

To study the prevalence of refractive error cases in primary school children

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ABSTRACT

Refractive errors, such as myopia, hyperopia, and astigmatism, are prevalent visual disorders impacting children globally. If overlooked and unaddressed, these problems may result in considerable learning challenges, diminished academic achievement, and hindered social development. Children of primary school age undergo a crucial phase of visual and cognitive development, rendering early diagnosis and intervention vital for their wellbeing and academic success. This analysis consolidates data from many national and international research to evaluate the prevalence and distribution of refractive errors in children aged 6 to 12 years. The results consistently demonstrate an increasing prevalence of refractive errors, especially myopia, in both industrialized and developing nations. Urbanization, augmented screen time, diminished outdoor activity, and academic pressure are primary contributing reasons. Research conducted in India, China, and Southeast Asia indicates prevalence rates varying from 5% to exceeding 30%, contingent upon the specific population and region examined. The review emphasizes discrepancies between urban and rural populations, indicating that urban children are more predisposed to developing refractive errors as a result of lifestyle and environmental factors. The deficiency of awareness, restricted access to pediatric eye care, and the nonexistence of regular school-based vision screening programs significantly aggravate the problem, particularly in low- and middle-income nations. The report finishes with a robust suggestion for the establishment of routine vision screening in educational institutions, public health initiatives, and heightened awareness among parents and educators. A collaborative strategy combining educational institutions, ophthalmic experts, and legislators is essential to tackle this escalating issue and to guarantee that every child may study and flourish with optimal vision.

Keywords: Refractive error, Hyperopia, Myopia

INTRODUCTION

Vision is essential for a child's growth and development, acting as a vital conduit for learning and engagement with the environment. Up to 80% of children's early learning is visual, rendering clear vision crucial for scholastic achievement and overall quality of life. Regrettably, numerous youngsters endure undetected vision impairments, especially refractive abnormalities, which can remain unrecognized until they impact academic performance or social engagement. Refractive errors, including myopia, hyperopia, and astigmatism, are the most common visual impairments in children and are highly correctable if detected promptly. Refractive error is a condition wherein the eye inadequately focuses light onto the retina, leading to blurred vision. The three primary types—myopia, hyperopia, and astigmatism— possess unique causes and symptoms, however all share a commonality: they considerably hinder vision if uncorrected. Myopia generally manifests during early schooling years and is increasingly linked to urban living, heightened screen exposure, and diminished outdoor activity. Hyperopia frequently exists from birth but may go unnoticed unless it is pronounced. Astigmatism, resulting from abnormal curvature of the cornea or lens, can coexist with either of the other two diseases and may impact both near and distant vision.

Worldwide, refractive errors constitute a primary cause of vision impairment in children. The World Health Organization (WHO) reports that more than 12 million children aged 5 to 15 are visually impaired as a result of uncorrected refractive defects. This burden is significantly greater in low- and middle-income nations, where access to vision screening and corrective procedures is restricted. In affluent nations, vision impairments in schoolchildren may go undetected due to irregular screening protocols or insufficient awareness among parents and educators.

The ramifications of unaddressed refractive defects in primary school children, often aged 6 to 12 years, are significant. During this developmental phase, children experience fast learning and skill gain. A youngster with undiagnosed visual impairments may have difficulty perceiving the chalkboard, reading textbooks, or engaging in classroom activities. Ultimately, this may result in diminished academic performance, lowered self-esteem, and behavioral problems. Furthermore, impaired eyesight might obstruct engagement in sports and other physical activities, so further isolating



affected youngsters from their friends.

Research indicates that refractive defects frequently remain undetected, as youngsters may struggle to express their visual challenges, believing their vision is "normal" due to a lack of comparative experience. In certain instances, symptoms like squinting, recurrent headaches, ocular strain, or proximity to the television may be erroneously ascribed to alternative causes. Consequently, systematic screening in educational institutions is an essential instrument for early identification and intervention.

In the last twenty years, an increasing amount of research has concentrated on measuring the prevalence of refractive errors across diverse groups. The findings have underscored substantial regional, demographic, and socio-economic disparities. For instance, elevated prevalence rates have been recorded in urban and semi-urban environments, especially in East and Southeast Asia, where scholastic expectations and diminished outdoor activity have been associated with increasing rates of myopia. Conversely, certain rural communities indicate a reduced frequency; nonetheless, access to corrective interventions in these regions continues to pose difficulties.

India, being one of the most populous nations globally with a substantial school-age demographic, offers a distinctive case study. Numerous regional studies have sought to quantify the prevalence and distribution of refractive errors among Indian children, demonstrating significant variance among states, types of schools (government versus private), and urban- rural contexts. Urban cities such as Delhi, Mumbai, and Hyderabad have elevated myopia rates among schoolchildren, frequently ascribed to increased screen exposure and rigorous academic schedules. Concurrently, rural areas encounter distinct obstacles, including insufficient awareness and a scarcity of qualified eye care practitioners.

Refractive errors constitute both a medical issue and a public health hazard. Visual impairment affects not just the individual child but also the family, educational institutions, and society as a whole. Children with visual impairments may have further assistance in educational settings, potentially hindering their academic progress and impacting their future opportunities. The economic impact of unaddressed refractive errors—resulting from diminished productivity, educational setbacks, and heightened healthcare demands—is significant. Fortunately, refractive problems can be readily rectified with straightforward measures such as prescription spectacles or contact lenses. This renders early identification via school-based screening programs a highly economical strategy.

Nonetheless, numerous nations, especially in the developing world, lack organized vision screening initiatives for school-aged children. Where such programs are present, they frequently suffer from inadequate funding or poor execution. Logistical obstacles may include a shortage of qualified workers, insufficient follow-up procedures, and restricted access to affordable eyewear. Cultural and socioeconomic considerations exacerbate the issue; in certain groups, children who wear glasses may encounter stigma or ridicule, deterring them from utilizing prescribed eyewear even post-diagnosis.

Technological innovations and mobile health efforts have commenced addressing several of these difficulties by enhancing the accessibility and scalability of vision screening. Smartphone-based vision assessments, community outreach initiatives, and teleophthalmology have surfaced as effective instruments, especially in resource-constrained environments. For these interventions to be genuinely effective, they must be incorporated into national health and education policies, supported by sufficient financing and public awareness initiatives.

This review aims to consolidate existing data on the prevalence of refractive errors in primary school children, investigate related risk factors, and emphasize optimal approaches for screening and therapy. By comprehending the magnitude and extent of the issue, stakeholders—including healthcare practitioners, educators, politicians, and parents—can undertake educated measures to guarantee that every child get the visual care they require. Ultimately, rectifying refractive defects in children transcends mere vision correction; it constitutes an investment in their academic achievement, psychological health, and future potential.

The frequency of refractive defects among elementary school children constitutes a substantial, albeit preventable, health concern with extensive ramifications. Due to the simplicity of diagnosis and treatment, there is a pressing necessity for regular vision screening initiatives, especially in educational institutions, to facilitate early detection and intervention. This study is to deliver a thorough analysis of current research on the occurrence of refractive errors in school-aged children and to endorse strategic measures that ensure clear vision for all children, irrespective of socio-economic status or geographic location.

Types and Distribution of Refractive Errors

Refractive errors in children often encompass three primary categories: myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. Each category of refractive error has distinct traits, developmental patterns, and therapeutic implications, particularly with early childhood vision screening. Comprehending these disparities is crucial for analyzing epidemiological data and executing suitable screening and intervention techniques.



Myopia (Nearsightedness): Myopia is a condition where parallel light rays entering the eye converge in front of the retina when accommodation is relaxed. This leads to impaired distance vision. Myopia typically arises from an extended axial length of the eyeball or an excessively bent cornea or lens.

Age of Onset:

Myopia typically begins to manifest between the ages of 6 and 12, often worsening during adolescence. Early-onset myopia, especially before the age of 10, is more likely to progress to high myopia in adulthood, which can be associated with serious ocular complications such as retinal detachment and glaucoma.

Prevalence Trends:

Numerous studies have shown a dramatic increase in the prevalence of myopia among schoolchildren in recent decades, especially in urban and high-income settings. For example:

- In East Asia, studies report myopia prevalence rates as high as 40% in children aged 6–12 years.
- In India, myopia prevalence among primary school children ranges from 7% in rural areas to over 20% in urban private schools.
- In the United States and Europe, the prevalence of myopia is estimated to be around 10–15% in children aged 6–12.

Risk Factors:

The rise in myopia prevalence has been attributed to multiple modifiable and non-modifiable factors, including:

- Genetics: A child with one or both myopic parents has a higher likelihood of developing myopia.
- Near work: Prolonged reading, writing, or screen use has been positively correlated with early onset and progression.
- Lack of outdoor exposure: Studies suggest that children who spend more time outdoors (at least 2 hours per day) have a lower risk of developing myopia, possibly due to higher light exposure and distance vision engagement.

Clinical Implications:

Uncorrected myopia can severely impact a child's ability to see the blackboard, play sports, or recognize distant objects, directly affecting educational performance and social interaction. Early detection through vision screening programs is crucial to prevent academic underperformance and progression to high myopia.

Hyperopia (Farsightedness)

Definition and Mechanism:

Hyperopia is a condition in which light rays focus behind the retina, often due to a shorter axial length of the eye. In mild cases, the child may still see clearly due to accommodation (focusing ability of the lens), but this can cause visual fatigue and headaches.

Age of Onset and Progression:

Hyperopia is often present at birth and tends to decrease as the eye grows. Many children experience physiological hyperopia in early childhood that resolves spontaneously during emmetropization—a process through which the eye grows to reduce refractive error naturally.

Prevalence Trends:

- Hyperopia is more commonly reported in younger children (ages 5–7) and tends to decrease by age 12.
- Studies show hyperopia prevalence ranges from 5% to 15%, depending on the population.
- In the UK, hyperopia has been reported in approximately 14% of children aged 6–7 years.
- In India, hyperopia prevalence is generally lower (2–5%) but varies with region and socioeconomic status.

Risk Factors:

Hyperopia does not show strong associations with lifestyle factors like near work or screen time. Instead, its prevalence is more influenced by age and ocular development.

Clinical Implications:

While mild hyperopia often goes unnoticed, moderate to high hyperopia can lead to accommodative strain, blurred near vision, and even strabismus (eye misalignment) or amblyopia (lazy eye) if left uncorrected. Children with high uncorrected hyperopia may struggle with reading, have reduced attention spans, and show signs of visual fatigue.

Astigmatism

Definition and Mechanism:

Astigmatism occurs when the cornea or lens has an irregular curvature, causing light to focus on multiple points in or around the retina rather than a single sharp point. This results in distorted or blurred vision at both near and far



distances.

Types:

- Regular astigmatism (most common) follows a predictable axis and can be corrected with cylindrical lenses.
- Irregular astigmatism is less common and usually results from eye disease or trauma.

Prevalence Trends:

- Astigmatism is reported in 3% to 7% of primary school-aged children.
- It often coexists with myopia or hyperopia.
- For example, a study by Pavithra et al. (2013) in southern India found that 4.7% of children aged 7–12 had astigmatism.

Age and Ethnic Variability:

- Astigmatism may be more prevalent in early childhood and tends to stabilize by late adolescence.
- Some studies suggest higher prevalence among certain ethnic groups, such as East Asians and Hispanics, though the causes are not fully understood.

Clinical Implications:

Astigmatism can impair both near and distance vision and may lead to symptoms such as headaches, squinting, and eye strain. It is a common contributor to refractive amblyopia, especially when uncorrected during the early developmental years.

Mixed and Compound Refractive Errors

Children may often present with compound or mixed refractive errors, where combinations of myopia, hyperopia, and astigmatism coexist. For instance:

- Compound myopic astigmatism: Both principal meridians are myopic.
- Mixed astigmatism: One meridian is myopic while the other is hyperopic.

These conditions require careful diagnosis and precise optical correction, especially during early schooling years when the visual system is still developing.

LITERATURE REVIEW

Tanmay Srivastava, Aalok Kumar et al. (2024) The study investigated the prevalence of refractive errors among school-aged children in urban and rural areas, concluding that myopia is the most prevalent refractive error in the 6-15 year age group. Our research emphasizes the necessity of routine screening for children in educational institutions, as undiagnosed refractive problems can result in amblyopia. This study was localized; therefore, a population survey on the prevalence of refractive errors among school-aged children throughout various regions of India could provide further insights into this subject.

Priyank kumar Patel,Heena Pannalal Kalasva et al. (2023) This study on the prevalence and determinants of refractive errors in school children highlights the need of recognizing and mitigating avoidable risk factors linked with refractive errors. It functions as a mechanism to enhance awareness among children, parents, and, importantly, educators, who are vital in influencing a child's academic and behavioral growth. This research underscores the need of regular and appropriate eyewear usage, as it can enhance children's ocular health and general well-being.

Elizabeth Joseph, Meena CK et al. (2022) Conducted a study on the prevalence of refractive errors among school-aged children in a multistate investigation in India, revealing that the prevalence and progression of myopia in childhood have been extensively examined and constitute a focal point of rigorous research due to their considerable health implications, including vision impairment from uncorrected myopia and ocular pathology associated with high myopia. 22 The prevalence of myopia is influenced by its definition, geographical location (e.g., rural versus urban), and the type of refraction (such as cycloplegia to mitigate accommodation-induced myopia). This study classified myopia in two ways: as spherical equivalent (SE) and as spherical ametropia, with a threshold of at least -0.50 D for each. A recent study conducted among schoolchildren in Tamil Nadu, utilizing a criterion of spherical equivalent (SE) of at least -0.75 D and including a comparable age range of 5 to 16 years, revealed a myopia prevalence of 12%. This is fivefold greater than the prevalence of spherical ametropia in the current study. A potential explanation for this disparity is that the prevalence of myopia is greater in Tamil Nadu compared to other states. The incidence of myopia was markedly elevated in Tamil Nadu and Kerala compared to the other states examined.

V R Ande, R K Peeta at al. (2015) a study was conducted on the prevalence of refractive errors among schoolchildren in a rural setting, concluding that vision impairment owing to refractive errors is more prevalent among school-aged children. The majority of the children were oblivious to their issue, resulting in a significant prevalence of undiagnosed



refractive defects. Vision screening for schoolchildren can be a straightforward and extremely successful method for identifying these disorders. Affordable corrective services must follow this.

DISCUSSION AND CONCLUSION

The significant occurrence of undiagnosed refractive errors in primary school students poses a public health issue. School-based visual screening programs have demonstrated efficacy in the early identification of these problems. Insufficient access to ophthalmic care, a deficiency of awareness among parents and educators, and socio-economic obstacles exacerbate the issue. Recent trends indicate that environmental and behavioral variables, particularly among urban schoolchildren, significantly contribute to the increasing prevalence of myopia.

Refractive errors are common in elementary school students and can remain undiagnosed in the absence of regular screening. This analysis emphasizes the critical necessity for routine vision assessments in educational institutions, parental education, and policies that advocate for children's ocular health. A collaborative strategy incorporating educators, healthcare professionals, and lawmakers is crucial to properly tackle this escalating issue.

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