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ORIGINAL ARTICLE

THE IMPACT OF MYOPIA ON VISUAL HEALTH AND QUALITY OF LIFE: MODERN APPROACHES TO PREVENTION, DIAGNOSIS, AND MANAGEMENT

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Abstract

Myopia is one of the most widespread refractive conditions affecting the human visual system and has become an important public health concern because of its increasing prevalence among children, adolescents, and young adults. The condition occurs when the optical power of the eye is excessive in relation to its axial length, causing light from distant objects to focus in front of the retina rather than directly on it. Although conventional spectacles and contact lenses can provide effective visual correction, myopia should not be regarded only as a refractive inconvenience. Progressive and especially high myopia can be associated with structural changes of the eye and an increased risk of retinal detachment, myopic macular degeneration, glaucoma, and other sight-threatening complications. Current evidence indicates that the global burden of myopia is increasing and that preventive strategies should begin before substantial progression occurs. This article examines the major causes and risk factors of myopia, its influence on visual function and quality of life, contemporary diagnostic approaches, and evidence-based strategies for prevention and management. Particular attention is given to increased outdoor activity, reduction of excessive near-work exposure, optical myopia-control interventions, orthokeratology, and low-concentration atropine. The article also discusses the importance of regular eye examinations, individualized treatment selection, patient adherence, and long-term monitoring. A comprehensive approach that combines early detection, environmental modification, appropriate optical correction, and clinically supervised myopia-control treatment may reduce the individual and societal consequences of progressive myopia.

Keywords: myopia, myopia progression, refractive error, axial length, visual health, quality of life, myopia control, atropine, orthokeratology, outdoor activity, eye examination, high myopia.v

1. Introduction

Myopia, commonly known as short-sightedness, is a refractive condition in which distant objects appear blurred while near objects can usually be seen more clearly. From an optical perspective, the primary problem is that parallel rays of light entering the eye are focused in front of the retinal plane when accommodation is relaxed. This optical imbalance is commonly associated with excessive axial elongation of the eye. The condition may develop during childhood and frequently progresses during school years and adolescence, although changes can also occur during early adulthood. Because the visual system develops rapidly during childhood, the age at which myopia begins is clinically important. Earlier onset generally provides a longer period during which refractive error can progress, potentially resulting in a higher final degree of myopia.

The worldwide epidemiological situation has made myopia more than an individual optical problem. A major global analysis based on 145 studies and approximately 2.1 million participants estimated that 1.406 billion people were myopic in 2000 and projected that the number could reach approximately 4.758 billion by 2050, representing nearly half of the global population. The same analysis estimated a substantial increase in the number of people with high myopia. (PubMed) More recent International Myopia Institute publications continue to characterize myopia as a major public health issue and emphasize the need for prevention and evidence-based management. (Myopia Institute -)

The development of myopia is multifactorial. Genetic susceptibility contributes to an individual's risk, but environmental and behavioral factors are also important. Increased educational demands, prolonged near work, limited exposure to outdoor light, urban living, and changes in children's daily activities have all been investigated as potential contributors. The relationship between these factors is complex, and no single cause explains the development of myopia in every patient. Therefore, modern management increasingly focuses on identifying children at elevated risk and modifying factors that can reasonably be changed.

The clinical significance of myopia depends not only on the refractive error itself but also on its magnitude and progression. Low or moderate myopia can often be corrected effectively, allowing patients to function normally in school, work, and daily activities. However, high and progressive myopia may be associated with elongation of the globe and pathological changes in ocular tissues. These changes can increase the probability of serious complications later in life. The International Myopia Institute emphasizes that myopia affects visual function, education, psychosocial well-being, quality of life, and economic productivity. (Myopia Institute -)

For these reasons, the objective of modern myopia care is no longer limited to improving visual acuity with spectacles. The broader goal is to preserve long-term ocular health, slow abnormal axial growth when appropriate, maintain functional vision, and reduce the probability of future complications. This requires cooperation between ophthalmologists, optometrists, parents, teachers, researchers, and patients.

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2. Materials and Methods

This article was prepared as a narrative scientific review of contemporary evidence concerning the epidemiology, risk factors, diagnosis, prevention, and management of myopia. Scientific literature was reviewed with particular attention to peer-reviewed clinical trials, systematic reviews, consensus reports, and clinical guidance published by internationally recognized ophthalmological and optometric organizations. The literature search focused on publications addressing childhood myopia, myopia progression, axial elongation, outdoor exposure, optical interventions, orthokeratology, pharmacological treatment, and quality-of-life outcomes.

The main evidence sources included PubMed-indexed scientific publications and International Myopia Institute reports. Priority was given to randomized controlled trials and systematic evidence when evaluating interventions. Important methodological considerations included participant age, baseline refractive error, duration of follow-up, changes in spherical equivalent refraction, changes in axial length, treatment adherence, adverse effects, and quality-of-life outcomes. The International Myopia Institute recommends that clinical myopia-control research should evaluate refractive error and/or axial length as primary outcomes while also considering patient-reported outcomes and treatment compliance. (PubMed)

The diagnostic component of the review considered clinical assessment of visual acuity, objective and subjective refraction, cycloplegic refraction when clinically indicated, ocular health examination, and measurement of axial length. Axial length is particularly valuable in monitoring progression because myopia development in children is frequently associated with elongation of the eye. The use of standardized clinical measurements improves the ability to distinguish true progression from short-term variation in refractive measurements.

The prevention and treatment literature was evaluated according to the strength and consistency of available evidence. Behavioral approaches were considered alongside optical and pharmacological interventions because current evidence suggests that myopia management is most effective when treatment decisions are individualized according to age, progression rate, risk factors, ocular characteristics, and patient preferences.

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3. Results

The review demonstrates that myopia represents a growing global challenge with consequences extending beyond blurred distance vision. Epidemiological projections indicate a substantial increase in both ordinary and high myopia during the first half of the twenty-first century. The projected increase in high myopia is particularly important because greater degrees of axial elongation are associated with a higher lifetime risk of ocular pathology. (PubMed)

The analysis also indicates that myopia is influenced by a combination of hereditary and environmental factors. A family history of myopia can increase susceptibility, particularly when one or both parents are myopic. Nevertheless, genetic predisposition does not mean that progression is unavoidable. Environmental exposure and daily behavior may modify the probability and rate of myopic development. This observation provides an important basis for preventive interventions during childhood.

One of the most consistently supported behavioral approaches is increasing time spent outdoors. A systematic review and meta-analysis of randomized controlled trials found evidence supporting outdoor activity as a preventive measure against the development of myopia in children. The review included five randomized controlled trials involving 3,014 participants. (PubMed) Outdoor exposure may influence ocular growth through several biological mechanisms, including the effects of light intensity and retinal signaling pathways. Although outdoor time should not be presented as a guaranteed method of preventing all cases of myopia, it is a relatively accessible behavioral strategy with broader health benefits.

Near work is another factor frequently discussed in relation to myopia. Reading, writing, prolonged use of digital devices, and other activities performed at short viewing distances may contribute to visual stress and may be associated with myopia risk in susceptible children. However, the relationship is not sufficiently simple to conclude that near work alone causes myopia. A more reasonable preventive approach is to encourage appropriate working distance, regular visual breaks, adequate lighting, and a balanced daily routine that includes outdoor activity.

The results of clinical research indicate that myopia-control interventions can slow progression in appropriately selected children. Optical approaches include specially designed spectacle lenses, myopia-control soft contact lenses, and orthokeratology. Pharmacological treatment, particularly low-concentration atropine, has also demonstrated clinically meaningful effects in several randomized trials. The International Myopia Institute classifies interventions into optical, pharmacological, behavioral, and surgical categories and emphasizes that the quality of evidence should guide clinical recommendations. (Myopia Institute -)

Low-concentration atropine has received substantial research attention. In the LAMP randomized clinical trial, 0.05%, 0.025%, and 0.01% atropine concentrations reduced myopia progression and axial elongation compared with placebo during the first year, with the 0.05% concentration demonstrating the greatest effect among the tested concentrations. (PubMed) Longer-term evidence is also important because myopia management often continues for several years. Five-year LAMP follow-up showed that continued 0.05% atropine treatment provided good control of progression, while many children required retreatment after treatment cessation. (PubMed) These findings indicate that treatment discontinuation should be monitored rather than assumed to be permanently successful.

Orthokeratology is another established myopia-control strategy. It involves specially designed rigid gas-permeable contact lenses worn during sleep to temporarily reshape the cornea, allowing acceptable daytime vision without conventional daytime correction. Clinical research has shown that orthokeratology can reduce axial elongation in appropriately selected children. Combination treatment has also been investigated. A randomized clinical trial involving children with myopia found that combining 0.01% atropine with orthokeratology could provide greater control of axial elongation than orthokeratology alone over two years. (PubMed)

More recent evidence continues to explore combination therapy. A 2025 systematic review and meta-analysis of randomized controlled trials reported that low-concentration atropine combined with orthokeratology reduced axial elongation more than orthokeratology alone, although treatment decisions must still consider individual patient characteristics and safety requirements. (PubMed)
The results further demonstrate that appropriate correction remains essential even when myopia-control treatment is being used. A child whose refractive error is inadequately corrected may experience difficulties with classroom learning, sports, social interaction, and everyday visual tasks. Myopia management should therefore distinguish between correction of existing refractive error and control of future progression. These are related but different clinical objectives.

4. Discussion

The findings demonstrate that myopia should be approached as a long-term ocular condition rather than simply as a need for stronger spectacles. The distinction is especially important in children because the eye can continue to elongate for years after myopia first becomes clinically apparent. Every additional diopter of myopia may increase the long-term burden associated with high refractive error, making early recognition and appropriate intervention important components of preventive eye care.
The impact of myopia on quality of life can occur at several levels. The most immediate effect is reduced distance vision without correction. Children may have difficulty reading classroom boards, recognizing faces at a distance, participating in outdoor activities, or performing visually demanding tasks. Adults may experience limitations in driving, occupational activities, sports, or other situations requiring clear distance vision. The psychosocial effects should also be considered because some individuals experience discomfort, self-consciousness, or practical difficulties associated with spectacles or contact lenses. The International Myopia Institute identifies quality of life, education, visual impairment, and economic productivity among the major areas affected by myopia. (Myopia Institute -)
High myopia is of particular concern because it is associated with structural changes in the posterior segment of the eye. Progressive axial elongation can stretch the retina, choroid, and other ocular tissues. In advanced cases, patients may develop pathological changes such as myopic macular degeneration, retinal tears or detachment, glaucoma, and other complications that can lead to permanent visual impairment. Therefore, reducing the progression of myopia during childhood may have significance that extends well beyond the period of school-age visual development.
The growing evidence for myopia-control treatment changes the clinical philosophy of care. Historically, the primary response to increasing myopia was simply to prescribe a stronger optical correction. Modern management asks an additional question: can the rate of progression be reduced? This shift has resulted in the development of specialized spectacle lenses, contact lenses, orthokeratology, and pharmacological interventions. The International Myopia Institute has emphasized the importance of evidence-based clinical management and standardized outcome assessment in this evolving field. (PubMed)
Atropine illustrates both the potential and complexity of modern treatment. Higher concentrations may have stronger pharmacological effects but can produce more noticeable pupil dilation and accommodative effects. Lower concentrations generally have fewer visual side effects, although their effectiveness varies by concentration, age, population, and individual response. The five-year ATOM2 evidence demonstrated that 0.01% atropine could slow progression with relatively limited effects on pupil size and accommodation compared with higher concentrations. (PubMed) More recent LAMP evidence suggests that 0.05% may provide stronger long-term control for many children, emphasizing the need to select treatment according to the individual rather than applying a single concentration universally. (PubMed)
Combination therapy may be valuable for children whose myopia progresses despite a single intervention. Research involving atropine and orthokeratology suggests that combining treatments can improve control of axial elongation in selected patients. (PubMed) Nevertheless, combination treatment should not automatically be considered superior for every patient. Cost, adherence, access to care, possible adverse effects, contact-lens hygiene, and the child's ability to follow the treatment regimen must all be considered.
Prevention remains equally important. Encouraging children to spend regular time outdoors is a practical public-health strategy supported by randomized evidence. (PubMed) Schools and families can

contribute by creating daily routines that balance academic work, screen use, indoor activities, and outdoor exposure. Preventive education should focus on sustainable habits rather than unrealistic restrictions on reading or digital technology.

Another important issue is early detection. Children may not always recognize that their distance vision has deteriorated because myopic changes can occur gradually. A child may adapt by sitting closer to the board, narrowing the eyes, or relying on classmates for visual information. Regular vision screening and comprehensive eye examinations can identify myopia earlier and allow timely management. In children with suspected progression, monitoring both refractive error and axial length can provide a more complete picture of ocular growth.

Clinical decision-making should also take into account the patient's age and progression history. A younger child with rapidly increasing myopia and a strong family history may have a different risk profile from an older adolescent with stable low myopia. Treatment selection should therefore be individualized. The goal is not merely to achieve a temporary improvement in visual acuity but to reduce the likelihood of continued pathological ocular growth while maintaining comfortable and functional vision.

There are also limitations in the current evidence base. Studies differ in age ranges, ethnic populations, baseline refractive errors, follow-up periods, definitions of progression, and outcome measures. Results obtained in one population cannot necessarily be applied directly to every patient. Furthermore, some interventions require specialized equipment, trained practitioners, regular follow-up, or significant financial resources. Access to effective myopia management therefore remains unequal across countries and communities.

Future research should focus on identifying children at the highest risk of rapid progression, understanding the biological mechanisms controlling axial growth, improving individualized treatment selection, and evaluating long-term outcomes of combination therapies. Research should also examine patient-reported quality of life, treatment adherence, affordability, and real-world effectiveness rather than relying only on refractive outcomes. The continuing development of standardized clinical and research protocols is essential for comparing treatments accurately.

5. Conclusion

Myopia is an increasingly important global visual-health problem that affects not only distance vision but also education, psychosocial well-being, quality of life, and long-term ocular health. The growing prevalence of myopia and the projected increase in high myopia emphasize the need for early detection and effective prevention. (PubMed)

The modern approach to myopia management should combine accurate diagnosis, appropriate optical correction, regular monitoring, healthy visual behavior, increased outdoor activity, and evidence-based myopia-control interventions when clinically indicated. Low-concentration atropine, orthokeratology, and specially designed optical corrections have demonstrated potential to slow myopia progression, while combination therapies may provide additional benefits for selected patients. (PubMed)

However, no single intervention should be considered universally appropriate. The most effective strategy depends on age, refractive error, rate of progression, ocular characteristics, family history, treatment adherence, and access to professional care. Long-term monitoring remains essential because myopia can continue to change after treatment begins or after treatment is discontinued.

Ultimately, successful myopia management requires a shift from simply correcting blurred vision to protecting future visual health. Early identification, preventive education, evidence-based treatment, and continuous follow-up can help reduce the burden of progressive myopia and improve the quality of life of affected individuals. As the prevalence of myopia continues to increase, integrating myopia management into routine pediatric and primary eye care should become an important component of modern ophthalmic practice.

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