ORIGINAL ARTICLE

Frequency of Amblyopia in Uncorrected an Isometropia in Children of age between 5-10 years

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ABSTRACT

Background: Uncorrected anisometropia is a leading cause of amblyopia and preventable visual impairment in children. Anisometropia disrupts binocular vision, resulting in cortical suppression and reduced visual acuity in the affected eye. Early identification and treatment are crucial to prevent permanent vision loss. However, the lack of routine vision screening in Pakistan often delays diagnosis and treatment.

Objectives: This study aimed to determine the prevalence of amblyopia among Pakistani children aged 5–10 years with uncorrected anisometropia and to evaluate the relationship between anisometropia severity and amblyopia.

Methods: A cross-sectional, hospital-based study was conducted at multiple ophthalmology centres in Pakistan from January 2020 to December 2022. A total of 150 children with uncorrected anisometropia underwent comprehensive assessments, including best-corrected visual acuity, cycloplegic refraction, and ocular alignment tests. Amblyopia was defined as BCVA ≤ 20/40 in one eye or an interocular difference of ≥2 lines. Data were analyzed using SPSS version 25.0, and chi-square tests were applied to evaluate the association between anisometropia severity and amblyopia.

Results: Amblyopia was diagnosed in 32% of the study population. The prevalence increased with anisometropia severity: 13.3% in mild cases, 29.1% in moderate cases, and 68.6% in severe cases ($p<0.001$). The mean age of amblyopia diagnosis was 7.5 ± 1.3 years. No significant gender difference in prevalence was found ($p=0.69$).

Conclusion: Uncorrected anisometropia significantly increases amblyopia risk. Early detection and timely treatment are essential to prevent long-term visual impairment. Implementing school vision screenings and improving access to refractive correction services could substantially reduce childhood amblyopia in Pakistan.

Keywords: Amblyopia, Anisometropia, Childhood Visual Impairment, Pediatric Ophthalmology, Vision Screening, Pakistan.

INTRODUCTION

Amblyopia, commonly known as "lazy eye," is a neuro-developmental visual disorder caused by abnormal visual stimulation during the critical period of visual maturation. It is characterized by a unilateral or bilateral reduction in best-corrected visual acuity (BCVA) despite the absence of any structural abnormalities of the eye[1]. Amblyopia remains the leading cause of preventable childhood visual impairment worldwide, with anisometropia being one of its most frequent underlying causes. Anisometropia refers to a significant difference in the refractive power between the two eyes, leading to unequal image sizes (aniseikonia), impaired binocular fusion, and cortical suppression of the weaker eye. If left uncorrected, anisometropic amblyopia can lead to permanent visual impairment, adversely affecting academic performance, quality of life, and future career opportunities[2].

Amblyopia is a significant yet often overlooked public health issue in Pakistan. Prior research has reported a prevalence of 1.5% to 4% in the country, with anisometropic amblyopia being the most commonly identified subtype[3]. However, early detection and intervention remain inadequate, as awareness among parents, teachers, and primary healthcare providers is limited. Unlike strabismic amblyopia, which presents with visible ocular misalignment, anisometropic amblyopia is often asymptomatic in early childhood. As a result, many cases remain undiagnosed until school screenings or incidental ophthalmologic evaluations. The lack of routine vision screening programs in Pakistan's primary healthcare system further contributes to delayed diagnosis and reduced treatment efficacy[4].

Multiple socioeconomic and healthcare barriers contribute to the underdiagnosis and undertreatment of amblyopia in Pakistan. Although pediatric eye care services exist, access remains highly limited, particularly in rural and underserved areas where qualified ophthalmologists and optometrists are scarce.

Additionally, while corrective spectacles are generally affordable and widely available, many families either cannot afford them or fail to prioritize their child's visual health. Furthermore, cultural misconceptions about eyeglasses, particularly concerning young girls, often hinder timely refractive correction, increasing the risk of developing amblyopia[5,6].

Globally, approximately 50% of all amblyopia cases are attributed to anisometropia. Research has demonstrated that the risk of amblyopia increases when anisometropic hyperopia exceeds +1.00 diopter (D), myopic anisometropia surpasses -2.00 D, or astigmatic anisometropia exceeds ±1.50 D. The effectiveness of amblyopia treatment is highest during the critical period of visual development, which extends up to 8–10 years of age. Beyond this age, neuroplasticity declines, limiting treatment outcomes. Since the majority of school-aged children in Pakistan do not undergo routine vision screening, a significant number of anisometropic amblyopia cases remain undiagnosed until after this critical period has passed[7,8].

Despite the growing recognition of amblyopia as a public health concern, Pakistan lacks sufficient epidemiological data to guide effective screening and management strategies. While studies from other countries have provided estimates of anisometropic amblyopia prevalence, localized data that consider Pakistan's unique demographic, environmental, and healthcare challenges are essential[9]. To address this gap, this study was conducted to determine the frequency of amblyopia among children aged 5–10 years with uncorrected anisometropia in Pakistan. This research can also support advocacy for national vision screening program and early intervention strategies for anisometropic amblyopia by assessing its prevalence, severity and related risk factors[10, 11].

There are public health implications associated with this study. Anisometropic amblyopia can be detected and treated early, and will not lead to long term visual disability, improved academic performance, and better quality of life in children. Screening for vision in Pakistan's primary healthcare and school health programs

would have a huge impact in reducing burden of visual impairment in childhood. This research reiterates the necessity for heightened parental, educational and health care provider awareness of the significance of routine eye examination and timely refractive correction in children. The final objective of this study is to support in the development of pediatric eye care policy to fill in the gaps and facilitate the visual health and prevent the blindness of avoidable childhood blindness in Pakistan[12,13].

MATERIALS AND METHODS

This was a cross-sectional study carried out between January 2020 to December 2022 in different ophthalmology departments in Pakistan. The aim was thus to assess the prevalence of amblyopia in children aged 5 to 10 years with uncorrected anisometropia. Statistical power considerations and feasibility of patient recruitment at participating institutions led us to select sample size of 150 children. A purposive sampling technique was used to recruit participants, including children who attended outpatient ophthalmology department for routine eye examination or for eye complaint, and hence the cases of the study were included.

Uncorrected anisometropia in children aged 5 to 10 years was included in the study. Anisometropia was defined as greater than 1.00 diopter (D) difference between the two eyes spherical equivalent refraction with hyperopic anisometropia greater than +1.00 D, myopic anisometropia greater than -2.00 D, or astigmatic anisometropia of greater than ±1.50 D.

Exclusion criteria included a history of previous refractive correction, previous ocular surgery, strabismus, ocular pathology or neurological disorders causing vision disturbance.

The institutional review boards (IRBs) of all participating centers approved the ethical approval. Ethical guidelines for research involving minors were followed and written informed consent was obtained from parents or legal guardians.

Each participant was subject to a comprehensive ophthalmic evaluation. Visual acuity was assessed with age-appropriate visual acuity charts and best corrected visual acuity (BCVA) was used. Refractive error was determined accurately by cycloplegic refraction with 1% cyclopentolate. Strabismus was ruled out using both cover and uncover test and alternate cover test for ocular alignment. A diagnosis of amblyopia was made when one eye had BCVA 20/40 or worse or interocular difference of two or more lines on the visual acuity chart.

The data were recorded and analyzed systematically by using SPSS version 25.0. Summary of demographic and clinical characteristics were done descriptive statistics. Associations between variables such as age, gender, severity of anisometropia and presence of amblyopia were assessed using the chi-square test. Statistically significant was considered a p value less than 0.05.

This structured methodology allowed accurate identification of amblyopia cases and reliable data on the prevalence of amblyopia and its risk factors in uncorrected anisometropic children in Pakistan.

RESULTS

A total of 150 children of 5 to 10 years of age, with mean age 7.2 ± 1.5 years, were included in this study. There were 85 (56.7%) males and 65 (43.3%) females in the cohort. Of these children, 48 had amblyopia and an overall prevalence of 32%. The age at diagnosis of amblyopia was 7.5 ± 1.3 years. Table 1 summarizes the demographic characteristics and clinical findings.

A significant association was observed between anisometropia severity and amblyopia prevalence. Children were categorized into three severity groups: mild (1.00–1.99 D, n=60), moderate (2.00–2.99 D, n=55), and severe (≥3.00 D, n=35). The prevalence of amblyopia increased with the severity of anisometropia, rising from 13.3% in the mild group, to 29.1% in the moderate group, and reaching 68.6% in the severe group. Statistical analysis confirmed this trend to be significant (p<0.001). These findings are detailed in Table 2.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Total (N=150)	Amblyopia Present (n=48)	Amblyopia Absent (n=102)	p-value
Age (years), mean ± SD	7.2 ± 1.5	7.5 ± 1.3	7.0 ± 1.6	0.07
Gender (Male)	85 (56.7%)	28 (58.3%)	57 (55.9%)	0.69
Gender (Female)	65 (43.3%)	20 (41.7%)	45 (44.1%)	0.69

Table 2: Prevalence of Amblyopia by Anisometropia Severity

Anisometropia Severity	Total (N=150)	Amblyopia Present (n=48)	Prevalence (%)	p-value
Mild (1.00–1.99 D)	60	8	13.3	<0.001
Moderate (2.00–2.99 D)	55	16	29.1	<0.001
Severe (≥3.00 D)	35	24	68.6	<0.001

In terms of amblyopia severity, the condition was classified as mild (20/30 to 20/40) in 18 children (37.5%), moderate (20/50 to 20/80) in 20 children (41.7%), and severe (worse than 20/80) in 10 children (20.8%). No significant differences were found in amblyopia severity between males and females (p=0.74). Although older children at diagnosis tended to have more severe amblyopia, this association did not reach statistical significance (p=0.07).

These results underscore the critical importance of early detection and intervention. The increasing prevalence of amblyopia with greater anisometropia severity highlights the need for routine vision screening and timely refractive correction. Early management of anisometropia could significantly reduce the burden of amblyopia and its associated long-term visual and quality-of-life impacts.

DISCUSSION

The findings of this study confirm that uncorrected anisometropia significantly increases the risk of amblyopia in children aged 5 to 10 years in Pakistan. With an overall amblyopia prevalence of 32%, the risk was strongly associated with the severity of anisometropia. These results align with prior international studies that identify anisometropia as a common and impactful cause of amblyopia. The rising prevalence—from 16.7% in mild anisometropia to 68.6% in severe anisometropia—highlights how large refractive disparities between the eyes lead to visual suppression and neural adaptation deficits, ultimately resulting in amblyopia[14,15].

Amblyopia is a neurodevelopmental disorder stemming from inadequate visual stimulation during early childhood. When anisometropia occurs, it disrupts binocular fusion, causing cortical suppression of the more refractive eye. This study underscores the importance of early intervention. The mean age of diagnosis at 7.5 years is particularly concerning, as this falls close to the critical period's end, around eight years of age, when neural plasticity declines, and treatment becomes less effective[16, 17].

The study found no significant differences in amblyopia prevalence between boys and girls, suggesting that uncorrected anisometropia affects both sexes equally. These findings are consistent with other studies reporting minimal gender differences in amblyopia susceptibility. However, the cultural context in Pakistan, where healthcare access may be more limited for female children, could delay diagnosis and treatment. This reinforces the need for gender-equitable healthcare initiatives[18].

One of the major strengths of this study is that it is multicentric having different hospitals and clinics from across Pakistan. This generalizability of the results and an understanding of anisometropic amblyopia in Pakistani children are improved. Nevertheless,

limitations remain. With hospital-based sampling, the likelihood of overestimating the prevalence of amblyopia is high, as children are sampled who already have preexisting visual complaints. Additionally, the anisometropia severity and amblyopia progression are not proven to be causal in this cross-sectional study. It will be necessary to conduct longitudinal research to ascertain the long term effects of uncorrected anisometropia on visual development and outcome of early intervention strategies[19].

These findings clearly highlight the importance of routine vision screening programs in schools and a greater awareness of vision health in children by their parents. This study also underscores the importance of timely intervention because late diagnosis was observed. There must be affordable, accessible refractive correction services with the aim to early identify and treat for anisometropic amblyopia before there are long term consequences[20].

CONCLUSION

The results of this study show that uncorrected anisometropia is a major risk factor for amblyopia in Pakistani children aged 5–10 years, and has a prevalence of 32%. This points to the importance of early detection and immediate refractive correction in minimising amblyopia risk, which is strongly associated with the magnitude of anisometropia. The mean diagnosis age of 7.5 years in these patients demonstrates delayed identification and treatment.

To do this, school-based vision screening programs and efforts to make refractive correction more affordable and accessible should be implemented. Early intervention is not only important to prevent childhood visual impairment but it also dramatically improves quality of life. The study reinforces that timely and targeted pediatric vision care can prevent the avoidable long-term consequences of amblyopia.

Conflict of interest: No conflict of interest was declared by authors.

Funding: No funding was received.

Authors contribution: All authors contributed equally and all authors agreed for the published version of manuscript.

Acknowledgement: The authors acknowledge the support of the ophthalmology centre staff.

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