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Childhood visual impairment in Qassim region of Saudi Arabia prevalence causes and risk factors

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To assess the prevalence of childhood visual impairment and refractive errors, as well as the causes and risk factors associated with visual impairment among children in the Qassim region of Saudi Arabia. This cross-sectional study included 850 children (aged 6–17 years) from six randomly selected primary schools in the Qassim region, conducted from March to May 2024. The study used the modified Refractive Error Study in Children (RESC) protocol. Refractive error was objectively assessed using a non-cycloplegic autorefractometer. Anterior eye examinations were performed using slit lamp biomicroscopy, while posterior segment examinations were conducted using a direct ophthalmoscope and 90 D fundus biomicroscopy. Visual impairment was classified according to the International Classification of Diseases, 11th revision (ICD-11), 2018. The prevalence of presenting childhood visual impairment was 25.5%, reduced to 7.1% with best correction. Presenting visual impairment included mild impairment in 15.5% of participants, moderate in 6.4%, severe in 2.1%, and 1.5% were classified as blind. The leading cause of childhood visual impairment was uncorrected refractive error (67.3%), followed by amblyopia (23.0%); cataract (5.5%); and congenital disorders (5.1%). The prevalence of hyperopia, myopia, and astigmatism were 30.5%, 19.3%, and 11.3%, respectively. The regression analysis showed that males had lower odds of visual impairment compared to females (OR: 0.57; $P = 0.001$). Children who never had their eyes checked had lower odds of visual impairment compared to those who had regular eye examinations (OR: 0.32; $P < 0.001$). Additionally, emmetropic children had lower odds of visual impairment compared to those with uncorrected refractive errors (OR: 0.22; $P < 0.001$). This study found a high prevalence of childhood visual impairment and refractive errors, with uncorrected refractive errors being the leading cause. Regular eye examinations and corrective measures are essential. Males had lower odds of visual impairment compared to females. These findings highlight the need for targeted interventions to enhance eye care services and reduce visual impairment in children.

Keywords Visual impairment, Child, Quality of life, Public health, Risk factor, Myopia

Global estimates indicate that almost 20 million children worldwide have visual impairments, with 1.4 million being blind, 17.5 million having severe visual impairment, and the majority living in developing countries[1]. The Lancet Commission on Global Childhood Eye Health predicted that childhood blindness would affect over 1.02 million children in the coming years, representing a global prevalence of 4.8 per 10,000 children[2]. A recent systematic review and meta-analysis among children in the Eastern Mediterranean Region showed a prevalence rate of visual impairment of 11.57%. The leading causes were uncorrected refractive error (51.89%), amblyopia (11.15%), retinal or congenital disorders (3.90%), corneal opacity (3.0%), and cataract (1.88%)[3].

Holden et al. stated that approximately 1.4 billion people had myopia in 2000, and they predicted that this number would increase to 4.8 billion by 2050, or half of world population will be myopic[4]. This high occurrence of myopia among the population poses a considerable global burden, with a substantial unmet need for vision correction, especially in poor nations[5]. While recent meta-analysis found that the prevalence rate of myopia among children in the Eastern Mediterranean Region is high, especially among older children, and more common in females. The authors recommended that early intervention to reduce the development of myopia is crucial in this region in order to prevent the children from visual impairment[6]. Additionally, a systematic review and meta-analysis showed that the prevalence of hyperopia with cycloplegic refraction was 7.35% among children in the Eastern Mediterranean Region[7].

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Uncorrected refractive errors have become a priority condition targeted by the global initiative for the elimination of avoidable blindness, known as the Right to Sight Initiative. Commonly, a high prevalence of visual impairment suggests insufficient access to eye care resources in the community[8,9]. The World Health Organization (WHO) recently launched a new initiative called SPECS 2030 to help nations achieve a 40% increase in the percentage of people with access to appropriate spectacles. This initiative aims to decrease preventable visual impairment among children due to uncorrected refractive errors[10]. Among the Saudi Arabian community, many studies have reported the prevalence of visual impairment and refractive errors. The prevalence of refractive errors ranges from approximately 4.5% to 69.7%[11,12] while visual impairment has been reported to be as high as 27.1%[10]. Overall, the prevalence of visual impairment and refractive errors in Saudi Arabia is considered high. Thus, the purpose of the present study is to assess the prevalence of childhood visual impairment and refractive errors, as well as the causes and risk factors associated with visual impairment among children in the Qassim region of Saudi Arabia.

Methods

Study design and participants

This cross-sectional, school-based study investigated visual impairment, refractive errors, and associated risk factors among children in the Qassim region of Saudi Arabia. The prevalence of visual impairment and refractive errors was assessed using the modified Refractive Error Study in School-aged Children (RESC) protocol[5]. Visual impairment was classified according to the International Classification of Diseases, 11th Revision (ICD-11), 2018[13]. Mild visual impairment is defined as visual acuity worse than (6/12(0.30 LogMAR)) but not worse than (6/18(0.50 LogMAR)). Moderate visual impairment is defined as visual acuity worse than (6/18(0.50 LogMAR)) but not worse than (6/60 (1.00 LogMAR)). Severe visual impairment is defined as visual acuity worse than (6/60 (1.00 LogMAR)) but not worse than (3/60 (1.30 LogMAR)), while blindness is defined as visual acuity worse than (3/60 (1.30 LogMAR))[10]. In this study noncycloplegic refraction was used to determine the prevalence of refractive errors, defined as follows: myopia of at least − 0.5 dioptres (D) in one or both eyes; hypermetropia of at least + 1.0D; and astigmatism of at least − 0.75 D cylindrical refraction[14].

Inclusion and exclusion criteria

Children aged 6–17 years who attended school on the days of examination and whose parents consented to their participation were included in the study. Children who were unable to obtain parental consent or did not agree to participate were excluded.

Study sample

The study sample was chosen using stratified multistage sampling technique. Assuming a prevalence of refractive error of 18%, based on the estimated prevalence among children in Saudi Arabia[15]. With a 95% confidence interval and a maximum acceptable random sampling error of 1.5%, the estimated sample size was 542, calculated using the formula below. Considering a design effect of 1.5, the final sample size was adjusted to 813.

$n = (z^2\ pq)/d^2 = (1.96^2 \times 0.18 \times 0.95)/0.035^2 = 542 => 542 \times 1.5 = 813.$

Considering a nonresponse rate of 10%, the final sample size was 894 children. The study sample selected from six schools (three for boys and three for girls) randomly selected from the Qassim region. From each grade (1–6), one class with at least 24 children was randomly chosen.

Ethical approval

The study was approved by the Qassim University Health Research Ethics Committee (Approval Number: 19-7-06) and complied with the Declaration of Helsinki guidelines. Confidentiality of the collected data was strictly maintained, ensuring no personal information was released. All children undergoing eye examinations were included in the study, and written informed/Informed consent was obtained from parents.

Clinical examination

Clinical examinations were conducted using the modified RESC protocol. Demographic data were collected from participants, and distance visual acuity was assessed using the Snellen tumbling E-chart with standard-sized E optotypes positioned at a distance of 6 m. Visual acuity was measured for each eye individually, starting with the right eye followed by the left. Both objective non-cycloplegic refraction and subjective refraction were performed. Best Corrected Visual Acuity (BCVA) was obtained using trial frames fitted with the participants' optimal refractive correction, determined through subjective refraction, and measurements were taken monocularly using the Snellen tumbling E-chart at a 6-meter distance. Furthermore, children who had prescribed glasses or wore spectacles were instructed to keep them on throughout the visual acuity testing to ensure accurate measurement of their BCVA. The Snellen tumbling E-chart used in this study was a standard wall chart featuring a single large E at the top, with crowding bars that increased from top to bottom. The presence of crowding bars is beneficial for detecting amblyopia, as the crowding effect enhances sensitivity to visual deficits, particularly in pediatric visual acuity assessment. These examinations were carried out by qualified eye care professionals, including ophthalmologists and optometrists from Qassim University. Visual impairment was classified according to the International Classification of Diseases, 11th Revision (ICD-11), 2018. Additionally, refractive error was objectively assessed using a non-cycloplegic autorefractometer, specifically the NIDEK autorefractor (RK-310). Furthermore, slit lamp biomicroscopy was used for anterior eye examinations, while posterior segment examinations were conducted using a direct ophthalmoscope and 90 D fundus biomicroscopy.

Data analysis

The data were collected using Microsoft Excel, cleaned for missing values, and then analysed with SPSS statistical software (Version 25). Frequencies and percentages were used to describe categorical variables. Refractive error was categorized rather than treated as a continuous variable to facilitate clinical interpretation, simplify statistical analysis, and allow for meaningful comparisons between the diagnostic groups, such as myopia, hyperopia, and astigmatism. The presence of refractive errors (RE), visual impairment, and its subtypes were assessed and analysed descriptively using cross-tabulation. The prevalence of visual impairment and RE among children by age groups and gender was analysed using MedCalc statistical software for Windows. Additionally, risk factors for visual impairment such as age, gender, date of last eye examination, and uncorrected refractive errors were analyzed using logistic regression with binary outcomes, presenting adjusted odds ratios (OR) and 95% confidence intervals (CI). Age and refractive error were treated as categorical variables. A significance level of a P-value less than 0.05 was used to determine statistical significance in all analyses.

Results

Demographic characteristics

A total of 894 children were requested to participate in the school-based study. Of these, 850 children attended school on the examination days, resulting in a participation rate of 95.0%. The ages of the participants ranged from 6 to 17 years, with a mean age of 9.9 ± 2.7 years. The study comprised 571 males (67.2%) and 279 females (32.8%). Most children, 735 (86.5%), reported never having had an eye examination, while only 115 (13.5%) reported using eyeglasses. Visual impairment among children was significantly associated with female gender ($P = 0.0001$), but not significantly associated with increased age ($P = 0.574$), as shown in Table 1.

Main ocular complaints among children

Among the participants, 80.3% reported coming for a check-up. Meanwhile, 10.7% complained of blurry vision, 1.8% reported dry eyes, 2.7% experienced headaches, 1.6% had itching, 2.0% reported redness, and only 0.9% experienced squinting.

Prevalence of visual impairment among children

In this study, the overall prevalence of presenting visual impairment among children was 217 (25.5%) [95% CI: 22.3–29.2] and best-corrected visual impairment was 60 (7.1%) [95% CI: 5.4–9.1]. The presenting visual impairment included mild visual impairment at 15.5% (95% CI: 13.0-18.4), moderate visual impairment at 6.4% (95% CI: 4.8–8.3), severe visual impairment at 2.1% (95% CI: 1.3–3.3), and blindness at 1.5% (95% CI: 0.8–2.6). These findings are presented in Tables 1 and 2.

Prevalence of refractive error among school-aged children

Table 3 shows the prevalence of RE in one or both eyes among children, categorized by age and gender. The overall prevalence of RE among children was 60.1% (519 children; 95% CI, 55.9–66.5). There was a statistically significant association between the prevalence of RE and age ($P = 0.001$), but no significant association with gender ($P = 0.213$). Hyperopia, myopia, and astigmatism were observed in 30.5% (259 children; 95% CI, 26.9–34.4), 19.3% (164 children; 95% CI, 16.5–22.5), and 11.3% (96 children; 95% CI, 9.2–13.8) of children, respectively. Myopia was more prevalent in the 11–17 age group (27.8%; 91 children; 95% CI: 22.4–34.2), and this difference was statistically significant ($P < 0.001$). It was also more common among males (19.6%; 112 children; 95% CI: 16.2–23.6), although this difference was not statistically significant ($P = 0.213$). In contrast, hyperopia was more prevalent among children aged 6–10 years (31.0%; 162 children; 95% CI: 26.4–36.2), and this difference was statistically significant ($P < 0.001$). It was also more common among females (33.3%; 93 children; 95% CI: 26.9–40.8), although this difference was not statistically significant ($P = 0.213$).

Demographic characteristics	Presenting Visual impairment n (%)	Total n (%)	*P-value*
Age group (years)			
6-10	137 (26.2)	523 (61.5)	0.574
11-17	80 (24.5)	327 (38.5)	
Gender			
Male	125 (21.9)	571 (67.2)	0.001
Females	92 (33.0)	279 (32.8)	
Last Examination Date			
Never	163 (22.2)	735(86.5)	0.000
One year or more	54 (47.0)	115(13.5)	
Eyeglass Usage			
Yes	47(71.2)	66(7.8)	0.000
No	170 (21.7)	784(92.2)	
Total	**217 (25.53)[95% CI, 22.3-29.2]**	**850(100)**	

Table 1. Demographic characteristics and visual impairment among children.

Visual impairment						Total
Characteristics	**Mild VIn (%)**	**Moderate VIn (%)**	**Severe VIn (%)**	**Blindnessn (%)**	**Best corrected VI n (%)**	
Age (years)	P = 0.099					
6-10	92 (17.6)	27 (5.2)	9 (1.7)	8 (1.5)	38 (7.3)	523
11-17	40 (12.2)	27 (8.3)	9 (2.8)	5 (1.5)	22 (6.7)	327
Gender	P = 0.013					
Male	74 (13.0)	33 (5.8)	11 (1.9)	7 (1.2)	44 (7.7)	571
Female	58 (20.8)	21 (7.5)	7 (2.5)	6 (2.2)	16 (5.7)	279
Total	132 (15.5)	54 (6.4)	18 (2.1)	13 (1.5)	60 (7.1)	850
95% CI	**15.5,13.0-18.4**	**6.4, 4.8-8.3**	**2.1, 1.3-3.3**	**1.5, 0.8- 2.6**	**7.1, 5.4- 9.1**	

Table 2. Prevalence of visual impairment among children by age group and Gender. VI = Visual impairment.

Refractive error 519 (61.1% [95% CI, 55.9–66.5])					Total
Characteristics	**Emmetropia n (%)**	**Hyperopia n (%)**	**Myopia n (%)**	**Astigmatism n (%)**	
Age (years)	*P* < 0.001				
6–10	207 (39.6)	162 (31.0)	73 (14.0)	81 (15.5)	523
11–17	124 (37.9)	97 (29.7)	91 (27.8)	15 (4.5)	327
Gender	*P* = 0.213				
Male	234 (41.0)	166 (29.1)	112 (19.6)	59 (10.3)	571
Female	97 (34.8)	93 (33.3)	52 (18.6)	37 (13.3)	279
Total	331 (38.9)	259 (30.5)	164 (19.3)	96 (11.3)	850
95% CI	**38.9, 34.9–43.4**	**30.5, 26.9–34.4**	**19.3, 16.5–22.5**	**11.3, 9.2–13.8**	

Table 3. Prevalence of refractive error by age groups and gender.

Characteristics	Adjusted odds ratio (95% CI)	*P*-value
Age group (years)		
11–17	Reference	
6–10	1.09(0.80–1.51)	0.574
Gender		
Female	Reference	
Male	0.57 (0.14–0.48)	0.001
Date of Last Examination		
One year or more	Reference	
Never	0.32 (0.22–0.48)	< 0.001
Refractive Error (RE)		
Uncorrected RE	Reference	
Emmetropia	0.22 (0.15–0.33)	< 0.001

Table 4. Impact of demographic characteristics and refractive error on visual impairment among children (Binary logistic regression analysis).

Risk factors for the visual impairment among the children

The regression analysis indicated that the likelihood of visual impairment was not associated with children's age ($P = 0.574$). Additionally, males had lower odds of visual impairment compared to females (OR: 0.57; 95% CI: 0.80–1.51). Children who never had their eyes checked had lower odds of visual impairment compared to children who had eye examinations for one year or more (OR: 0.32; 95% CI: 0.22–0.48). Furthermore, emmetropic children had lower odds of visual impairment compared to children with uncorrected refractive errors (OR: 0.22; 95% CI: 0.15–0.33), as presented in Table 4.

The leading cause of visual impairment among children

In general, the primary cause of visual impairment among children was uncorrected refractive error (67.3%), followed by amblyopia (23.0%), cataract (5.5%), and congenital disorders (5.1%) as illustrated in Table 5.

Table 5 presents the prevalence of the main causes of visual impairment among children as follows: refractive error (19.6%), amblyopia (5.9%), cataract (1.4%), and congenital disorders (1.3%).

Causes	Presenting VI					Prevalence of main causes of VI
	Mild VI *n* (%)	Moderate VI *n* (%)	Severe VI *n* (%)	Blindness *n* (%)	Total *n* (%)	*n* (%)
Refractive error	105 (72.9)	29 (20.1)	9 (6.3)	1 (0.7)	144 (67.3)	144(16.9)
Amblyopia	23 (45.1)	18 (35.3)	6 (11.8)	3 (5.9)	50 (23.0)	50(5.9)
Cataract	1 (8.3)	4 (33.3)	2 (16.7)	5 (41.7)	12 (5.5)	12(1.4)
Congenital disorders	3 (27.3)	3 (27.3)	1 (9.1)	4 (36.4)	11 (5.1)	11(1.3)
Total	132 (15.5)	54 (6.4)	18 (2.1)	13 (1.5%)	217 (100)	850

Table 5. The main causes of visual impairment.

Discussion

This study, conducted among school-aged children in the Qassim province of Saudi Arabia, aimed to determine the prevalence, causes, and risk factors associated with childhood visual impairment. The findings of this study highlight a significant prevalence of childhood visual impairment in the Qassim region, with 25.5% of children presenting with visual impairment. However, with correction of refractive errors, this prevalence reduced to 7.1%, indicating the effectiveness of corrective measures. These results are consistent with global trends, where uncorrected refractive errors remain the leading cause of childhood visual impairment[16–18]. The study revealed that a considerable proportion of children experienced varying degrees of visual impairment: 15.5% had mild visual impairment, 6.4% had moderate visual impairment, 2.1% had severe visual impairment, and 1.5% were affected by blindness. This distribution highlights the critical need for early detection and intervention to reduce childhood visual impairment. Similar studies have shown that timely detection and correction of eye disorders can reduce visual impairment and significantly improve children's educational outcomes and quality of life[15,16,19].

In the present study, uncorrected refractive errors were identified as the leading cause of childhood visual impairment (67.3%), followed by amblyopia (23.0%), cataract (5.5%), and congenital disorders (5.1%). These findings align with other research indicating that uncorrected refractive errors are the most common cause of visual impairment in children worldwide[3,5,10]. A recent study in the rural community of the Qassim region found uncorrected refractive error is the main cause of visual impairment, followed by amblyopia and cataract[10]. The study recommended that improving access to primary eye care, such as mobile units or subsidized eyewear, can effectively address these issues and reduce visual impairment.

The present study investigated the prevalence and causes of visual impairment among children, with a particular focus on amblyopia, refractive errors, cataract, and congenital disorders. The findings revealed that uncorrected refractive error was the most prevalent, accounting for 19.6% of cases, followed by amblyopia (5.9%), cataract (1.4%), and congenital disorders (1.3%). The prevalence of amblyopia in the current study (5.9%) is notably higher than that reported in a systematic review conducted in Saudi Arabia, which found a prevalence of 2.3% among children[20]. Similarly, Aldebasi (2015) reported low prevalence of 3.9% among primary school children in the Qassim region of Saudi Arabia[21]. This suggests a potential increase in detection rates or a shift in population health dynamics. The observed differences may be attributed to variations in study populations, diagnostic criteria, and screening protocols, as well as advancements in screening technologies. While the higher prevalence of childhood amblyopia may reflect improved case identification, it also underscores persistent gaps in public awareness particularly among parents and the absence of standardized nationwide screening programs. Despite some progress in healthcare provider training and localized educational initiatives, the lack of coordinated national efforts and limited parental knowledge continue to hinder early detection and effective management of childhood amblyopia. These findings highlight the urgent need for comprehensive public health strategies to address these challenges.

The relatively high prevalence of refractive errors in resent study (19.6%) aligns with global trends, where uncorrected refractive errors remain a leading cause of visual impairment in children[5,10]. This finding underscores the need for early vision screening programs and access to corrective services, particularly in school settings. Although cataract and congenital disorders were less prevalent in this study, their presence is clinically significant due to the potential for long-term visual disability if not addressed quickly. Overall, the findings underscore the need for comprehensive school-based vision screening programs, public health awareness campaigns, and improved access to paediatric eye care services.

The high prevalence of amblyopia among children in the present study also highlights the importance of early screening and management to prevent long-term visual deficits that consequently leads to the visual impairment. Aldebasi[21] reported prevalence of amblyopia among children in Qassim province. The study revealed that anisometropic refractive errors are the most common cause of amblyopia. The study recommended that visual screening programs for children should be implemented to ensure early detection and proper management of amblyopia. Furthermore, Aljohani et al. conducted a study on children with amblyopia in the Qassim region of Saudi Arabia and found that the most common types were strabismic and anisometropic amblyopia. Their study emphasized the importance of early diagnosis and management of childhood amblyopia and uncorrected refractive errors to prevent adverse effects on quality of life[22]. In comparison, the present study reported the overall prevalence of amblyopia, which included cases of both anisometropic and strabismic amblyopia. These findings reinforce the need for timely screening and intervention strategies to address the leading causes of amblyopia and mitigate their long-term impact on children's visual development and daily functioning.

The occurrence of hyperopia (30.5%), myopia (19.3%), and astigmatism (11.3%) in this study is comparable to other countries. For instance, a study in São Paulo, Brazil, reported similar patterns of refractive errors

among school-aged children[17]. A systematic review and meta-analysis conducted among children in the Eastern Mediterranean Region, which includes Saudi Arabia, showed a high prevalence of myopia among children. The study suggested that early intervention to slow myopia progression is essential to prevent childhood visual impairment in the region[6]. Furthermore, another study showed a high prevalence of hyperopia in this region. It recommended early interventions and management to prevent the development of amblyopia and strabismus in children[7]. The present study showed a high prevalence of hyperopia, which could be due to using the benchmark for defining hyperopia as having at least + 1.00 D in one or both eyes. Furthermore, most of the study sample consisted of young children aged 6–10 years. At this age, some degree of hyperopia is considered physiological and can be managed by accommodation amplitude without affecting vision. In determining the appropriate threshold for hyperopia in children aged 6 years and above particularly when using non cycloplegia refraction previous study[23] suggest that a + 1.50 D threshold May be more suitable than the traditionally used + 2.00 D. This adjustment is recommended because undilated refraction tends to underestimate hyperopia due to active accommodation. Furthermore, recent study has proposed optimized referral criteria ranging between + 1.25 D and + 1.88 D to improve the sensitivity and specificity of detecting amblyopia risk factors in children[24]. Therefore, we recommend that future studies adopt a threshold of + 1.50 D for hyperopia when using non-cycloplegic refraction, and + 2.00 D when using cycloplegic refraction. The current study revealed a high prevalence of myopia, which possibly could be due to environmental factors like a lack of outdoor activities, with many children engaged in near tasks. Genetic predispositions may also contribute; as consanguineous marriages are common in the Saudi community. This is consistent with recent study that has shown genetic correlations with the development of myopia[25].

The regression analysis indicated that males had lower odds of visual impairment compared to females (OR: 0.57; $P = 0.001$). This gender disparity has been observed in another study in the region as well, suggesting potential biological or behavioral differences that need further investigation[10]. Several factors may contribute to this gender difference. Biologically, sex-linked variations in ocular development or the progression of refractive errors could play a role. Additionally, females in the Qassim region may have less access to eye care services, lower health-seeking behaviour, or may be less prioritized for vision care within families or communities. Cultural and socioeconomic barriers may also delay the identification and correction of refractive errors in girls[26]. These findings underscore the need for gender-sensitive public health strategies and targeted vision screening programs to ensure early detection and correction of refractive errors, particularly among female children. Interestingly, children who never had their eyes checked had lower odds of visual impairment compared to those who had regular eye examinations (OR: 0.32; $P < 0.001$). This counterintuitive finding may reflect a selection bias, where children with existing visual problems are more likely to undergo regular eye examinations. It underscores the importance of universal screening programs to ensure all children receive timely eye care. Emmetropic children had significantly lower odds of visual impairment compared to those with uncorrected refractive errors (OR: 0.22; $P < 0.001$). This finding emphasizes the critical role of correcting refractive errors to prevent childhood visual impairment and its associated impacts on children's development and quality of life[16,17].

To effectively address the high rates of visual impairment and refractive errors among children in the Qassim region, it is essential to improve access to eye care services. Timely detection and treatment of childhood visual impairments could be achieved through mobile eye clinics, community outreach programs, and school-based screenings. Public health campaigns should emphasize the impact of childhood visual impairment on academic performance and quality of life. Policymakers must arrange subsidized eye care and encourage public-private partnerships to enhance the accessibility and affordability of eye care services for children. Additional research is needed to identify the barriers children face in accessing eye care and to understand how genetic and environmental factors contribute to the development of refractive errors. The study recommends partnering with local healthcare providers and non-governmental organizations in Saudi Arabia to enhance access to childhood eye care and implement sustainable interventions. In addition, longitudinal studies should be conducted to assess the long-term effects of childhood visual impairment on quality of life. Assessing the effectiveness and cost-efficiency of interventions such as mobile clinics and health education programs will guide resource allocation and policy development. These actions will help develop targeted strategies to reduce childhood visual impairment and to improve eye health in the Qassim region.

Limitations

The study had some limitations that need to be addressed. Firstly, the gold standard for assessing refractive errors in children is cycloplegia. However, this study used non-cycloplegic methods, which may lead to inaccurate detection of certain types of refractive errors. However, non-cycloplegic refraction may be a practical method to guide screening programs, especially where cycloplegic refraction is challenging to implement. The use of fogging could also be considered as an alternative approach in future studies. Secondly, the study revealed a high prevalence of hyperopia, possible due to defining hyperopia as having at least + 1.00 D in one or both eyes. Additionally, most of the study sample consisted of young children aged 6–10 years. This age group is known to have a higher prevalence of hyperopia, which could have influenced the findings. Future studies should consider including a broader age range to provide a more comprehensive view of refractive errors, particularly hyperopia, across different age groups. Furthermore, anisometropia was not reported separately as a type of refractive error; differences in refraction between the two eyes were classified as hyperopia, myopia, or astigmatism may result in high prevalence of these conditions. Despite the mentioned limitations, the study provided valuable insights into the prevalence, causes, and risk factors of childhood visual impairment in the Qassim region.

Conclusion

This study highlights the high prevalence of visual impairment and refractive errors among school-aged children in the Qassim region of Saudi Arabia. Uncorrected refractive error is the leading cause of childhood visual impairment, followed by amblyopia and cataract, emphasizing the need for regular eye examinations early detection, screening programs, and corrective measures. The gender differences and the impact of eye examinations on childhood visual impairment prevalence suggest areas for further research and targeted interventions. These insights underscore the importance of targeted interventions to improve eye care services and reduce the burden of visual impairment in children.

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Author contributions

"All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by, [Saif H. Alrasheed], [Muhammed S. Alluwimi], [Saleh Alshammeri] [Waleed M. Alghamdi], [Sulaiman Aldakhil], [Majid A. Moafa]] and [Bandar Alenezi]. The first draft of the manuscript was written by [Saif H. Alrasheed] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript."

Declarations

Competing interests

The authors declare no competing interests.

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