Advances in Social Science, Education and Humanities Research, volume 658
4th Social and Humanities Research Symposium (SoRes 2021)

The Effect of Online Learning during the Covid-19 Pandemic on Eye Health Problems of Elementary School-Aged Children

Nur Azizah Komara Rifai*, Icih Sukarsih, Afina Ramdhania
Faculty of Mathematics and Natural Sciences
Universitas Islam Bandung
Bandung, Indonesia
*azizah_kr@yahoo.com. sukarsh75@gmail.com, ramdhaniaafina2@gmail.com

Eva Rianti Indrasari
Faculty of Medicine
Universitas Islam Bandung
Bandung, Indonesia
evaindrasariMD@gmail.com

***Abstract*—The Covid-19 pandemic has affected almost all countries in the world. The biggest impact felt by Indonesian people is in the economic and education sectors. To reduce the impact of the Covid-19 pandemic, all learning activities at schools throughout Indonesia are carried out online so that the intensity of gadget use by students increases. Prolonged computer use may have negative effects on vision, known as Computer Vision Syndrome (CVS). This study aims to analyze how online learning during the Covid-19 pandemic affects eye health problems of primary school age children. The population of this study is students at SD Islam Ibnu Sina Bandung in 2021 with a sample of 180 people. The McNemar paired two-sample test was used for analysis. The result showed that there is a significant difference between eye health of children before and after the Covid-19 pandemic. The three symptoms of CVS with the highest increase experienced by children were eyestrain (38.89%), fatigue (31.11%), itching, neck, shoulder, and back pain (23.89%, respectively). The factors that cause symptoms of the eye health problems of children are the type of gadget used, the amount of time using gadget, the lighting conditions of the monitor, and the indoor air quality.**

Keywords—children, computer vision syndrome, corona virus disease, gadget, online learning

I. INTRODUCTION

Corona Virus Disease (Covid-19) or coronavirus first appeared at the end of December 2019 in Wuhan, then entered various countries in early January 2020. Almost all countries in the world are facing adversity in various sectors due to the Covid-19 pandemic. In Indonesia, the biggest impact felt by the community is on the economic and education sectors. After President Joko Widodo announced that two people in Indonesia declared positive Covid-19 on March 2, 2020, the Ministry of Education and Culture Republic of Indonesia issued a Circular Letter Number 4 of 2020 concerning the Implementation of Education Policy in the Emergency Period of the Covid-19.

Based on that Circular Letter, all learning activities in schools and universities throughout Indonesia were suspended. Through the online learning process, students can still school from home to prevent the spread of the Covid-19. On the other hand, online learning has resulted in increasing the intensity of students' gadget use. Various studies have shown that in addition to having a positive impact, the use of gadgets has a negative impact on children's social development, and can also lead to the risk of radiation exposure. According to the American Optometric Association (AOA), prolonged viewing of digital screen can lead to Computer Vision Syndrome (CVS) [1]. CVS has a significant impact on visual comfort, as between 64% and 90% of computer users experience vision symptoms such as eyestrain, headache, ocular discomfort, dryness, diplopia and blurred vision when looking near or far after prolonged computer use [2]. The use of gadgets with high intensity by elementary school-age children has a fairly high risk of eye health disorders [3]. Other results showed that the most common eye health disorders experienced by primary school students are watery eyes, itching, eye redness, and headache [4].

Based on the results of interviews with some parents at one of the elementary schools in Bandung, before the Covid-19 pandemic, most parents had limited the use of gadgets for their children and did not allow their children to have their own gadgets. However, since the enactment of online learning during the Covid-19 pandemic, inevitably, children have to be in front of a computer or mobile phone for a relatively long time. Looking at the condition, this study want to know whether online learning during the Covid-19 pandemic could affect the eye health of primary school age children.

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II. METHODS

Blehm in Blehm[5] categorize CVS symptoms into four main categories, namely asthenopia, ocular disorders, visual disorders, and extraocular symptoms. The variables of this study were determined based on the symptoms in Segui [6] that relate to exposure to computer. Asthenopia is a symptoms such as eyestrain and eye fatigue. Ocular disorders include dryness, tearing, eye redness, itching, excessive blinking, feeling of a foreign body. Visual disorders is also referred to blurred vision, double vision, difficulty focusing for near vision, increased sensitivity to light (glare). Extraocular symptoms include neck and shoulder pain, back discomfort, headache, fatigue.

A sample of 180 students was taken from 327 students at SD Islam Ibnu Sina Bandung, West Java in 2021 who have middle to upper socioeconomic backgrounds by using simple random sampling. This school is a full day Islamic school model from 07.00 to 16.00 and all students are not allowed to bring gadgets to school, so students rarely use gadgets for play. This school has several learning activities that have been integrated with computers and other devices. This research used primary data from questionnaires that filled out by parents of students. The questionnaire consisted of some questions about eye and vision problems that occur in their children related to computer use before undergoing online learning (before Covid-19) and after online (during Covid-19). The types of questionnaires were a closed question with two alternative answers (yes or no) and three answers (never, sometimes, or often), as well as some open-ended questions which had translated and adapted to Bahasa Indonesia [3]. The validity and reliability of the questionnaire were tested before being distributed to parents.

The data were categorical with nominal and ordinal measurement scales, so the test used a paired two-sample nonparametric test namely McNemar test. The McNemar test using RStudio software was used to assess paired sample, namely the CVS symptoms felt by students before and during the Covid-19 pandemic. The analysis was conducted as follows. First, form a 2×2 contingency table [7] from the data obtained. Second, formulate the test hypothesis. Third, calculate the test statistic based on the chi-square distribution. Finally, draw conclusions.

III. RESULTS AND DISCUSSION

A. Result

In term of social demographic characteristics, there were 180 students with details of 56.11% (101 people) male and 43.89% (79 people) female. The age range of students is 6 years to 13 years with the largest percentage there are 22% (39 people) of respondents aged 7 years. The majority of respondents came from grade 1 with a percentage of 26.11% (47 people). Students with a previous history of eye disease were only 11.11% (20 people) and students who wore glasses/contact lenses only 7.22% (13 students) consisting of minus, plus, and cylindrical.

More than 50% (91 people) of students use mobile phone for online learning activities during the Covid-19 Pandemic. In addition, other gadgets used by students are laptop (38.89%), tablet (6.67%), and computer or PC (3.89%). The length of time students use gadgets for online learning activities during the Covid-19 pandemic was 5% (9 people) for more than 7 hours per day, 18.33% (33 people) for between 5 to 7 hours per day, 32.22% (58 people) for between 3 to 4 hours per day, 38.89% (70 people) for between 1 to 2 hours per day, and 5.56% (10 people) for less than 1 hour per day. Students who using gadgets for online learning activities during the Covid-19 pandemic per week are 10% (18 people) for between 1 to 3 days, 27.78% (50 people) for between 4 to 5 days, and 62.22% (112 people) for between 6 to 7 days.

Currently, more children are using gadgets outside at online learning, e.g. for recreational or entertainment purposes. From the survey shows that 91.67% (165 people) students use gadgets outside at online learning during the Covid-19 pandemic. The length of time students use gadgets outside at online learning during the Covid-19 pandemic is 5% (9 people) for more than 7 hours a day, 6.67% (12 people) for between 5 to 7 hours a day, 32.22% (58 people) for between 3 to 4 hours a day, 34.44% (62 people) for between 1 to 2 hours a day, and 13.33% (24 people) for less than 1 hour a day.

Children rarely think about monitor lighting conditions that can affect their vision. The lighting for proper computer use is half of the light in a classroom (without glare). From the survey shows that the lighting conditions of the room used for online learning during the Covid-19 pandemic are 49.44% (89 people) for bright light, 50.56% (91 people) for sufficient light, and no one uses dim or less light. Other environment al factors that are likely to cause eye symptoms are poor indoor air quality and high room temperatures. From the survey shows that students who have a window in their room when use gadgets are 93.89% (169 people), while students who use air conditioning or AC are only 2.78% (5 people).

Table I summarizes the answer of students who answered “yes” as well as “sometimes” or “often” to the questions given regarding CVS symptoms before undergoing online learning (before Covid-19) and after being online (during Covid-19). From Table I, it can be seen that there has been an increase in the number and percentage of CVS symptoms from before and after the Covid-19 pandemic. On average, the highest to lowest increase occurred in asthenopia symptoms (28.61%), extraocular symptoms (24.72%), ocular disorders (17.31%), and visual disorders (11.53%). However, the three symptoms of CVS with the highest increase experienced by students were eyestrain (38.89%), fatigue (31.11%), and itching, neck and shoulder pain, back discomfort (23.89% respectively).

The significance value (p-value) of the McNemar test shows that all p-value $< \alpha = 0.05$, so all the null hypothesis (there is no difference between the CVS symptoms before and after the Covid-19 pandemic) are rejected. That means, there is a significant difference between eye health of children before and after the Covid-19 pandemic.

TABLE I. SYMPTOMS COMPUTER VISION SYNDROME (CVS) BEFORE AND AFTER THE COVID-19 PANDEMIC

No	CVS Symptoms	Before the Covid-19 Pandemic		After the Covid-19 Pandemic		p-value
		Number (n)	Pecentage (%)	Number (n)	Pecentage (%)	
A	**Asthenopia**					
1	Eyestrain	29	16.11	99	55	< 2.2e-16*
2	Eye fatigue	27	15	60	33.33	1.435e-07*
B	**Ocular Disorders**					
1	Dryness	20	11.11	45	25	< 2.2e-16*
2	Tearing	25	13.89	67	37.22	6.37e-10*
3	Eye redness	29	16.11	66	36.67	8.185e-09*
4	Itching	45	25	88	48.89	1.504e-10*
5	Excessive blinking	22	12.22	53	29.44	4.251e-08*
6	Feeling of a foreign body	16	8.89	25	13.89	0.0265*
C	**Visual Disorders**					
1	Blurred vision	25	13.89	41	22.78	0.000407*
2	Double vision	14	7.78	23	12.78	0.007661*
3	Difficulty focusing for near vision	14	7.78	35	19.44	1.275e-05*
4	Increased sensitivity to light (glare)	28	15.56	65	36.11	8.185e-09*
D	**Extraocular**					
1	Neck and shoulder pain	22	12.22	65	36.11	3.825e-10*
2	Back discomfort	25	13.89	68	37.78	8.993e-10*
3	Headache	26	14.44	62	34.44	1.365e-08*
4	Fatigue	49	26.67	105	58.33	2.848e-12*

* Significant at the level of 0.05

Data source: The result of the analysis calculation

B. Discussion

Online learning during the Covid-19 pandemic has a real impact on changes in the eye health conditions of children. The results of this study showed that the amount of time using gadget both at online learning and outside online learning is mostly between 1 to 2 hours per day. This finding is in line with the America Academic Pediatrics and WHO which suggest that the duration of gadget use for school age children (6-10 years) is 1-1.5 hours per day. However, the increased time of use visual display terminals (VDT) may affect eye complaints [8]. Children who were previously rarely exposed to gadgets during class hours become more focused on gadgets during online learning. The duration of online learning varies, larger classes certainly have a longer number of hours of the study compared to smaller classes. The long of screen time duration causes various complaints to the eyes, ranging from mild to severe. This study showed an increase in CVS symptoms after children underwent online learning. The symptoms of CVS increased in all categories, including asthenopia, ocular disorders, visual disorders, and extraocular symptoms. In Iqbal [9] also explained that all ocular and extraocular complaints in students increased in line with the length of screen time duration, and worsened as the year progressed. This condition can be prevented by applying the "rule of 20" which is to rest the eyes for 20 seconds after staring at the gadget for 20 minutes. Resting the eyes can be done by looking at objects 20 feet away, closing the eyes or distracting them from the gadget.

Most of the students to this study did online learning using mobile phone, the remaining students used laptop, tablet, and PC. Previous research [10] has shown that mobile phone users are more at risk of CVS than desktop users. This is because mobile phones have smaller screen sizes and fonts, so the eyes have maximum accommodate when viewing the screen of the mobile phone. The condition results the intra and extraocular muscles to work harder to focus vision to keep shadows falling right in the retina. The long duration of mobile phone use will make the muscles that contract to experience fatigue, resulting in blurred vision, eyestrain, and headache. The previous studies [9] reported that only 19% of desktop users experienced CVS, while 50% of mobile phone users experienced CVS. The desktop users experienced fewer CVS symptoms because the distance between the eyes and the desktop was relatively further than when using a mobile phone. In addition, the font size on the desktop is also larger, the screen resolution is better to reduce the risk of eye fatigue, although the duration of use remains something that cannot be ignored.

Various other factors can influence the occurrence of CVS. Among these factors are previous eye conditions, room lighting when online, adequate ventilation (including the use of air conditioning or AC) in the online room. Children with eye disorders have more severe symptoms of CVS than children with eyes without abnormalities, especially if the eye disorders are not corrected, either with glasses or other medical interventions. To overcome this, parents should check the eye health of their children periodically to the ophthalmologist, so that they can make corrections or interventions early if abnormalities are found, either refractive abnormalities or accommodation abnormalities. For the room light factor, in Ganne [11] showed that children who use gadgets in dim rooms suffer more from CVS than those with sufficient light. In dim or dark conditions, the eye will adapt by dilating the pupil so that more light enters the eye. This condition triggers fatigue in the eye muscles, so patients complain of eyestrain. Another factor is the adequate ventilation. The temperature and humidity of the room to carry out online learning also determine the health condition of the eyes. The room should have fairly cool air with good ventilation. The condition of the room that is too hot can increase the evaporation of the tear layer from the eyes, as well as the presence of AC that is not fit can make the surrounding air dry so that the surface of the eye becomes more easily irritated, characterized by red, painful, and watery eyes [11].

IV. CONCLUSION

There are significant differences between the eye health conditions of children before and after the Covid-19 pandemic. In other words, online learning during the Covid-19 pandemic has an impact on eye health conditions of children. The three symptoms of Computer Vision Syndrome (CVS) with the highest to lowest increase experienced by students were

eyestrain, fatigue, and itching, neck and shoulder pain, back discomfort.

There are several factors that may cause symptoms of eye health problems in students are as follows. Firstly, students use mobile phones (smartphones) for online learning activities. Secondly, more that half of students use gadgets at online learning and almost half of students use gadgets at outside online learning for more than 3 hours per day. Thirdly, more than half of students use proper light for online learning. Lastly, almost all students use sindowed rooms and do not use AC when using gadgets.

The limitation of this study is that visual examination was not performed on the respondents so that refractive errors and other accommodations could not be ruled out. In addition, the diagnosis of CVS was made only based on the operational definition of the study, and the possibility of recall bias could not be ruled out because filling out the questionnaire was based solely on the respondent's memory. Therefore, for future research, it is recommended to include a visual examination with a diagnosis from an ophthalmologist.

ACKNOWLEDGMENT

We would like to thank the Lembaga Penelitian dan Pengabdian Kepada Masyarakat (LPPM) Universitas Islam Bandung for the funding support to this research project and publication. We would also like to thank the principal of the Ibnu Sina Islamic Elementary School and his staff for assistance in in distributing the questionnaires for this research. We are grateful to the anonymous reviewers for their insightful feedback on the content of the manuscript.

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