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Relationship between Elementary Students' Activity Patterns and the Occurrence of Refractive Disorder

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ABSTRACT

Background: Refractive disorder is circumstance in which the eye fails to focus the light coming from an object onto the retina resulting in blurred shadows. One of the risk factors that cause or increase the progressivity of refractive disorder is environmental factors. Environmental factors are avoidable factors and are related to the social aspects of a child, such as a child's habitual patterns in carrying close range activities (reading, using a computer, playing video games, and watching television), and also outdoor activities. **Objective:** To examine the correlation between student activity patterns and the occurrence of refractive disorder. **Methods:** This study used an analytical method with a cross sectional design. The data used are primary data obtained directly through visus examination with the Snellen Chart and filling out questionnaires by elementary school students. **Results:** Based on the results of the Chi-square test, it was found that there was a significant relationship ($p < 0.05$) between the duration, distance and position of the body when reading books with the occurrence of refractive disorder. There was also a significant relationship ($p < 0.05$) between duration, distance and body position when using gadgets with the occurrence of refractive disorder. **Conclusion:** There is a significant relationship between the activity patterns of the students when reading books and when using gadgets with the occurrence of the refractive disorder.

Keywords: Activity Patterns, Elementary Students, Refractive Disorder

ABSTRAK

Latar Belakang: Kelainan refraksi adalah keadaan di mana mata gagal untuk memfokuskan cahaya yang berasal dari suatu objek ke retina sehingga dihasilkan bayangan yang kabur. Salah satu faktor yang berisiko menyebabkan maupun meningkatkan progresivitas kelainan refraksi adalah faktor lingkungan. Faktor lingkungan merupakan faktor yang dapat dihindari dan berkaitan dengan aspek sosial seorang anak, seperti pola kebiasaan seseorang dalam melakukan aktivitas jarak dekat (membaca, menggunakan komputer, bermain video games, dan menonton televisi), dan juga aktivitas di luar ruangan. **Tujuan:** Untuk mengetahui hubungan antara pola aktivitas siswa dengan terjadinya kelainan refraksi. **Metode:** Penelitian ini menggunakan metode analitik dengan desain *cross sectional*. Data yang digunakan adalah data primer yang diperoleh secara langsung melalui pemeriksaan visus dengan *Snellen Chart* serta pengisian kuesioner oleh siswa/i sekolah dasar. **Hasil:** Berdasarkan hasil uji Chi-square didapati adanya hubungan yang signifikan ($p < 0,05$) antara durasi, jarak dan posisi tubuh ketika membaca buku dengan terjadinya kelainan refraksi. Didapati juga adanya hubungan yang signifikan ($p < 0,05$) antara durasi, jarak dan posisi tubuh ketika menggunakan gawai dengan terjadinya kelainan refraksi. **Kesimpulan:** Terdapat hubungan yang signifikan antara pola aktivitas para siswa pada saat membaca buku ataupun pada saat menggunakan gawai dengan terjadinya kelainan refraksi.

Kata Kunci: Kelainan Refraksi, Pola Aktivitas, Siswa SD.

1. Introduction

The advancement of science and technology has greatly impacted the global civilization. With the arrival of the 21st century, we have entered the era of Industrial Revolution 4.0, where all aspects of life, including the process of learning, are closely connected with Information and Communication Technology (ICT).[1] Thus, the learning process at every level, from elementary education to college, cannot be separated from the use of communication tools, such as computers, laptops, and smartphones. On the other hand, student activities in using these communication tools can have an unfavorable impact, if used excessively. The use of communication devices for excessive duration of time can be a risk factor for refractive disorder. Refractive disorder is a condition in which the eye fails to focus light coming from an object onto the retina resulting in a blurred image. Refractive disorders can be classified into myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. Among the three refractive disorder, it was found that myopia had the highest percentage.[2]

According to global estimates, there are currently 285 million individuals worldwide who are affected by visual impairment. The most prevalent cause of this condition is uncorrected refractive disorders, accounting for 48.99% of cases, followed by cataracts (25.81%) and age-related macular degeneration (4.1%).[3] In Indonesia, refractive disorders have emerged as the foremost cause of visual impairment, with a prevalence rate of 22.1%. School-age children constitute the majority of those affected, with nearly 10% of the country's 66 million children experiencing refractive disorders. It is worth noting that refractive disorders in children can negatively impact themself, particularly if left untreated. Such children are at risk of developing complication such amblyopia if refractive disorder not corrected in a timely manner.[4] The following matter warrants particular attention due to the fact that a mere 12.5% of Indonesian children who suffer from refractive disorder have worn corrective glasses. [5] In addition, it is also important to pay close attention to the refractive health condition of children because the occurrence of refractive disorders in children not only has profound impacts on their physical health but also on their quality of life and academic performance.[6] The presence of visual impairment caused by refractive disorders can potentially hinder a child's psychological, physical, and intellectual development. This is because the development process of a child is intricately tied to their visual experiences.[7] According to research, there are two primary factors that can contribute to refractive disorder: genetic and environmental. Genetic factors are inherited from parents and cannot be avoided, while environmental factors are avoidable and are related to social aspects of a child, such as a child's habitual pattern in doing close range activities (such as reading, using a computer, playing video games, and watching television), as well as outdoor activities.[8] If everyone is aware of these avoidable factors, it could potentially reduce the occurrence of refractive disorders and any related complications that potentially arise.

The COVID-19 pandemic that has hit the world in recent years has also had a major impact on everyone's daily activity patterns, including school-age children. Based on studies conducted in China, it was found that there had been changes in the behavior patterns of school-aged children during the implementation of online learning. The advent of online learning has led to an increase in the frequency of activities carried out by students at close range, such as using smartphones, computers, and laptops. This trend is associated with a higher risk of refractive disorders in children. COVID-19 has also caused many school-aged children to experience a decrease in the duration of activities carried out outdoors.[9] In fact, increasing the duration of outdoor activities is thought to reduce the risk of refractive disorder and reduce their progressivity.[10] Based on how risky a child is to experience refractive disorder and the consequences they can cause to the development process of a child, especially school-age children, a study was conducted that aimed to assess the relationship between students' daily activity patterns (reading, using gadgets, watching television and playing outdoors) with the occurrence of refractive disorder.

2. Method

2.1 Research Design

The study utilized an analytical approach with a cross-sectional design.

2.2 Research Design

The subjects involved in this research were elementary school students from one of the sub-districts in the city of Medan, who had been selected using a cluster sampling technique (multi stage cluster) and had met the inclusion and exclusion criteria.

The inclusion criteria for subjects in this study were grade 6 elementary school students aged 11-13 years, cooperative and willing to take part in the research and know how the position and lighting conditions of the room and how far and long their daily duration is in doing close range activities (watching television, using gadgets, reading books). Meanwhile, the exclusion criteria for subjects in this study were grade 6 elementary school students who had a history of other eye diseases, such as cataracts, glaucoma, trauma to the eye, and disorders of the optic nerve or retina as well as grade 6 elementary school students who did not experience improvement in vision when a pinhole was used to check for refractive disorder.

2.3 Data Collection Methods and Tools

This study used primary data. The data was obtained directly from the subjects studied through filling out questionnaires by the subjects and visual acuity examination conducted by researchers on subjects using tools in the form of Snellen charts and pinholes.

2.4 Research variable

Through filling out questionnaires by the research subjects, data were obtained in the form of independent variables from this study, including the daily duration of students reading, playing gadgets, watching television, and the daily duration of students doing outdoor activities (exercising, playing in the yard, etc.). Furthermore, data were also obtained in the form of distance between the eyes to objects while reading, playing with gadgets, and watching television and how the body position that tends to be used by students while reading books, or using gadgets, tends to be in an upright sitting position or a lying position. Then, through the visual acuity examination, the dependent variable of this study was obtained, namely whether the subject experienced refractive disorder (visus other than 6/6) or the subject did not experience refractive abnormalities (normal visus 6/6).

2.5 Analysis Methods

The data obtained in this study will be analyzed using the Chi-square test. The Chi-square test (p-value<0.05 means the relationship is statistically significantly) will be used to assess the relationship or influence of student activity patterns (independent variable) on the occurrence of refractive disorder in students (independent variabel).

2.6 Research Ethical Clearance

This research has received approval from the Health Research Ethics Committee of the University of Sumatra Utara based on letter No: 775/KEPK/USU/2022.

3. Results

3.1 Characteristics of Research Respondents

The total respondents in this study were 193 students who were grade 6 elementary school students. Among the 193 students studied, 96 (49.7%) were male and 97 (50.3%) were female. Among the students studied, it was found that 128 (66.3%) had experienced refractive disorder, while there were 65 (33.7%) who did not experience refractive disorder or had normal visus (Table 1).

Table 1. Characteristics of Research Respondents

Characteristics	N=193	%
Sex		
Male	96	49.7
Female	97	50.3
Refractive disorder		
Have refractive disorder	128	66.3
Normal visus	65	33.7

3.2 Relationship between Reading Activity Patterns and the Occurrence of Refractive Disorder

Based on the results of the research listed in Table 2, it was found that in respondents who read books with a duration of less than 1 hour every day, there were 52 (59.8%) who experienced refractive disorder, and those who did not experience refractive disorder 35 (40.2%). Meanwhile, in respondents who read books with a duration of 1-2 hours every day, 34 (61.8%) experienced refractive disorder, and those who did not 21 (38.2%).

Furthermore, in respondents who read books more than 2 hours every day, it was found that 42 (82.4%) had refractive disorder, and those who did not 9 (17.6%). Then, the Chi-Square test was carried out and obtained p value, which is 0,018 ($p < 0.05$) which means there is a significant relationship between the daily duration of reading books and the occurrence of refractive disorder.

From Table 2 it was found that in respondents who read books with an eye distance to books that were less than 30 cm every day, there were 90 (75.6%) experiencing refractive disorder, and those who did not 29 (24.4%). Meanwhile, in respondents who read books with a distance of 30 cm or more every day, 38 (51.4%) experienced refractive disorder, and those who did not 36 (48.6%). Then the Chi-Square test was carried out, obtained p value of 0,001 ($p < 0.05$) which means there is a significant relationship between the distance of the eye to the book when reading with the occurrence of refractive disorder.

Table 2. Relationship between Reading Activity Patterns and the Occurrence of Refractive Disorder

Reading Activity Patterns	Visus		N	**P**
	Normal	Refractive disorder		
	n	n		
Daily duration of reading				
<1 hour	35	52	87	
1-2 hours	21	34	55	0.018
>2 hours	9	42	51	
Distance of the eye to the book when reading				
<30cm	29	90	119	0.001
≥30cm	36	38	74	
Position of the body when reading				
Lying down	20	68	88	0.003
Upright sitting	45	60	105	

From table 2, it was also found that in respondents who tended to read books lying down, there were 68 (77.3%) who had refractive disorder, and those who did not 20 (22.7%). Meanwhile, in respondents who tend to read books in an upright sitting position, 60 (57.1%) experience refractive disorder, and those who did not 45 (42.9%). Then, the Chi-Square test was carried out, obtained p value of 0,003 ($p < 0.05$) which means there is a significant relationship between the position of the body when reading and the occurrence of refractive disorder.

3.3 The Relationship of Activity Patterns Using Gadgets with the Occurrence of Refractive Disorder

Based on the results of the research listed in table 3, it was found that in respondents who used gadgets with a duration of less than 2 hours every day, there were 23 (34.3%) who experienced refractive disorder, and those who did not as many as 44 (65.7%). Meanwhile, in respondents who used gadgets with a duration of 2 hours or more every day, there were 105 (83.3%) who experienced refractive disorder, and those who did not as many as 21 (16.7%). Then, a Chi-Square test was carried out and p value of 0,000 ($p < 0.05$) was obtained, which means that there is a significant relationship between the daily duration of using gadgets and the occurrence of refractive disorder.

From table 3, it was found that in respondents who used gadgets with an eye distance to the screen of less than 30 cm every day, there were 82 (75.2%) who experienced refractive disorder, and those who did not as many as 27 (24.8%). Meanwhile, in respondents who use devices with an eye distance to the screen of more than 30 cm or more every day, there were 46 (54.8%) who experienced refractive disorder, and those who did not as many as 38 (45.2%). Then, a Chi-Square test was carried out on the data and obtained p value of 0.003 ($p < 0.05$) which means there is a significant relationship between the distance of the eyes to the screen when using gadgets with the occurrence of refractive disorder.

From table 3, it was found that in respondents who tended to use gadgets in a lying position, there were 137 (75.2%) who experienced refractive disorder, and those who did not as many as 34 (24.8%). Meanwhile, in respondents who tend to use gadgets in an upright sitting position, there were 25 (44.6%) who experienced refractive disorder, and those who did not as many as 31 (55.4%). Then, the Chi-Square test was carried out

and obtained p value of 0.000 ($p < 0.05$) which means there is a significant relationship between the position of the body when using gadgets with the occurrence of refractive disorder.

Table 3. Relationship of Activity Patterns Using Gadgets with the Occurrence of Refractive Disorder

Activity Patterns Using Gadgets	Visus		N	P
	Normal	Refractive disorder		
	n	n		
Daily duration of using gadgets				
<2 hours	44	23	67	0.000
>2 hours	21	105	126	
Distance of the eye to the screen when when using gadgets				
<30cm	27	82	109	0.003
≥30cm	38	46	84	
Position of the body when using gadgets				
Lying down	34	103	137	0.000
Upright sitting	31	25	56	

3.4 Relationship of Activity Patterns Watching Television with the Occurrence of Refractive Disorder

Based on the results of the research listed in table 4, it was found that in respondents who watched television with a duration of less than 1 hour every day, there were 59 (66.3%) who experienced refractive disorder, and those who did not 30 as many as (33.7%). Meanwhile, in respondents who watched television with a duration of 1-2 hours every day, there were 45 (70.3%) who experienced refractive disorder, and those who did not as many as 19 (29.7%). Furthermore, in respondents who watched television with a duration of more than 2 hours every day, it was found that as many as 40 (60%) experienced refractive disorder, and those who did not as many as 16 (40%). Then, a Chi-Square test was carried out on the data and obtained p value of 0.557 ($p > 0.05$) which means there is no significant relationship between the daily duration of watching television and the occurrence of refractive disorder.

From table 4, it was found that in respondents who watched television with an average distance of eyes to the screen of less than 1.5 m every day, there were 37 (63.8%) who experienced refractive disorder, and those who did not as many as 21 (36.2%). Meanwhile, in respondents who watched television with an average distance of eyes to the screen of more than 1.5 m every day, there were 91 (67.4%) who experienced refractive disorder, and those who did not as many as 44 (32.6%). Then, a Chi-Square test was carried out and obtained p value of 0.626 ($p > 0.05$) which means there is no significant relationship between the average distance of the eyes to the screen when watching television and the occurrence of refractive disorder.

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Table 4. The Relationship of Activity Patterns Watching Television with the Occurrence of Refractive Disorder

Activity Patterns Watching Television	Visus		N	P
	Normal	Refractive disorder		
	n	n		
Daily duration of watching television				
<1 hour	30	59	89	
1-2 hours	19	45	64	0.557
>2 hour	16	24	40	
Distance of the eye to the screen when when watching television				
<1,5 m	21	37	58	0.626
≥1,5 m	44	91	135	

3.5 Relationship of Outdoor Activities with the Occurrence of Refractive Disorder

Based on the results of the research listed in table 5, it was found that in respondents who carried out outdoor activities (exercising, playing in the yard, cycling, etc.) with a duration of less than 1 hour every day, there were 44 (73,3%) who experienced refractive disorder, and those who did not as many as 16 (26,7%). Meanwhile, in respondents who carried out outdoor activities with a duration of 1-2 hours every day, there were 57 (63,3%) who experienced refractive disorder, and those who did not as many as 33 (36.7%). Furthermore, in respondents who carried out outdoor activities with a duration of more than 2 hours every day, there were 27 (62,8%) who experienced refractive disorder, and those who did not as many as 16 (37,2%). Then, the Chi-Square test was carried out and obtained p value of 0,383 ($p > 0,05$) which means there is no significant relationship between the daily duration of outdoor activities and the occurrence of refractive disorder.

Table 5. Relationship of Outdoor Activities with the Occurrence of Refractive Disorder

Daily Duration of Outdoor Activities	Visus		N	P
	Normal	Refractive Disorder		
	n	n		
<1 hour	16	44	60	
1-2 hours	33	57	90	0.383
>2 hour	16	27	43	

4. Discussion

4.1 Relationship between Reading Activity Patterns and the Occurrence of Refractive Disorder

In this study, it was found that there was a significant relationship between reading activity patterns and the occurrence of refractive disorder ($p < 0.05$). The results of this study are in accordance with previous research conducted on children in Singapore, where in the study it was found that children who read books for a longer duration of time had a 1.43 – 3.05 times higher risk of experiencing refractive disorder when compared to children who had less daily duration of reading. In this study, it was also found that the distance between the eyes and the book of less than 30 cm when reading has the potential to increase the risk of refractive disorder. In the study, a theory was also expressed that is in line with the results of this study, where the theory states that close range activities, such as reading, can increase the risk of refractive disorder because when looking

from a close distance the eye will experience accommodation. Continuous accommodation will cause the tone of the ciliary muscle to increase, then the lens becomes more convex, and axial elongation of the eyeball occurs.[12]

4.2 Relationship of Activity Patterns Using Gadgets with the Occurrence of Refractive Disorder

In this study, it was found that there was a significant relationship between the activity patterns of using gadgets and the occurrence of refractive disorder ($p < 0.05$). The results of this study are in accordance with the results of previous research on school-aged children in North India, where in the study it was found that in students who used gadgets for more than 2 hours the risk of refractive disorder increased up to 8.33 times more than students who use gadgets for less than 2 hours.[13] The results of this study are also in accordance with the results of other studies that have been carried out previously, where in this study it was found that in children who used gadgets with an eye to screen distance of less than 30 cm there were 60.3% who experienced refractive disorder, whereas in children who use gadgets with an eye distance to the screen are more than 30 cm, 14.3% of those experience refractive disorder. In this study, the results of the Chi-Square test were also found which showed a significant relationship between the distance of the eye to the screen when using a gadget and the occurrence of refractive disorder ($p < 0.05$).[14]

4.3 Relationship of Activity Patterns Watching Television with the Occurrence of Refractive Disorder

In this study, it was found that the daily duration of watching television and the distance between the eyes and the screen when watching television did not have a significant relationship with the occurrence of refractive disorder ($p > 0.05$). The results of this study are different from the results of previous research conducted on 147 school-age children in America, where in the study it was found that children who had refractive disorder had a higher average duration of watching television than children who did not have refractive disorder.[15] This result is also different from the results of previous research, where in this study it was found that there was a relationship between the distance of the eye to the screen when watching television and the occurrence of refractive disorder. In this study, it was found that children who had the habit of watching television at a distance of less than 1.5 m had a higher risk of experiencing refractive disorder compared to children who had the habit of watching television at a distance of 1.5 m or more.[16] The difference in results found in this study and previous research can be attributed to the situation, that as time goes by and the times develop, there has now been a change in the trend of each person's daily activity patterns, where based on surveys that have been conducted, it was found that nowadays, people are more likely to spend time playing with gadgets than watching television, in fact quite a few of them have not watched television at all in the last week, so that the amount of time that everyone, including school-age children, has been watching television has decreased.[17] Researchers suspect that this change in trend in activity patterns has the potential to cause a decrease in the influence of television watching activities on the occurrence of refractive disorder.

4.4 Relationship of Outdoor Activities with the Occurrence of Refractive Disorder

In this study, it was found that the students' daily duration of outdoor activities (exercising, playing in the yard, cycling, etc.) did not have a significant relationship with the occurrence of refractive disorder ($p > 0.05$). The results of this study are different from the results of previous research that was carried out to assess the relationship between the duration of activities carried out outdoors and the occurrence of refractive disorder, where in this study p value of 0,017 ($p < 0.05$) was found, which means that between the two of these variables were found to have a significant relationship. In this research, it was found that the higher the daily duration of outdoor activities, the lower the risk of a student experiencing refractive disorder (protective factor).[18] The difference in results found in this study and previous research can be attributed to the situation, that since the COVID-19 pandemic occurred in 2019, students' daily activity patterns tend to change, where it was found that at this time, students tend to choose to carry out activities in indoors after school rather than doing outdoor activities. Apart from that, the rapid development and progress of information and communication technology has also influenced students' activity patterns, where advances in technology and information have provided all the things that students need, so that it is found that students tend to carry out activities in room after school rather than doing outdoor activities that require interaction with many people. This change in the tendency for indoor activities is thought by researchers to have the potential to cause a decrease in the influence of the duration of outdoor activities on the occurrence of refractive disorder.

5. Conclusions

Based on the results and discussion that have been discussed, it can be concluded that among the 193 elementary school students who were respondents in this study, it was found that 128 students (66.3%) had experienced refractive disorder. The activity pattern (daily duration, eye distance to the object, and body

position) of elementary school students when reading books and using gadgets has a significant relationship with the occurrence of refractive disorder. In this study, the activity patterns (daily duration and body position) of elementary school students when watching television were found to have no significant relationship with the occurrence of refractive disorder. The daily duration of elementary school students' outdoor activities was also found to have no significant relationship with the occurrence of refractive disorder.

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