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Computer Usage Behavior Relationship Against Refraction Status in Students of the Faculty of Medicine, University of Muhammadiyah Semarang

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ABSTRACT

During the 2019 COVID pandemic, the learning process was carried out online so that the level of computer usage was higher every day. Physical disorders that often occur due to computer use in the eyes include refractive errors, one of which is myopia. The purpose of this study was to determine the relationship between visual distance, sitting position, and computer screen brightness on refractive status in students of the Faculty of Medicine, University of Muhammadiyah Semarang. This research is an analytic observation research by design *cross-sectional*. The sample for this study was students from class 2019 – 2021 at the Faculty of Medicine, Muhammadiyah University, Semarang. The sampling technique uses *simple random sampling* which selects objects at random. Researchers used the questionnaire method where the questionnaire contained written questions that had been validated. The data obtained were analyzed using the chi-square test. The number of respondents to this study was 74 students. The distance from the eye to the screen of most respondents is ca lose distance as many as 40 people (54.1%), The position of most respondents when using a laptop is bending as many as 50 people (67.6%), The brightness of the laptop screen used by most respondents uses optimal brightness as much as 73 people (98.6%). Respondents who experienced an increase in myopia were 24 (32.5%). The results of this study showed that there was no relationship between distance (p 0.456), sitting position (p 0.690) and screen brightness (p 0.485) on refractive status, because both respondents the distance, position and lighting are appropriate or not, all show almost the same percentage to experience an increase in myopia.

INTRODUCTION

The development of the times makes it easier for someone to find information with available technology, one of which is a computer, laptop, or gadget. The use of computers, laptops, gadgets, and tablets cannot be separated from life, especially in the Industrial Revolution 4.0 era. Many people work, go to school, or even just spend time in front of a computer or laptop for hours without a break which has an effect on their physical and mental health problems. Physical disorders that often occur in the eye, including the occurrence of refractive errors.[1]

Myopia is a refractive disorder in which parallel rays that enter the eye without accommodation are refracted to a focal point in front of the retina. In myopia, because the eyeball is too long or the lens is too strong, near light sources are brought to focus on the retina without accommodation (although accommodation is normally used to see near objects), while distant light sources focused in front of the retina appear blurred. Therefore, people with myopia have better near vision than far vision, a condition that can be corrected with convex lenses. Provision of the weakest or minimal negative spherical or concave glasses that produce the best visual acuity.[2]

The prevalence of myopia at school age has increased in various parts of the world. The highest prevalence occurs in East Asia such as China (78.4% at the age of 5-15 years), Hong Kong (70% at the age of 17 years), Taiwan (84% at the age of 16-18 years), Japan (65.6% at 17 years old).[3] There are several risk factors that can increase the occurrence of myopia including genetics, activity habits at close range, and light intensity or lighting factors.[4]

Children with myopia parents have a higher prevalence. The inherited genetic pattern varies, both autosomal recessive, autosomal dominant, and sex-linked. Close viewing causes continuous accommodation, which increases refraction by dilating the lens. Sitting distance of less than 30 cm in front of the computer for more than 4 hours without any breaks will make the eye muscles work harder, resulting in eye fatigue. Blue-violet light will damage eye cells and muscle cells if you get continuous exposure thereby increasing the risk Age- related Macular Degeneration. Lighting that is too strong causes excessive glare but lighting that is too dim can also make the eye work harder to see. Therefore, adequate lighting is needed to prevent bad lighting when working at close range, especially when using visuals which will cause eye fatigue or asthenopia.[4]

During the 2019 COVID pandemic, especially students are encouraged to carry out the learning process online resulting in a higher level of use of computers every day. Therefore, researchers are interested in knowing the relationship between visual distance, sitting position and computer screen brightness on refractive status in students of the Faculty of Medicine, University of Muhammadiyah Semarang.

METHODS

This research has received ethical approval by the Health Research Ethics Commission (KEPK) Faculty of Medicine, University of Muhammadiyah Semarang with number 119/EC/KEPK - FK/UNIMUS/ 2022. This research is an analytic observation research by design cross-sectional. The sample for this study was students from class 2019 – 2021 at the Faculty of Medicine, Muhammadiyah University, Semarang. The sampling technique uses simple random sampling which selects objects at random. The sample inclusion criteria are FK UNIMUS students' classes 2019, 2020, and 2021, who use laptops for more than 4 hours/day, willing to fill out a questionnaire. Sample exclusion criteria were consuming drugs that have side effects such as CVS symptoms (antihistamines, antidepressants), having disorders such as glaucoma, hypertension, allergic conjunctivitis, and damage to N. trigeminus [N. V] and diabetes mellitus, using glare or filter layer, not completing the complete questionnaire.

This research examines computer usage behavior, namely the distance between the eyes and the screen, the position of using the gadget, and the brightness of the screen on refraction status. Screen brightness is checked using the Luxmeter tool. Meanwhile, data on refraction status and other gadget usage behavior uses a questionnaire. Researchers used the questionnaire method where the questionnaire contained written questions that had been validated and then answered by the respondents. The form of the questionnaire is a closed and open questionnaire, where a closed questionnaire is using a multiple-choice technique that already has a choice of answers so that the respondent chooses the desired answer. Meanwhile, the open questionnaire is a short form filled in subjectively by the respondent. The questionnaire contains symptoms and habits when using a computer that affects the occurrence of refraction status. Increased myopia is a change or increase in the respondent's negative spherical diopters. The initial refraction status baseline is based on the refraction status questionnaire question data before the start of online learning (2019) while the final refraction status is the refraction status in December 2022. The questionnaire was carried out using Google Forms and distributed to students of class 2019, 2020, and 2021.

RESULTS

Research conducted from December 16 2022 to January 8 2023 was carried out through the application Zoom meeting as well as face-to-face meetings. This study uses observational analytic methods cross-sectional. The research sample was students of the Faculty of Medicine, University of Muhammadiyah Semarang, class of 2019, 2020 and 2021. The samples that met the inclusion criteria were 74 student samples.

Table 1. Characteristics of Respondents

Variable	n	Percentage (%)
Gender		
Man	19	25,7
Woman	55	74,3
The distance between the eyes and the laptop screen		
Very close (less than 40 cm)	31	41,9
Close (between 40 – 76 cm)	40	54,1
Deep (>76 cm)	3	4
Position when using a laptop		
Lie down	6	8,1
Bend over	50	67,6
Sit up straight	18	24,3
Laptop screen brightness		
Optimum brightness	73	98,6
The brightness is not optimal	1	1,4
Refractive status baseline		
Myopi	38	51,4
Emetropi	36	48,6
Last refractive status		
Myopia increase	24	32,4
No changes	50	67,6

Based on the data in Table 1, the results showed that there were 55 female respondents (74.3%) more than 19 male respondents (25.7%). The distance from the eye to the screen of most respondents is a close distance of 40 people (54.1%), then a very close distance of 31 people (41.9%), and the least distance is the long distance of 3 people (3.7 %). Respondents are said to be close, namely the distance between the eyes and the screen as far as 40-76 cm, very close distance, which is less than 40 cm, while the distance is far, which is more than 76 cm.

The position of most respondents when using a laptop was bending as many as 50 people (67.6%), then respondents with an upright sitting position were 18 people (24.3%) and respondents who used laptops in a lying position were 6 people (8.1%). The brightness of the laptop screen used by most respondents used optimal brightness for as many as 73 people (98.6%) while the brightness was not optimal for as many as 1 person (1.4%).

Table 2. Relationship between distance and refractive status

Distance	Refractive status				Total	P value
	Myopia increase		No changes			
	n	%	n	%		
Very close	11	35.5	20	64.5	31	
Near	13	32.5	27	67.5	40	0.456
Far	0	0	3	100	3	

Based on Table 2, test results *Chi-Square* obtained p value = 0.456 p (> 0.05) meaning that there is no relationship between distance and refractive status.

Table 3. The relationship between sitting position and refractive status

Position	Refractive status				Total	P value
	Myopia increase		No changes			
	n	%	n	%		
Lie down	1	16.7	5	83.3	6	
Bend over	17	34.0	33	66.0	50	0.690
Sit up straight	6	33.3	12	66.7	18	

Based on Table 3, test results *Chi-Square* obtained p value = 0.690 p (> 0.05) meaning that there is no relationship between position and refractive status.

Table 4. The relationship between screen brightness and refractive status

Screen brightness	Refractive status				Total	P value
	Myopia increase		No changes			
	n	%	n	%		
Not optimal	0	0	1	100	1	
Optimal	24	32.9	49	67.1	73	0.485

Based on Table 4, test results *Chi-Square* obtained p value = 0.485 p (> 0.05) means that there is no relationship between screen brightness and refraction status.

DISCUSSION

Relationship between distance, sitting position, and screen brightness with refraction status

Learning through online methods was enforced during the Covid-19 pandemic. Learning that is carried out online makes students stare at screens of gadgets or other electronic devices that exceed the reasonable time limit for our eyes' endurance to see the screen. Spending time in front of a computer or laptop for hours without a break can have an effect on physical and mental health problems. The most common physical disorder is the eye. The excessive intensity of looking at the screen has an impact on our sharpness and increases the number of sufferers of myopia. In fact, recent findings show that a higher incidence of myopia can be seen during the pandemic than before the pandemic. Shows the risk of developing myopia is directly proportional to the time intensity of using electronic devices.[5] Therefore, researchers are interested in knowing the relationship between visual distance, sitting position, and computer screen brightness on changes in refractive status in students of the Faculty of Medicine, University of Muhammadiyah Semarang.

The number of respondents to this research was 74 students. The majority of respondents used laptops at a close range of 40 people and a very close distance of 31 people. Respondents who used laptops at close range experienced a 32.5% increase in myopia while respondents who used laptops very closely experienced a 35.5% increase in myopia. The results of this study indicate that both respondents who use laptops at close and very close distances, more than 30 percent experience an increase in refractive status, so statistical tests show that there is no relationship between distance and refractive status.

The most common position when using a laptop respondent was a hunched-down sitting position of 50 people and an upright sitting position of 18 people. Respondents who used laptops in a hunched position experienced an increase in myopia of 34%, while respondents who used laptops in a sitting position experienced an increase in myopia of 33.3%. The results of this study indicate that more than 30 percent of respondents who use laptops in a bent or upright sitting position experience an increase in refractive status, so statistically, there is no relationship between sitting position and refractive status.

Brightness is categorized as optimal brightness if it has a brightness range of 10-150 lux and bright brightness is more than 150 lux. The screen brightness that the majority of respondents use when using laptops is optimal, namely as many as 73 people and only 1 person uses a screen brightness that is not optimal. Respondents using laptops with optimal brightness of 32.9% experienced an increase in myopia, so statistically, it shows that there is no relationship between screen brightness and refractive status.

The results of this study indicate that there is no relationship between distance, position, or screen brightness on refractive status because whether the distance, position, and lighting are appropriate or not, all of them show almost the same percentage of experiencing an increase in myopia. There are other factors that affect refractive status due to computer use, among others due to the duration of using the gadget. The duration of using a laptop during online learning is approximately 8 hours per day. The average use of gadgets for more than 4 hours a day will have a higher risk of visual disturbances, while those who use 1-2 hours and less than 1 hour will have a lower risk.[6] Excessive use of digital smart devices, including smartphones and tablet computers, can be a risk factor for myopia.[7]

The duration of using gadgets is also known to be related to eye fatigue. gadget use for more than 4 hours a day will have a higher visual risk, while those who use gadgets for 1-2 hours and less than 1 hour have a lower risk.[8] The use of gadgets and the like for a long time is significantly associated with a decrease in visual acuity and the occurrence of myopia.[8] The use of gadgets is not the only major cause of health problems but contributes significantly to various health problems, especially visual disturbances, namely decreased visual acuity, myopia, and computer vision syndrome. Proper management of gadget use can prove beneficial in understanding education and other fields better, while excessive use can lead to various health problems.[8]

The use of smartphones and laptops makes respondents more intensely exposed to gadget screens in their daily activities compared to respondents who only use smartphones. These conditions increase the risk of greater eye fatigue. Learning online carried out during the pandemic made students access laptops or smartphones while attending lectures. Besides that, gadgets are also widely used by students to access social media and play games, which in turn increases the risk of eye fatigue.[910]

The duration of using the gadget ^{3} 2 hours increases the incidence of dry eyes, but statistically, there was no significant difference between a duration of 1 hour and 2 hours.[11] Statistical test results using the Chi-Square test showed eye health history (0.000), type of gadget used (0.000), position of gadget use (0.020), distance of gadget use (0.000), and duration of gadget use (0.000) associated with complaints of fatigue eye. Age (0.325) and gender (0.973) had no significant effect. This study concluded that a history of eye health, using more than 1 type of gadget, using gadgets for a long time, poor body position, and too close a distance trigger complaints of eye fatigue.[12]

This close proximity places increased demands on both ocular accommodations. If maintained for long periods of time, it can exacerbate symptoms when compared to the longer viewing distances more common when viewing printed material.[13] The results showed that there was no effect on the duration of using the gadget, the intensity of light, or the position of using the gadget on refractive errors, but there was an effect of visibility and genetics on refractive errors.[14]

Long-term use of digital devices causes a variety of eye problems in children, the most common of which is refractive error. Refractive error occurs when the optical image is not properly focused on the retina, because of the shape of the eye. Myopia, hypermetropia, and astigmatism are three types of refractive errors. Nearly 20% of young people have refractive errors that require the use of glasses.[15–17] The results of the study show that there is a relationship between the use of computers and gadgets with a long-time intensity and close viewing distance, which will result in a decrease in visual acuity.[18]

The cause of myopia refractive error is multifactorial, it can occur and is influenced by several factors, including age, gender, activities with or without screens, outdoor activities, genetic history, and environment. The results of previous studies showed a significant relationship with genetic factors that influence the incidence of myopia.[19] Myopia is a refractive disorder in which parallel rays coming from an object are focused in front of the retina when the eye is not accommodated.[20] This often happens to school students and college students who have to deal with books that have to be studied and assignments that are done and collected every day, not to mention the demands of the times for students and students to get more information via the internet. and have to use gadgets or face-to-face with computer and cellphone monitor screens which emit radiation and interfere with the process of refraction in the eye.[21]

Medical students are at high risk of experiencing myopia because they do a lot of long and intensive reading and other close-up activities (with a monitor).[22] There are several theories that explain the occurrence of myopia. Among them is the axial theory which explains that the status of refraction depends on the axis of the eyeball and environmental factors that cause eyeball elongation without corneal changes caused by long-term close viewing activities. Another theory is the sato theory which states that environmental influences on the lens adaptation mechanism are due to accommodation that occurs continuously. Close viewing does not affect the cornea and eyeball axis but increases the refractive power of the lens.[23]

The limitations of this research include the instruments used by researchers, one of which is Google Forms, which allows some respondents to give opinions that are not true., such as the understanding factor, and honesty of the respondent cannot be controlled, so it would be better to carry out a direct visual inspection. Even though screen brightness measurements have been carried out objectively using a lux meter, it would be better if room lighting was also measured.

CONCLUSION

The characteristics of female respondents were 55 respondents (74.3%) more than 19 male respondents (25.7%). The distance from the eye to the screen of most respondents is a close distance of 40 people (54.1%), then a very close distance of 31 people (41.9%), and the least distance is a long distance of 3 people (3.7 %). The position of most respondents when using a laptop was bending as many as 50 people (67.6%), then respondents with an upright sitting position were 18 people (24.3%) and respondents who used laptops in a lying position were 6 people (8.1%). The brightness of the laptop screen used by most respondents used optimal brightness for as many as 73 people (98.6%) while the brightness was not optimal for as many as 1 person (1.4%). The results of this study indicate that there is no relationship between distance, position, or screen brightness on refractive status because whether the distance, position, and lighting are appropriate or not, all of them show almost the same percentage of experiencing an increase in myopia.

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