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Description of Stereoscopic Vision Between Amblyopia And Emmetropia Eyes In Students At Kuta Bakmee Aceh Besar Public Elementary School

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ABSTRACT

Amblyopia is a decrease in vision in a person's eyes even though it has been corrected with the best vision correction which cannot be related to structural abnormalities of the eye or visual axis. The state of amblyopia in children can cause binocular vision disorders resulting in decreased stereoscopic vision function. This study aims to determine the stereoscopic vision between amblyopia and emmetropia in students at Kuta Bakmee Aceh Besar Elementary School. This research is a descriptive observational study with a cross-sectional design that looks at stereoscopic vision between amblyopia and emmetropia based on visual acuity results. The research sample was selected by non-probability sampling method using total sampling. The results showed that the characteristics of the research subjects were mostly male students, namely 62 students (58. 40%) and the 8 years old group (28%). Most research subjects were emmetropes with fine stereoscopic vision, namely 105 students (99.1%) and research subjects who were amblyopia with gross stereoscopic vision were found to be 1 student (0.9%).

Keywords: *Stereoscopic vision,children, amblyopia, emmetropia, TNO book.*

1. INTRODUCTION

Good visual acuity has an important role in the growth and development of a child. The ability to see is needed to carry out daily activities such as learning, playing, and reading. Decreased visual acuity will affect school performance and affect the social and psychological life of children and families. Decreased visual acuity in children can occur in two eyes or one eye. One of the causes of decreased visual acuity in children is the presence of uncorrected refractive errors resulting in a condition called amblyopia.1

Amblyopia (lazy eye) is a cause of impaired visual function in normal eye anatomy. Amblyopia is responsible for a unilateral decrease in visual acuity in children with the prevalence of amblyopia in the world in 2020 reaching 0.2 – 6.2%. The prevalence of amblyopia in North America is 2-4%. About a third of them are caused by refractive disorders, namely myopia, hypermetropia, and astigmatism. Amblyopia can also be caused due to visual deprivation. This situation is quite concerning because most cases of amblyopia can be prevented and treated if detected early and appropriate interventions are made. The state of amblyopia can persist into adulthood if proper intervention is not carried out.2

Amblyopia is defined as decreased vision in a person's eye even though it has been corrected with the best vision correction that cannot be related to structural abnormalities of the eye or visual axis. Usually occurs unilaterally, rarely occurs bilaterally. Amblyopia is a marker of failure of normal neurodevelopment in adult vision due to a disturbed visual experience early in life resulting from abnormalities such as strabismus, refractive errors such as anisometropia or bilateral high refractive errors (isoametropia). If assessed based on vision with the best correction, amblyopia is classified into 3 types, namely mild, moderate, and severe amblyopia.2 Amblyopia in children can cause binocular vision problems. This binocular vision disorder causes a decrease in stereoscopic vision function. Stereoscopic vision is binocular vision regarding depth perception (three-dimensional vision). This stereoscopic vision occurs due to the fusion of images on the two retinas which are identical and clear and is a function of high vision. The development of stereoscopic vision begins in childhood, so that if visual acuity disorders occur during childhood, the development of stereoscopic vision is not optimally achieved.3,4

There are studies that have examined the relationship between anisometropia, amblyopia, and decreased stereoscopic vision. Research conducted by Velma Dobson et al. said that the severity of amblyopia depends on the magnitude of the refractive

error suffered and the ability to see stereoscopically depends on the similarity of the refractive error in each eye. The prevalence of stereoscopic disturbances has a wide range and is also quite high, ranging from 2% to the highest, namely 30%.5

Disorders of stereoscopic vision cause long term impairment, which results in a person being unable to do certain types of work that require three-dimensional vision, for example driving a motorized vehicle, driving an airplane, and can prevent someone from becoming a member of the police or millitary. Decreased stereoscopic vision also causes a decrease in children's academic performance at school.5 Based on the explanation above, it was found that amblyopia can persist into adulthood if proper intervention is not carried out, so researchers want to find stereoscopic vision images between amblyopia and emmetropia eyes in students at Kuta Bakmee Aceh Besar Public Elementary School. The researcher chose Kuta Bakmee Public Elementary School on the grounds that Kuta Bakmee Public Elementary School is far from the city so that parents rarely check their children's eyes with an ophthalmologist even though there are already problems with the child's eyes.

2. METHOD

Study design and setting

This type of research is an observational study using primary data. The data was taken from a visual inspection at SDN Kuta Bakmee Aceh Besar. This study aims to determine the stereoscopic vision between amblyopia and emmetropia in students at Kuta Bakmee Aceh Besar Public Elementary School. This research was conducted at Kuta Bakmee Aceh Besar Public Elementary School. Data collection was carried out from October-November 2022.

Sample size and randomization

The research sample is the object under study and is considered to represent the entire population selected by the non-probability sampling method using total sampling, namely selecting the sample by taking all members of the population as a sample.

Participants

The research subjects were students of SD Negeri Kuta Bakmee in grades I to VI who were recorded at the school in the 2022-2023 school year, the number of samples in this study was 106 subjects taken using the total sampling method. The inclusion criteria for this study sample were: (1) Students diagnosed with amblyopia after a visual acuity examination, (2) Students diagnosed with emmetropic eyes after a visual acuity examination, The exclusion criteria for this study sample were: (1) Students diagnosed with have eye abnormalities in the anterior segment, (2) Students diagnosed with eye abnormalities in the posterior segment.

Intervention

Subjects who met the inclusion criteria were examined with the help of the Snellen chart tool. Subjects with amblyopia and normal vision (emmetropia) were then subjected to stereoscopic test using TNO book. Stereoscopy is assessed in units of second of arc (second of arc or arc second). One second of arc is equal to 1/3600 of a degree arc. There are 7 steps in using the TNO book. The first step is to position the patient in a relaxed sitting state with 40 cm from the TNO book. In the second step, the patient is asked to use red-green glasses for examination purposes. In the third step, the patient is asked to state the number and location of the butterflies seen on the first page. There are two pictures of butterflies where one of them is hidden and can only be seen when both eyes are used. In the fourth step, the patient is asked to state the number and order the sizes of the circles on the second page that appear from the largest to the smallest. The second page contains four images of circles, the largest and smallest of which can only be seen stereoscopically. In the fifth step, the patient is asked to look at sample images on the third page, then asked to find the same image on the examination page. The third page has four pictures (circles, triangles, squares and diamonds). In the sixth step, the patient is asked to look at the two circles on the fourth page and then ask which one is bigger and the position of the circle (right or left), so that one can estimate which eye is more dominant. The fourth page serves to assess suppression. There are two small circles flanked by two large circles. In the seventh step, the patient was assessed for stereoscopic sensitivity on the fifth page. This page contains images of circles with missing parts (resembling a pie or pac-man picture) and have different degrees of depth, retinal disparity distances of 15-480 seconds of arc. The patient's stereoscopic ability was assessed on the basis of the last image that could be identified correctly. Patients who fail to mention the correct answer on one page, then the test is not continued.

Statistical analysis

The data used in this study is primary data from an eye vision examination. Data analysis was performed univariately. Univariate analysis was performed to determine the characteristics of sex, age, vision correction, and stereoscopic vision.

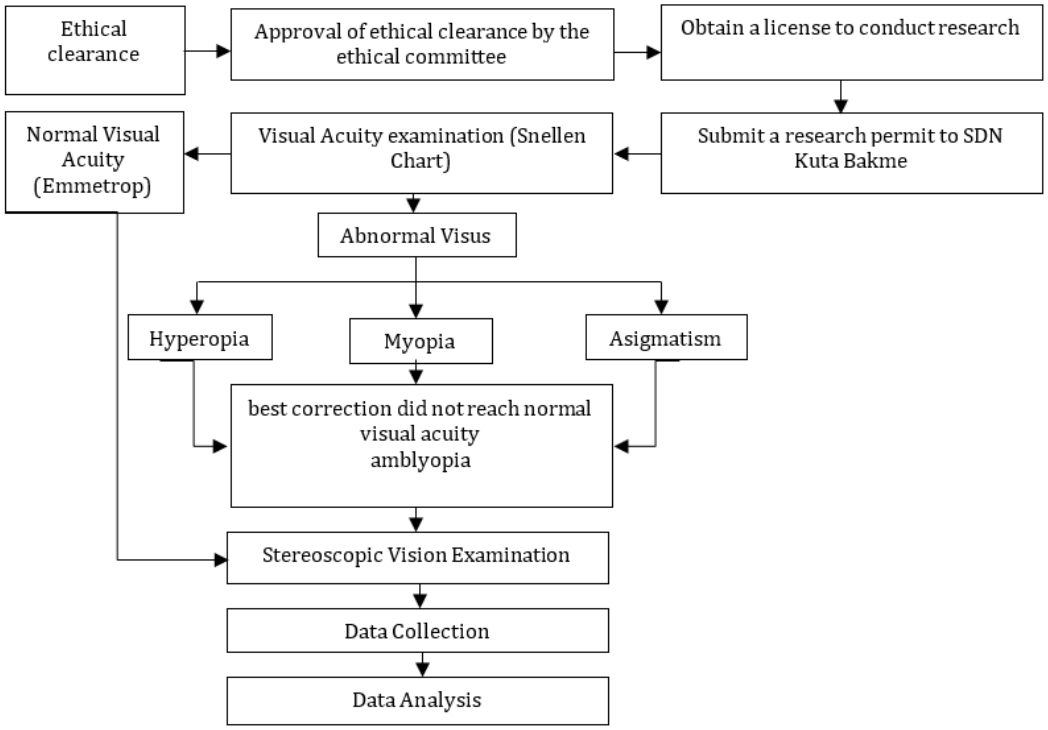

Figure 1. CONSORT flow diagram of the research

3. RESULTS AND DISCUSSION

Characteristics of patients

The characteristics of the subjects of this study were grouped based on the age and sex of the subjects. The data displayed in tabulated form is in Table 1.

Table 1 Characteristics of research subjects

Patient characteristics	N	Percentage (100%)
Sex		
Male	62	58.40%
Female	44	41.50%
Age		
7-9 Years	66	62.3%
10-13 Years	40	37.7%

Table 1 shows that the largest sample was male with 62 subjects (58.40%) while female subjects totaled 44 subjects (41.50%). Based on age characteristics, it was found that students aged 7-9 years were the most respondents with a total of 66 students (62.3%) compared to 10-13 years, namely 40 students (37.7%)

Visual correction description

The results of the visus examination with the Snellen chart can be seen in Table 2.

Table 2 Description of visual correction at SDN Kuta Bakmee Aceh Besar

Category	n	Percentage (100%)
Amblyopia	1	0,9 %
Emmetropia	105	99,1 %
Total	106	100 %

Table 2 shows the results of the vision examination conducted on 106 subjects. Based on the examination results, amblyopia and normal vision (emmetropia) groups were found. The results of this study indicated that there was 1 student (0.9%) who was diagnosed with amblyopia and there were 105 students (99.1%) who were diagnosed with emmetropia.

Stereoscopic vision

Table 3 Overview of Stereoscopic Vision at SDN Kuta Bakmee Aceh Besar

Category	n	Percentage (100%)
Gross Stereoscopic	1	0,9 %
Fine Stereoscopic	105	99,1 %
Total	106	100 %

Table 3 shows the results of different stereoscopic vision measurements. It shows that 1 student (0.9%) of 1 student has gross stereoscopic vision and there are 105 students (99.1%) of 105 students who have fine stereoscopic vision.

Stereoscopic vision vision images based on visual correction

Table 4 Cross Table

Vision Correction	Stereoscopic				Amount	
	Fine		*Gross*			
	n	%	n	%	n	%
Emmetropia	105	100	0	0	105	100.0
Amblyopia	0	0	1	100	1	100.0

Table 4 shows that 105 students (100%) emmetropes have fine stereoscopic vision. This study also showed that 1 student (100%) amblyopia had gross stereoscopic.

Stereoscopic vision is high-level vision in binocular vision, stereoscopic vision is also affected by depth perception and can affect three-dimensional vision. The focus of this study was on stereoscopic assessment of students with emmetropic eyes and students diagnosed with amblyopia at the Kuta Bakmee Aceh Besar Public Elementary School. Visual examination and stereoscopic vision assessment were carried out by an Optometrist Refractionist (RO) and directly guided by an ophthalmologist in determining the diagnosis of amblyopia.

There were two groups in this study, namely the amblyopia group and the emmetropia group. The research sample was selected according to the inclusion and exclusion criteria set by the researcher. Factors that can affect stereoscopic vision such as refractive errors, anterior segment and posterior segment eye abnormalities have been excluded so as not to affect the results of the study.

The results of this study indicate the characteristics of gender and age in the subjects of the visual correction research for elementary school students. This study found that at elementary school age it was found that students with normal vision

correction were more dominant, this result is in line with research by Gama (2019) who found that 77 .3% of male students and 87.2% of female students of primary school age have normal visual acuity (emetropia).[6]

Stereopsis is one of the levels of binocular vision along with simultaneous perception and fusion. Binocular vision is vision using both eyes normally. Disorders of stereopsis can interfere Vision Correction Stereoscopic Amount Fine gross n % n % n % Emmetropia 105 100 0 0 105 100.0 amblyopia 0 0 1 100 1 100.0 4 [December 2022] with binocular vision and interfere with a person's quality of life. The reason why stereopsis occurs is because the object seen falls on the two retinas, which have a small disparity due to the horizontal distance between the left and right eyes, thus integrating cortically and forming depth perception. Once both eyes can see images separately, the brain then combines the resulting images. For example, if the right eye sees the top of a pine tree and the left eye sees the bottom, the brain must be able to combine the two images to see the complete picture of the entire pine tree.[7,8] After the fusion process occurs the analysis process. In this process, the brain analyzes the object in the image in one eye and compares it to the other. By observing the subtle differences in the two producing an image based on the distance between our eyes, the brain creates a 3D visual cortex perception, this process is called stereopsis.[8]

Based on the results of the study, 1 student was diagnosed with amblyopia, This is in line with research that was conducted in Makassar, where only 2.25% of 155 pediatric patients were found to have amblyopia. This indicates that cases of amblyopia in children are rare. There were 105 cases of emmetropia found. From these case findings, the researcher described the quality of stereoscopic vision between students with emmetropic eyes and students with amblyopic eyes.[9] Under normal vision conditions, with both eyes open, the amblyopic person's vision is dominated by the strong eye. Thus, Webber and Wood suggest that the most common impairment associated with amblyopia in ordinary (binocular) vision conditions is disturbance of stereoscopic depth perception. This is because it is known that in normal vision, decreased vision in one eye by obscuring, filtering, or reducing contrast results in decreased stereoacuity. In addition, stereopsis was more degraded by monocular blur (or monocular contrast reduction) than both eyes were clouded. The amblyopia patient, whom we discuss here, faces a similar state of degradation.[10]

4. CONCLUSION

Research on stereoscopic vision between amblyopia and emmetropia eyes in Kuta Bakmee Aceh Besar Public Elementary School students can be concluded that:

1. The stereoscopic vision in the amblyopic eye has decreased by 240 seconds of arc (gross stereoscopic).
2. Stereoscopic vision in emmetropic eyes does not decrease with a value of 60 seconds of arc (fine stereoscopy).

Ethics approval

This research was approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Syiah Kuala, before conducting the study (No 079/EA/FK/2022).

Competing interests

The authors declare that there is no conflict of interest.

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