DRY EYE AND SLEEP DISORDERS AMONG OPTOMETRY STUDENTS IN KNUST AMIDST ON-LINE TEACHING AND LEARNING: A CROSS-SECTIONAL STUDY

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ABSTRACT

Globally, dry eye disease is a major public health concern with underestimated patient health consequences. Exposure to digital devices is identified as a common risk factor associated with dry eye. The increasing population of students with inadequate lecture hall has further increased exposure to digital devices especially among students as on-line teaching has been integrated into the university teaching. Increased dry eye symptoms are linked with sleep disorders, yet there is a paucity of data among the student populace. This study investigates the association between dry eye disease and sleep disorders amidst increased exposure to screens of digital technology namely, computers and cell phones. A probability proportionates to the size and systematic randomized sampling technique were used to recruit 285 participants. The demographic characteristics of participants were gathered using a questionnaire. Dry eye disease and sleep disorders were ascertained using the Ocular Surface Disease Index (OSDI) and the standard Pittsburgh Sleep Quality Index (PSQI) questionnaire respectively. The mean age (±SD) of the study participants was 20.8 ±1.9 years with the majority being males (51.2%). About 62.1% of the participants had a normal score on the OSDI assessment. The OSDI showed a strong correlation with PSQI scores (p = 0.002), indicate most of the individuals who experienced dry eye symptoms also had sleep disorders. A significant correlation was found between increased in screen time and dry eye disorders . Individuals should be educated to put measures in place to reduce prolonged screen exposure. This will help in reducing symptoms of dry eye, which significantly can lead to sleep disorders, and thus affect productive output.

Keywords: Dry eye, Sleep disorders, On-line, Teaching, Screen time.

INTRODUCTION

In sleep there is a reduction in perception of external stimuli (Mandal, 2020). It is very important for the functioning of the human body without which a lot of bodily processes can be impaired. It is important for both physical and mental well-being. Sleep deprivation is however becoming very common in modern society (Jain & Verma, 2016).

A number of diseases have a significant association with sleep disorders and sleep duration, which includes depression (Chang, *et al.*,1997; A disorder in sleep is a very significant dimension with regard to the sleep-wake functioning because it has been linked to poor academic performance and wellbeing (Trockel, *et al.*, 2000). According to the American Psychiatric Association (2020), sleep disorders involve problems with the quality, timing, and amount of sleep, which leads to daytime distress and impairment in functioning. Sleep disorders have been shown to lower productivity and efficiency, especially at the work place. Studies performed on adolescents in Japan implicated among other factors, the use of blue light devices such cell phones computers for studies, and the brightness of the room. These cause sleep disturbances (Munezawa *et al.*, 2011). As a public health issue, sleep disorders need to be explored, especially in the context of developing young adults.

Dry eye, on the other hand, is defined as a condition that affects the ocular surface and tear film, which causes discomfort and visual disturbances (Lemp & Foulks, 2007). It is recognized as a multifactorial chronic disease that is highly prevalent and it affects a number of peoples across the world. It affects many people in the United States alone (Schaumberg, *et al.*, 2002; Stern & Pflugfelder, 2004) and represents the most frequent reasons for ophthalmic consultations (Schaumberg *et al.*, 2002).

Recently, dry eye disease has been identified as a public health issue (Brewitt & Sistani, 2001), with consequences of widely underestimation. Dry eye presents with symptoms which include impaired vision, psychological disorders, or both, and have a major impact on an individual's quality of life and job abilities, as well as their physical, social, and psychological well-being. (Catalan *et al.*, 2009; Friedman, 2010; Li *et al.*, 2012). A recent study of a group of healthy young male adults discovered that staying up all night could stimulate tear hyperosmolarity and decrease its secretion. Increases in the occurrence of dry eye symptoms were also linked to shorter sleep periods in a study that involved a large Korean adult population (Lee *et al.*, 2015), which is consistent with the higher prevalence of sleep disorders among dry eye patients (Ayaki *et al.*, 2016).

MATERIALS AND METHODS

A descriptive cross-sectional study carried out in the College of Science in Kwame Nkrumah University of Science and Technology. Students in the Department of Optometry and Visual Sciences were recruited for the study. A Systematic Randomised Sampling technique was used for the recruitment of the participants. Sort and Filter commands were employed to eliminate duplication. Random codes were then generated using the 'Sort by Sequence (number) and Randarray (number) formula.

The proportionate-to-size approach was used to compute the respective sample drawn from each of the classes. At an interval of two, samples were systematically drawn from the sampling frame after selecting the two participants at random. The first randomisation process selected a total of 245 out of the expected 372. The unselected ones were arranged in a sampling frame in ascending order and subjected to a second systematic randomisation until the targeted

sample size was attained. A reserve list was created to cater for those who voluntarily opted out of the study. Primary data was obtained from respondents through open-ended questionnaire, which was gathered through printed forms. Standard questionnaires comprising both close-ended and open-ended portions were employed in the data collection. These questionnaires are Ocular Surface Disease Index (OSDI) and Pittsburgh Sleep Quality Index (PSQI). A section on demographics preceded the standard questionnaire. The OSDI is a 12-item questionnaire that assesses both dry eye symptoms and their effects on vision-related functioning over the past week. It contains three sub-sections including vision-related functions, ocular symptoms and environmental triggers (Schiffman *et al,* 2000). The scale is capable of accurately discriminating among normal, mild to moderate and severe dry eye disease.

The PSQI is an 18-item constructed a questionnaire designed to assess overall sleep quality over a 1-month period. The 18 items are categorised into 7 derived component scores: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, medication use and daytime dysfunction.

Data Analysis

The Statistical analysis was completed using Statistical Package for Social Science (SPSS) version 20.0. Descriptive statistics was used to ascertain the frequencies and proportions of the socio-demographic variables of all the participants of the study. Statistical significance was set at $p < 0.05$.

RESULTS

Sample size calculations through systematic randomization, were employed to include 372 participants. 320 people responded to the questionnaires that were administered, yielding a response rate of 86.1%. We further excluded 35 participants giving us 285 participants with analyzable data.

Socio-demographic Profile of Respondents

The demographic characteristics of the students who responded to the survey are shown in Table 1 below. Out of the respondents, 51.2% were males. The ages of all the respondents were between 17 years and 28 years with the mean age (±SD) of 20.84 (±1.908) years. Each year group was duly represented.

Of the participants recruited, none of them had any systemic illness. Some however indicated that they had some ocular conditions. About 46 people indicated that they used spectacles out of the total population. No one recorded a history of ocular infection, inflammation or ocular surgery in the past six months, and 7 individuals indicated that they smoked, out of the 286 people recruited in the study.

Table 1: Socio-demographic Characteristics of Respondents

Variable	n (%)
Sex	
Male	146(51.2)
Female	139(48.8)
Age in of participants in years	
17	3(1.1)
18	20(7.0)
19	59(20.7)
20	50(17.5)
21	53(18.6)
22	45(15.8)
23	31(10.9)

24	16(5.6)	Second year	73(25.6)
25	5(1.8)	Third year	48(16.8)
27	1(4)	Fourth year	37(13.0)
28	2(7)	Fifth year	44(15.4)
		Sixth year	14(4.9)

Education Level

First year   69(24.2)

n; number of responses, %; percentage of responses

Table 2: Socio-demographic Characteristics of Respondents

Variable	Yes (n)	(%)	No (n)	(%)
Systemic illness of participants	0	0	286	100
Eye condition of participants	40	14	246	86
Spectacle or contact lens use	46	16.1	240	83.9
Ocular infection, inflammation/surgery in the past six months	0	0	286	100
Eyelid Abnormalities or extensive ocular scaring	0	0	286	100
Systemic drug intake	0	0	286	100
Smoking in the past month	7	2.4	279	97.6
Stimulant use in the past month	0	0	286	100

n; number of responses, %; percentage of responses

The Prevalence of Dry Eye among Respondents

Dry eye symptoms were assessed using the Ocular Surface Disease Index (OSDI). A summary of the findings has been presented in Table 3 below. The mean (±SD) OSDI score was 19.408(±16.03). A maximum score of 79.5% was recorded. 62.1% of the total sample had a normal score on the OSDI assessment making 62.1% of the total sample. 21.8% of the people had a mild dry eye. There were 44 with moderate dry eye symptoms 15.4% and only 2 people with severe dry eye symptoms 0.7%.

Table 3: Prevalence of dry eye symptoms among respondents

OSD I grade	n (%)
Normal	178(62.1)
Mild	62(21.8)
Moderate	44(15.4)
Severe	2 (0.7)

61.37% of the males had no dry eye compared to 63.6% of females in the same category. 22.8% of the males had mild dry eye symptoms and 20% of females were recorded. The distribution for both males and females with regards to moderate dry eye symptoms was 15.7% and 15.8% respectively. Those with severe dry eye symptoms were 0.7% and 0.7% representing the least proportions in both males and females. Figure 1.
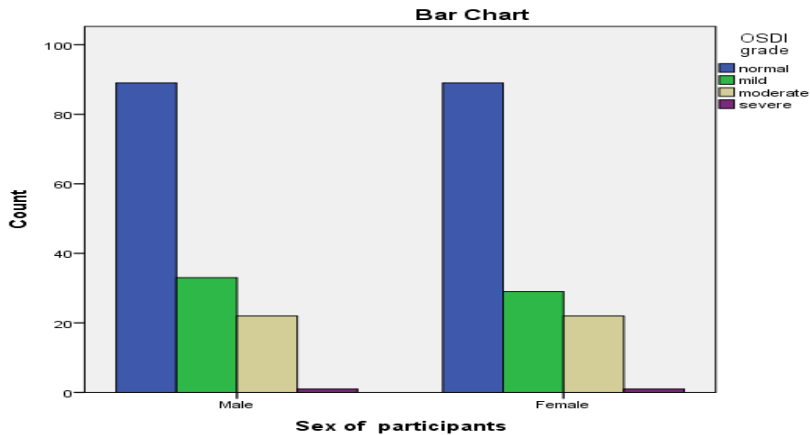
Fig 1: The association between dry eye and gender of participants.

Screen-time and dry eye

The association between screen-time and dry eye was evaluated based on three components namely, digital device use, number of hours of usage of these devices and increase frequency of screen time as a result of on-line teaching arrangements.

Whether or not an individual uses digital devices did not show a significant correlation with dry eye (p = 0.68). Those who reported an increase in screen time as a result of the on-line teaching and learning was 76.9%. 23.1% of the students however indicated the time spent on screens has not changed as a result of on-line teaching. A significant association between dry eyes and whether screen time increase was established. (p = 0.04). Majority of the sample population (51.4%) reported that using digital devices for 5 to 8 hours due to on-line arrangement followed by those who used digital devices for 9 to 12 hours with a prevalence of 29.4%. There was also a significant association between dry eyes and the number of hours digital devices are used. (p = 0.029).

Screen time and Sleep disorders

For individuals who indicated that their hours of screen use has increased as a result, 37.8% experienced sleep disorders and for those who did not record any increase, 48.27% recorded sleep disorders, thus there is no significant association between screen time increase and sleep disorders were observed, p = 0.09. This means an increase in screen time could not be correlated with sleep disorders in this study. Also, the association between the hours used of digital devices and sleep disorders analyzed showed no significant association. p = 0.59.

The Prevalence of Sleep Disorders

With the use of Pittsburgh Sleep Quality Index, the sleep quality was assessed and all seven components of the PSQI were analyzed to generate the global PSQI score. A response rate of 76.6% was recorded. The mean (±SD) PSQI score was 5.36 (±3.172), with a maximum of 18. Among the individuals without sleep disorders, 49.4% were males and 50% representing females. The prevalence of sleep disorders was 40.9% of the total participants. Among these individuals, the prevalence of sleep disorders was in males, as compared to 47.0% of females who had sleep disorders.

Within the age groups, those aged 21 had the greatest prevalence of sleep disorders. They constituted 18.8% of the individuals with sleep disorders, followed by those aged 20 with a representation of 17.1%. Those aged 22 followed, with a prevalence of 17.1%, than those aged 19 (16.2%). The 23 old year group had a prevalence of 12.8% and the 18-year-old group had a prevalence of 9.4%, 24-year-olds 5.1%. Those aged 25 had a prevalence of 1.7%. The 17-years-old group had a prevalence of 0.9%. There was no prevalence of sleep disorders in the 27 years and 28 years old respectively. Table 4.

Table 4: Age Distribution and Sleep Quality

Age of participants	PSQI Grade		Total
(Yrs)	0-5	6-21	
17	2	1	**3**
18	9	11	**20**
19	40	19	**59**
20	30	20	**50**
21	33	20	**53**
22	26	20	**46**
23	16	15	**31**
24	10	6	**16**
25	3	2	**5**
27	1	0	**1**
28	2	0	**2**
Total	**172**	**114**	**286**

Association between Dry Eye and Sleep Disorders

Dry eye symptoms were associated with sleep disorders among the participants as measured by OSDI. 51.9% of the participants in the dry eye group had sleep disorders (p = 0.004). Among the individuals without sleep disorders, 69.1% had no symptoms of dry eye and 30.8% had a dry eye. In individuals with sleep disorders, dry eye symptoms were more prominent than in those without sleep disorders. 48.2% had dry eye symptoms and 48.2% did not have dry eye symptoms. Sleep disturbances were significantly correlated with dry eye symptoms, with p = 0.002. Out of those who had dry eyes, 17.2% did not experience any discomfort sleeping due to cough, cold, bad dreams etc., compared to the 66.7% of the dry eye population who experienced these symptoms either once or twice a week or more twice a week. In addition, there was a significant association between daytime dysfunction and dry eyes (p = 0.005). About 30% of the respondents never had trouble staying awake while driving etc., and no problem with enthusiasm in getting things done as compared to those who experienced difficulties either once, twice, or more times a week, amid dry eye symptoms. 80% of the respondents with dry eye symptoms however had trouble staying awake and diminished enthusiasm in getting things done. There was also a significant correlation between the duration of sleep and dry eye symptoms as determined by OSDI (p = 0.02) with those who slept for more than 7 hours had a low prevalence of 30.8% as compared with those who slept for less than five hours with a prevalence of 48.4%. There were however no significant correlations between sleep quality, sleep latency and medicine-induced sleep and dry eye symptoms (p > 0.05). Table 5.

Table 5: Association between the sleep components and dry eye.

Components of PSQI	p values
Subjective sleep quality	0.24
Sleep latency	0.49
Sleep duration	0.02
Habitual sleep efficiency	0.4
Sleep disturbance	0.009
Use of sleep medication	0.5
Daytime dysfunction	0.005

DISCUSSION

On the whole, there were 145 males and 141 females, who took part in the study, indicating more male than female participants.

With each year group fairly represented, all participants fell within the age limits of 17-28. The mean age of the participants was 20.84 (±1.908) indicating that the population for the study was relatively very young adults. This finding is comparable to a

study conducted to find the prevalence of sleep disorders, in which the participants had a mean age of 20.38 (Gaultney, 2010). Generally, most university students fall within these age boundaries.

In this study, there was no correlation between gender and dry eye symptoms. This is similar to the results of the study conducted by Pavithra and Deepak (2020). It however differs from the results obtained in the study by Hyon *et al*., (2019), in which there was a strong association between the female gender and dry eye symptoms, with a p-value of 0.003, and also that conducted by Shah and Jani (2015).This could be attributed to the fact that both the males and females were exposed to the same risk factors such as increased screen time.

The mean PSQI score recorded in this study was 5.36 (±3.172). A study by Kawashima *et al.*, (2016) also recorded a total mean score of 5.1 (±2.3) which is quite similar to the findings of this study. In a study conducted on the sleep quality of incoming university students however, a different total mean of 6.0 (±2.5) was observed. Our study found the prevalence of sleep disorders to be 40.5%. This is comparable to the results of the study by Ghoreishi and Aghajani (2008) which found a prevalence of 40.6%. It is however lesser than the reported prevalence of 51% found by Ghrouz *et al*., (2019) and by Lemma *et al*., (2012) as 55.8% of university students. These differences in the prevalence of sleep disorders could be attributed to the different academic settings and different stress levels in the various student populations. Comparatively, the prevalence of sleep disorders among males is higher compared to that in females.

The OSDI showed a strong correlation with PSQI scores (p = 0.002), indicate that most of the individuals who experienced dry eye symptoms also had sleep disorders. These results are similar to the findings in the Osaka study (Kawashima *et al.*, 2016). Consistent with the findings of this study, poor sleep quality has recently been reported to be a risk factor for Dry Eye symptoms. A study that was conducted to find out whether sleep disorders are co-morbidities in the dry eye also showed that individuals who had dry eyes had poor PSQI scores thus, also consistent with our findings (Ayaki *et a*l., 2019).

A significant association was found to exist between dry eyes and some components of sleep such as daytime dysfunction, sleep disturbance and duration which was consistent with some of the findings from a study by Yu *et al.*, (2019) in which dry eye and sleep quality was determined in Hangzhou however in their study other components like subjective sleep quality, sleep latency, habitual sleep efficiency were found to be significant with dry eyes contrary to our study. Also, the findings were consistent with findings by Yang *et al.*, (2018) implying a common sleep problem among college students. Thus sleep deprivation results in excessive daytime sleepiness. This corresponded with a general population-based study which was conducted in Korea by Ahn *et al.*, (2021) showed that shorter sleep durations were associated with symptoms of dry eye.

Findings from this study also showed a significant association between the use of sleep medication and dry eyes similar to a study in Japan (Ayaki *et al.*, 2016).

A significant correlation was found between increased screen time and dry eye disorders (p = 0.044). Similarly, this result was achieved in the study conducted by Pavithra and Deepak (2020). In a study conducted in Japanese office workers as well, similar findings were obtained. In that study, screen time of greater than 5 hours was identified as a greater risk of dry eye disease (Al Tawil *et al.*, 2020).

CONCLUSION AND RECOMMENDATION

The study strongly suggests that dry eye symptoms are significantly associated with sleep disorders. The prolonged hours spent on digital devices has been identified as the provoking factor for dry eye symptoms, which in turn leads to sleep disorders.

Education on the use of screens with blue light regarding the number of hours should be embarked on by stake holders to create awareness among students and other users of such devices having challenges with sleep and dry eye. Sound sleep could be achieved for good health and productivity.

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