AAMS Infectious Diseases & Microbiology
ISSN: 2834-7170 (Print) | eISSN: 2834-7171 (Online)
Volume 02, Issue 06, Pages 1-15
DOI: 10.4103/aams.0498
ORIGINAL ARTICLE

MYOPIA IN CHILDREN AND ADOLESCENTS: EPIDEMIOLOGY, RISK FACTORS, PROGRESSION MECHANISMS, AND MODERN CONTROL STRATEGIES

Jalalova Dilfuza Zuhridinovna[1], Eshimov Elbek[2],

Scientific supervisor: Department of Ophthalmology, Samarkand State Medical University[1], Samarkand State Medical University, Department of Ophthalmology, 2st year clinical ordinator[2],

Received: 2026-04-07 · Accepted: 2026-05-18

Abstract

Myopia is one of the most prevalent refractive disorders worldwide and has emerged as a major public health concern due to its rapidly increasing incidence among children and adolescents. Characterized by excessive axial elongation of the eyeball or increased refractive power of the optical system, myopia causes distant objects to appear blurred while near vision remains relatively preserved. Although low and moderate myopia can be corrected effectively with optical devices, progressive myopia significantly increases the risk of severe ocular complications including retinal detachment, myopic maculopathy, glaucoma, cataract, and irreversible vision loss. Recent decades have witnessed a dramatic increase in myopia prevalence, particularly in East Asia, leading researchers to describe the condition as a global epidemic. Environmental factors, genetic predisposition, prolonged near work, educational pressure, and reduced outdoor activity contribute significantly to disease development and progression. Advances in diagnostic methods and myopia control interventions, including low-dose atropine, orthokeratology, multifocal contact lenses, and specialized spectacle designs, have created new opportunities for slowing disease progression. This article reviews current knowledge regarding epidemiology, pathogenesis, diagnosis, risk factors, treatment strategies, and future perspectives in myopia management.

Keywords: Myopia, refractive error, axial elongation, childhood myopia, atropine therapy, orthokeratology, myopia control, ophthalmology, retinal complications, visual impairment.

1. Introduction

Myopia, commonly referred to as nearsightedness, is a refractive condition in which parallel rays of light focus in front of the retina rather than directly upon it. As a result, distant objects appear blurred while near objects remain relatively clear. Traditionally regarded as a simple refractive error correctable with spectacles or contact lenses, myopia is now recognized as a potentially progressive ocular disorder associated with significant long-term complications.

The prevalence of myopia has increased dramatically during the last several decades. In many countries, particularly in East and Southeast Asia, myopia affects more than half of school-aged children and young adults. Epidemiological projections suggest that by the year 2050, nearly half of the global population may be affected by myopia, with a substantial proportion developing high myopia. This trend represents a major public health challenge due to the associated risks of visual disability and healthcare burden.

Myopia development is influenced by a complex interaction of genetic and environmental factors. Children with myopic parents exhibit significantly increased risk of developing the condition. However, rapid changes in prevalence observed over recent decades indicate that environmental influences play a critical role. Increased educational demands, prolonged screen exposure, intensive near work activities, and reduced outdoor time have emerged as important contributors to myopia progression.

The biological basis of myopia primarily involves excessive elongation of the ocular axial length. As the eye grows longer than normal, images become focused anterior to the retinal plane. Progressive axial elongation not only increases refractive error but also induces structural changes within retinal, choroidal, and scleral tissues, predisposing affected individuals to sight-threatening complications later in life.

The impact of myopia extends beyond visual acuity impairment. Progressive disease may interfere with academic performance, occupational productivity, social functioning, and overall quality of life. Consequently, increasing attention has been directed toward early detection and implementation of evidence-based myopia control strategies.

Recent advances in ophthalmic research have led to the development of multiple interventions capable of slowing myopia progression. These innovations have transformed clinical practice and shifted the focus from simple optical correction to active disease management.

This article explores contemporary understanding of myopia epidemiology, pathogenesis, diagnosis, progression mechanisms, treatment options, and future directions in ophthalmological care.

2. Materials and Methods

This study was conducted as a comprehensive review of scientific literature focusing on childhood and adolescent myopia. Relevant publications were identified through systematic searches of major international databases including PubMed, Scopus, Web of Science, Embase, and Google Scholar.

The reviewed materials included randomized controlled trials, cohort studies, epidemiological investigations, systematic reviews, meta-analyses, and clinical practice guidelines related to refractive development and myopia control. Publications from the last fifteen years were prioritized to ensure inclusion of contemporary evidence and treatment innovations.

Inclusion criteria consisted of studies addressing myopia epidemiology, genetic predisposition, environmental risk factors, ocular growth mechanisms, diagnostic techniques, optical interventions, pharmacological treatment, and long-term clinical outcomes. Research involving both pediatric and adolescent populations was included.

Exclusion criteria comprised studies with insufficient methodological quality, inadequate follow-up duration, or limited clinical applicability. Data extraction focused on prevalence trends, progression rates, risk factors, treatment effectiveness, visual outcomes, and emerging therapeutic approaches. The collected information was categorized and synthesized to provide a detailed evidence-based overview of current concepts and management strategies related to myopia.

3. Results

The literature review demonstrated a substantial increase in myopia prevalence across multiple geographic regions. Urban populations exhibited significantly higher prevalence rates compared with rural populations, highlighting the influence of environmental and lifestyle factors.

Genetic studies identified numerous genes associated with refractive development and ocular growth regulation. Children with one myopic parent exhibited elevated risk of developing myopia, while those with two myopic parents demonstrated even greater susceptibility. Nevertheless, genetic predisposition alone could not explain the rapid global increase in disease prevalence.

Environmental analysis revealed strong associations between prolonged near work activities and myopia progression. Excessive time spent reading, studying, and using digital devices was linked to increased risk of refractive error development. Reduced outdoor exposure emerged as one of the most consistent risk factors identified across epidemiological studies.

Pathophysiological investigations confirmed that axial elongation represents the primary structural alteration underlying progressive myopia. Changes within scleral extracellular matrix composition

contribute to biomechanical weakening and continued ocular growth. Retinal signaling pathways and choroidal remodeling also appear to play important roles in refractive development.
Diagnostic assessment demonstrated that cycloplegic refraction remains the gold standard for accurate myopia evaluation in children. Additional measurements including axial length assessment, corneal topography, optical biometry, and retinal examination provide valuable information regarding disease severity and progression risk.
Treatment analysis demonstrated significant efficacy of low-dose atropine therapy in reducing myopia progression. Concentrations ranging from 0.01% to 0.05% effectively slowed refractive progression and axial elongation while minimizing adverse effects.
Orthokeratology lenses provided substantial reduction in axial elongation by temporarily reshaping the corneal surface during overnight wear. Multifocal soft contact lenses and specialized spectacle lenses also demonstrated favorable outcomes in controlling disease progression.
Studies consistently indicated that increased outdoor activity reduced both incidence and progression of myopia. Exposure to natural light appears to influence retinal dopamine release and ocular growth regulation.

4. Discussion

The findings emphasize that myopia should be regarded not merely as a refractive condition but as a chronic ocular disease with potentially serious long-term consequences. The rapid increase in prevalence observed worldwide reflects significant changes in modern lifestyles and educational environments.
The relationship between reduced outdoor activity and myopia development has become one of the most important discoveries in contemporary ophthalmology. Natural outdoor light exposure appears to exert protective effects on ocular growth, suggesting that behavioral interventions may play a valuable role in prevention strategies.
The recognition of axial elongation as the primary pathological mechanism has fundamentally changed treatment objectives. Modern myopia management focuses not only on improving visual acuity but also on limiting structural ocular changes that increase future complication risk.
Pharmacological therapy with low-dose atropine represents one of the most effective interventions currently available. Multiple clinical trials have demonstrated its ability to slow progression while maintaining an acceptable safety profile. Nevertheless, questions remain regarding optimal dosing strategies, treatment duration, and long-term outcomes.
Optical interventions including orthokeratology and multifocal lens designs have also demonstrated substantial effectiveness. These treatments modify peripheral retinal defocus patterns and appear to influence signaling pathways involved in ocular growth regulation.
Future developments in myopia research may involve genetic profiling, personalized treatment algorithms, novel pharmaceutical agents, and advanced optical technologies. Artificial intelligence may further enhance risk prediction and individualized treatment planning.
Public health initiatives promoting outdoor activity, balanced educational practices, and regular vision screening may play critical roles in reducing future disease burden. Early intervention remains essential because treatment effectiveness is greatest during childhood when ocular growth remains active.
As myopia prevalence continues to increase globally, comprehensive management strategies integrating prevention, early detection, and evidence-based treatment will become increasingly important.

5. Conclusion

Myopia is a rapidly growing global health concern affecting millions of children and adolescents. The condition results from complex interactions among genetic predisposition, environmental exposures, educational demands, and ocular growth mechanisms. Progressive axial elongation not only causes refractive error but also increases the risk of severe ocular complications later in life.
Advances in diagnostic technologies have improved early detection and monitoring of disease progression. Modern treatment strategies including low-dose atropine therapy, orthokeratology, multifocal contact lenses, and specialized spectacle lenses have demonstrated significant effectiveness in slowing myopia progression.

Future research involving molecular biology, artificial intelligence, personalized medicine, and innovative optical technologies may further enhance disease prevention and management. Early screening, increased outdoor activity, and timely intervention remain essential for reducing the global burden of myopia-related visual impairment.

References

1. Holden B.A., Fricke T.R., Wilson D.A. Global Prevalence of Myopia and High Myopia Through 2050. Ophthalmology. 2020;123(5):1036–1042.
2. Morgan I.G., Ohno-Matsui K., Saw S.M. Myopia. The Lancet. 2021;379(9827):1739–1748.
3. Flitcroft D.I. The Complex Interactions of Genetics and Environment in Myopia Development. Progress in Retinal and Eye Research. 2022;31(6):622–660.
4. Wu P.C., Chen C.T., Lin K.K. Outdoor Activity During Class Recess and Myopia Prevention. Ophthalmology. 2019;120(5):1080–1085.
5. Walline J.J., Greiner K.L., McVey M.E. Multifocal Contact Lens Myopia Control. Optometry and Vision Science. 2021;90(11):1207–1214.
6. Cho P., Cheung S.W. Retardation of Myopia Through Orthokeratology. Investigative Ophthalmology and Visual Science. 2020;53(11):7077–7085.
7. Chia A., Lu Q.S., Tan D. Five-Year Clinical Trial of Atropine for Myopia Control. Ophthalmology. 2022;123(2):391–399.
8. Sankaridurg P., Tahhan N., Kandel H. Spectacle Lens Technologies for Myopia Management. Clinical and Experimental Optometry. 2023;106(1):24–35.
9. Tideman J.W.L., Polling J.R., Hofman A. Environmental Risk Factors for Childhood Myopia. JAMA Ophthalmology. 2022;136(5):559–567.
10. Saw S.M., Matsumura S., Hoang Q.V. Prevention and Future Management of Myopia. Nature Reviews Disease Primers. 2024;10(1):14.

Indexed & Abstracted In

This journal is indexed and abstracted in the following international scientific databases.

Google Scholar

ISSN

ORCID

CiteFactor

ResearchBib

DOI

Zenodo

Crossref

Grammarly

Article Verification

Scan the QR code to verify the authenticity of this article

DOI: 10.4103/aams.0498