Visual impairment Among Children Attending a Pediatric Ophthalmology Unit of a Tertiary Hospital in Central Saudi Arabia

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ABSTRACT

Visual impairment (VI) during childhood has an impact on the quality of life, social interactions, educational performance, and earning potential in the future. The aim of this study was to examine the prevalence rate of VI in children and their associated predictors among patients attending the pediatric ophthalmology clinic of a tertiary hospital in central Saudi Arabia in 2021. This was a prospective cross-sectional observational study that was conducted between February and December 2021 in the pediatric ophthalmology clinic at University Hospital, Qassim region, Saudi Arabia. All children aged twelve years or younger who attended the pediatric ophthalmology clinic during the study period were included. pediatric ophthalmology consultant performed a comprehensive eye examination for the study sample. The World Health Organization's recommended definitions of VI were used. The prevalence rate of VI, strabismus, and refractive error were estimated. In a year, 300 children attended the clinic. The prevalence rate of unilateral SVI, bilateral MVI, unilateral MVI, and amblyopia were 7 /1,000 (95% CI 5.7 – 7.6), 20/1,000 (95% CI 22 – 25), 43/1,000 (95% CI 41 – 46), and 4.7% (95% CI 2.3; 11.1), respectively. Blurred vision was the presenting symptom in 35.7% of children. Strabismus was found in 134 (44.6%) children. Refractive error was present in 221 (73.7%) children. Only 94 (42%) children with RE used spectacles at presentation. Comprehensive assessment in pediatric ophthalmology clinics is crucial for children's eye care. A low rate of VI but substantial cases of strabismus and amblyopia is worth noting. Early detection and continuous monitoring of children with eye ailments is recommended.

Keywords: Childhood blindness, Cycloplegic refraction, Refractive error, Strabismus, Visual impairment

INTRODUCTION

Visual impairment (VI) in childhood impacts overall health, quality of life, social life, education performance, and earning capacity later in life[1]. The eye health of children is essential for achieving the global goals set by the United Nations called Sustainable Development Goals (SDGs)[1,2]. The World Health Organization (WHO) described grades of VI; vision <20/200 is considered to indicate severe visual impairment (SVI), and vision <20/400 is considered to indicate blindness. To address uncorrected visual acuity due to refractive error (RE), presenting and best corrected vision are documented[3]. Previous research reported that the global community-based prevalence of VI based on presenting vision in the population <20 years old was 3.82%, and that of blindness was 0.17%[4]. The community-based pooled prevalence rate among 5- to 17-year-old children was 8.34% (presenting VI) and 1.21% (blindness)[5]. Community-based surveys for childhood blindness are a major challenge; therefore, to understand the magnitude of VI and blindness, blind school data, screening data, and hospital-based information are used for public health planning[6-8]. The causes of VI in children vary based on gross domestic product and <5-year mortality rates in countries of the Middle East[7,9].

In 2014, it was estimated that the Kingdom of Saudi Arabia had 2,750 children with bilateral blindness and 7,850 children with functional low vision who were <15 years of age[7]. A hospital-based study in the Eastern Province of Saudi Arabia reported that 22.9% of 2- to 16-year-old children attended the hospital were blind, and 71.2% had VI[10]. Retinal dystrophies and optic nerve diseases were the main causes of blindness, while SVI was caused by RE, strabismus, and retinal dystrophies[10].

Eye diseases and complications are common and cause considerable health burden[11-15]. Due to the paucity of data on vision and eye screening for preschoolers and school children currently living in Saudi Arabia, hospital-based information on the magnitude and causes of VI in different regions of Saudi Arabia will be useful for planning child and eye health care. At present, in Qassim, a region of central Saudi Arabia, there could be 310,700 million children <15 years of age. Recent research on kindergarten eye and vision screening showed that 4.5% of 222 children were using spectacles[16-18]. The aim of this study was to examine the prevalence rate of VI in children and their associated predictors among patients attending the pediatric ophthalmology clinic of a tertiary hospital in central Saudi Arabia in 2021.

METHODS

Study design: This was a prospective cross-sectional observational study that was conducted between February and December 2021 in the pediatric ophthalmology clinic at University Hospital, Qassim region, Saudi Arabia.

Study population: All children aged twelve years or younger who attended the pediatric ophthalmology clinic during the study period were included. There were no exclusion criteria concerning patients' gender or socioeconomic status.

Study outcomes and procedures: This research collected data related to patients' demographics information such as age at presentation, sex, and nationality. Pediatric ophthalmology consultant performed a comprehensive eye examination for the study sample. The uncorrected

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(UCVA) and presenting (PVA) visual acuity were checked using the Snellen chart with E-optotype E, and for uncooperative children, a chart with a picture-optotype was used. If the child was uncooperative or of preverbal age, a fix and follow test was performed using a LANG fixation cube.

Ocular alignment was tested by the cover-uncover test, alternate-cover test, or alternate-prism cover test, and extraocular muscle movement in the 9 cardinal gaze positions was evaluated. The anterior segment was examined using a slit lamp biomicroscope (Topcon, USA). The pupils were dilated using cyclopentolate 1% and phenylephrine 2.5% eyedrops. The posterior segment was evaluated using a 20-Diopter Volk lens and binocular indirect ophthalmoscope (Welch Allyn Retinoscope, US). Cycloplegic refraction was assessed by the same ophthalmologist. The refractive status of each eye, the spherical and cylindrical values, and the axis of astigmatism, as mentioned on the display of the spot screener, were noted. The spherical equivalent of the RE of each eye was calculated using the formula [spherical value + (cylindrical value/2)]. The reasons for failed tests, such as small pupils, strabismus, and significant RE, were also noted for each child.

At the end of the consultation visit, the pediatric ophthalmologist recorded the clinical diagnosis. The degree of VI and blindness was determined using new ICD-10-CM codes for blindness and VI. Severe VI was defined as an eye with presenting/uncorrected visual acuity <20/200. Blindness was defined as vision <20/400 in the better eye after correction. If the best corrected vision in the two eyes differed by two or more lines, the child was diagnosed with amblyopia. The severity of amblyopia was classified as mild if the vision of the amblyopic eye was 20/30–20/40, moderate if it was <20/40–20/150, and severe if it was <20/150 [19].

Ethical approval: The Institute Research Board (IRB) of Qassim University approved this research (19-05-05). Since this was a part of the routine examination in the clinic and no confidential information was obtained, written informed consent was waived. However, the tenets of the Helsinki Declaration were strictly adhered to.

Statistical analysis: The data were collected from the electronic medical records of the patients. The Statistical Package for Social Sciences software (SPSS 25) (IBM, NY, USA) was used to analyse the data for this study. Categorical variables were presented as frequencies and percentages. The normality of continuous variables was checked using histogram and skewness and kurtosis measures. The mean and standard deviation (SD) were estimated to present continuous variables. The rate of VI and other risk factors are presented with a 95% confidence interval. The associations of VI and amblyopia with age group and sex were evaluated using the chi-square test. Logistic regression analysis was carried out to identify risk factors for VI. A p-value of < 0.05 was considered to indicate statistical significance.

RESULTS

Demographic characteristics of the study sample

A total of 300 children who were presented to the pediatric ophthalmology clinic in 2021 were involved in this research. More than two-thirds of the children (71.7%) were aged less than 8 years. Around 53.0% of the study sample were females. The vast majority of the patients (98.0%) were Saudis. The demographic characteristics of the study sample are presented in Table 1.

Table 1. Demographic characteristics of the study sample

		Frequency	Percentage
Age	Less than 8 years	215	71.7
	8 to 12 years	85	28.3
Gender	Male	143	47.7
	Female	157	52.3
Nationality	Saudi	293	98.0
	Non-Saudi	7	2.0

Ocular profile for the patients

None of the children had bilateral blindness or bilateral SVI. Two children (0.66%) having unilateral SVI, and the prevalence rate was 7/1,000 (95% CI 5.7–7.6 per 1,000). There were six (2%) children with bilateral moderate VI, and the prevalence rate of 20/1,000 (95% CI 22–25 per 1000). Another 13 (4.3%) children had unilateral MVI, and the prevalence rate was 43/1,000 (95% CI 41–46 per 1,000).

There was no visual disability in 279 children. The prevalence rate of amblyopia was 14 (4.7%) (95% CI 2.3- 11.1). There were 215 (71.67%) children < 8 years old, 18 with moderate VI and 2 with severe VI. There were 85 (28.33%) children aged 8 to 12 years; of those, only one child had moderate VI. The prevalence rate of VI among children <8 years was significantly greater than that among children 8 years and older [RR = 7.9 (95% CI 1.1- 58), P = 0.008]. Of the 21 children with VI, 13 were male and 8 were female. The VI rates were 9.1% and 5.1% among boys and girls, respectively. There was no significant difference according to sex [(RR = 1.4 (95% CI 0.7- 3.4) P =0.34].

Of the 21 children with VI, all had RE, but 3 (14.3%) had strabismus only, 10 (47.6%) had strabismus and amblyopia, 2 (9.5%) had only amblyopia, and 2 (9.5%) had Duane retraction syndrome. Most of them were younger than 8 years of age. Interestingly, this research did not observe any child with glaucoma or cataracts. Two children had myopic changes in the retina and posterior segment. One child with albinism had hypopigmented hypoplastic fovea.

Table 2. Complaints of children on presentation at pediatric ophthalmology clinic.

Presented with	Frequency	Percentage
Tearing	14	4.7
Dry eyes	2	0.7
Eye itching	7	2.3
Red eye	5	1.7
Lid abnormality	3	1.0
Abnormal cornea	1	0.3
Trauma in eye	6	2.0
Drooping of eyelid	4	1.3
Eye screening for prematurity	1	0.3
Cataract	0	0.0
Glaucoma	0	0.0
Impaired vision	107	35.7
Rapid eye movements	3	1.0
Optic nerve problem	1	0.3
Other	52	17.3
Normal screening	94	31.3
Total	**300**	**100**

Table 2 below presents complaints of children on presentation at pediatric ophthalmology clinic. Nearly one-third of the attending children had no complaints and were brought for normal eye screening. Impaired vision was a presenting symptom in 35.7% of the children. Among the participants, 45 (15%) had unilateral eye ailments, while 255 (85%) had bilateral ophthalmic manifestations.

The causes of presenting to the pediatric ophthalmology department were reviewed, and 134 (44.6%) patients had strabismus. Refractive error was present in 221 (73.7%) children. The rates at which each condition was diagnosed by a pediatric ophthalmologist are given in Table 3.

Table 3. Diagnosis of children attending the pediatric ophthalmology unit of Central Saudi Arabia

Diagnosis	Frequency	Percentage	**95% CI**
Refractive Error	221	73.7	68.3 - 78.3
Strabismus	136	45.3	44.5 - 46.1
Amblyopia	32	10.7	10.3 - 11.1
Accommodative spasm	10	3.3	3.1 - 3.5
Lid diseases	14	4.7	4.5 - 4.9
Conjunctival and cornea diseases	27	9.0	8.7 - 9.3
Diseases of lens	1	0.3	0.2 - 0.4
Retinal disorder	2	0.7	0.6 - 0.8
Retinopathy of Prematurity	1	0.3	0.2 - 0.4
Lacrimal drainage obstruction	7	2.3	2.1 - 2.5
Optic nerve-related diseases	4	1.3	1.2 - 1.4
Other	11	3.7	3.5 - 3.9
'Normal' found in eye screening	28	9.3	9.0 - 9.6
Total	**300**	**100**	

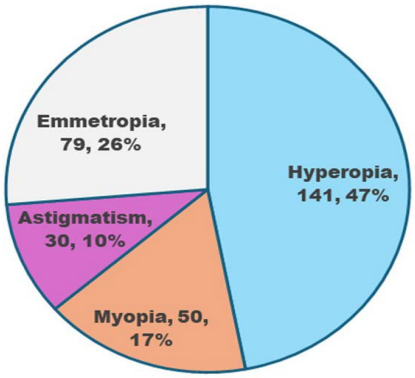

Figure 1. Distribution of children with visual impairment attending pediatric ophthalmology clinic by type of refractive error.

The types of REs among the children are shown in Figure 1. Only one-fourth of the children were emmetropic. Nearly half of the children presented to the pediatric ophthalmology clinic had hyperopia. Only 94 (42%) of 221 children with RE were found using spectacles when they presented to the clinic. Amblyopia was diagnosed in 14 (4.7%) children (95% CI 2.3; 11.1%). Strabismic amblyopia occurred in 11 (78.6%) children, while anisometric amblyopia occurred in 3 (21.4%) children. Of the 300 children, 91 (30.3%) had previously been examined by ophthalmologists outside the university hospital. As many as 209 (69.7%) patients sought treatment from a pediatric ophthalmologist without consulting other ophthalmologists.

DISCUSSION

This study aimed to investigate the prevalence of VI in children and its associated predictors among patients visiting the pediatric ophthalmology clinic of a major hospital in central Saudi Arabia in 2021. This hospital-based study demonstrated a low prevalence rate of bilateral blindness and severe VI in children aged 12 years or younger in the study area. Additionally, a low prevalence rate of unilateral SVI and moderate SVI was observed. The majority of these children with VI were under 8 years old. Nearly fifty percent of the children visiting the pediatric ophthalmology clinic exhibited strabismus. Hyperopia was observed in almost fifty percent of the children with RE. Approximately one-fourth of the children exhibited emmetropia.

In the paucity of community-based data on childhood blindness in Saudi Arabia, the hospital-based information obtained in this study offers essential insights for decision-makers to enhance pediatric eye care [6-8]. Merely one-third of the children attending the pediatric ophthalmology clinics were referred by ophthalmologists. The lack of vision screening for preschool and school-aged children in the study area indicates a pressing necessity to develop a reference protocol aimed at alleviating the burden of non-referred patients at the tertiary level, as well as facilitating the early detection and prompt management of REs at the primary and secondary levels of eye care.

This research did not find a single case of bilateral blindness or SVI among the children attending pediatric ophthalmology clinics. Based on global projections and those in Saudi Arabia, the Qassim region is likely to have 93 and 265 children with bilateral blindness and functional low vision, respectively [7]. This shows that there is a wide gap between community- and hospital-based data for children with visual disabilities in one year in Qassim. In a study conducted for a period of four months in 2018 at a tertiary eye hospital in eastern Saudi Arabia, the authors reported 74 children with blindness and 230 children with VI [10]. The later study was conducted at a well-established pediatric ophthalmology unit serving 1.2 million children. In a study on children attending a pediatric ophthalmology hospital in Makkah, Saudi Arabia, the authors reported that nearly two-thirds of REs were hyperopic astigmatism [20]. This finding matched the RE profile in the present study.

Qassim University Hospital is an emerging hospital, and during the study period, the university hospital had only outpatient clinical services and no ocular surgeries for children. This was the reason for not having any patients with cataracts or glaucoma at the University hospital. These patients are referred to Riyadh for surgical management directly by the maternity and children's hospital soon after diagnosis. As Qassim is a region near the capital of Riyadh, parents of children with more serious eye problems might visit the tertiary eye centers of Riyadh both in the government and in the private sector. This could be the reason for the low number of children with VI noted in the present study.

The children with VI had uncorrected REs, strabismus, and amblyopia. Most of them were younger than 8 years of age; thus, one can deduce that there is an urgent need to treat them before irreversible changes occur, and these children can become emmetropic [21]. The rates of VI among boys and girls in our study were not different. Sex was not a risk factor for VI among preschool children in Australia [22]. Al Harby et al. in their study showed that the sex variation in VI among school children in a large screening-based study was not significant [23].

Among young children with RE, it is difficult to determine who should be advised to use spectacles. Therefore, even if one knows children with RE, estimating the compliance rate for spectacle use is a challenge. In

an Australian study of 12-year-old children with a 12% prevalence rate of RE, only 19% were using spectacles, compliance varied by type of RE, and the compliance rate among the children with hyperopia was only 11% [24]. Of the total REs, only 17% were associated with myopia. This number is much greater than that in Danish children, where none of the 445 children had myopia [25]. In contrast, myopia constitutes 25% of RE among children in Hong Kong [26]. Arab children seem to have myopia profiles between those of Asian and Western populations. In our study, in addition to RE, strabismus and amblyopia, other eye ailments that were diagnosed included congenital nasolacrimal obstruction and allergic conjunctivitis. In a study at an eye hospital in northern Saudi Arabia, the allergic conjunctivitis rate was high [27]. It seems that allergic conjunctivitis rates vary by region of Saudi Arabia.

Universal preschool and school vision screening initiatives can identify REs, strabismus, and amblyopia in children at early stages. There is an immediate necessity for parental and educator counseling to enhance knowledge regarding VIs in children and the accessibility of pediatric ophthalmology services in the area. Prompt identification and effective care of impaired vision, strabismus, amblyopia, and ocular disorders are essential to restore vision and enhance vision-related quality of life in children with VI. The children with strabismus identified in this study warrant additional investigation to ascertain the etiologies, diagnostic profiles, and management outcomes.

This study, conducted in the post-COVID-19 era, indicated a limited number of children with VI seeking pediatric ophthalmology clinics. A significant disparity exists between the estimated number of children with VIs and those diagnosed with permanent visual disability. The pediatric ophthalmology team mostly provides general ophthalmology services for children, such as vision assessments and refractive procedures. In certain children with strabismus and/or amblyopia, the oversight of a pediatric ophthalmologist is essential for the provision of medical, surgical, and optical management at local eye clinics. The absence of a referral system from primary eye care to secondary eye care centers, and subsequently to pediatric ophthalmology clinics, appears to have led to numerous children attending pediatric ophthalmology clinics for vision screenings rather than for significant ocular conditions such as congenital cataracts, glaucoma, or retinopathy of prematurity. These findings indicate alternative referral pathways to subspecialists beyond the study area.

There were a few limitations in our study. It was based on an emerging single tertiary eye clinic in an emerging university hospital, and children attending the clinic are not representative of the eye disease profile of the entire Qassim region of Saudi Arabia. Despite this, the outcome of the present study provides a hint of a high rate of hyperopia in children reaching pediatric ophthalmology clinics. Besides, this study is prone to selection bias as hospital-based data not reflecting the entire population, which might affect the generalizability of the study findings.

CONCLUSIONS

Comprehensive assessment in pediatric ophthalmology clinics is crucial for children's eye care. A low rate of VI but substantial cases of strabismus and amblyopia is worth noting. Early detection and continuous monitoring of children with eye ailments is recommended. Structured screening programs for early intervention in pediatric eye care are needed.

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