Narrative Review

Paediatric Myopia in Pakistan and its Readiness for Control–A Narrative Review

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ABSTRACT

This narrative review was conducted to provide evidence on paediatric myopia in Pakistan, and its risk factors, and readiness for myopia control. A search was conducted using PubMed and PakMediNet with terms that combined "Pakistan" with "myopia," "refractive error," "school screening," "atropine," "orthokeratology," and "myopia control." The studies indicate a substantial burden, including a 54% prevalence among adolescents in Karachi. Reported risk factors include increased near work, poor sleep quality, parental myopia, screen exposure, and reduced outdoor activity. Pakistan's readiness for myopia control is limited due to the training gaps, inadequate monitoring, inconsistence practice, and cost barriers. Effective myopia control in Pakistan needs a multifaceted approach. Expanding prevention and detection capabilities and then a national effort on legislation and guidance, funding, work force training, and access to interventions.

Keywords: Myopia, Refractive Errors, Child, Adolescent, Vision Screening, Atropine, Risk Factors, Pakistan.

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INTRODUCTION

Myopia has become a major challenge for eye health globally in the 21st century.[1] It is predicated that by 2050 half of the world's population could suffer from myopia. 10% of them would be categorised as high myopia. This would then increase the risks of complications such as retinal detachment, maculopathy, glaucoma, and visual impairment.[2] The earlier the myopia begins in childhood the more years of progression and therefore increasing the chances of high myopia in adulthood.[3]

Pakistan has a large youth population and is undergoing rapid urbanisation with a growing digital footprint. This alongside its academic pressures and social landscape make myopia a significant issue.[4] Nonetheless, national screening and monitoring is limited and unevenly distributed across the country. Some eye health and screening programmes in schools have been launched, which are led by teachers and supported by smart devices. These do show promise for large scale application.[4,5] Interventions to control myopia and its progression rather than just correcting refractive error, require more groundwork. This requires easy access to management options, monitoring systems, devices, and national guidelines.[3,4,5]

This review synthesises report on paediatric myopia in Pakistan, looking at its risk factors and appraises a national readiness to implement modern myopia control in the clinical setting.

METHODS

A narrative review was conducted to evaluate the available evidence regarding myopia in Pakistan. Relevant studies, school screening program evaluations, clinical surveys, and published reports were reviewed. A narrative review approach was adopted because of the heterogeneity of the available

literature, including variations in study designs, methodologies, and outcome definitions.

Structured searches were conducted in PubMed and PakMediNet, along with key organizational reports related to child eye health program in Pakistan. Search terms included combinations of "Pakistan" with "myopia" or "refractive error," and "children," "adolescents," or "school." Additional searches included terms such as "school eye health," "screening programs," "Peek" or "mHealth" initiatives, and myopia control interventions including "atropine" and "orthokeratology." Reference lists of included articles and relevant program reports were also hand-searched to identify additional relevant literature.

Studies conducted in Pakistan that involved patients under ≤18 years and reported myopia prevalence, refractive error patterns, or related risk factors were included. School eye health screening programmes, implementation studies, clinician surveys on myopia control, and relevant global guidelines or high-quality systematic reviews were also considered. Adult- only studies were excluded unless directly relevant to workforce capacity or service readiness, and non-Pakistan paediatric epidemiology studies were excluded unless used for the global context. The process is summarised in Figure 1.

Findings were synthesised thematically into three domains: epidemiology and burden; risk factors; and national readiness, including health system capacity, workforce preparedness, service delivery, and equity considerations.

The literature that is available on paediatric myopia in Pakistan is limited and varies in its methodology. Many studies are from schools and focus on urban areas. They have inconsistent refraction techniques and case definitions. This hampers the ability to compare across studies. The lack of surveys using cycloplegic refraction that are nationally representative further limits the accuracy of estimation of prevalence across Pakistan. Furthermore, existing evaluation focus on screen and referral outcomes rather than looking at the long-term impact and progression of myopia. There is limited published data on the availability and cost of myopia control interventions across the country.

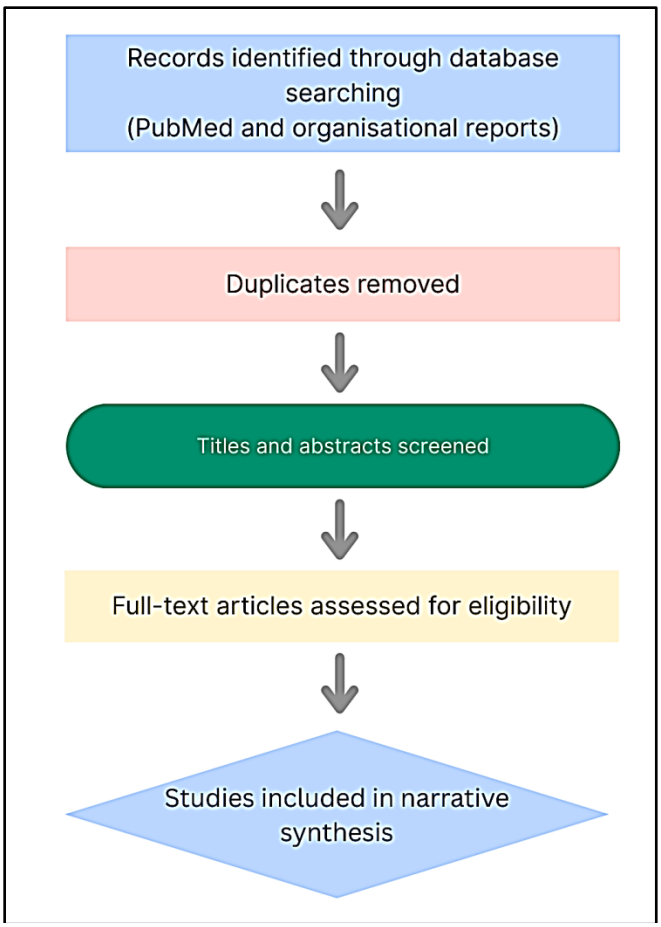

Figure 1: Methodology flowchart used for the literature search and study selection process in the narrative review.

Epidemiology of Paediatric Myopia in Pakistan

One of the challenges when assessing epidemiology is the difficulty and limitations when comparing available studies. The studies on paediatric myopia are school based and that excludes children who are not in school attendance. They could differ in their socioeconomic status and their access to health.[3,4] Mostly the studies are conducted in the cities where there are different educational demands and use of digital devices.[3,4,5] This potentially could lead to an under representation of demographic groups that live outside urban areas.

Furthermore, some studies are based on different types of screening or refraction methods hindering the direct comparison of prevalence.[4,5]The differences in methods can lead to an overestimation of myopia due to accommodative spasm. As a result, there is a lack of country wide data that is representative of cycloplegic refraction. The available data should be considered

Table 1: *Key Epidemiological Studies on Paediatric Myopia in Pakistan.*[3,4,5]

Study	Location	Study Design	Sample Size	Age Group	Key Findings
Cross-sectional adolescent myopia study	Karachi	School-based cross-sectional	335	10–16 years	Myopia prevalence reported at 54%
Public school refractive error study	Lahore	School screening study	533	Secondary school students	Refractive errors are present in ~20% of students; myopia accounts for most cases.
High school refractive error survey	Lahore	Cross-sectional school study	1000	Adolescents	Refractive errors are present in 24.4%; myopia represented majority of the cases.

indicative of myopia burden and not the exact prevalence nationally.

School and Facility Based Study Evidence

Despite the issues with methodology, evidence of available studies consistently points towards refractive errors as a significant health concern amongst the school children in Pakistan. Out of which Myopia is found to be the substantial proportion of cases.[4,5] A school-based study in the city of Lahore showed prevalence of refractive errors as 20%, with myopia being found in 60% of the cases.[4] Similarly, another study from Lahore reported refractive errors in 24.4% of students and myopia accounting for over 50% of the cases.[5]

A cross-sectional study of adolescents reported myopia prevalence of approximately 54%.[3] While this estimate may reflect differences in study design, sampling methods, and refractive techniques, it indicates the possibility of a substantial burden of myopia among urban Pakistani adolescents. These findings are consistent with global trends showing increasing myopia prevalence among schoolchildren, especially in cities and populations exposed to intensive educational demands.[1,2] These results show that myopia is the most common refractive error amongst the school children and adolescents according to the Pakistani school-based studies. The results are summarised in Table 1.

Overall, these data suggest that paediatric myopia is an emerging public health concern in Pakistan. Given Pakistan's large youth population and increasing educational and digital exposure, the burden of childhood myopia is likely to rise in the coming decades if preventive and control strategies are not implemented.

Paediatric Myopia Risk Factors

Genetic susceptibility affects the development of childhood myopia. Parental myopia is recognised as one of the strongest indicators of its onset. A meta-analysis has shown that children with one myopic parent face a markedly higher risk of developing myopia.[6] The risk increases further when both parents are myopic. These results imply that both genetic and environmental factors contribute to the development of myopia.

Some school-based studies showed that children with myopia had a positive family history of spectacles use.[4,5] Supporting the influence of genetics and environment on developing refractive errors. Identifying children with positive family history of myopia provide an opportunity of early risk assessment, monitoring, and treatment of high-risk groups. This can be done by school screening programmes.

Near work activities such as reading and writing have shown to be an environmental risk factor for myopia development.[7] A systematic review and meta-analysis revealed that increased near work activities showed a link with increased risk of myopia in children and adolescents.[7]Similarly, a cross-sectional study of adolescents in Karachi showed that increased time spent studying was associated with myopia.[3]

Digital screen exposure has become an increasingly significant factor in myopia risk, mainly because it is associated with prolonged near work and less time spent outdoors. A recent systematic review and dose–response meta-analysis found that each additional hour of daily screen time was linked to about a 21% rise in the odds of developing myopia.[8] The relationship also seemed to follow a nonlinear pattern, with evidence indicating that the risk rises sharply beyond relatively low daily exposure levels. In Pakistan, use of digital devices has grown rapidly in recent years, and children are increasingly using these devices for both education and entertainment. Therefore, including guidance on healthy screen habits in school eye health programmes and paediatric counselling can be a practical and expandable approach for reducing myopia progression.

Outdoor time has repetitively shown to be linked to a decreased risk of myopia.[9] A Cochrane systematic

Table 2: *Major Risk Factors for Paediatric Myopia Relevant to Pakistan.*[3,6,7,8,9,10]

Risk Factor	Type of Evidence	Key Findings
Parental myopia	Meta-analysis	Children with one or two myopic parents have an increased risk of developing myopia.
Near work	Systematic review and meta-analysis	Prolonged reading and writing associated with higher odds of myopia
Digital screen exposure	Dose–response meta-analysis	Each additional hour of daily screen time is associated with increased odds of myopia.
Reduced outdoor exposure	Evidence synthesis and systematic reviews	Increased outdoor time reduces the risk of myopia onset
Sleep patterns	Cross-sectional study	Poor sleep quality is associated with a higher likelihood of myopia

Table 3: *Myopia Control Interventions Summarised.*[2,9,10,11,12]

Intervention	Mechanism	Evidence	Applicability in Pakistan
Low-dose atropine	Pharmacologic reduction of axial elongation	Demonstrated effectiveness in slowing myopia progression	Potentially scalable with appropriate prescribing protocols
Orthokeratology	Corneal reshaping produces peripheral myopic defocus	Shown to slow myopia progression	Limited by cost and specialist fitting requirements
Defocus spectacle lenses	Peripheral retinal defocus modification	Clinical trials demonstrate a reduction in progression	Availability and cost may limit widespread use
Increased outdoor activity	Environmental protective effect	Associated with reduced myopia onset	Highly scalable through school-based policies

review further supported that outdoor activities could help prevent the onset of childhood myopia.[10] The possible reason is outdoor light and reduced accommodative burden. Promoting outdoor activities and sunlight exposure can be a cost-effective strategy to tackle myopia in Pakistan. However, its implementation maybe difficult due to varied infrastructure, environmental challenges, and resources at school. National guidelines should take into consideration the local challenges when being applied.

Sleep patterns have also been shown to influence the development of myopia. A study conducted among adolescents in Karachi reported that poor sleep quality was associated with a 1.6-fold increased risk of developing myopia.[3] These findings suggest that sleep hygiene may contribute to myopia development and should be considered in national myopia prevention and control guidelines.

Urbanization has been consistently associated with a higher risk of myopia worldwide. Urban settings often involve greater educational demands, prolonged near work, increased digital device use, and reduced outdoor activity, all of which are recognized risk factors for myopia development.[1,2] In Pakistan, most epidemiological studies have been conducted in urban school populations, which may partly explain the higher reported prevalence of myopia in certain groups.[3-5] Socioeconomic factors, including differences between private and public schooling, educational expectations, and financial status, may further influence myopia risk through their effects on academic pressure, screen exposure, outdoor time, and access to eye care services.

Relationship of the mentioned risk factors demonstrate an association but do not prove direct causation. This can be due to the multi-faceted cause rather than a single risk factor. Table 2 summarises the risk factors for paediatric myopia in Pakistan.

Myopia control can be achieved by reducing axial elongation which needs a proactive management approach. Importance of early identification in childhood and using interventions to slow its development and progression cannot be overemphasized.[9,10] The myopia control guidelines recommend early risk assessment, prompt management and long term follow up of childhood myopia.[2]Strategies to control myopia include increasing outdoor exposure, reducing near work, and moderating digital device use.[2]

Evidence shows that low dose atropine usually 0.01% can slow myopia progression in children.[11]A quasi-experimental study from Pakistan found that low dose atropine (0.01%) significantly reduced myopia progression when compared to the placebo.[12]Higher concentrations such as 0.025% and 0.05% may offer greater effectiveness but carry more side effects.[11] Therefore currently 0.01% is used as a balance between effectiveness and a tolerable side effect

profile.

Ortho keratology lenses, dual focus or peripheral defocus lenses and defocus-incorporated multiple segment (DIMS) specialised glasses are examples of some optical solutions.[2] These approaches aim to modify the retinal defocus which reduces the stimuli causing axial elongation. However, it is challenging to implement them in the low- and middle-income countries. Cost, non-availability of specialised lenses, limited expertise in fitting and monitoring and lack of education are some of the hurdles in its way.

Table 3 summarises the interventions in myopia control.

National Readiness for Myopia Management

National readiness refers to Pakistan's healthcare systems capacity to delivery effective myopia care. This includes early screening and detection, referral pathways from primary to secondary care, treatments, monitoring progression, and follow-up. To examine readiness the existing health infrastructure, healthcare delivery platforms, capacity, accessibility of the interventions and national guidelines must be explored. This is summarised in Figure 2.

Pakistan has some national eye programmes for controlling avoidable blindness. These programmes have focused on strengthening workforce capacity, expanding service delivery, and improving access to eye care nationwide.[13] Child eye health programmes have benefited from collaborations with non-governmental organisations and international partners, which have supported school-based screening programmes, training initiatives, and community awareness activities.[14,15] These efforts have established a solid foundation for developing and executing more extensive strategies for myopia control.

School-based eye health programmes are among Pakistan's most effective platforms for detecting visual issues in children. Integrated school eye health programs have been suggested as efficient approaches to address uncorrected refractive errors and facilitate the large-scale implementation of screening programmes in schools.[16] Teacher-led vision screening efforts have shown that teachers can be trained to identify children with visual impairments and refer them for further evaluation, boosting early detection of refractive errors.[17]

Digital health technologies have been integrated into school screening programmes. Smartphone-based visual screening tools, such as the Peek system, have been tested in districts of Punjab, including Chakwal and Layyah, demonstrating the capability for screening, referral, and follow-up of children with suspected visual impairment.[18] Large-scale child eye health schemes, through partnerships with non-governmental organisations, have aimed to screen about 1.2 million school children, train teachers, and provide spectacles.[14] These projects imply that Pakistan has a relatively secure foundation for large-scale detection of refractive errors among school children. However, most existing screening programmes mainly focus on detecting reduced visual acuity and providing spectacles for refractive correction. Myopia control requires additional steps beyond detection, including risk assessment, monitoring refractive change, starting therapeutic measures, and long-term follow-up. Clinical workforce and its capacity to implement management policies is an important factor for myopia control. A national survey of eye care in Pakistan which included ophthalmologist and optometrist found that there was awareness about management but some knowledge gaps and discrepancies in clinical practice.[19] The survey found that many physicians only start treating myopia when annual progression rates become relativity high (over 1.0 D per year). This is not in line with international recommendations.[2,19] Axial length monitoring was not routinely used in myopia monitoring which was due to lack of availability of equipment reflecting a deficit in health infrastructure and delivery.

Equitable access to healthcare remains a concern in Pakistan. Disparities are present due to socioeconomic status, geographic locations, and the healthcare system itself. Even in areas where refractive correction is available there remain many barriers to limit its access. These barriers include cost of glasses, limited follow up and shortage of practitioners in certain areas. Furthermore, the additional challenges in Pakistan are the availability of advanced optical interventions such as orthokeratology and specialised defocus lenses. Despite these barriers, Pakistan has been trying to improve delivery of eye care services through its school screening and glasses distributions programmes where possible and funding allows.[14,15] Extending these programmes to include myopia would help reduce the disparities and increase access and reduce overall myopia burden.

Without a national clinical standard in Pakistan, there is variation in practice and leads to disparity in treatment and patient outcomes. Strengthening governance and policies would be an essential step to help implement effective myopia control. Starting by developing standardised definitions and measurement protocols which include cycloplegic refraction and axial length monitoring. Finaly vigorous data systems are essential to track myopia with incidence rates, progression, and treatment progress. This would identify gaps, monitor successful interventions, and help plan policies and services based on nationally collected data.

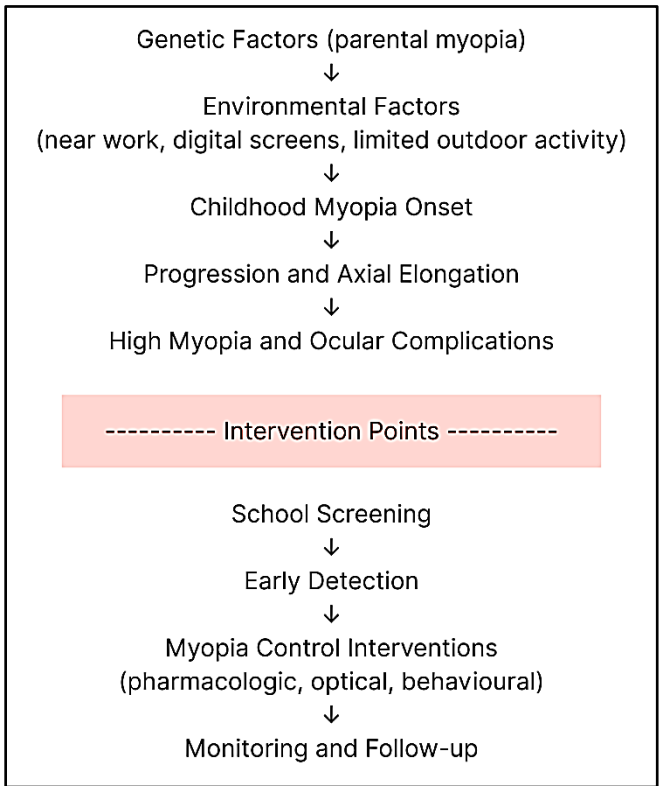

Figure 2: Framework of myopia development and control.[2,6,7,8,9,10,11]

DISCUSSION

Evidence suggests that paediatric myopia is heading towards becoming public health concern in Pakistan, especially in the cities. It is hard to get an accurate and exact prevalence due to methodology weaknesses, differences in sampling and non-cycloplegic refraction. Studies from schools in Lahore have repeatedly shown myopia as the most common refractive error.[4,5] This combined with increased near work and digital device use across all school children in urban areas, has led to rising myopia rates globally.[1,2]

Despite this growing concern there is evidence to suggest that early identification and prevention is a possible option for Pakistan. It has a strong school screen infrastructure which includes teacher led screening initiatives and mobile health technologies. These can help refer children for further assessment showing that it is achievable.[16,17,18] However, the existing eye health school programme focuses on detection of visual impairment and then providing glasses for correction.

Improving national readiness for myopia would need a coordinated action from government and healthcare systems. A practical national roadmap could involve improved data collection to help understand epidemiology in Pakistan. Accurate eye exams including axial length and refractive error monitoring would help understand its prevalence and track trends. Further research on how cost-effective different management strategies are such as atropine and optical lenses or glasses and environmental changes, can help guide national policy.

Changes in timetables to add outdoor time, having breaks in the timetable from screens and near work plays important role in prevention. Developing referral pathways from schools to help identify high risk children and facilitate earlier intervention.

In addition to the above strategies, national clinical guidelines need to be developed in line with international recommendations. Equitable policies should be central to the national myopia strategy. Without clear consideration myopia interventions may only be available to wealthier families in the bigger cities. Expanding this to include affordable myopia treatments can help lower income groups to benefit too. Incorporating risk stratification in training programmes as a standard across the nation can help monitor and enhance the workforce readiness for myopia management.

CONCLUSION

Pakistan has an increasing incidence of paediatric myopia, which has become the most common type of refractive error in school children. However, Pakistan's readiness for modern myopia management in line with international standards is limited by gaps in clinician training, lack of proper equipment

(monitoring axial length and cycloplegic refraction), varied treatment practices and finally unequal access to management options. A national multifaceted effort is required to address these gaps by establishing a national policy to slow down myopia progression.

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Conflict of Interest: Authors declared no conflict of interest.

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