Evaluation of the vision screening programs in school-age children

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ABSTRACT

Background: Visual acuity (VA) screening programs, especially during early childhood, are important for the early detection of eye disorders. **Objectives:** The objective of this study is to evaluate the effectiveness of eye surveys conducted by guide teachers in school-age children. **Design:** This was a cross-sectional study. **Patients and Methods:** Detailed eye examinations were conducted by an ophthalmologist in 462 children aged 5–15 years, who were believed to have impair vision according to the snellen eye chart by guide teachers working in various primary schools between September 2017 and December 2017. Then VA, Eye movements, cycloplegic refractions and detailed retinal examinations were also examined by this ophthalmologist. **Results:** Among 462 patients, 239 (51.7%) were male and 223 (48.3%) were female. Various refraction defects were detected in 350 patients (75.8%). We detected myopia in 138 (29.9%) patients, hypermetropia in 102 (22.1%) patients, and astigmatism in 110 (23.8%) patients. Amblyopia was noted in 61 patients (13.2%), and it was caused by anisometropia in 32 patients (6.92%), ametropia in 18 patients (3.89%), pseudophakia in 2 patients (0.43%), corneal opacity in 2 patients (0.43%), and nystagmus in 1 patient (0.22%). **Conclusion:** Visual impairment is commonly noted in school-age children referred to outpatient clinics by counselors. Thus, more screenings are needed to provide early and effective diagnosis, treatment, and vision rehabilitation in school-age children.

Key words: *Amblyopia, Hyperopia, School health program*

Each year, approximately half a million children in developing countries are believed to be afflicted by blindness. An uncorrected refractive error is the second leading cause of treatable blindness and the primary cause of visual disability among children [1,2].

Although ocular screening programs at schools do not provide exhaustive sampling and prevalence data for school-age children, they may help to identify risk factors, including refractive errors, amblyopia, and strabismus, in children. Consequently, the prophylaxis and treatment of amblyopia may be possible [3,4]. In addition, investigating the prevalence and causes of childhood visual impairment helps in the planning of protective programs for eye diseases.

As visual impairment in school-age children can lead to poor performance in school, it is important to promptly correct refractive errors using appropriate spectacles [5]. The first 2 years of life are very important for normal visual development. Unfortunately, many children are not diagnosed with visual impairment at such a young age [6,7]. The critical period for visual development may vary from 8 to 9 years. Therefore, the diagnosis and treatment of visual problems are important in pre-school and school-age children.

Although amblyopia and strabismus are the most common causes of permanent vision loss during childhood, infantile esotropia and congenital cataracts may also permanently disrupt vision if not treated within the first 3 months of life [8]. Early detection and treatment of amblyopia in children are believed to improve visual acuity (VA) [9,10]. The present study aimed to determine the prevalence and causes of refractive errors, eye diseases, and amblyopia in school-age children.

METHODS

This study presents the results from the examination of patients who were referred to the Bismil State Hospital Eye Clinic between September 2017 and December 2017 by various primary school teachers. Each patient's name, sex, age, and home address were recorded. Examinations were then performed.

The anterior segment (eyelids, conjunctiva, cornea, iris, and pupils) was examined by an ophthalmologist using a slit lamp (Inami, Japan). Best-corrected visual acuity (BCVA) was measured using the Snellen chart at 6 meters. Finger count, hand movement, and light sensation were evaluated in patients with sub-par vision. Ocular motility was assessed using the cover–uncover test at 33 cm and 6.0 m distances. Strabismus was evaluated using the Hirschberg light reflex [11,12]. Cycloplegia was achieved in the eyes of patients with three drops of 1% cyclopentol administered in 10-min intervals. In addition, 20–30 min later, five consecutive refraction outcomes were measured using an auto refractometer when light reflex was absent. Pupils were fully dilated (≥6 mm).

A SE (spherical equivalent) value of ≤−0.50 D was defined as myopia, ≥ +2.00 D was defined as hyperopia, and ≥1.00 D was defined as astigmatism. Anisometropia was defined as a SE refraction difference of at least 1.5 D and/or a cylinder refraction difference of at least 1.0 D between two eyes.

Unilateral amblyopia was defined as a two-line intraocular difference between eyes with BCVA ≤20/32 (>log MAR 0.2) in the impaired eye, while bilateral amblyopia was defined as BCVA in both the eyes <20/40 (>log MAR 0.3). Isoametropic amblyopia was defined as the bilateral reduction in corrected VA to <20/40 (log MAR 0.3). If heterotropia or microstrabismus was present, strabismic amblyopia was defined as the cause of visual impairment. If both anisometropia and strabismus were present, mixed amblyopia was defined as the cause of visual impairment [13,14].

BCVA of 0.8 Snellen or worse in one or both eyes was defined as amblyopia after the diagnosis of organic eye disease was excluded. BCVA categories were defined as normal/near-normal vision (≥20/32 in both eyes), unilateral visual impairment (≥20/32 in one eye only), mild impairment in the better eye (≤20/40–≥20/63 in the better eye), moderate impairment in the better eye (≤20/80–≥20/160), and blindness (≤20/200 in both eyes).

Data analysis was performed using SPSS 22 (Statistical Package for the Social Sciences, Chicago, Illinois, USA). Continuous variables were presented as the mean±standard deviation, whereas categorical variables were presented as frequencies and percentages. Differences between categorical variables were evaluated using the Chi-square test. Continuous variables were compared using the Student's *t*-test for two independent groups. A two-sided p<0.05 was considered to be statistically significant for all analyses.

RESULTS

In total, 462 patients comprising 239 (51.7%) males and 223 (48.3%) females (mean age: 10.71±2.9 [6–15] years) were included in the present study (Table 1). Table 2 shows the frequencies of myopia, hyperopia, and astigmatism, and 350 (75.8%) patients had refractive errors. Of the 350 patients, 138 had myopia (29.9%), 102 had hyperopia (22.1%), and 110 (23.8%) had astigmatism; the remaining 112 patients (24.2%) had no refractive errors.

Table 3 presents VA. 221 patients (47.8%) had uncorrected normal/near-normal VA (≥20/32) in at least one eye, 135 patients (29.2%) had mildly impaired VA (≤20/40), 95 patients (20.6%) had moderately impaired VA (≤20/80), and 11 patients (2.4%) had low VA (≤20/200). Table 4 shows the ratios of refractive errors. In patients with myopia, 0.50 D occurred at the highest frequency (16.0%). In patients with hyperopia and astigmatism, SE values of 2.00 D and 1.00 D were the most frequently occurring, respectively. In 180 (74.6%) of 241 patients with poor VA, normal/near-normal VA was achieved with refractive correction.

There was no statistically significant difference between the patients' refraction error, uncorrected VA, and BCVA values according to patients' gender (p>0.05) (Table 5). Table 6 shows refractive errors according to the age and sex of the patients. In

Table 1: Demographic data of the patients

Characteristics	
Age (years)	10.7100±2.91050, (6–15)
Gender (%)	
Female	223 (48.3)
Male	239 (51.7)
Total	462

Table 2: The prevalence of refractive disorders

Characteristics	
Myopia (%)	138 (29.9)
Hyperopia (%)	102 (22.1)
Astigmatism (%)	110 (23.8)
Total	350

Table 3: The categories of VA

Category	Uncorrected VA (%)	Best-corrected VA (%)
≥20/32 both eyes	98 (21.2)	389 (84.2)
≥20/32 one eye only	123 (26.6)	12 (2.6)
≤20/40–≥20/63 better eye	135 (29.2)	26 (5.6)
≤20/80–≥20/160 better eye	95 (20.6)	26 (5.6)
≤20/200	11 (2.4)	9 (1.9)
Total	462 (100)	462 (100)

VA: Visual acuity

Table 4: The prevalence of refractive error types

Characteristics	
Myopia	
≤−0.50	74 (16.0)
> −0.50–≤t−2.00	45 (9.7)
≤−6.00	19 (4.2)
Hyperopia	
≤ +2.00	84 (18.2)
> +2.00	18 (3.9)
Astigmatism	
>0.5–≤1.00	74 (16.0)
>1.00–≤2.00	27 (5.8)
>2.00	9 (1.9)
None	112
Total	462

Table 5: The analyses of refraction error, UCVA, and BCVA between genders

Category	Gender
Refractive disorder	0.957
Refractive error	0.839
UCVA	0.769
BCVA	0.994

UCVA: Uncorrected visual acuity, BCVA: Best-corrected visual acuity

Table 6: Relationship between gender and refractive disorder with age

Age (in years)	Gender					
	Female			Male		
	Disorder			Disorder		
	Myopia n (%)	Hyperopia n (%)	Astigmatism n (%)	Myopia n (%)	Hyperopia n (%)	Astigmatism n (%)
6	23.1	46.2	30.8	23.1	46.2	30.8
7	18.8	43.8	37.5	23.1	46.2	30.8
8	21.4	35.7	42.9	25.0	37.5	37.5
9	35.7	35.7	28.6	28.6	35.7	35.7
10	38.5	23.1	38.5	33.3	33.3	33.3
11	33.3	33.3	33.3	44.4	22.2	33.3
12	35.0	25.0	40.0	37.5	33.3	29.2
13	40.0	30.0	30.0	55.0	15.0	30.0
14	61.1	22.2	16.7	52.0	16.0	32.0
15	57.1	14.3	28.6	60.0	20.0	20.0

female patients, myopia was most frequently observed at the age of 14 and least frequently at the age of 6. Hyperopia was seen noted most frequently at the age of 6 and least frequently at the age of 15. In male patients, myopia was most frequently observed at the age of 15 and least frequently at the age of 6. Hyperopia was most frequently observed at the age of 6 and least frequently observed at the age of 13. Astigmatism was observed at similar rates in all age groups across both the genders. Sixty-one (13.2%) patients had amblyopia. The cause of amblyopia was an isometropia in 32 patients (6.92%), ametropia in 18 patients (3.89%), pseudophakia in 2 patients (0.43%), corneal opacity in 2 patients (0.43%), and nystagmus in 1 patient (0.21%).

DISCUSSION

We found the following results from the ocular screening of school-age children sent to the polyclinic from various schools: The majority of children had refractory errors and myopia was the most frequently observed refractive error. Although more than half of the children were visually impaired, most of them achieved normal/near-normal VA after refractive correction. In both the genders, as age increased, the frequency of myopia increased while that of hypermetropia decreased. The rates of refractive error were similar between the genders. The most significant cause of amblyopia was anisometropia.

As shown in many studies, a large proportion of the world's population is affected by refractive errors. Although they can easily be diagnosed and corrected by eyeglasses and other refractive treatments, refractive errors are responsible for half of the observed visual impairments. If not corrected, these errors may cause severe vision loss and blindness [15–17]. As the prevalence of refractive errors may vary with age, gender, race, and geography, the results of prevalence studies may vary across different regions of the world [18–23]. Myopia may be observed more frequently in children from families with higher education levels, in children with the lower amount of time spent on near work, and in children with a family history of myopia [24–26].

In our study, we determined the rates of myopia, hypermetropia, and astigmatism to be 29.9%, 22.1%, and 23.8%, respectively. Some differences were observed in refractive error rates between urban and rural areas. Urban areas generally had higher rates of myopia, whereas rural areas had lower rates of myopia. This may be associated with the different amounts of time spent on near work and outdoor activities. Furthermore, the differences in the rates of refractive error between the sexes may be related to the amount of time spent by children in open areas.

Myopia may be more common in children from highly educated families, children from families with high welfare levels, children with higher IQ levels, and children with a family history of myopia. Therefore, even if high rates of myopia are detected both in school screening and ocular screening programs performed by teachers, these results may be misleading in estimating the rates of myopia in the entire population [24,27,28].

In our study, we found the lowest frequency of myopia at the age of 8 (18.8%) and the highest frequency at the age of 14 (61.1%). Hyperopia was observed at the highest frequency at the age of 6 (46.2%) and at the lowest frequency at the age of 15 (14.3%). We found a large percentage of children with refraction errors in our study (75.8%). This is possibly because of effective screening by teachers in schools. There was no significant relationship between gender and refractive error rates in our study. In some countries, the significant increase in myopia rates occurs at the age of 8, whereas in others, the increase starts between ages 13 and 14. While the frequency of myopia is high in the Far East, it is significantly less in Southern Africa [2,29,30].

In our study, uncorrected visual impairment was observed in more than half (52.2%) of the children who were directed to our polyclinic. Most of the affected children (74.6%) achieved normal/near-normal VA with refractive correction. We found that 24.25% of the children referred to our polyclinic on suspicion of visual impairment did not have any refractive error. Unlike other studies, our study was not a school scan. Therefore, the rates of refractive errors and amblyopia (13.2%) were higher than those

reported by many other studies [31–33]. Anisometropia was the most common cause of amblyopia.

CONCLUSION

VA scans conducted by school counselors for early diagnosis and treatment of visual impairment, especially during early childhood, can direct children from rural area families toward proper health care. Thus, more screenings are needed to provide early and effective diagnosis, treatment, and vision rehabilitation in school-age children.

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