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Digital Eye Strain among undergraduate medical students at Majmaah University, Saudi Arabia: CROSS-SECTIONAL STUDY

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ABSTRACT

Background / Introduction: The novel coronavirus disease pandemic (COVID-19) has affected the world entirely. The government of Saudi Arabia adopted varieties of measures to mitigate the spread of the novel virus; one of the measures taken was to close all schools and universities across the kingdom and promoting online education. The aim of our study is to determine the prevalence of digital eye strain, the associated risk factors and the most prevalent associated symptoms among under graduated medical students at Majmaah University in Saudi Arabia.

Objective: to study the prevalence of digital eye strain among undergraduate students in the college of medicine, and to identify the risk factors associated with digital eye strain, and to identify the preventive measures taken to avoid eye strain symptoms related to digital device use.

Methodology: Observational descriptive study (Cross-sectional study) to evaluate Digital Eye Strain among undergraduate students in the college of medicine at Majmaah University, to

determine the prevalence of DES, associated risk factors, and measures taken to relieve the symptoms. Data will be analyzed by researchers using SPSS version 20**.**

Results: Our study showed that digital eye strain was positively associated in female gender more than male, also it was positively associated in people who have preexisting eye conditions like myopia. Regarding the incidence of digital eyestrain with the intensity, it has been shown that most of our participants had mild strain eyestrain (41%). Moreover, it was observed that headache was the most common complaints by our participants. Using the digital devices for more than 4 h/day, and takings a breaks during using the devices in frequency 60 minutes or more and not using antiglare screen were significant risk factors linked to sys strain symptoms ($P<0.001$, $P=0.02$, $P=0.04$) respectively .In regard the preventive measure taking to reduce the digital eye strain our study found that there was no significant association between practicing the rule of 20-20-20 and the prevalence of digital eye strain among participant using eye drops was significantly associated with low incidence of digital eye strain ($P=0.01$).

Conclusion: In conclusion, digital eye strain is an emergent public health problem that is proportional to the duration of exposure to digital screens. It has also been associated with multiple digital devices among medical students most commonly iPads. Digital devices are mandatory in every institution and prevention of digital eye strains with the consequences must be included in the curriculum.

Keywords: eye strain, Majmaah, Digital devices

INTRODUCTION

The novel coronavirus disease pandemic (COVID-19) has affected the world entirely. WHO and many healthcare agencies have adopted many measures like social distancing and face mask wearing to limit the spread of the virus [1]. The government of Saudi Arabia adopted varieties of measures to mitigate the spread of the novel virus; one of the measures taken was to close all schools and universities across the kingdom as well as closing the governmental and private sector offices and promoting online education and remote working. Thus, these measures caused a shift from the traditional method of teaching into virtual online teaching [2]. Due to these factors, digital eye strain became an emergent public health problem that is proportional to the duration of exposure to digital screens.

According to the American optometric association, digital eye strain (DES) is known as a complex of both eye and vision related symptoms that are associated with prolonged use of digital screens [3]. American optometric association came to the conclusion that 14.25% of individuals who visited optometry clinic complained primarily of symptoms related to prolonged exposure to digital screens [4]. These symptoms can be grouped into two categories, internal symptoms such as eye pain, headache, and blurred vision. And external symptoms such as tearing, dryness, itching and burning sensation [5]**.**

Many factors have been suggested to explain these symptoms, the electronic images contain thousands of pixels combined that need more visual demands to the point that they may exceed

the person's visual ability [6]. Another factor that has been suggested that low blinking reflex while starring at a digital screen contribute to exaggerated dryness of the eye [6].

Digital eye strain incidence among medical students has been reported in multiple studies, for example, in a paper published by El Massry et al they found that 86% of digital appliance users that spend 3 hours or more per day complained of digital eye strain symptoms. In addition the most common symptom with a percentage of 31% was blurred vision [7]. Similarly, another study done among medical students in Jordan they found that 55% of the students use digital devices more than 6 hours per day with overall prevalence of digital eye straining is 94.5%, and the most prevalent complain was tearing in 59% [8].

Similar studies were done in Saudi Arabia regarding digital eye strain among specific targeted population [9-10]. However, the aim of the present study is to determine the prevalence of digital eye strain, the associated risk factors and the most prevalent associated symptoms among under graduated medical students at Majmaah University in Saudi Arabia.

Materials and Methods

Observational Descriptive study (Cross-sectional study) to evaluate Digital Eye Strain among undergraduate students in the college of medicine at Majmaah University, to determine the prevalence of DES, associated risk factors, and measures taken to relieve the symptoms. The study will conduct in collage of medicine in Majmaah University. The study will only target male and female students in college of medicine in Majmaah university.

The sample frame was all male and female students in the college of medicine in Majmaah university. The sample size was calculated using an online calculator (according to 95% confidence interval, 5% margin error and 50% is the expected population of outcome variable). The sample technique was random sampling technique to allocate the participants where every student has an equal chance to be selected.

An online questionnaire was distributed among students in college of medicine. The questionnaire was obtained from the article on the Journal of Clinical Epidemiology in which reliable and valid questionnaires were developed to measure CVS at the workplace [11]. The questionnaire consists of 4 parts, the first part about demographic data which include (gender, age, the current year level) and the type of studying device and the use of visual aids and the purpose of it. Second parts qualitatively assess digital eye strain symptoms and signs based on symptom frequency (never, occasional, or always/often) and severity (moderate, or intense) of 16-related eye symptoms, total score was calculated by the following formula:

DES score= $\sum_{i=1}^{16}(frequency \times intensity)$

Considering that:

- Frequency: Never = 0, Occasionally = 1, Often or always = 2
- Intensity: Moderate = 1, Intense = 2

- If the total score was ≥6 points, the student was considered to have CVS
- The result of Frequency X Intensity should be recorded as: 0 = 0; 1 or 2 = 1; 4 = 2
- DES score was further categorized into mild (6-12), moderate (score=13-18), and sever (score=19-32).

The third parts about risk factors associated with eye strain symptoms which include (duration of using digital devices, taking breaks and frequency of it, distance from screen, level of screen, posture while using the device, brightness of the screen, source of lighting and using of antiglare screen). The last part about measures taken by students to relieve eye strain symptoms which include (20-20-20 rule, frequent blinking, location of the screen, proper lighting source, using of antiglare screen and using of eye drop) the participants also informed to record how frequent they use these measures as always, occasionally, or never/rarely.

The inclusion criteria were: Only male and female students in the college of medicine in Majmaah university who use digital devices for studying. Exclusion criteria were students who refuse to participate, Visitors and employees, student of the preparatory year.

Data will be analyzed by researchers using SPSS database, descriptive data will be presented as percentage, chi-square test (Fisher's exact test when required) was used to study the significance of associations. P value less than 0.05 is considered significant.
For ethical consideration, the study acquired ethical approval from Majmaah University ethics committee. Data will be kept confidential and will be used only for the purpose of this study.

RESULTS

Total number of responses was 172 participants. Table (1) shows the characteristics of the participants correlated with eye strain status. Majority of the participants were male (n= 142) in which 60.5% of them (n= 75) are considered to have digital eye strain, however, majority of the female participants are considered to have eye strain (n= 40, 83%) which was statistically significant (P= 0.004). regarding device of study, iPad devices were the most prevalent method of study (n=128) followed by Laptops (n=29) however no significant difference was observed (P= 0.08). regarding eye condition, majority of the participants do not have an eye pathology (n= 75) in which 54.7% of them are considered to have digital eye strain, however, myopia is considered the most prevalent refractive error in our participants (n= 66) and majority of them are considered to have digital eye strain (n= 50, 75.8%), furthermore, there were 23 of the participants known to have astigmatism and majority of them are considered to have digital eye strain (n= 18,78.3%) and it was statistically significant (P=0.03).

figure (1) displays the incidence of digital eye strain in proportion to its intensity. It revealed that majority of the participants (41%) experienced mild symptoms. However, 30% did not complain

of digital eye strain while 26% expressed moderate symptoms and only 3% mentioned severe symptoms.

Regarding Figure (2) which shows the numerical figures of digital eye strain with their frequency and severity among our target population (n= 172). The most prevalent symptom was headache followed by itching (n= 114, n= 112 respectively). It was observed that dryness of eyes was a common complaint of severe intensity at all times (n=12). In addition, the majority of participants stated that double vision was never a concern (n=120). Furthermore, the only significant complaint in regard to moderate intensity at all times was a feeling of dryness of the eyes (n=14). Moreover, headaches were occasional complains of severe intensity (n=18). In the end, itchy eyes were occasionally seen in moderate intensity (n=92).

Table (2) shows the association between digital eye strain and risk factors. The majority of participants were studying more than 4 hours per day (n=124) of which 70.2% (n=87) were having digital eye strain and 29.8% (n=37) didn't have it. The participants were studying 1-2 hour per day majority of them 90.9% (n=10) didn't have eye strain and 9.9% (n=1) were have eye strain which was statistically significant (P=0.00). The participants were taking breaks every 60 minutes most of them 73.4% (n=47) have digital eye strain and 26.6% (n=17) didn't have eye strain. Whereas in participants where having breaks every 30 minutes or less 48.9% (n=23) didn't have eye strain and 51.1%(n=24) were having eye strain, in which it was significant in statistics point of view (P=0.02). in participants were using the screen below eye levels 70.1%(n=75) were having eye strain and 29.9%(n=32) didn’t have eye strain it was statistically insignificant (P=0.51).

Regarding the preventive measures taken to relief eye strain symptoms Table (3) shows the correlation between digital eye strain prevalence and the preventive measures. In the participants practice 20-20-20 rule always/ very often 35.7% (n=5) didn’t have digital eye strain whereas 64.3%(n=9) were having eye strain on the other hand 68.5%(n=76) of participants practice the 20-20-20 rule rarely/never were having digital eye strain however it was statistically insignificant. In participant were screen is located more than length of arm and forearm and below level of eye rarely/never 64.6%(n=53) were having digital eye strain and 35.4%(n=29) of them didn’t have digital eye strain whereas in participants screen is located more than length of arm and forearm and below level of eye always/ very often 47.4%(n=19) didn’t have digital eye strain and 52.6%(n=10) were having eye strain , it was statistically insignificant (P=0.20). in participants using eye drops always/very often 94.1%(n=16) were having digital eye strain and 5.9%(n=1) didn’t have it. In participants using eye drops rarely/never 40.4%(n=36) of them weren’t have digital eye strain and 59.6%(n=53) have digital eye strain, it was significant in statistics point of view (P=0.01).

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Table (1): characteristics of the participants.

Variable		Digital eye strain		Total N (%)	P value
		Positive N (%)	Negative N (%)		
Gender	Male	75(60.5%)	49(39.5%)	124(100%)	0.004*
	Female	40(83 %)	8 (16.7%)	48(100%)	
Cumulative average	Less than 3	7(63.6%)	4(36.4%)	11(100%)	0.68
	3-4	51(70.8%)	21(29.2%)	72(100%)	
	4-5	57 (64%)	32 (36%)	89(100%)	
School year	2nd year	18(75%)	6(25%)	24(100%)	0.07
	3rd year	20(83%)	4(16.7%)	24(100%)	
	4th year	18(64.3%)	10(35.7%)	28(100%)	
	5th year	31(73.8%)	11(26.2%)	42(100%)	
	6th year	17(53.1%)	15(46.9%)	32 (100%)	
	7th year	11(50%)	11 (50%)	22(100%)	
Device of study	Laptops	16 (55%)	13(45%)	29 (100%)	0.08
	Ipad devices	92(71.9%)	36(28.1%)	128(100%)	
	Cell phone	5(50%)	5(50%)	10(100%)	
	Desktop PC	2(40%)	3(60)	5(100%)	
Eye condition	Myopia	50(75.8%)	16(24.2)	66(100%)	0.03*
	Hyperopia	2(50%)	2(50%)	4(100%)	
	Astigmatism	18(78.3%)	5(21.7%)	23(100%)	
	Dry eye	2(100%)	0(0%)	2(100%)	
	Astigmatism and myopia	2(100%)	0(0%)	2(100%)	
	Normal eye	41(54.7%)	34(45.3%)	75(100%)	
Visual aids	Spectacles to correct vision	43(70.5%)	18(29.5%)	61(100%)	0.056
	Contact lens	4(100%)	0(0%)	4(100%)	
	Spectacles and contact lens	14(87.5%)	2(12.5%)	16(100%)	
	No contact lens or spectacles	54(59.3%)	37(40.7%)	91(100%)	
Purpose of visual aids	Spectacles of distance	38(74.5%)	13(25.5%)	51(100%)	0.669
	Spectacles for reading	8(88.9%)	1(11.1%)	9(100%)	
	Spectacles for both	20(71.4%)	8(28.6%)	28(100%)	

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Figure (1) incidence of Digital eye strain

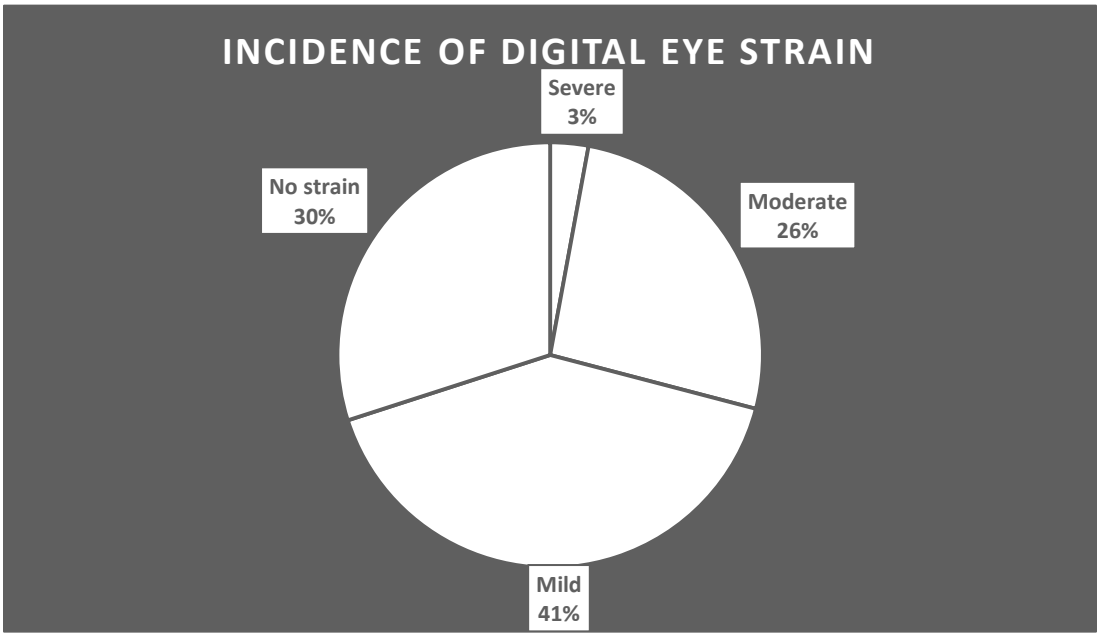

Figure (2) frequency and intensity of eye strain symptoms

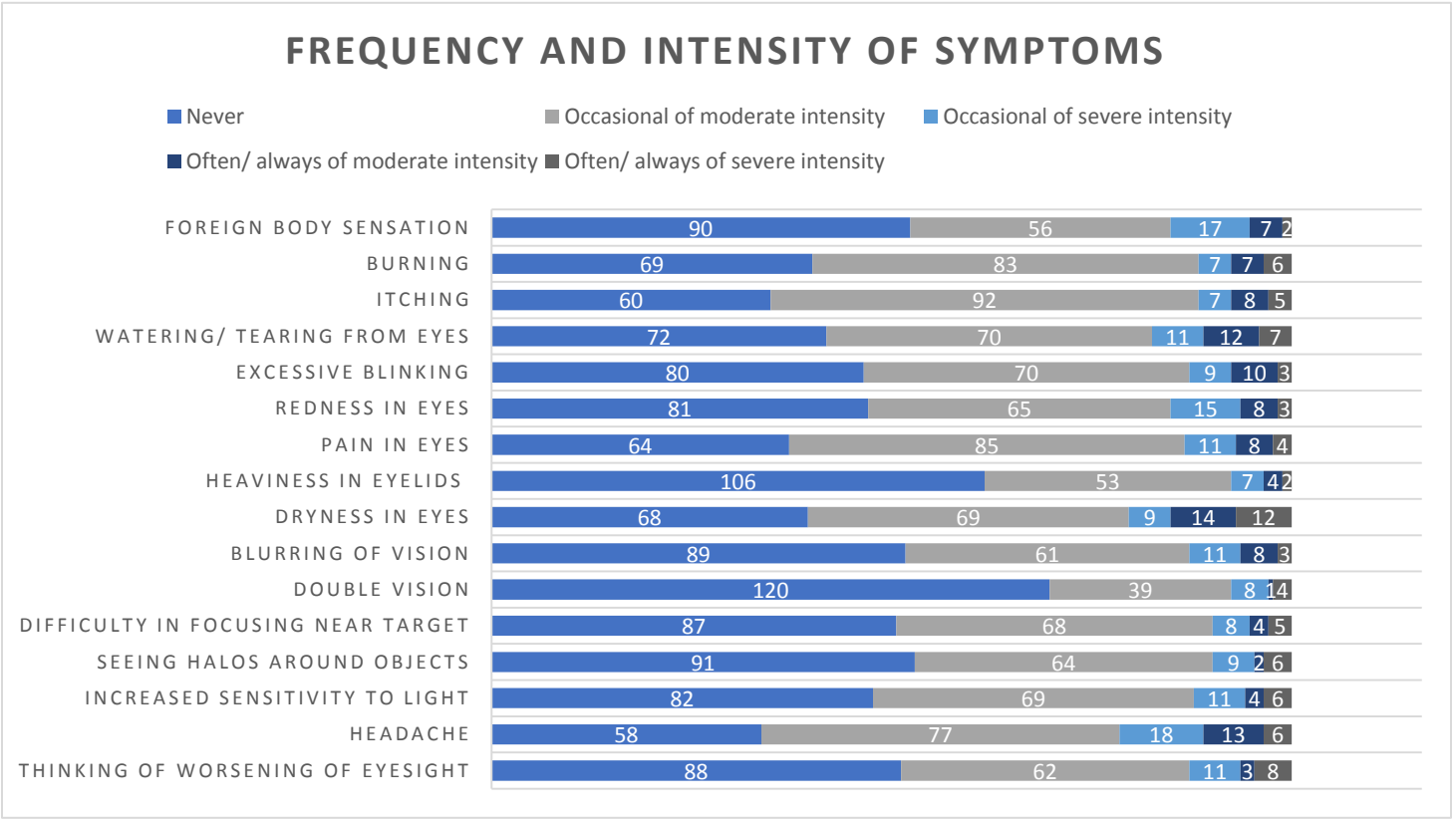

Table (2) Association between the prevalence of digital eye strain and risk factors

Variables	Groups	Digital eye strain				Total		P value
		Positive		Negative		N	%	
		N	%	N	%			
Duration of studying	1-2 hours per day	1	9.1	10	90.9	11	100	0.00
	3-4 hours per day	27	73	10	27	37	100	
	More than 4 hours per day	87	70.2	37	29.8	124	100	
Taking breaks	Yes	91	66.9	45	33.1	136	100	0.97
	No	24	66.7	12	33.3	36	100	
Frequency of taking breaks	Every 30 minutes or less	24	51.1	23	48.9	47	100	0.02
	Every 30-60 minutes	44	72.1	17	27.9	61	100	
	Every 60 minutes or more	47	73.4	17	26.6	64	100	
Distance from the screen	More than arm and forearm length	17	56.7	13	43.3	30	100	0.19
	Less than arm and forearm length	98	69	44	31	142	100	
Posture	Sitting	47	69.1	21	30.9	68	100	0.70
	Lying	5	55.6	4	44.4	9	100	
	Both	63	66.3	32	33.7	95	100	
Level of the screen	Below level of the eyes	75	70.1	32	29.9	107	100	0.51
	Same level of the eyes	37	61.7	23	38.3	60	100	
	Above level of the eyes	3	60	2	40	5	100	
Source of lightening	From the ceiling /wall	101	66.9	50	33.1	151	100	0.98
	Darkroom	14	66.7	7	33.3	21	100	
Brightness of the screen	Very bright	8	61.5	5	38.5	13	100	0.29
	Bright	63	72.4	24	27.6	87	100	
	Dull or dark	44	61.1	28	38.9	72	100	
Using screen filter/antiglare screen	Yes	15	88.2	2	11.8	17	100	0.04
	No	100	64.5	55	35.5	155	100	

Table (3) Association between digital eye strain prevalence and the preventive measures

Variable	Groups	Eye strain prevalence				Total		P value
		Positive		Negative		N	%	
		N	%	N	%			
20-20-20 rule Taking short breaks every 20 minutes for 20 seconds and looking at objects at least 20 feet away	Always/very often	9	64.3	5	35.7	14	100	0.83
	Occasionally	30	63.8	17	36.2	47	100	
	Rarely/never	76	68.5	35	31.5	111	100	
practicing frequent blinking	Always/very often	16	66.7	8	33.3	24	100	0.52
	Occasionally	66	70.2	28	29.8	94	100	
	Rarely/never	33	61.1	21	38.9	54	100	
screen is located more than length of arm and forearm and below level of eye	Always/very often	10	52.6	9	47.4	19	100	0.20
	Occasionally	52	73.2	19	26.8	71	100	
	Rarely/never	53	64.6	29	35.4	82	100	
I use overhead lightening from ceiling	Always/very often	64	68.8	29	31.2	93	100	0.76
	Occasionally	37	66.1	19	33.9	56	100	
	Rarely/never	14	60.9	9	39.1	23	100	
I use an anti-glare screen	Always/very often	8	66.7	4	33.3	12	100	0.97
	Occasionally	24	68.6	11	31.4	35	100	
	Rarely/never	83	66.4	42	33.6	125	100	
I use eye drops	Always/very often	16	94.1	1	5.9	17	100	0.01
	Occasionally	46	69.7	20	30.3	66	100	
	Rarely/never	53	59.6	36	40.4	89	100	

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DISCUSSION

Our study revealed that digital eye strain was positively associated with female gender more than males, also it was positively associated with people who have preexisting eye conditions like myopia, and astigmatism similar study was done at a university in the central region of Saudi Arabia which show similar results, being female age and having refractive error were independent predictors for having digital eye strain [12]. Another study done among medical students in Jeddah city trying to identify which gender was more affected by digital eye strain, showed that females were significantly affected, however, they did not find an association between refractive error and digital eye strain prevalence [9].

Regarding digital eyestrain incidence with intensity, it has been shown that most of our participants had mild strain eyestrain (41%). However, according to the paper by Mohan et al. their prevalence was 50.2% with 26.3%, 12.9% and 11.1% compromising mild, moderate and severe symptoms of digital eye strain [13]. In our study it was observed that headache was the most common complaints by our participants however according to Baker et al. the most frequent complaint was eye pain and burning sensation [14]. In addition, another Indian open study found out that headache and painful eyes were the most significant symptoms [13]. Moreover, another study conducted on children studying online in India stated itching and headache. Finally, a recently conducted study involving undergraduates in Saudi Arabia and Spain stated headache and dry eyes as their most common complaint [15]. Computer vision syndrome has a notable effect on students' life. It could disturb their studying and overall performance, productivity and progression. Dry eye which is a common complaint in our study may affect concentration, reading and writing, memory and even mental health [16].

In regard to the preventive measure taking to reduce the digital eye strain our study found that there was no significant association between practicing the rule of 20-20-20 and the prevalence of digital eye strain among participant this is in contrast to a study done at King Abdulaziz University which show significant association between the 20-20-20 rule and decrease in digital eye strain [3]. In a study done at King Saud bin Abdulaziz University for Health Sciences in Saudi Arabia they found that significant association between observing glare and increase the digital eye strain however in our study there was no association [17]. The American optometric association recommend that digital eye strain could be prevented by practicing the preventive measures like frequent blinking, screen located more than arm and below the eye level, proper lightening , using antiglare screens [18]. however, in our study there was no significant association between these preventive measures and digital eye strain. This could be because our sample size was small.

The majority of participants were studying more than 4 hours per day (n=124) of which 70.2% (n=87) were having digital eye strain and 29.8% (n=37) didn't have it. The participants were studying 1-2 hour per day majority of them 90.9% (n=10) didn't have eye strain and 9.9% (n=1) were have eye strain which was statistically significant (P=0.00). Similarly as a study done on digital

eye strain and it's risk factors among University students population in Jordan which reveals that there is a relation between hours spent on DD and CVS symptoms, with 93.9% (n=199) of the students who used DD for more than six hours total during the day suffering from CVS [8].

CONCLUSION

In conclusion, digital eye strain is an emergent public health problem that is proportional to the duration of exposure to digital screens. It has also been associated with multiple digital devices among medical students most commonly iPads. Digital devices are mandatory in every institution and prevention of digital eye strains with the consequences must be included in the curriculum**.**

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