ORIGINAL ARTICLE

Impact of COVID-19 on the Prevalence of Dry Eye Among Young Adults in Kuala Lumpur Malaysia

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ABSTRACT

Introduction: Dry eye is a significant eye health issue. In dry eyes, the tear film is weakened, mostly due to low tear film quality and the quantity of secretion. This low quality of tear secretion can lead to the rapid breakup of tears. In recent times, particularly since the COVID-19 pandemic, the prevalence of dry eye has increased. Relevant studies found that the prevalence of dry eye is higher in females than males. This research work is based only on symptoms of dry eye disease in Malaysia to determine its prevalence among students at the UCSI University KL campus because of the increase in reported cases of dry eyes especially post Movement Control Order (MCO). **Methods:** A total of 199 students, ranging in age 17 to 30, were included in this research. This is a cross-sectional study that was conducted on participants who fulfilled the inclusion criteria. Demographic questionnaires and Ocular Surface Disease Index (OSDI) results were collected. **Results:** On the UCSI KL Campus, students who suffer from dry eye are 82% of the population. The Pearson Chi-Square test showed a significant difference between gender and dry eye, X2 (1, N= 199) = 8.64, $p < 0.0033$. Female students are more likely to develop dry eye than male students. **Conclusion:** The prevalence of dry eyes among UCSI students is high. This could be attributable to prolonged or improper mask-wearing. It is suggested that researchers and health policymakers should take heed to these emerging risk factors related to wearing of mask.
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INTRODUCTION

A common eye problem prevalent in Malaysia is dry eye (1). Dry eye in patients usually occurs when the tear film is depleted because of low tear secretion quantity and film quality. Early tear break-up can also occur when there is no tear secretion (2). Therefore, long-term treatment and management of dry eye are essential to reduce the negative effect. According to Guo et al. (3), a lack of consistent management of dry eye could result in regular eye grittiness leading to severe irritation, itchiness, and, in most cases, a burning sensation. The risk associated with long-term untreated, dry eye is possible irreparable sight impairment and related problems such as blurriness when seeing written words, driving, and difficulties operating visual devices. Milner et al. (2) opined that a patient's quality of life could be severely affected.

The objective of this research work is based on the symptoms of the OSDI questionnaire to determine the prevalence of dry eye disease in students at the UCSI University Kuala Lumpur Campus. The result of this research will also help identify the severity of dry eye in students at UCSI.

Based on the 2017 TFOS DEWS II Definition and Classification Subcommittee (4), dry eye is defined as "a multifactorial disease of the ocular surface characterised by tear film homeostasis and accompanied by ocular symptoms in which instability and hyperosmolarity of the tear film, inflammation, and damage play a role". The 2017 TFOS DEWS II Definition and Classification Subcommittee (4) mentioned that other factors that play a role include "surface and neurosensory abnormalities in the aetiology of dry eye." A detailed analysis of a patient's dry eye case is crucial as it provides diagnostic procedures and treatment guidelines. It is essential for the classification of fundamental subtypes of dry eye, such as evaporative or aqueous deficiency, because these factors are an integral part of the underlying dry eye disease and the efficacy guide of treatment strategy (4).

Matossian et al. (5) observed that the rate of dry eye in women is greatly higher than in men. According to the researcher, females are more likely to develop dry

eye due to these factors, synthesis and mix-reaction of tear film properties and the disorder of sex steroids. This disorder includes androgen deficiency, and even anatomic differences in structures, as well as meibomian glands and lacrimal apparatus (3). As a result, a balanced tear film is important to maintain the quality of the image's standard visual function (2).

The COVID-19 era brought a paradigm shift in public social life that required the government to introduce precautionary policies as a measure of prevention. There were two popular policies during this era to help reduce the spread of the virus. The first policy under the Standard of Procedure (SOP) issued a public order for mandatory and constant wearing of the face mask, especially in public areas. These masks helped in reduce the spread of the virus. However, recent studies have observed that the constant wearing of face masks could affect the eye, resulting in dry eye (6-8). The second policy was the movement restriction policy code-named "Movement Control Order" (MCO), which lasted an approximate period of one year, from 18 March, 2020, until 31st December, 2021 (9) and has continued through 2022. The MCO prevented public gatherings and also prevented students from attending physical classroom lectures. Thus "e-Learning" designed based on a mix-mode curriculum, becomes the new method of attending classes for university students.

Although the mix-mode curriculum was intended to accommodate 50 percent online and 50 percent physical classroom lecturing, the era brought about an unprecedented increase in the use of e-learning tools such as digital devices for studying.

The paradigm also saw a sharp increase in the amount of time students spent on digital devices for learning or attending online classrooms. It is important to point out that instances where students spend long hours using digital devices to study can go a long way towards causing dry eye issues.

As part of the precautionary measure to reduce the spread of the virus on campus, the management of UCSI complied with COVID-19 government policies, such as the Standard Operating Procedure (SOP) and the Malaysian Optical Council (MOC), that required all students and staff of the institution to wear face masks. According to Lin et al. (10), the COVID-19 pandemic, which saw an increase in the use of masks and electronic devices, contributed to dry eye disease.

According to Fan et al. (6), the sudden increase in the prevalence of dry eyes during the COVID-19 pandemic was associated with increased use of face masks. This is known as mask-associated dry eye (MADE). Furthermore, Krolo et al. (7) and Scallini et al. (8) also discovered an association between prolonged face mask use and worsening dry eye symptoms.

Studies have shown that dry eye is treatable; however, administering treatment to a patient at the early stage of dry eye disease is important to prevent a possible permanent loss of sight that could occur due to insufficient or lack of treatment. Early-stage treatment is also helpful to improve a patient's four core stages of life, which include "physical health, physiological well-being, level of independence, and environmental impact," as well as prevent the overall adverse effects associated with dry eye disease. Guo et al. (3) pointed out that, when left untreated, dry eye disease can disrupt these four stages of life, thereby affecting the quality of life.

MATERIALS AND METHODS

This research had a cross-sectional study design. The sampling method was random sampling. The participants were recruited among the students from all seven faculties in the UCSI KL campus, ages 17 - 30. Faculties include the Faculty of Applied Sciences, the Faculty of Business and Management, the Faculty of Engineering Technology and Built Environment, the Faculty of Hospitality and Tourism Management, the Faculty of Medicine and Health Sciences, the Faculty of Pharmaceutical Sciences and, the Faculty of Social Sciences and Liberal Arts.

This study was carried out from July through November 2022. The researcher used face-to-face interviews for data collection. This method aimed to determine if the participants fell under the inclusion or exclusion criteria before the questionnaire was handed over to them. Informed consent was obtained from participants before the study commenced. The questionnaire used for the study is the Ocular Surface Disease Index (OSDI). The OSDI questionnaire was designed to evaluate the signs and symptoms of ocular symptoms in dry eye disease and how they impact vision-related functioning. The main purpose of the questionnaire is to determine the number of patients who have dry eyes; it is not intended to categorize patients into those who have evaporative or aqueous types of dry eyes (11).

Although patients were examined with their face masks on during the slit lamp examination, the anterior segment related to dry eye characteristics data was not used in the study due to the limitation of data for aqueous deficiency and evaporative dry eye.

The sample size is calculated according to Charan et al. (12). Also, Cochran's formula, N = Z2 PQ/ e2, for determining the level of precision, confidence level, and estimation ratio of the assigned population for an idealistic sample size was adopted because the formula is highly appropriate for studying large population sample size. N is the sample sizes, Z is the statistic corresponding to the level of confidence, where a 95% confidence level will give us Z values of 1.96, P is

the expected prevalence (from previous studies), Q is dependent on the expected prevalence P, and e is the desired level of precision. Based on the incidence of dry eye in a sample population in Kuala Lumpur. According to Mohd-Ali et al. (13) , the prevalence of dry eye was 15%. Therefore:

$$N = \frac{1.96^2(0.15)(1-0.15)}{0.05^2}$$

N= 195

This study obtained ethical approval from the Ethics Committee at UCSI University. The ethical approval has the ref code IEC-2022-FMHS-046.

Participants eligible fulfilled the inclusion criteria: the age group was 17 –30 years old (14) , of all genders, and they were Malaysian students. The exclusion criteria included international students, patients who have ocular infections, and any autoimmune disorders. Based on the health history obtained during the face-to-face interview, participants who admitted of having a history of autoimmune disorders were excluded. Other groups on the exclusion criteria are those who have previously had intra-ocular or extra-ocular surgery in the past six months, as well as those who wear contact lenses (15) , female students who are pregnant and mothers who are still breastfeeding their babies (16) .

The data set was analysed using IBM's Statistical Package for Social Sciences (SPSS) version 25. The alpha was set at 0.05, and a confidence interval of 95% was used for all the statistical tests in this study. The chi-square test was used to analyse the data. A p-value of <0.05 was considered statistically significant for this study.

Table I: Socio-demographic distribution of studied samples

Characteristic	Total number of students n (%)
Age (years)	
17-20	79 (39.70)
21-25	110 (55.28)
26-30	10 (5.03)
Total	199
Gender	
Male	62 (31.16)
Female	137 (68.84)
Total	199

Table II: Normality Test of Gender Against OSDI Severity Scale

	Scale	Kolmogorov – Smirnov	P-value
		df	
Female	Normal	18	<.001
	Mild	34	<.001
	Moderate	37	<.001
	Severe	46	<.001
Male	Normal	18	<.001
	Mild	15	<.001
	Moderate	9	<.001
	Severe	19	<.001

*df, degree of freedom

RESULTS

Respondents recruited for this study were 199 students of aged 17 to 30 years old. The mean age for participants was 21.50 ± 4.39 years old. The response rate was 94.76%, and a total of 210 respondents were collected. Although only 199 respondents were accepted, 4 respondents who are 16 years old and 7 respondents who are over 30 years old were not eligible due to age restrictions. Table I shows the distribution of socio-demographic data. The respondents were classified by race: the majority (n = 171, 85.9%) were Chinese, followed by other races (n = 22, 11.06%), Indian (n = 5, 2.5%), and Malay (n = 1,0.5%).

A normality test was carried out, and the result is presented in Table II. Also, the skewness and kurtosis calculations show a skewness of -0.184 ± 0.536 and a kurtosis of -1.373 ± 1.038 for female participants whereas a skewness of -0.429 ± 0.536 and a kurtosis of -0.857 ± 1.038 for male participants. This result is presented on a normal OSDI severity scale.

Females with mild dry eye has a skewness of 0.026 ± 0.403 and a kurtosis of -0.911 ± 0.788. And for females with moderate dry eyes, a skewness of 0.441 ± 0.388 and a kurtosis of -0.959 ± 0.759 were observed. Finally, females with severe dry eyes had a skewness of 0.65 ± 0.35 and a kurtosis of -0.424 ± 0.688.

In contrast, a skewness of 0.294 ± 0.580 and a kurtosis of -1.681 ± 1.121 were presented in male mild dry eye. And for males with moderate dry eyes, a skewness of 0.441 ± 0.717 and a kurtosis of -1.438 ± 1.400 were observed. Lastly, a skewness of 1.116 ± 0.524 and a kurtosis of 0.720 ± 1.014 were presented in male severe dry eye.

The distribution of the severity of dry eye among genders is shown in Table III. A Chi-square analysis to determine if gender has an association with dry eye was done, and the results are presented in Table IV.

In this study, it was observed that 82% of students at the UCSI University Kuala Lumpur campus have dry eye

Table III: Distribution of OSDI severity of dry eye among genders

	Scale (%)				Total N (%)
	Normal N (%)	Mild N (%)	Moderate N (%)	Severe N (%)	
Male	19 (30.6)	16 (25.8)	9 (13.6)	18 (29.0)	65 (31.2)
Female	18 (12.5)	35 (25.5)	37 (27)	47 (34.3)	137 (68.8)
Total	37 (18.6)	51 (25.6)	46 (23.1)	65 (32.7)	199

Table IV: Association of gender and dry eye using Chi-square analysis

Gender	Dry Eye (%)	Non Dry Eye (%)	Total (N)
Male	43 [1.11]	19 [4.84]	63
Female	119 [0.5]	18 [2.19]	137
Total	162	37	199

cases. The prevalence is the addition in the percentage of mild dry eye, moderate dry eye, and severe dry eye. In Fig. 1, the data presentation shows that 26% of respondents registered to have mild dry eye, 23% registered to have moderate dry eye, and 33% of those having severe dry eye were registered. The overall prevalence is 82%.

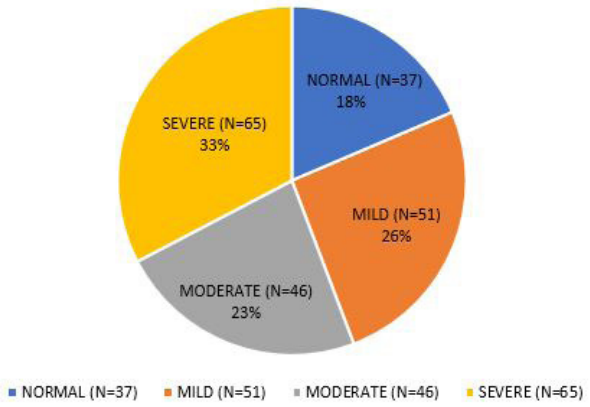

Figure 1: The Percentage of Dry Eye according to the severity in OSDI

DISCUSSION

This research aimed at identifying the prevalence of dry eye disease at the UCSI University Kuala Lumpur Campus, where an OSDI questionnaire was used to determine severity. Variables studied with the OSDI severity scale include ethnicity, age, and gender. The study found significant differences in gender and dry eye cases.

This research shows that the overall number of cases of dry eye in the UCSI University KL campus is 82%. This study provides evidence that the number of dry eye cases has increased since the last research was conducted in 2011. Mohd Ali et al. (13) observed that the prevalence of dry eye at that time was 15%. This current research observed a 67% difference, which is significantly higher compared to previous research. Although the OSDI severity scale shows that males (25.8%) and females (25.5%) have an equivalent rate of mild dry eye, the percentage of female students at 27% was approximately twice as likely to develop moderate dry eye than that of men at 13.6%. Additionally, female students' percentage rate of 34.3% has a more or less severe prevalence rate of dry eye than male students, rate of 29.0%. According to Vehof et al. (17) study, moderate dry eye was twice as common in female participants than in male participants. Whereby the study by Borelli et al. (18) published in 2018, found that female has a higher prevalence of dry eyes , which also supports the finding of this study.

The prolonged usage of face masks as a result of the COVID-19 pandemic may have worsened the prevalence of dry eye symptoms. This study was carried out during the endemic period to ensure that critical research data was analysed. Also, several studies show that the prevalence of dry eye in those countries was higher due to the COVID-19 pandemic. Some of these studies include (10),(19-20). Mashael (19) observed that the peak of COVID-19 in the United States shows that the rate of dry eye was 77.5%. While Tangmonkongvoragul et al. (20) study at Chiang Mai University shows that the rate of dry eye increased by 70.8% during the pandemic, Lin et al. (10) studied a selected population of students in nine high schools in Shanghai and found an increase of 70.5% in dry eye cases.

Several studies noted that wearing masks for up to three to six hours during the COVID-19 pandemic contributed to the increase in the prevalence of dry eye. This phenomenon is known as mask-associated dry eye (MADE) (6-8). According to Fan et al. (6), "prolonged mask wear, improper face mask use, decreased outdoor time, decreased daily reading time", and a dry environment is the factors that lead to the development of dry eye during COVID-19. Fan et al. (6) , however, defined improper mask wearing as an ill-fitting pattern of mask wearing and, in some cases, as not wearing the proper type of face mask. Fan et al. (6) also emphasized that MADE is commonly found in adults of age 20 years old and above, as opposed to those aged of 19 years old and below, and juveniles. Krolo et al.(7) and Scalinci et al.(8) in their research, they pointed out that wearing a face mask longer than three and six hours long can be associated with dry eye. It was observed that wearing a face mask for more than three hours can increase the risk of dry eye disease. The participants in this study estimated that they used face masks for an average of six to seven hours each day during office and non-office hours. Such prolonged mask use can worsen dry eye symptoms (21).

According to Pandey et al. (22) research findings which supported MADE stated that a face mask creates a unique airflow on the ocular surface, and the redirected upward

exhaled air from an inadequately fitted face mask will cause an acceleration of evaporation of cornea tear film which will lead to the development of dry eye and worsening symptoms of dry eye (22).

Furthermore, another observation suggests that regularly rubbing hands on the face as well as advertently or inadvertently rubbing hands in the eye regions of the face to fit the mask on the face properly could lead to an allergic reaction and may worsen the dysregulation of dry eye disease (23). Some researchers also suggested that the face mask could slightly pull down the lower eyelids region which causes difficulties for natural blinking that helps to restore healthy ocular surface (22).

In addition, one of the major factors that cause dry eye disease is smart schooling. According to Giannaccare et al. (24), smart schooling causes students to increase the use of visual display terminal (VDT) which is a major risk factor for dry eye disease. The researcher also observed that excessive tear fluid evaporation due to prolonged blinking while gazing is thought to be a major causative factor. Therefore, students are encouraged to blink more frequently. At the same time, those wearing face masks should take frequent breaks by removing their mask every few hours and reapplying lubricant eye drops, practising blinking exercise, and preventing displacement or improper wear that contribute to air leakage and dryness of the eye.

Several studies found significant differences in the prevalence of dry eye between males and females (5), (18,19). Moreover, Noor et al. and Barabino et al. (27,28) showed that elderly people are more prone to dry eye, as this research did not compare the dry eye severity scale with age.

Due to limitations in sample distribution that did not allow for sufficient coverage, this research could not draw a comparison on the relationship between ethnicity and dry eye. Thus, the result of this research is largely influenced by the Chinese ethnic population, which made up most of the respondents. Muna'aim et al. (29) research findings show that 40.3% of ethnic Malay are more susceptible to dry eye, while the Chinese are 35.1%, and Indians are 8.7% susceptible. However, a study by Mohd-Ali et al. (13) found that dry eye disease is more common among Chinese. Specifically, the severity is higher by 48.1% among Chinese, 44% among Malay, 7.4% among Indian, and 0.5% among other ethnicities in Malaysia. Niven et al. (30) in their study on Malay glaucoma eye disease suggested that the Chinese ethnic group is more prone to developing dry eye disease than other ethnic groups.

Based on the findings, it is likely that the increased prevalence of dry eye among young adults could be due to wearing masks. Since the COVID-19 pandemic, wearing a mask has become mandatory, especially in public and high-density areas. In addition, the participants in this study are university students, and during the COVID-19 pandemic, most students were engaged in distance learning and online classes. During this period, they will use laptops, smartphones, and computers more frequently than in the pre-COVID-19 era. In this regard, the authors would like to conclude that the high prevalence of dry eye in this study could be attributable to wearing masks and increased usage of e-learning tools for online learning activities.

There are several limitations to the present study. Most of the respondents were of Chinese ethnicity, while other ethnic groups were less numerous in comparison. Also, the age range for the survey was mostly 20-year-old respondents, which was not sufficient to draw an overall conclusion that age is a determinant factor that can increase the risk of dry eye disease. Therefore, in future research, it is recommended to include other ethnic groups in equal distribution to properly represent the country's multi-ethnicity in the spread of dry eye disease. Another limitation is the lack of data to adequately represent the ten-years-old age groups. Therefore, it is essential to point out that future research should consider studying ten-year-old groups in comparable, equal numbers to ensure data on the age group is properly represented. In this study, the anterior segment results related to dry eyes were not reported due to insufficient data. It is suggested to include anterior segment eye examinations specifically related to the tear quality and quantity in future studies.

The menstrual cycle of the participants were not taken into account during data collection because it is unrelated to the objectives of the study. Due to insufficient data, the study did not consider the participants' daily time spent using digital devices. In order to conduct a more insightful study, it is advised that future researchers take these factors into account.

CONCLUSION

The prevalence of dry eye based on symptoms among university students on the UCSI University KL campus is 82%. Regarding moderate dry eye cases, female students have approximately two times the susceptibility rate of male students. In terms of severe dry eye cases, finding shows a slightly higher prevalence rate of severe dry eye among female students than male students. For mild dry eye cases, no significance difference was found between gender and the normal grouping. From the study results, the author suggest several recommendations. It is suggested that facemasks should not be used for prolonged hours to reduce the possible development of dry eye issues. The face mask can be used only in areas where it is required and should not be used in places such as homes or non-restricted areas to help reduce mask-wearing time and dry eyes. There should be a concerted effort to drastically reduce the amount of time

students spend in the online classroom or completely revert to the traditional classroom lecturing method. This will not only help to reduce the amount of time students spend on digital learning devices but will also improve their ocular health and general well-being. Finally, the difference in pain sensitivity of dry eye symptoms among males and females and the high rate of dry eye cases associated with females, suggest that females have a significantly higher dry eye prevalence rate and are more likely to be affected by dry eye. It is important for males and females to regularly check their ocular health; however, females should pay more attention to risk factors and reduce or avoid activities that could lead to the possible development of dry eye symptoms.

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