final sample size to 415.

The list of all registered students was picked up from the university database and labeled according to their faculties. Google random number generator (https://stattrek.com/statistics/random-number-generator.aspx), was used to select 415 study participants.

Though the gold standard diagnostic test is debatable, the symptom questionnaire is the most repeatable diagnostic test. There are various questionnaires for the diagnosis of SDED. But, the ocular surface disease index (OSDI) is the best-validated standard questionnaire with 12 questions, having high sensitivity (80%), specificity (79%), and reliability (>0.7 by Cronbach's α) for discriminating patients with and without SDED.[36] The standard OSDI questionnaire was adapted by incorporating factors that affect SDED after the literature review.[3,37–42] The questionnaire was divided into three sections: the first evaluated the frequency of symptoms; the second evaluated the effect of symptoms on daily tasks; and the third evaluated the effect of environmental factors, such as windy conditions and air conditioning. The scores on the three sections were summed up to get the final OSDI score (sum of the 12 questions multiplied by 25 and divided by 12), which ranged from 0 to 100, with higher values indicating symptom severity. Symptomatic dry eye was defined as an OSDI score ≥13.[43] Because of Covid-19 pandemic restrictions, online data collection was the method used to collect data. The student's contact was obtained from the university database. Consent sheets and questionnaire forms were sent out to those students with their email. Following getting the consent email, research investigators sent the questionnaire link to each student.

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The dependent variable was symptomatic dry eye disease and explanatory variables were age, sex, ethnicity, previous ocular surgery, refractive error, smoking, total VDU use hour per day, consistent near work, use of systemic medications, an omega-3 supplement, family history of dry eye, education about dry eye and protective cover of VDUs.

Collected data downloaded from browsers and checked for completeness and consistency before merging with Microsoft Excel 2010. Finally, merged data was exported to SPSS version 20.0, to clean, code, and analyzed. The prevalence of symptomatic dry eye with 95% confidence interval (CI) was determined by using the OSDI score. Descriptive components summarized were frequency, percent, and summary statistics. Binary logistic regression model was fitted and variables with a p-value less than 0.2 with bi-variable analysis were considered for the multivariable analysis. In multivariable logistic regression, explanatory variables with a value of $p < 0.05$ were significant. Odds ratios (OR) and 95% confidence intervals were calculated to determine the magnitude of association. Hosmer–Lemeshow test was used to assess the model fitness.

SDED was defined as symptomatic dry eye disease with OSDI score $\geq$13.[42] VDU use hour was defined as the average continuous hours of visual display unit use like a computer, television, and smartphones per day.[20,21] Current smoking was defined as a daily smoker who smokes any tobacco product at least once a day within the last week.[39] Previous ocular surgery was defined as a history of ocular surgery within the last 1 year.[44]

Ethical approval was obtained from the University of the West Indies, Saint Augustine campus, Research and Ethics Committee (Registration number: CREC-SA.0721/01/2021). The study followed the tenets of the Declaration of Helsinki.

Results

In this study, 400 undergraduate students took part with a response rate of 96.4% (400/415). The participants' age ranges from 18 to 35 years. The majority of participants (64.8%) were females and about half (50.5%) were of East Indian ethnicity. Nearly half (48%) of the participants used VDU for an average of 10–15 hours per day, whereas nearly 2/3rd (63%) performed near work consistently for 2–5 hours. Additionally, 2/3rd (67.5%) used reading mode (blue light filter or increase the warmth of the device's screen display) when using their computers. About 1/4th (24.8%) of the study participants had history of systemic medication and 8.3% of them reported taking an Omega 3 supplements (Table 1).

The prevalence of SDED among the participants was 84.3% (95% CI = 80.8–87.5%). The bi-variable logistic regression model found an association (p<0.2) between SDED and, sex, family history of dry eye, refractive error, education about dry eye, average hours of VDU use per day, hours of consistent near activity, use of reading mode on the VDU and systemic medication history.

A multivariate logistic regression found an association between SDED and education about dry eye 2.69 (95% CI: 1.41–5.13) times, use of reading mode of computer 3.92 (95% CI: 1.57–9.80) times, average hours of VDU use per day (p<0.001), refractive error 3.20 (95% CI: 1.66–6.20) times and previous systemic medications 2.80 times (95% CI: 1.15–6.81) (Table 2).

Discussion

This study found that, the prevalence of SDED was 84.3% (95% CI, 80.8–87.5) with a standard OSDI score. This prevalence is higher than the study done university students at University of Murcia (Spain) during the COVID-19 lockdown, which was 51.8%. This discrepancy could be because of criteria difference to say SDED that, they diagnosed a participant as having SDED when she/he have OSDI score >22, in contrast to our study which uses $\geq$13 as a cut point.[31] This prevalence is also higher than the prevalence conducted among 4393 VDU users 32.3%,[20] and 3443 high-school students 21.6% in Japan.[21] It was also higher than other studies among students ranging from 18.7% to 48.1%[2,23] with sample size of 1139 and 700, respectively, and also two studies conducted among Turkey lecturers and Saudi Arabia population who found 52.8% and 62.4%, respectively.[17,19] The higher value of this study may be because of wearing masks during the COVID-19 lockdown though we have not studied.[45,46] The discrepancies may also be because of an intensified VDU use among students during the lockdown of the COVID-19 pandemic could contribute positively to the high prevalence of SDED.[1] The high prevalence in this study could be also because more than half of the participants (64.8%) were females who are more likely to be vulnerable to dry eye because of hormonal changes and oral

Table 1 Factors of SDED Among Undergraduate Students at the University of West Indies (n=400)

Variables	Categories	Frequency	Percent
Sex	Male	141	35.3
	Female	259	64.8
Reading mode	Yes	270	67.5
	No	130	32.5
Ethnicity	East Indian	202	50.5
	African	75	18.8
	Mixed	113	28.3
	Others*	10	2.5
Consistent near work			
	<2 hours	86	21.5
	2–5 hours	252	63.0
	6–10 hours	44	11.0
	>10 hours	18	4.5
Average hours of VDU use			
	1–4	19	4.8
	5–9	95	23.8
	10–15	192	48.0
	>15	94	23.5
Omega 3 supplement			
	Yes	33	8.3
	No	367	91.8
Current smoking status			
	Yes	32	8
	No	368	92
Previous systemic medication			
	Yes	99	24.8
	No	301	75.3

Note: *Others: includes Chinese, Syrians, Whites, non-Trinidadians.

contraceptive use.[47–49] This difference also may be due to difference in environmental exposures, weather parameters, and climate of study areas.[50,51]

This study found previous education on dry eye found to be associated with SDED. The odds that developing SDED is 2.69 times higher among students who have no previous education about dry eye as compared to participants who have previous education. It may be because of the reason that since awareness and knowledge about a disease can lead people to prevent themselves from its awareness about dry eye disease pushes people to protect themselves from the disease and its consequences.

In this study, the odds of developing SDED are 3.92 times higher for participants who do not use reading mode (blue light filter or increase the warmth of the device's screen display when using it) than those who use it. The use of reading mode or blue light filters is highly advisable, especially for those who worked on VDU for an extended period. Therefore, blue light filters can improve comfort; the majority of symptoms of dry eye relieves with blue light filters.[52]

This study found that the odds of developing SDED are 3.20 times higher for ametropic participants as compared to emmetropic participants. Similar findings were obtained among studies in China and Ghana.[1,2,23,25] The reason may be because of common and shared reported symptoms between refractive error and SDED as the study is based on symptoms[53] or it may also be because of contact lens use of participants, which is one of the factor for SDED although our study did not assess it.[21,22,33]

Table 2 Result of Binary Logistic Regression Analysis of SDED Among Undergraduate Students at the University of West Indies (n=400)

	SDED		Crude OR (95% CI)	Adjusted OR (95% CI)
	Yes(%)	No(%)		
Gender				
Male	114 (80.9)	27 (19.1)	1	1
Female	223 (86.1)	36 (13.9)	1.467 (0.848–2.537)	1.33 (0.68–2.61)
Family dry eye history				
Yes	115 (86.5)	18 (13.5)	1.295 (0.717–2.339)	0.99 (0.50–1.96)
No	222(83.1)	45 (16.9)	1	1
Reading mode				
Yes	218 (80.7)	52 (19.3)	1	1
No	119 (91.5)	11 (8.5)	4.37(1.93–9.88)	3.92 (1.57–9.80)*
Educated about dry eye				
Yes	100 (74.6)	34 (25.4)	1	1
No	237 (89.1)	29 (10.9)	2.78 (1.61–4.81)	2.69 (1.41–5.13)*
Average VDU use hour				
1–4 hours	7 (36.8)	12 (63.2)	1	1
5–9 hours	78 (82.1)	17 (17.9)	7.87 (2.70–22.92)	5.43 (1.65–17.85)*
10–14 hour	167 (87.0)	25 (13)	11.45 (4.12–31.84)	9.08 (2.88–28.67)*
>14 hour	85 (90.4)	9 (9.6)	16.19 (5.09–51.54)	13.59 (3.59–51.47)*
Consistent near activity				
< 2 hours	63 (73.3)	23 (26.7)	1	1
2–5 hours	220 (87.3)	32 (12.7)	2.51 (1.37–4.59)	2.63 (1.30–5.32)*
6–10 hours	39 (88.6)	5 (11.4)	2.85 (1.00–8.11)	1.76 (0.53–5.81)
> 10 hours	15 (83.3)	3 (16.7)	1.83 (0.48–6.89)	1.05 (0.23–4.80)
Refractive error				
Yes	225 (91.1)	22 (8.9)	3.74 (2.13–6.59)	3.20 (1.66–6.20)*
No	112 (73.2)	41 (26.8)	1	1
Previous systemic medications				
Yes	91(91.9)	8(8.2)	2.54 (1.17–5.55)	2.80 (1.15–6.81) *
No	246 (81.7)	55(18.3)	1	1

Note: *→ p <0.05.

Those participants with a history of use of systemic medication are found to be 2.80 times at risk of having SDED as compared to those not using. This finding is supported by study conducted in Saudi Arabia[17] where up to 70% of the participants with systemic conditions suffer from SDED.[54]

Our study found that those who use VDU for 5–9, 10–14, and >14 total hours have 5.47 times, 8.70 times, and 12.39 times higher chance of developing SDED, respectively, as compared to those participants who use VDU for only 1–4 average total hours per day. This was consistent with findings from studies in China,[23] Japan,[20] and Turkey.[19] The possible reason for the association could be due to extended exposure to VDU which is linked to increased tear evaporation and low blinking rate, which eventually leads to SDED.[20]

Limitations

Using a single validated questionnaire instead of a combined tool (OSDI and other objective assessments) could affect the estimates of SDED prevalence and make comparison difficult with previous studies. This study result could be inflated because visual status, the presence of uncorrected refractive error, and other ocular and near vision problems were not measured in online data collection.

Contact lens use of participants, hours of face mask use, which could be factors for SDED were not assessed.

Recall bias to social and behavioral past exposure may occur among participants.

Conclusion

In this study, symptomatic dry eye disease is a common ocular problem experienced by majority of undergraduate students at the University of West Indies. An average of >5 hours of VDU use per day, refractive error, history of systemic medication, and education about dry eye were significantly associated factors.

Disclosure

The authors declare no competing interests in this work.

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