



Refractive Errors and Learning Achievement: A Cross-Sectional Study on Elementary School Students

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Abstract. Refractive errors are an imbalance in the eye's visual system, resulting in blurred vision. If not properly addressed, it can have a negative impact on the intellectual development of children and their learning process. This study aims to determine the relationship between refractive errors and the learning achievement of elementary school students. The research used a cross-sectional design with a sample size of 83 students from SD Inpres Bangkala III, Manggala District, Makassar City, Indonesia. A chi-square statistical test was used in this study. The results showed that out of 83 students, 14 (16.9%) had refractive errors. Based on the status of refractive errors, it was found that 7 (50%) students had myopia, and 7 (50%) students had astigmatism. There was no significant relationship existed between emmetropia and ametropia status and learning achievement. However, among the students with refractive errors, 14 students had relatively lower learning achievements, with 12 (85.7%) having sufficient achievements and 2 (14.3%) having good achievements. There was no significant relationship between myopia and astigmatism status with emmetropia concerning learning achievement. Therefore, routine screening at school age should be conducted to detect refractive errors early. Schools are expected to pay attention to students' eye health, especially those who have difficulty seeing while reading or learning, and the role of parents play a crucial role in monitoring their daily activities that may affect their vision.

Keywords: Refractive Errors, Learning Achievement, Elementary Students.

1. Introduction

Refractive error is a state of firm shadows not formed on the retina, where an imbalance in the vision system in the eye results in blurred shadows. The rays are not refracted exactly on the retina but can be in front or behind the retina or not located at one focal point [1]. As many as 19 million children have visual impairment with uncorrected refractive errors, accounting for two-thirds of cases of pediatric visual impairment worldwide [2].

Uncorrected refractive errors account for half of the global burden of avoidable visual impairment and nearly one-third of the worldwide burden of avoidable blindness [3]. Children in Southeast Asia have the lowest prevalence of astigmatism, hyperopia, and myopia compared to other WHO regions [4]. In Indonesia, the prevalence of refractive errors ranks first in eye diseases. According to the Director General of Health

Efforts, 15% of school-age children have refractive errors out of the total population [5].

Children often do not realize their vision is declining and may not complain even when they suffer from eye fatigue or blindness. About 10% of Indonesia's 66 million school-age children (5-19 years old) have refractive errors, and the rate of wearing corrective glasses to date is still low at 12.5% of the need. If this condition is not adequately addressed, it will negatively impact the development of children's intelligence and the learning process, further affecting the workforce's quality, creativity, and productivity [6].

Eye acuity screening in primary school children is one of the activities conducted to identify children's eye disorders. In Indonesia, the research results examining the relationship between refractive errors and learning achievement have been carried out in several places but still show differences in research results [7] – [9]. There are still differences in the results of various studies conducted and the lack of research on the relationship between refractive errors and the learning achievement of elementary school children in Makassar city, so researchers want to conduct research on the Relationship of Refractive Error to Learning Achievement in one of the elementary schools located in Makassar city. This study aimed to determine the relationship between refractive errors and learning achievement based on the refractive status of students in SD Inpres Bangkala III.

2. Method

This research was a cross-sectional study. The population of this study was all fifth and sixth-grade students at SD Inpres Bangkala III in 2022. A sample of 83 students was selected to be the subject of the study based on inclusion and exclusion criteria. Inclusion criteria are students in grades V-VI, willing to participate in the study and present during the study; exclusion criteria are students with diseases such as infection, anatomical abnormalities, uncooperative students, and those who already use visual aids and normal vision, students whose vision does not progress with the pinhole test. If one eye had a refractive error and one was normal, it was categorized as normal.

Data were collected using primary data, which included refractive error, gender, and age, and secondary data, including school report card grades. Bivariate analysis was used in this study to see the relationship between the independent and dependent variables using the chi-square test. The data obtained will then be processed using the Statistical Product and Service Solution (SPSS) computer program.

3. Results

Based on the visual acuity examination results, 84 students were obtained, 1 of which was categorized as an exclusion so that the sample that met the inclusion criteria was 83. In this study, 14 students were found to have refractive errors.

Table 1. Characteristics of Samples According to Refractive Status, Gender, and Learning Achievement in Students

Characteristics	n	%
Refractive status		
Ametropia	14	16.9
Emmetropia	69	83.1
Gender		
Male	41	49.4
Female	42	50.6
Learning Achievement		
Good Enough	55	66.3
Very Good	28	33.7

Characteristics of the sample according to refractive status, gender, and learning achievement in students of SD Inpres Bangkala III showed that out of 83 students, students with emmetropia refractive status were found to be more, namely 69 (83.1%) compared to ametropia students, namely 14 students (16.9%). Regarding gender, there were almost the same number of male and female students, with 41 male students (49.4%) and 42 female students (50.6%). In learning achievement, it was found that students who achieved learning achievement with a sufficient predicate were more, namely 55 students (67.5%). In comparison, those who earned learning achievement with a good predicate were 27 students (32.5%) (Table. 1).

Table 2. Frequency Distribution of Refractive Abnormalities Based on Age and Gender

Characteristics	Refractive status				Total	
	Myopia		Astigmatism		n	%
	n	%	n	%		
Gender						
Male	5	55.6	4	44.4	9	100
Female	2	40.0	3	60.0	5	100
Age (years)						
11	4	80.0	1	20.0	5	100
12	3	33.3	6	66.7	9	100

Table 2 shows that of the students who experienced refractive errors, myopia was more in the male gender, which was five students (55.6%). Astigmatism was also more experienced by men, which was four students (44.4%), while there were fewer women, namely two students (40.0%) who experienced myopia and three students (60.0%) who experienced astigmatism. The type of refractive error based on age showed that there were 4 (80.0%) 11 years students with myopia and 1 (20.0%) with astigmatism. Whereas students aged 12 years who experienced myopia were 3 (33.3%), and those who experienced astigmatism were six students (66.7%).

Table 3. Relationship between student learning achievement and refractive status

Refractive status	Learning Achievement				Total		p-value
	Good Enough		Very Good		n	%	
	n	%	n	%			
Ametropia	12	85.7	2	14.3	14	100	0.091
Emmetropia	43	62.3	26	37.7	69	100	
Total	55	66.3	28	33.7	83	100	

The results of learning achievement in ametropia and emmetropia students show that good learning achievement is mainly obtained by emmetropia students 26 (37.7%) and in ametropia two students (14.3%). There were also emmetropia students with moderate learning achievement, as many as 43 (62.3%). Based on the chi-square test results, the p-value is 0.091 (≥ 0.05), which indicates that there is no relationship between the refractive status of ametropia and emmetropia with learning achievement (Table. 3). Based on Table 4, the relationship of refractive errors to learning achievement shows that students who experience myopia and astigmatism with good learning achievement are one student each (14.3%) and more than those with emmetropia namely 26 students (37.7%), with the results of the chi-Square test obtained a p-value of 0.218 (≥ 0.05), indicating no relationship between the refractive status of myopia and astigmatism with learning achievement.

Table 4. Relationship between Refractive Abnormalities and Student Learning Achievement

Refractive Abnormalities	Learning Achievement				Learning Achievement		p-value
	Good Enough		Very Good		n	%	
	n	%	n	%			
Refractive Status							
Myopia	6	85.7	1	14.3	7	100	0.218
Emmetropia	43	62.3	26	37.7	6	100	
Total	49	64.5	27	35.5	7	100	
Refractive Status							
Astigmatism	6	85.7	1	14.3	7	100	0.218
Emmetropia	43	62.3	26	37.7	6	100	
Total	49	64.5	32	35.5	7	100	

4. Discussion

Based on the study results, there were more students with emmetropia than students with refractive errors. The prevalence of refractive errors in this study is in line with Juneti's research at SDN 017 Bukit Raya Pekanbaru that the prevalence of refractive errors of elementary school students is (16.24%) (Juneti et al., 2015) and Wardany's

research at SD X Pekanbaru that the prevalence of students who experience refractive errors is (16%) [9] in contrast to the results of Novitasari's research at Baiturrahman 1 Semarang Elementary School which stated that the number of refractive errors was 61 children (62.25%)[10]. Respondents in this study consisted of 41 male students with a percentage (49.4%) and 42 female students with a rate (50.6%); from these data, the number of male and female respondents did not differ much, but more female respondents. The learning achievement of students of SD Inpres Bangkala III shows that the learning achievement achieved out of 83 students are more learning achievement with good enough achievement 56 (67.5%) students and very good 27 (32.5%) students.

The frequency distribution of refractive errors based on gender showed that the results of refractive errors obtained were myopia and astigmatism, each as many as seven students (50.0%). No students were found to have hypermetropia. Based on gender, myopia was experienced more by male students, namely five students (55.6%), while only two students (40.0%) were female. Males also experienced astigmatism, namely four students (44.4%), while three students (60.0%) were female. From these data, refractive errors, both myopia and astigmatism, are more common in males. The results of this study are almost the same as Zubaidah's research on private junior high school students in Berastagi, which states that refractive errors in boys are more prevalent than in girls [11]. In contrast to Lestari's research at Pertamina Bintang Amin Hospital Lampung in 2020, the most refractive errors were found in the female gender group, with as many as 37 respondents (56.9%) [12]. This is because refractive errors in children in the form of myopia, hyperopia and astigmatism can affect boys and girls and can be influenced by various activities (Saiyang et al., 2021). The habit of looking closely and outdoor activities that are always carried out by boys and girls, such as reading books, looking at computer screens, playing games, and watching television, can cause weakness of the ciliary muscle of the eye, resulting in muscle disorders to see far away, which results in blurred vision. This lifestyle factor is supported by high access to visual activity media [6]

The results of this study age grouping are 11 and 12 years according to the age of the child, showing that refractive errors are more prevalent in students aged 12 years, with nine students, including the type of refractive error astigmatism is more prevalent at the age of 12 years, which is six students (66.7%) and those with myopia are few, namely three students (33.3%). Of students 11 years old, five students were found to have refractive errors, including the type of refractive error of myopia in four students (80.0%) and astigmatism in 1 student (20.0%). Based on these data, refractive errors were found at the age of 12 years and the age of 11 years with myopia and astigmatism. This is in line with research at Cicendo Eye Hospital, which states that the most refractive errors were found in the age range of 11-15 years, with the most types of refractive errors being astigmatism and myopia [13]. In contrast, research conducted by Handayani at Denpasar Bali Hospital states that the most common refractive error found in children was astigmatism [14]. This may be caused by various factors such as an increase in near vision activities such as reading books or additional study time, which is thought to cause more children in the 9 – 12 years age group to experience refractive errors, close viewing activities in students can lead to increased myopia progressivity. Eyes forced to keep looking can damage the eye itself [15]. Refractive errors can also be found in various age groups. Students usually do not realise a

decrease in the level of refractive acuity, and the condition that occurs is still not optimal. International studies show that 25% of school-age children have some form of visual deficiency. According to the theory, refractive errors in children are more common from 9-12 years to young adulthood [16].

The relationship between the refractive status of ametropia and emmetropia with learning achievement shows that learning achievement with suitable predicates is more widely obtained by emmetropia students, with 26 students (37.7%) as well as learning achievement with sufficient predicates is more widely accepted by emmetropia students, with 43 students (62.3%), and in ametropia students learning achievement with good predicates is the lowest, namely two students (2.4%) on achievement with sufficient predicates as many as 12 students (14.5%). This is probably because there are more emmetropia students than ametropia students. And suppose a child has a refractive error that is not corrected. In that case, several impacts can be caused by the visual disturbances experienced, such as difficulty concentrating while learning, which can affect the child's achievement or doing other activities that can affect the child's learning activities [15]. From the results of this study, there was no relationship between refractive status and learning achievement. This study is in line with Wardany's research at SD X Pekanbaru, which states that there is no significant influence between refractive errors and learning achievement, in contrast to Nandy's research at Eben Hezar Christian Junior High School, which says that there is a meaningful relationship between students who experience refractive errors and learning achievement [7]. This difference may be due to the different learning achievement assessment parameters between the studies. In addition, in ametropia students, sharply reduced vision will impact the learning process, where the main information pathway that is important in the learning process is vision. Impaired vision will cause a reduced ability to absorb learning material. This inhibits the potential to develop their intelligence, impacting learning achievement.

Based on the relationship of refractive errors to student learning achievement, it shows that good learning achievement is obtained more by emmetropia students, namely 26 students (37.7%) compared to students who have myopia only one student (14.3%) who get good learning achievement. Hence, the learning achievement of emmetropia students is much better than the learning achievement of students who experience myopia. Based on the study's results, there was no significant relationship between myopia and astigmatism refractive errors with learning achievement. This study's results align with Prahantyo's research at SD Yogyakarta in 2017, which also states no significant relationship between learning achievement between myopia and astigmatism children with the results [17]. In contrast to Malda's research at SD Negri in Surakarta, which states that a significant relationship exists between refractive errors and learning achievement [18]. This difference is because other factors affect learning achievement apart from abnormalities such as internal factors are factors that come from students in the form of physiological factors (health and body condition), psychological (interest, talent, intelligence, emotions, fatigue, and learning methods), physiological factors (health and body condition) include the sensory organs possessed, namely vision, hearing, touch, smell, and taste [19] – [21]. The main factors that affect the learning process are vision and hearing. Sharp vision can decrease visual impairment, namely refractive errors (myopia, hypermetropia, and astigmatism). This can affect a student's learning achievement. And external factors that can be influenced

by the family, school, and community environment [19]. External factors come from outside the student and are influenced by the family environment, school environment, community environment, and natural environment. All of these factors must contribute synergistically to each other because they affect learning achievement and assist students in achieving the best possible learning achievement.

4. Conclusion

Based on the research, the types of refractive errors found in SD Inpres Bangkala III students are myopia and astigmatism. There is no significant relationship between the refractive status of ametropia and emmetropia on learning achievement, and there is no meaningful relationship between myopia and astigmatism refractive errors on student learning achievement. Screening at school age should be done routinely to detect refractive errors early, and it is hoped that the school can pay attention to the health of the eyes of students who have difficulty seeing when reading or studying and the role of parents in supervising daily activities that can interfere with the vision of students.

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