COMPUTER VISION SYNDROME IN MEDICAL STUDENTS IN THE ERA OF THE COVID-19 PANDEMIC

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ABSTRACT

Introduction: In the era of the COVID-19 pandemic, there are pretty drastic lifestyle changes, one of which is in the field of education. A distance learning system (PJJ) increased the use of Visual Digital Terminal (VDT) such as computers, laptops, mobile phones, and tablets for lecture and non-lecture activities. This causes a group of problems in the eyes and sight called Computer Vision Syndrome. Some factors that cause Computer Vision Syndrome include long duration, the distance between the eyes and screen is not optimal, incorrect ergonomics, angle of vision above eye level, and using the air conditioner.
Aim: To analyze the factors that affect the incidence of Computer Vision Syndrome in students in the era of the COVID-19 pandemic.
Methods: This research uses a cross-sectional study with non-probability sampling techniques through consecutive sampling. The research period is online from July 31st to September 9th, 2021.
Result: Respondents who experienced Computer Vision Syndrome were 92 people out of a total of 147 respondents. Multivariate analysis with multiple logistic regressions showed that total duration, distance, and room temperature significantly affected Computer Vision Syndrome ($P<0.05$), with the most dominant factor being the use of air conditioning (OR 6.214).
Conclusion: Factors that significantly affect the incidence of Computer Vision Syndrome in FKUKWMS students in the era of the COVID-19 pandemic with distance learning system are total duration, distance, and air conditioner use.
Keywords: *Computer Vision Syndrome*, *Visual Digital Terminal*, Non-ocular factors.

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INTRODUCTION

The application of an online learning system or known as the Distance Learning System (PJJ) in the era of the Coronavirus disease (COVID-19) pandemic has led to an increase in the use of electronic devices (Visual Digital Terminals) such as computers, laptops, handphone, and tablet. A visual Digital Terminal (VDT) is defined as a device formed by a Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), or other forms of image projection technology that converts electrical signals into a visual display. This means VDT is a monitor screen that aims to convey information through images, photos, text, videos, and others.[1,2] The result of a survey by APJII (Association of Indonesian Internet Service Providers) in 2019 and 2020 showed increased internet use.[3] The use of VDT has led to an increase in the prevalence of Computer Vision Syndrome, a group of eye and vision problems due to prolonged use of VDT. Ganne et al. in 2020 reported that the prevalence of CVS was higher in online learning during COVID-19.[2]

Clinical manifestations of Computer Vision Syndrome include tired eyes, dry eyes, eye strain, blurred vision, double vision (*diplopia*), and musculoskeletal pain (neck, shoulders, and back pain). Until now, no risk factors explain the occurrence of CVS. Several factors can cause Computer Vision Syndrome, such as long duration of using VDT, close eye-screen distance, lighting, viewing angles, use of air conditioning, monitor screen display, refractive errors, use of contact lenses, and no breaks/rests when using electronic devices.[4,5] This study aims to determine the factors influencing the incidence of Computer Vision Syndrome and the most dominant factors.

METHODS

This research is an observational analytic study with the cross-sectional method. Data were taken using the CVS-Q (Computer Vision Syndrome Questionnaire) and characteristics of using the VDT questionnaire by google forms. A consecutive sampling technique was used to select the final study respondent. The minimum estimated sample in this study was 145 subjects, calculated using the *Lemeshow* formula.

The sample of this study were medical students from the Faculty of Medicine, Widya Mandala Catholic University, Surabaya, which used VDT for at least the last six months as the inclusion criteria. Responses were collected from July to September 2021. The total sample size was 147 subjects after the inclusion-exclusion selection process. Data were analyzed sequentially using multiple logistic regression (binary logistic) on SPSS.

RESULT

Table 1. Distribution of VDT usage

No	Variable	n (%)
1	**VDT Type**	
	For Lecture	
	Computer	5 (3,4%)
	Laptop	137 (93,2%)
	Tablet/Ipad	5 (3,4%)
	Handphone	-
	For Non-Lecture	
	Computer	-
	Laptop	27 (18,4%)
	Tablet/Ipad	20 (13,6%)
	Handphone	100 (68%)
2	**VDT Brand and Screen Size**	
	For Lecture	
	Macbook 13”	40 (27,2%)
	Asus 14-18”	59 (40,1%)
	HP 14-15,6”	19 (12,9%)
	Lenovo 14-15,6”	13 (8,8%)
	Acer 14”	7 (4,8%)
	iMac 24”	3 (2%)
	Viewsonic 24”	2 (1,4%)
	Ipad 9,7-11”	4 (2,7%)
	Non-Lecture	
	Iphone 5,5-6,7”	61 (41,5%)
	Samsung 6-7”	19 (12,9%)
	Vivo 6”	5 (3,4%)
	Oppo 6,5”	11 (7,5%)

	Huawei 6,5”	2 (1,4%)
	Xiaomi 6,5”	1 (0,7%)
	Tablet/Ipad 9,7-12” (Apple, Samsung)	20 (13,6%)
	Laptop 13-15,6” (Acer, Asus, Lenovo, HP)	27 (18,4%)
3	**Duration**	
	For Lecture	
	2-4 hours	-
	4-6 hours	21 (14,3%)
	6-8 hours	79 (53,7%)
	8-10 hours	35 (23,8%)
	>10 hours	12 (8,2%)
	Non-Lecture	
	2-4 hours	32 (21,8%)
	4-6 hours	48 (32,7%)
	6-8 hours	26 (17,7%)
	8-10 hours	22 (15%)
	>10 hours	19 (12,9%)
	Total Duration	
	8-12 hours	36 (24,5%)
	>12 hours	111 (75,5%)
4	**Dominant VDT**	
	Computer/Laptop	100 (68%)
	Tablet/Ipad	8 (5,4%)
	Handphone	39 (26,5%)
5	**Viewing Distance**	
	Optimal	65 (44,2%)
	Not Optimal	82 (55,8%)
6	**Viewing Angles**	
	Below the eye level	120 (81,6%)
	Above the eye level	27 (18,4%)
7	**Ergonomics**	
	Sitting Position	
	Sitting	146 (99,3%)
	Sleep/Lying	1 (0,7%)
	Sitting Posture	
	Straighten	73 (49,7%)
	Bend down	74 (50,3%)
8	**Use of Air Conditioning**	
	Yes	81 (55,1%)
	No	66 (44,9%)
9	**CVS**	
	Yes	92 (62,6%)
	No	55 (37,4%)

Table 2. CVS Symptoms Distribution

Symptoms	n (%)	
	Yes	No
Headache	80 (87%)	12 (13%)
Itchy Eyes	72 (78,3%)	20 (21,7%)
Blurred Vision	70 (76,1%)	22 (23,9%)
Dry Eyes	66 (71,7%)	26 (28,3%)
Watery Eyes	65 (70,7%)	27 (29,3%)

Table 3. Multivariate analysis and the relationship between variables with Computer Vision Syndrome

Variable	*Computer Vision Syndrome*		Total n (%)	*Odds Ratio* (95% CI)	P-Value (P<0,05)
	Yes	No			
Total Duration					
8-12 hours	11 (7,5%)	25 (17%)	36 (24,5%)	5,06 (2,0:12,8)	0,001*
>12 hours	81 (55,1%)	30 (20,4%)	111 (75,5%)		
Viewing Distance					
Optimal	30 (20,4%)	35 (23,8%)	65 (44,2%)	2,9 (1,3:6,6)	0,009*
Not Optimal	62 (42,2%)	20 (13,6%)	82 (55,8%)		
Viewing Angles					
Below the eye level	76 (51,7%)	44 (29,9%)	120 (81,6%)	1,7 (0,5:5)	0,693
Above the eye level	16 (10,9%)	11 (7,5%)	27 (18,4%)		
Ergonomics					

Sitting Position					
Sitting	91 (61,9%)	65 (37,4%)	146 (99,3%)	-	1
Sleep/Lying	1 (0,7%)	0 (0%)	1 (0,7%)		
Sitting Posture					
Straighten	42 (28,6%)	31 (21,1%)	73 (49,7%)	0,7	0,499
Bend down	50 (34%)	24 (16,3%)	74 (50,3%)	(0,3:1,6)	
Use of Air Conditioning				6,2	0,000*
Yes	66 (44,9%)	15 (10,2%)	81 (55,1%)	(2,7:14,1)	
No	26 (17,7%)	40 (27,2%)	66 (44,9%)		

DISCUSSION

Among the 147 total respondents, 92 people were found to experience CVS, with the most common symptoms being headache (87%), itchy eyes (78.3%), blurred vision (76.1%), and dry eyes (71.7%). A previous study by Amit Mohan in 2020 also showed that the most common symptoms encountered by students doing online e-learning during the COVID-19 period were headache and itchy eyes.[5]

The types of VDT most used by respondents are laptops and handphones. A similar result was also found in a study by Mohammad Iqbal et al. in 2021. Most respondents used VDT for lecture and non-lecture activities for >12 hours a day, with 81 people who experienced CVS. The results of multivariate analysis with multiple logistic regression showed that duration significantly affected the incidence of Computer Vision Syndrome (P=0.001). The increase in duration in using VDT may be affected by the COVID-19 pandemic situation, resulting in limited activities outside and mostly online. There is a possibility that the respondents also use two devices (multitasking) which can increase the risk of CVS.[5] Long duration will cause muscle tension and eye fatigue due to the re-focusing process and dry eye symptoms due to decreased blinking frequency and eye movement. Similar result by Ghufran Abudawood in 2020, the longer the duration, the more frequent the symptoms and prevalence of CVS.[6]

This analysis shows that the viewing distance in using VDT, which respondents dominantly use with most of the distance, does not significantly provide optimal results (P=0.009). This is in line with a study by Ghufran Abudawood in 2020.[6] The triad of near vision mechanisms includes accommodation, convergence, and miosis. Seeing at a close eye-screen distance causes an increase in eye accommodation and the work of the eye muscles, especially the ciliary muscles, to contract. In addition, there is a tendency for eyelid squinting, which causes increased work and blood flow to the orbicularis oculi muscle. This mechanism causes ocular symptoms such as tired eyes, heavy eyes, blurred vision, and headaches.[7,8]

The majority of the respondents use VDT with the optimal viewing angles, which is below eye level. The American Optometric Association (AOA) recommends the viewing angle of the eye on the monitor screen 15°-20° below the eye level. The screen position above the eye level causes respondents to tend to lift their heads so that musculoskeletal pain can occur, especially in the neck and trapezius muscles. In addition, it can cause a decrease in blinking frequency and extraocular muscle fatigue, which results in dry eyes and eye fatigue symptoms.[7] The analysis result in this study showed that the viewing angle had no significant effect on CVS (P=0.693). This can be caused by more dominant factors such as duration, viewing distance, and use of air conditioning. Dwi Astuti and Ghufran Abudawood 2020 reported the same result with this finding.[6,9] However, these results

were contradicted by Mohammad Iqbal (2021), who found that viewing angle had a significant effect.[10]

Close eye-screen distance causes the body to be more forward and bent; it can cause muscle fatigue.[11] Most of the respondents in this study were sitting and staring at the monitor screen during lectures, and this study showed that the sitting position had no significant effect (P=1). Meanwhile, characteristics for the sitting posture, the majority of the respondents have a bent posture. This study showed that posture was significantly related in bivariate analysis but had no significant effect in multivariate analysis (P=0.499). This can be influenced by the presence of more dominant factors such as duration, viewing distance, and use of air conditioning. And there is a possibility that respondents may change their sitting posture while using VDT so that they do not maintain their bent posture while using VDT. A similar result was also reported by Ghufran Abudawood.[6]

The use of air conditioning can cause increased exposure to airflow to the eyes, so that tear evaporation also increases. AC also causes the room's humidity to decrease, affecting the eye surface's humidity. This process can cause dry eye symptoms.[12] The result of this study showed that air conditioning had a significant effect (P=0.000). Similar results were found in a study by Fauzia and Rani in 2018.[12] The factor of using AC has the highest Odds Ratio (OR) value of 6.214. This means that the most dominant factor that affects the incidence of Computer Vision Syndrome is the use of air conditioning. Respondents' activities can influence this during the pandemic, primarily online, and also from the weather factor in the surrounding environment, which tends to be hot. According to temperature measurements by *Accu weather*, Surabaya has an average daily temperature of 30° to 35°C (February to August).

CONCLUSION

Based on this study's results, 92 respondents (62.6%) experienced Computer Vision Syndrome, with the most common symptom being headache (87%). The analysis results in this study indicate the factors that significantly influence the incidence of Computer Vision Syndrome in medical students at Widya Mandala Catholic University in the era of the COVID-19 pandemic who participate in distance learning (PJJ) are total duration, viewing distances, and use of air conditioning. And the most dominant affecting factor is the use of air conditioning (OR=6.214).

ACKNOWLEDGEMENT

The writer/researcher thanked to:

1. Supervisors
2. Research respondents
3. Friends and family who always support

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