Characteristics of Refractive Errors in Elementary School Students in Maros District

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Abstract. Refractive errors are the leading cause of visual impairment in children. Therefore, determining the severity of the problem in every region is necessary for management strategy. However, there is a lack of data on the prevalence of refractive errors in children in Indonesia. This study aims to determine the characteristics and distribution of refractive errors in elementary school students in the Maros district. In this descriptive study, 361 students from elementary schools in Maros district with visual acuity less than 20/20 in October 2019 were involved. Students who had refractive errors and no other ocular abnormalities were included. The eligible participants were divided into two age groups: 7-9 years and 10–12 years. Furthermore, the distribution of refractive errors was recorded. The participants were 183 girls (61.62%) and 114 boys (38.38%). Participants in groups ages 7–9 years were 80 (26.94%), and 10–12 years were 217 (73.06%). In the distribution of right eye refractive error in the 7-9 year group, 43 had myopia (53.75%), 2 had hyperopia (2.5%), and 32 (40%) had astigmatism. The most common astigmatism was simple myopic astigmatism (40.63%). In the 10–12 age group, 114 had myopia (52.53%), 4 were hyperopia (1.84%), and 92 (42.4%) had astigmatism. Compound myopic astigmatism was the most common (69.57%). In the distribution of left eye refractive error in the 7-9 year age group, 48 eyes had myopia (60%), 2 had hyperopia (2.5%), and 27 eyes (34.75%) had astigmatism. The most common astigmatism disorder was simple myopic astigmatism (48.15%). In the 10–12 year age group, 118 had myopia (54.38%), 4 had hyperopia (1.84%), and 81 (37.33%) had astigmatism. The most common was compound myopic astigmatism (65.4%). Myopia is the most common refractive error in elementary school students in the Maros district and tends to increase with age.

Keywords: Children, Myopia, Astigmatism, Hypermetropia, Refractive Error, Elementary School.

1   Introduction

Refractive errors are ocular abnormalities that could be easily diagnosed, assessed, and corrected with glasses or other devices to achieve normal vision. However, if not treated or corrected adequately and promptly, it can be a major cause of visual impairment and even blindness, particularly in children [1]. In 2014, the International Agency for the Prevention of Blindness (IAPB) identified that 3 million people, or 1.5% of the population in Indonesia, are blind. This blindness rate is the highest in Southeast Asia. According to the WHO and IAPB, refractive errors are the third primary cause of blindness (0.14%) in Southeast Asia and the second most common worldwide. Therefore, the treatment of refractive errors has become one of the priorities of WHO Vision 2020 [2,3].

According to the 2014-2016 RAAB report, refractive errors are the leading cause of visual impairment in children [2]. One of the Ministry of Health of the Republic of Indonesia's efforts regarding the Management of Visual Impairment is to ensure that school-age children with refractive errors obtain their vision corrected. In general, the first stage in the Visual Impairment Management program plan is determining the severity of the problem of visual impairment in every region [4]. However, there is currently a lack of data on the prevalence of refractive errors in school-age children in Indonesia, particularly in Maros District.

The purpose of this study was to determine the characteristics and distribution of refractive errors in elementary school students in the Maros district, in order to utilize the data to promote the enhancement of eye health services, particularly for elementary school-age children.

2   Methods

Present study is a descriptive study conducted from in October 2019. The participants were Maros district elementary school children with visual acuity less than 20/20. The Snellen chart was used to assess visual acuity. The ophthalmological examination consisted of anamnesis, anterior segment, and intraocular pressure. The best visual acuity correction was performed using a non-cycloplegic autorefraction examination or retinoscopy and proceeded by subjective refraction procedures by an optometrist, eye resident, or ophthalmologist. If the visual acuity correction did not achieve 20/20, a further ophthalmoscopy examination was performed to assess for abnormalities in the posterior segment.

The kind of refractive error in each eye was classified as follows: myopia, hyperopia, simple myopic astigmatism, simple hyperopic astigmatism, compound myopic astigmatism, compound hyperopic astigmatism, and mixed astigmatism. Inclusion criteria was participants who had refractive errors in either one or both eyes. Exclusion criteria included participants with other ocular abnormalities and incomplete data.

3   Results

All elementary school students in the Maros district participated in this study. There were 361 students with visual acuity less than 20/20. However, the number of study participants who met the inclusion and exclusion criteria was 297, consisting of 114 male and 189 female (Table 1).

Table 1. Characteristics of Maros District Elementary School students with refractive errors based on gender

Gender	n	Percentage (%)
Male	114	38.38
Female	183	61.62

The age range of the study participants was 7–12 years, which were divided into two age groups: 7-9 years and 10–12 years (Table 2). In this study, students aged 10 to 12 had greater refractive errors.

Table 2. Characteristics of elementary school students in Maros Regency with refractive errors based on age

Age (Year)	n	Percentage (%)
7-9	80	26.94
10-12	217	73.06

Table 3 presents the distribution of refractive states based on age group. There is an emmetropia state due to certain participants in both age groups having monocular refractive errors. The distribution of astigmatism types varies across the two age groups. However, neither one of them includes compound hyperopic astigmatism.

Table 3. Distribution of refractive errors based on age group

Refractive States	7-9 Years		10-12 Years	
	RE, n(%)	LE, n (%)	RE, n (%)	LE, n (%)
Emmetropia	3 (3.75)	3 (3.75)	7 (3.23)	14 (6.45)
Myopia	**43 (53.75)**	**48 (60)**	**114 (52.53)**	**118 (54.38)**
Hyperopia	2 (2.5)	2 (2.5)	4 (1.84)	4 (1.84)
Astigmatism	32 (40)	27 (33.75)	92 (42.4)	81 (37.33)
Types of astigmatism				
Simple myopic astigmatism	**13 (40.63)**	**13 (48.15)**	12 (13.04)	13 (16.05)
Simple hyperopic astigmatism	0 (0)	1 (3.7)	1 (1.09)	3 (3.7)
Compound myopic astigmatism	9 (28.12)	9 (33.33)	**64 (69.57)**	**53 (65.43)**
Compound hyperopic astigmatism	0 (0)	0 (0)	0 (0)	0 (0)
Mixed astigmatism	10 (31.25)	4 (14.82)	15 (16.3)	12 (14.82)

RE: right eye; LE: left eye.

4   Discussion

Refractive error is a condition in which a clear image is not formed on the retina due to an imbalance in the visual system, resulting in a blurred image. Rays from an object at optical infinity through a non-accommodating eye are not promptly focused on the retina but instead at one point anterior (*myopia*) or posterior (hypermetropia*) to it, or are not located at a single point (astigmatism*). Refractive errors can be caused by abnormalities in the curvature of the cornea or lens, changes in the refractive index, or abnormalities in the axial length of the eyeball [5]. Uncorrected refractive errors have a negative impact on individuals and society, as these conditions can lead to lower educational achievement and future employment opportunities [3].

Only 297 of 361 children with visual acuity less than 20/20 met the study criteria in this school-based descriptive study. Other ocular pathologies such as corneal opacity, lens opacity, strabismus, and posterior segment abnormalities led to this exclusion. In addition, subjective refraction data for certain children was incomplete to determine the type of refractive error. This current study had more female participants (61.62%), indicating that girls had higher refractive errors than boys. This is similar to several studies, such as the screening population of children aged 6–11 years in Turi Subdistrict, Special Region of Yogyakarta, by Fauzi et al., where the proportion of girls was 62.3% and boys was 37.7% [6]. Opubiri et al. discovered 22.5% of refractive errors in children aged 4–15 years in Southern Nigeria in a tertiary hospital-based study of refractive errors, with a proportion of boys (36.8%) and girls (63.2%) [7]. The distribution of this study participants was higher among those aged 10-12 (73.06%) than among those aged 7-9 (26.94%). This suggests that the number of children with refractive errors in the Maros District increase with age. Similar result was found in study conducted by Jie Zhang et al. a large-scale school-based cross-sectional study among children and adolescents in the city of Weifang, which demonstrated that myopia was highly prevalent among school students and gradually increased with age [8].

Myopia had the largest distribution of refractive errors across all age groups (7 to 12 years), with 52.86% in the right eye and 55.89% in the left eye. Astigmatism was the second most common, while hyperopia was the lowest in the two age groups. Similar results were found in study by Pandey et al. and Harrington et al. They reported that myopia was the most common refractive error in older children, although hyperopia was the most common refractive error in younger children [3,9]. In a different trend, a systematic review and meta-analysis study by Hashemi et al. in 2017 reported that astigmatism was the most common refractive error in children, followed by hyperopia, while myopia was the least common [10].

The strength of this study is the availability of data on the distribution of astigmatism types, with compound myopic astigmatism being the most common type. As a result, the characteristics of refractive errors in elementary school-age children are more comprehensive. Moreover, all elementary schools in the Maros district participated in this study. While the limitation of this study is the assessment of refractive errors using a non-cycloplegic refraction examination, it cannot eliminate accommodation in children. However, our findings offered an initial basis for future studies.

5   Conclusion

There are 297 elementary school students aged 7–12 years in Maros district, South Sulawesi Province, Indonesia, with refractive errors. In both age groups, refractive errors are more common in girls than boys. The most common refractive error is myopia, followed by astigmatism and hyperopia. Compound myopic astigmatism is the most common type of astigmatism. As there is an increasing trend of students with refractive errors as they get older, it is necessary to perform early detection and prevention of the progression of refractive errors in elementary school.

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