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Juvenile Myopia: The Silent Vision Understanding, Preventing, and Managing Childhood Myopia

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This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Juvenile myopia, a significant visual impairment characterized by blurred distance vision, is increasingly prevalent among Indian children. This review explores the multifactorial etiology of myopia, including genetic predisposition, environmental influences, and lifestyle factors such as prolonged near work and limited outdoor activities. The pathophysiology involves abnormal eye elongation driven by genetic and environmental factors, leading to refractive errors. Clinical manifestations include blurry distance vision, squinting, eye strain, and headaches, impacting academic performance and quality of life.

Emphasis on early detection, parental awareness, and adherence to treatment protocols is crucial in controlling myopia progression and preventing long-term complications such as retinal detachment, myopic maculopathy, and glaucoma. This review underscores the need for comprehensive public health strategies to address the growing burden of juvenile myopia in India.

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Juvenile myopia is rapidly becoming a significant public health concern in India, with increasing prevalence driven by lifestyle changes, urbanization, and academic pressures.
This systematic review aims to examine the prevalence, risk factors, and interventions for childhood myopia, with a focus on understanding the silent nature of this condition, identifying early prevention strategies, and outlining management techniques to curb its progression.

Keywords: Juvenile myopia; paediatric ophthalmology; silent vision.

1. INTRODUCTION

Juvenile myopia, commonly known as nearsightedness in children, has emerged as a significant concern in paediatric ophthalmology. This visual impairment, characterized by the ability to see nearby objects clearly while distant objects appear blurred, has witnessed a remarkable surge in prevalence over recent years. Understanding its implications and addressing this growing issue is vital for safeguarding the vision and well-being of our younger generations [1,2].

In an era dominated by digital screens and increasingly urbanized lifestyles, the incidence of juvenile myopia has soared to unprecedented levels. Studies from across the globe have reported an alarming increase in the number of children and adolescents affected by myopia [2]. This trend not only impacts the quality of life for these young individuals but also poses significant public health challenges for the future [3].

The importance of addressing juvenile myopia extends beyond mere vision correction. High myopia is associated with an increased risk of severe ocular complications later in life, including retinal detachment, myopic maculopathy, glaucoma, and early-onset cataracts [1]. Therefore, early detection, appropriate management, and potential prevention of myopia progression in children have become crucial areas of focus in pediatric eye care.

2. METHODS

A comprehensive search was conducted in PubMed, Medline, Embase, and other databases for peer-reviewed articles published between 1980 and 2023. Keywords included "juvenile myopia," "childhood myopia," "myopia prevention," and "myopia control." Only studies focusing on children aged 5 to 18 years were included. This review also incorporates global data, with a particular focus on high-prevalence regions such as East Asia, Europe, and urban India.

2.1 Definition

Juvenile myopia, often referred to as childhood or juvenile nearsightedness, is a refractive vision condition characterized by a person's ability to see nearby objects clearly while distant objects appear blurry. This occurs because the light entering the eye focuses in front of the retina instead of directly on it, causing distant images to be out of focus [4].

2.2 Types of Juvenile Myopia [1,5,6]

2.2.1 Simple myopia (Physiological Myopia)

- This is the most common type of myopia in children and adolescents.
- It occurs due to a mismatch between the length of the eye and its focusing power. The eye is usually longer than normal, causing light to focus in front of the retina.
- It is often hereditary and can be influenced by environmental factors such as prolonged close-up activities like reading or screen time.

2.2.2 High myopia (Pathological Myopia):

- This is a more severe form of myopia, where the refractive error is greater than -6.00 diopters.
- It is often associated with changes in the structure of the eye, such as excessive elongation of the eyeball.
- High myopia can increase the risk of other ocular complications, such as retinal detachment, glaucoma, and cataracts.

2.2.3 School myopia

- This type is associated with the educational demands placed on children, such as prolonged reading and studying.
- It usually begins during the early school years and progresses with age and educational activities.

2.2.4 Late-onset myopia

- This type of myopia develops later in childhood or during adolescence.
- It often progresses more slowly compared to early-onset myopia.

2.2.5 Night myopia

- Some children may experience myopia that is more pronounced under low-light conditions, causing difficulty in seeing distant objects at night.

2.3 Causes of Juvenile Myopia [7,5,3,6]

2.3.1 Genetic Factors

- **Family History:** Myopia often runs in families. Children with one or both parents who are myopic are at a higher risk of developing myopia themselves.
- **Genetic Predisposition:** Specific genes have been associated with eye growth and refractive errors, increasing the likelihood of myopia in some individuals.
- **As per recent research published states the Genes that impact myopia are GJD2 (Gap Junction Protein Delta2), SHISA6 (Shisa Family Member 6), LAMA1 (Laminin Subunit Alpha 1)**

2.3.2 Environmental factors

- **Prolonged Near Work:** Extended periods of activities requiring close focus, such as reading, writing, and screen use, are associated with an increased risk of developing myopia.
- **Limited Outdoor Time:** Spending less time outdoors during childhood is linked to a higher incidence of myopia. Exposure to natural light is thought to help regulate eye growth and reduce the risk of myopia.

2.3.3 Lifestyle factors

- **Education Level:** Higher levels of educational attainment and the associated near work are correlated with a greater prevalence of myopia.
- **Screen Time:** Increased use of digital devices, especially at close range, can contribute to the development and progression of myopia.
- Excessive screen time has been linked to attention problems, decreased cognitive development, and sleep disturbances.

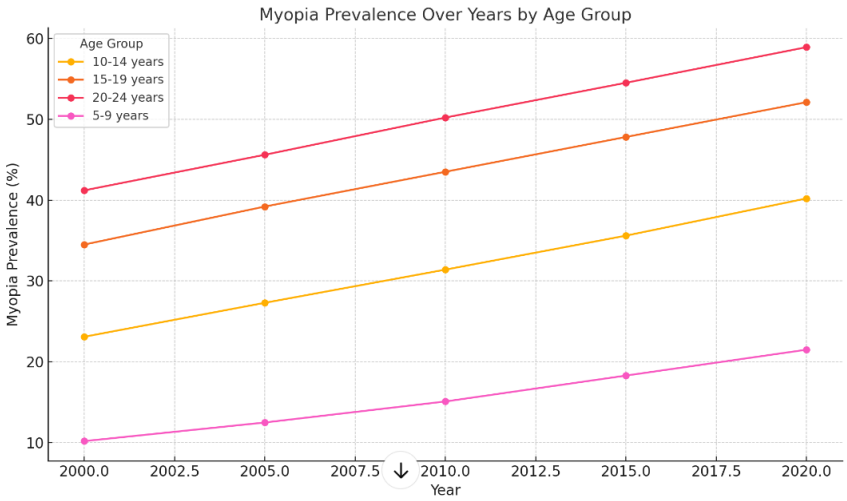


Fig. 1. Myopia prevalence by age group [3,2,8]

Table 1. Prevalence of Myopia in children

Year	10-14 years	15-19 years	20-24 years	5-9 years
2000	23.1	34.5	41.2	10.2
2005	27.3	39.2	45.6	12.5
2010	31.4	43.5	50.2	15.1
2015	35.6	47.8	54.5	18.3
2020	40.2	52.1	58.9	21.5

2.3.4 Cutoffs beyond which risks increase

- 2 hours per day: Increased risk of attention problems and decreased cognitive development in children.
- 4 hours per day: Increased risk of sleep disturbances and decreased melatonin production.
- 6 hours per day: Increased risk of obesity, decreased physical activity, and decreased social skills.

2.3.5 Biological factors

- **Eye Growth Patterns:** Abnormal eye growth patterns during childhood and adolescence can lead to myopia. This is often a result of the eye growing too long for the focusing power of the lens and cornea.
- **Accommodation and Convergence:** Excessive use of the eye's focusing (accommodation) and alignment (convergence) mechanisms during near work can contribute to myopia.

2.3.6 Potential contributing theories

- **Hyperopic Defocus Theory:** This theory suggests that when the eye is focused on close objects for long periods, the periphery of the retina experiences defocus, stimulating axial elongation and leading to myopia.
- **Retinal Defocus and Visual Feedback:** The eye grows in response to visual signals from the retina, and prolonged defocus (blurred vision) can lead to changes in eye shape and size.

3. PATHOPHYSIOLOGY

3.1 Pathophysiology of Myopia

3.1.1 Normal eye structure

- In normal vision, the eye has a balanced axial length, and light focuses precisely on the retina, leading to clear vision of both near and distant objects.

3.1.2 Genetic Factors

- **Family History:** Myopia often runs in families, with children of myopic parents being at higher risk.
- **Eye Growth Genes:** Specific genes influence eye development, contributing to abnormal elongation of the eye, a key feature of myopia [6,9].

3.1.3 Environmental Factors

- **Prolonged Near Work:** Activities such as reading, writing, and extensive screen use require sustained focus, which can contribute to eye strain and changes in eye growth.
- **Limited Outdoor Activity:** Less time spent outdoors and insufficient exposure to natural light are associated with a higher incidence of myopia in children [10].

3.1.4 Biological Mechanisms

- **Eye Growth Stimulation:** Both genetic predisposition and environmental factors can stimulate abnormal growth patterns in the eye, particularly elongation of the eyeball.
- **Retinal Signals:** The retina sends signals that regulate eye growth in response to the clarity or blur of visual images. Abnormal signaling can drive further eye elongation. [1]

3.1.5 Retinal Defocus

- **Peripheral Hyperopic Defocus:** When the peripheral retina receives blurred or defocused images, it may stimulate further elongation of the eyeball in an attempt to bring images into clearer focus.
- **Visual Feedback:** The retina provides feedback that influences the growth and shape of the eye, playing a crucial role in myopic progression [6].

3.1.6 Axial Length Elongation

- **Increased Axial Length:** The eyeball grows longer than normal, causing images to focus in front of the retina rather than directly on it.
- **Scleral Remodeling:** Changes in the structure of the sclera, the outer coat of the eye, involve alterations in collagen that contribute to elongation and increased eye size [7].

3.1.7 Refractive Changes

- **Corneal Curvature:** Changes in the curvature of the cornea can increase the eye's focusing power, worsening myopia.
- **Lens Thickening:** The lens may also contribute to increased refractive power,

causing further focus in front of the retina [5].

3.1.8 Myopia Development

- As the axial length of the eye increases, light rays focus in front of the retina, resulting in blurred vision when viewing distant objects [2].
-

3.1.9 Myopia Progression

- **Risk of High Myopia:** Progressive elongation of the eye increases the risk of developing high myopia, which is associated with additional ocular complications.
- **Complications:** These may include retinal detachment, glaucoma, and other vision-threatening conditions. [11].

3.2 Clinical Manifestation

3.2.1 Blurry distance vision

- The most prominent symptom of myopia, where distant objects appear blurry while near objects are seen clearly.
- Children may struggle to see the blackboard at school, distant signs, or objects across the room [12].

3.2.2 Squinting

- Children often squint their eyes in an attempt to improve focus on distant objects. Squinting temporarily reduces the size of the blurred image and can make distant vision clearer [4].

3.2.3 Eye Strain (Asthenopia)

- Eye strain is common, especially after prolonged near work like reading, writing, or using digital screens.
- Symptoms can include tired, aching eyes, and discomfort, especially when switching from near to distant vision [13].

3.2.4 Frequent Headaches

- Children with myopia may experience headaches, particularly after activities that require visual focus on distant objects.
- The strain on the eyes from trying to see clearly can lead to frontal or temporal headaches [7].

3.3 Difficulty Seeing the Board in School

- A common sign of juvenile myopia is difficulty reading or seeing the board in the classroom, often noticed by teachers or parents.
- This can negatively impact academic performance and may be one of the first indications of myopia.

Fig. 2. Pressure on eye

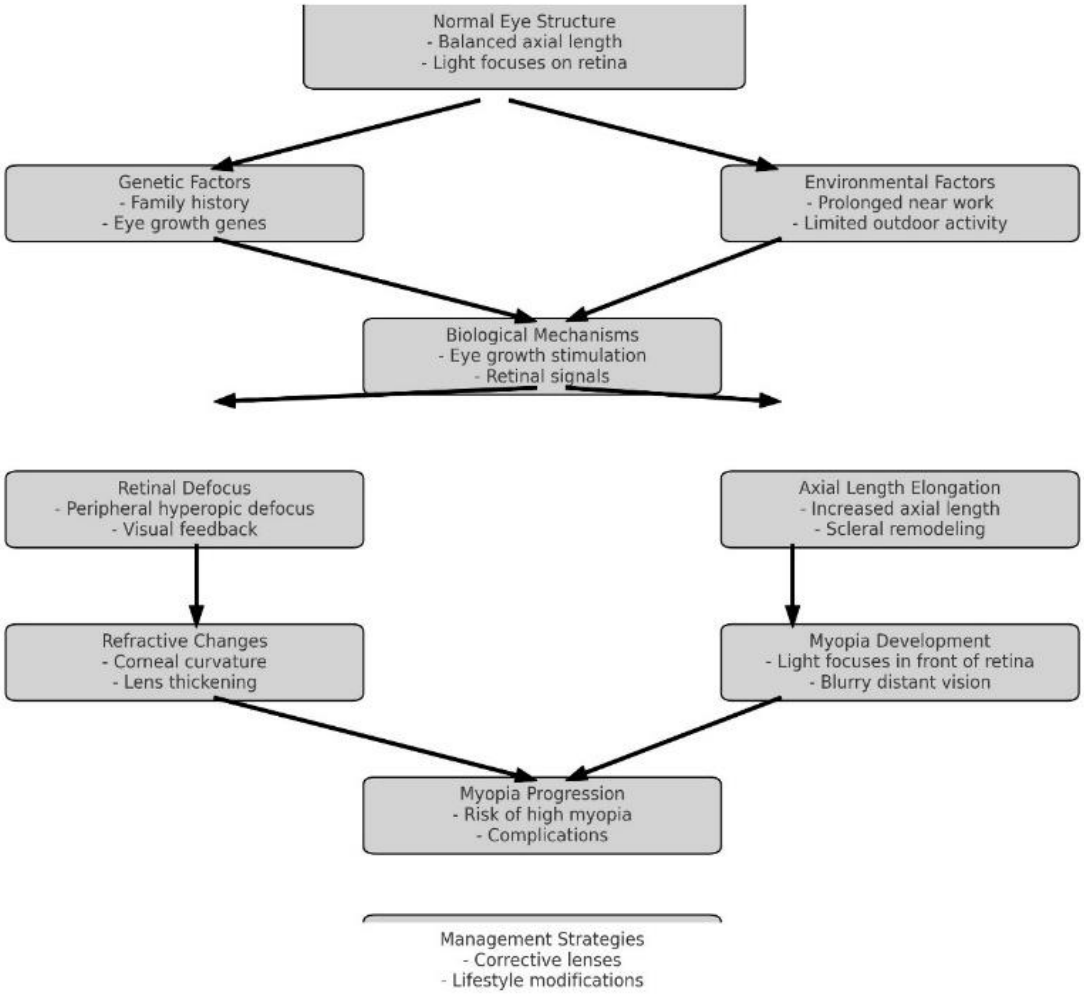


Fig. 3. Pathophysiology of Myopia

3.4 Sitting Close to the Television or Holding Books Close

- Children with myopia often sit very close to the TV or hold books unusually close to their face to see clearly.
- This behaviour helps to compensate for the blurred distance vision [3].

3.5 Frequent Rubbing of Eyes

- Children may frequently rub their eyes, a sign of eye strain or discomfort.
- This rubbing can be due to visual fatigue from trying to focus on distant objects.

3.6 Poor Night Vision (Nyctalopia)

- Some children with myopia may experience difficulty seeing in low-light conditions or at night.
- Poor night vision can exacerbate the effects of myopia and lead to complaints about vision in dim lighting.

3.7 Tendency to Blink Excessively

- Excessive blinking can be a compensatory response to clear blurred vision, especially

when trying to focus on objects at different distances [5].

3.8 Tilting or Turning the Head to See Better

- Children may develop the habit of tilting or turning their head to the side to see better, which might help them align their eyes better for focusing [13].

Outdoor Activities: Myopia can impact a child's ability to participate fully in outdoor activities or sports that require good distance vision.

Social and Psychological Impact: Children with myopia may feel self-conscious about wearing glasses or frustrated with their vision difficulties.

4. DIAGNOSTIC EVALUATION [14]

4.1 History Collection

- **Patient History:** Obtain a detailed history of visual symptoms, including blurry distance vision, squinting, eye strain, and difficulty seeing the board at school.
- **Family History:** Enquire about a family history of myopia or other refractive errors, as this increases the risk of juvenile myopia.
- **Lifestyle Factors:** Assess the child's reading habits, screen time, outdoor activity levels, and any reported difficulties with vision during specific tasks [1].

4.2 Visual Acuity Testing

- **Snellen Chart Test:** Measures how well the patient can see letters or symbols from a standard distance (usually 6 meters). A reduced ability to read smaller letters indicates myopia.
- **Near Vision Test:** Ensures that near vision is intact and primarily affected by distance tasks [15].

4.3 Refraction Test

- **Objective Refraction (Retinoscopy or Autorefraction): [courtesy: google]**

  - Retinoscopy: A manual method where a retinoscope shines light into the eye, and the reflection is observed to determine refractive error.
  - Autorefraction: A computerised device that automatically measures the eye's refractive error and provides a preliminary prescription [7].

4.4 Subjective Refraction

- Conducted by an optometrist using different lenses in a phoropter to refine the prescription based on the child's feedback about visual clarity.

4.5 Cycloplegic Refraction

- **Purpose:** Cycloplegic eye drops (e.g., atropine, cyclopentolate) temporarily paralyse the ciliary muscle, preventing accommodation (focusing). This allows for a more accurate measurement of the eye's true refractive state.
- **Indication:** Cycloplegic refraction is particularly useful in children, as they often accommodate during tests, potentially masking the true degree of myopia [5].

4.6 Ocular Alignment and Binocular Vision Assessment

- **Cover Test:** Evaluates eye alignment and detects any strabismus (eye misalignment), which can be associated with myopia.
- **Binocular Vision Tests:** Assesses how well the eyes work together, as myopia can sometimes affect convergence and other aspects of binocular vision [16].

4.7 Slit-Lamp Examination

- **Purpose:** A detailed examination of the anterior segment of the eye, including the cornea, lens, and anterior chamber, to rule out other conditions that may mimic or coexist with myopia.

Fig. 4. Stress factors

Fig. 5. Retinoscopy [courtesy: google]

4.8 Fundus Examination (Dilated Eye Exam)

- **Indirect Ophthalmoscopy:** After pupil dilation, the retina and optic nerve are examined for signs of myopia-related changes, such as peripheral retinal thinning, lattice degeneration, or myopic maculopathy.
- **Retinal Assessment:** Helps detect complications associated with high myopia, such as retinal tears or detachment.

4.9 Axial Length Measurement (Biometry)

- **Purpose:** Measures the length of the eyeball, as an increased axial length is the primary structural change associated with myopia.
- **Tools:** A-scan ultrasound or optical coherence biometry (IOL Master) are commonly used to assess axial length.

4.10 Keratometry and Corneal Topography

- **Keratometry:** Measures the curvature of the cornea, which contributes to the refractive power of the eye. Changes in corneal shape can affect myopia.
- **Corneal Topography:** Provides a detailed map of the corneal surface to detect irregularities that could influence the overall refractive error [17]

4.11 Additional Imaging (If Necessary)

- **Optical Coherence Tomography (OCT):** Can be used for a detailed examination of the retina, particularly if complications such as myopic maculopathy are suspected.
- **B-scan Ultrasound:** Useful in cases of high myopia where the posterior segment cannot be clearly visualised due to media opacities.

4.12 Management of Juvenile Myopia

The management of juvenile myopia can be broadly divided into general, pharmacological, surgical, and nutritional strategies [1].

4.13 Corrective Lenses

Single-Vision Glasses: The most common method to correct myopia by focusing light directly onto the retina.
Contact Lenses: Including soft lenses for daily use and specialised lenses like Ortho-K for myopia control [6].

4.14 Orthokeratology (Ortho-K)

Overnight wear of rigid gas-permeable lenses that temporarily reshape the cornea, allowing for clear vision during the day without glasses or lenses [8].

5. MULTIFOCAL/BIFOCAL LENSES

Glasses or contact lenses with different zones for near and far vision to reduce eye strain and slow myopic progression.

5.1 Lifestyle Modifications

Increased Outdoor Activity: Encouraging outdoor play (at least 2 hours daily) helps delay the onset of myopia.

Reduced Near Work: Implementing breaks during prolonged near tasks, like the 20-20-20 rule (every 20 minutes, look at something 20 feet away for 20 seconds) [18].

5.2 Pharmacological Management

5.2.1 Atropine eye drops

Low-Dose (0.01% to 0.05%): Effective in slowing myopia progression with fewer side effects like photophobia and blurred near vision.
Mechanism: Reduces eye elongation by affecting retinal signals and accommodation.

Atropine eye drops have become a **frontline treatment** for managing the progression of juvenile myopia. Various clinical trials have demonstrated its ability to **slow myopic progression by 50-60%** in children aged 6 to 15 years. Low-dose atropine, particularly at concentrations of **0.01%**, has been found to be both effective and safe, with fewer side effects such as photophobia and near-vision blur compared to higher doses [17].

- **The ATOM (Atropine for the Treatment of Myopia) 1 and 2 trials** conducted in Singapore are two of the largest and most cited studies on this topic. ATOM1 found that 1% atropine reduced myopia progression significantly, while ATOM2 tested lower doses (0.5%, 0.1%, and 0.01%), showing that **0.01% was optimal** in slowing progression while minimizing side effects [19]
- **Pirenzepine Gel:** Less commonly used; reduces muscarinic receptor activity related to eye growth with fewer side effects than atropine.
- **Tropicamide Eye Drops:** Shorter acting but less effective compared to atropine; not widely used for myopia control [7]

5.3 Nutritional Management

5.3.1 Diet rich in antioxidants

Fruits and Vegetables: Diets high in vitamins A, C, E, and beta-carotene support overall eye health [7].

Omega-3 Fatty Acids: Found in fish, flaxseed, and walnuts, these are beneficial for retinal health and reducing eye strain [13].

5.4 Vitamin D

Adequate outdoor exposure and a diet rich in vitamin D may help reduce the risk of myopia progression [19].

5.5 Limiting Sugar Intake

High sugar diets can impact insulin levels, which may influence eye growth. Balanced nutrition is key to overall eye health.

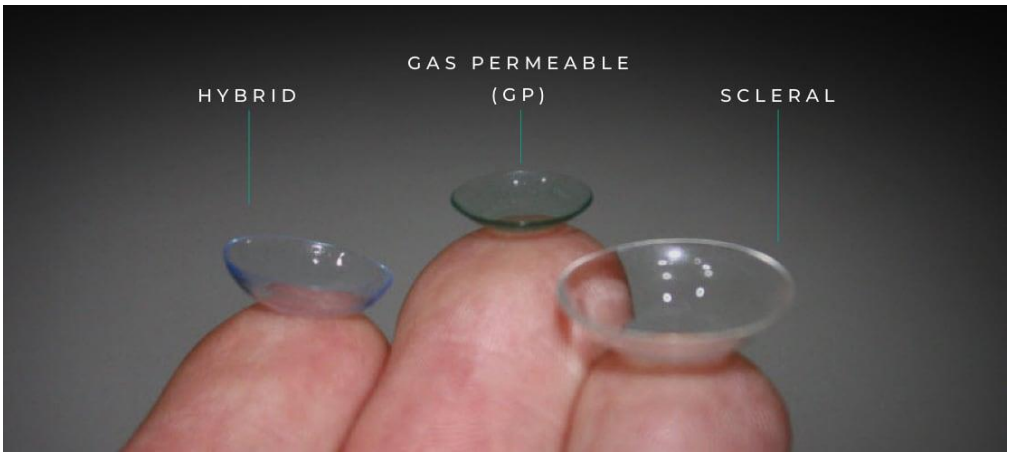
Fig. 6. Multi FOCAL glasses

Table 2. Advantage and disadvantages of corrective lenses [5,18,13,11]

Type of lens	Description	Advantage	Disadvantage
Single-Vision Glasses	Corrects distance vision only.	Easy to use, affordable.	No control over myopia progression.
Multifocal Glasses	Lenses with zones for near and distance.	Reduces strain, potential myopia control.	C an be difficult to adapt to initially.
Soft Contact Lenses	Corrects vision, worn directly on the eye.	Comfortable, better field of vision.	Requires maintenance and hygiene compliance.
Ortho-K Lenses	Worn overnight, reshapes cornea temporarily.	No need for glasses during the day, slows progression.	Requires consistent overnight wear.
Bifocal Contact Lenses	Different power zones for near and far vision.	Effective for myopia control.	Adaptation period required; more expensive.

Image courtesy; google

Fig. 7. Soft lens



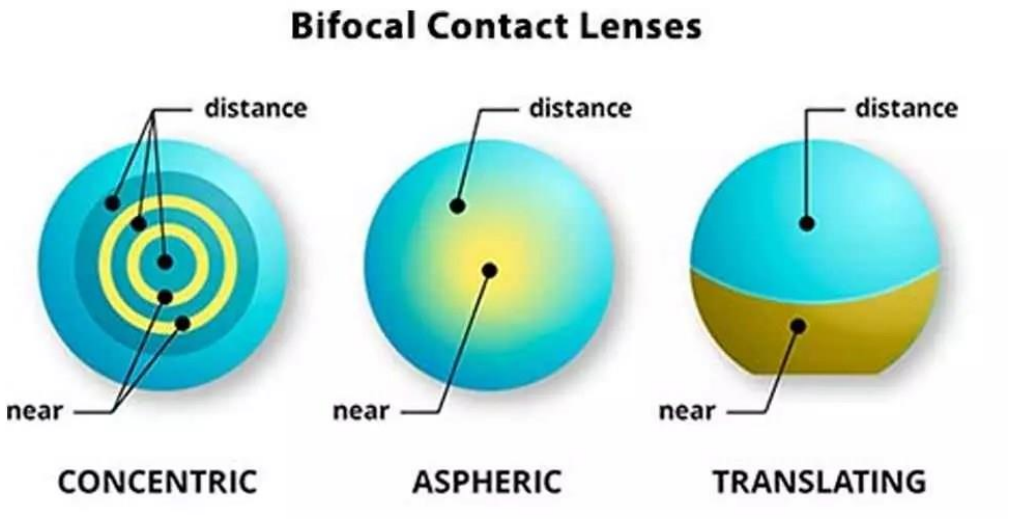


Fig. 8. Bifocal contact lenses

6. SURGICAL MANAGEMENT [5,18,11,20,6,10,14]

6.1 Laser Vision Correction (e.g., LASIK, PRK)

Not typically recommended for children due to ongoing eye growth but considered in severe or high myopia in adults.

Reshapes the cornea to correct refractive errors.

6.2 Implantable Collamer Lenses (ICL)

An option for patients unsuitable for laser surgery; involves inserting a lens inside the eye to correct vision.

Often used in high myopia cases where traditional laser surgery is not feasible.

6.3 Surgical Management Procedures for Myopia

While surgical interventions for myopia are generally reserved for adults, they may be considered in specific cases of severe or high myopia in older adolescents or adults. Here are the main surgical options available:

6.4 Laser Vision Correction (LASIK, PRK, LASEK)

6.4.1 LASIK (Laser-Assisted In Situ Keratomileusis):

- **Procedure:** A laser is used to create a thin flap in the cornea, which is lifted, and then the underlying corneal tissue is reshaped to correct the refractive error.
- **Benefits:** Rapid recovery, improved vision without glasses or contact lenses.
- **Indications:** Suitable for mild to moderate myopia and patients with stable refractive error.

6.4.2 PRK (Photorefractive Keratectomy):

- **Procedure:** The outer layer of the cornea (epithelium) is removed, and the underlying corneal tissue is reshaped using a laser.
- **Benefits:** An option for patients with thinner corneas; no flap creation.
- **Indications:** Mild to moderate myopia.

6.4.3 LASEK (Laser Epithelial Keratomileusis):

- **Procedure:** Similar to PRK but involves loosening the epithelial layer with alcohol before laser reshaping.
- **Benefits:** Suitable for patients with thinner corneas or higher myopia.
- **Indications:** Moderate myopia.

7. IMPLANTABLE COLLAMER LENS (ICL)

7.1 Procedure

- A biocompatible lens is implanted inside the eye, between the natural lens and the iris, without removing any corneal tissue.
- The ICL provides an additional lens to correct the refractive error.

7.2 Benefits

- Reversible procedure, excellent for high myopia or patients unsuitable for LASIK.
- Provides high-quality vision and can be adjusted or removed if necessary.

7.3 Indications

- High myopia, thin corneas, dry eyes, or other contraindications for laser surgery.

7.4 Refractive Lens Exchange (RLE)

7.4.1 Procedure

- Similar to cataract surgery; the natural lens is removed and replaced with an artificial intraocular lens (IOL) to correct the refractive error.
- Often considered when LASIK or ICL are not suitable options.

7.4.2 Benefits

- Effective for very high myopia or presbyopia.
- Can correct a broad range of refractive errors.

7.4.3 Indications

- Severe myopia, especially in older adults or those with early lens changes.

7.5 Preoperative Nursing Responsibilities

7.5.1 Patient assessment and education

- **Assessment:** Conduct a thorough history and physical examination, focusing on eye health, general medical conditions, and previous ocular surgeries.
- **Informed Consent:** Ensure the patient understands the procedure, risks, benefits, and potential complications.
- **Preoperative Instructions:** Educate the patient on fasting requirements if applicable, discontinuing contact lens use (to allow cornea to stabilise), and avoiding eye makeup or facial creams.

7.5.2 Preoperative eye preparations [6,9,5,18]

- **Medications:** Administer prescribed preoperative medications, such as antibiotic eye drops to reduce the risk of infection.
- **Eye Cleansing:** Clean the periocular area to minimize infection risk.

7.5.3 Anxiety management

- **Emotional Support:** Provide reassurance, address concerns, and answer questions.
- **Relaxation Techniques:** Offer relaxation techniques to help reduce preoperative anxiety.

7.5.4 Verification procedures

- **Site Verification:** Verify the correct eye for surgery, ensuring proper documentation.
- **Allergy Check:** Confirm any allergies, particularly to medications used during the procedure.

8. POSTOPERATIVE NURSING RESPONSIBILITIES [6,9,11,16]

8.1 Immediate Postoperative Care

- **Monitor Vital Signs:** Regularly check vital signs, including blood pressure, heart rate, and oxygen saturation.
- **Observation for Complications:** Monitor for signs of complications such as excessive tearing, pain, or visual disturbances.

8.2 Eye Care

- **Eye Protection:** Provide eye shields or goggles to protect the eye from accidental rubbing or injury.
- **Medication Administration:** Administer prescribed eye drops, including antibiotics and anti-inflammatory drops, as per the postoperative regimen.

8.3 Patient Education

- **Postoperative Instructions:** Educate the patient on proper eye drop administration, wearing eye protection, and avoiding activities that increase eye pressure (e.g., bending, heavy lifting).
- **Signs of Complications:** Instruct the patient on symptoms of potential complications such as severe pain, sudden vision loss, or increased redness, and advise on when to seek immediate medical attention.

8.4 Activity Restrictions

- **Rest and Activity Limitations:** Advise the patient to avoid strenuous activities, swimming, and contact sports for the recommended period.
- **Follow-Up Appointments:** Ensure the patient understands the importance of follow-up visits for monitoring recovery and adjusting the treatment plan as needed.

8.5 Pain Management

- **Pain Control:** Provide pain relief as needed, using oral analgesics if necessary, and ensure comfort during recovery.

8.6 Emotional Support

- **Supportive Care:** Provide emotional support, particularly if there are concerns about visual recovery.
- **Reassurance:** Reinforce positive outcomes and encourage adherence to postoperative care instructions for optimal results.

8.7 Nursing Responsibilities for Juvenile Myopia

Nurses play a critical role in the management of juvenile myopia, particularly in early detection, education, and supporting patients and their families. Below are the key nursing responsibilities:

8.8 Patient and Family Education

- **Education on Myopia:** Provide clear information to the child and parents about myopia, its causes, and its progression.
- **Corrective Lens Use:** Educate on the proper use, care, and maintenance of glasses or contact lenses to ensure they are worn consistently and effectively.
- **Encourage Outdoor Activities:** Advise parents to encourage at least 2 hours of outdoor play daily, which can help slow myopia progression.
- **Screen Time Management:** Educate about limiting screen time and implementing the 20-20-20 rule (every 20 minutes, look at something 20 feet away for 20 seconds) [18].

8.9 Promoting Adherence to Treatment

- **Medication Compliance:** For those on pharmacological treatments such as atropine eye drops, ensure understanding of proper administration, potential side effects, and adherence to the prescribed regimen.
- **Follow-Up Visits:** Emphasise the importance of regular eye examinations to monitor myopia progression and adjust corrective measures as needed.

8.10 Vision Screening and Early Detection

- **Routine Vision Screening:** Conduct vision screenings in schools or clinics to identify children at risk of myopia early.
- **Referral to Specialists:** Refer children with signs of myopia to an optometrist or ophthalmologist for a comprehensive eye examination.

8.11 Supporting Psychological Well-Being

- **Addressing Concerns:** Provide reassurance to children who may feel self-conscious about wearing glasses or having vision problems.
- **Encourage Participation in Activities:** Support involvement in regular activities, adjusting as needed to accommodate vision limitations without limiting participation.

8.12 Monitoring for Complications

- **Eye Health Monitoring:** Regularly assess for signs of eye strain, discomfort, or worsening vision, and ensure timely referral if complications arise.
- **Safety Measures:** Advise on protective eyewear during sports and activities to prevent eye injuries.

9. NURSING DIAGNOSIS

9.1 Nursing Diagnosis: Impaired Visual Perception Related to Refractive Error (Myopia)

Interventions:

- **Assess Visual Acuity:** Regularly monitor the child's vision using standard tests (e.g., Snellen chart) to assess the effectiveness of corrective lenses and identify any changes.

- **Ensure Proper Use of Corrective Lenses:** Educate the child and parents on the importance of wearing glasses or contact lenses consistently and maintaining them properly. Reinforce the need for prescription updates during follow-up visits.
- **Promote Environmental Adjustments:** Encourage the use of adequate lighting for reading and studying to reduce eye strain. Suggest positioning desks and screens to minimize glare.
- **Enhance Learning Environment:** Work with teachers to ensure the child sits in the front of the classroom or near the board to improve visual access to learning materials.
- **Teach Compensatory Strategies:** Instruct the child to use compensatory techniques, such as taking breaks during near work (20-20-20 rule), to minimize eye fatigue.

9.2 Nursing Diagnosis: Risk for Injury Related to Impaired Vision

Interventions:

- **Ensure Safety in Home and School:** Educate parents and caregivers on modifying the environment to reduce fall risks, such as keeping pathways clear and providing adequate lighting.
- **Protective Eyewear for Activities:** Advise the use of protective eyewear during sports or activities that pose a risk of eye injury, especially in children with myopia who are more vulnerable to eye trauma.
- **Supervise Outdoor Play:** Encourage supervised play and activities, particularly in unfamiliar or potentially hazardous environments where the child's vision may be challenged.

9.3 Nursing Diagnosis: Anxiety Related to Changes in Vision or Use of Corrective Lenses

Interventions:

- **Provide Emotional Support:** Offer reassurance and support to the child and parents, addressing concerns about wearing glasses or adapting to changes in vision.
- **Normalize the Use of Glasses:** Encourage acceptance by discussing the commonality of myopia and the benefits of glasses or contact lenses in enhancing vision and daily functioning.
- **Facilitate Peer Support:** Suggest participation in groups or activities where other children wear glasses, helping to reduce stigma and foster acceptance.

9.4 Nursing Diagnosis: Deficient Knowledge Related to Myopia Management

Interventions:

- **Educate About Myopia:** Provide clear information to the child and parents about myopia, its progression, and management options, including corrective lenses, lifestyle modifications, and pharmacological treatments.
- **Demonstrate Proper Medication Use:** If prescribed atropine or other eye drops, demonstrate the correct technique for administering the drops and discuss potential side effects.
- **Encourage Regular Eye Examinations:** Emphasise the importance of attending scheduled eye exams to monitor myopia progression and adjust treatments as needed.
- **Lifestyle Modifications:** Educate on the benefits of increased outdoor activities, reduced screen time, and ergonomic study environments to help control myopia progression.

9.5 Nursing Diagnosis: Risk for Impaired Social Interaction Related to Vision Problems

Interventions:

- **Support Social Participation:** Encourage the child to participate in social activities and sports that accommodate their visual limitations, promoting inclusion and interaction with peers.
- **Facilitate Adaptations in Activities:** Work with parents and coaches to adapt activities that require good vision, ensuring the child can still participate safely and confidently.
- **Build Self-Esteem:** Reinforce positive self-image by highlighting the strengths and abilities of the child beyond their vision issues.

9.6 Nursing Diagnosis: Risk for Complications Related to Progressive Myopia

Interventions:

- **Monitor for Symptoms of Complications:** Educate parents on signs of complications such as retinal detachment, including flashes of light, sudden vision loss, or increased floaters, and instruct them to seek immediate medical care if these occur.
- **Promote Adherence to Myopia Control Treatments:** Reinforce the importance of adhering to prescribed treatments like atropine drops, Ortho-K lenses, or other recommended interventions to slow myopia progression.
- **Ensure Timely Referrals:** Refer to an ophthalmologist for further evaluation and management if rapid progression or complications are suspected.

9.7 Complications of Juvenile Myopia

Juvenile myopia, if not adequately managed, can progress and lead to various complications, especially in cases of high myopia.

9.8 Retinal Detachment

- **Description:** Myopia increases the risk of retinal detachment, where the retina pulls away from the back of the eye. This occurs because the elongated eye can stretch and thin the retina, making it more susceptible to tears.
- **Symptoms:** Sudden flashes of light, a shadow or curtain over part of the visual field, and an increase in floaters (spots in vision).
- **Impact:** If not treated promptly, retinal detachment can lead to permanent vision loss.

9.9 Myopic Maculopathy (Myopic Macular Degeneration)

- **Description:** Degenerative changes in the macula (the central part of the retina responsible for sharp vision) due to excessive elongation of the eye. This condition can include atrophy, neovascularization (abnormal blood vessel growth), and bleeding.
- **Symptoms:** Distorted vision, central vision loss, and difficulty with activities requiring fine visual detail, such as reading or recognizing faces.
- **Impact:** Myopic maculopathy is a leading cause of vision impairment in high myopia and can significantly affect quality of life.

9.10 Glaucoma

- **Description:** Myopia is a risk factor for open-angle glaucoma, a condition characterized by increased intraocular pressure that damages the optic nerve.
- **Symptoms:** Often asymptomatic in the early stages but can lead to peripheral vision loss, tunnel vision, and eventually complete blindness if untreated.
- **Impact:** Early detection and management are crucial as glaucoma can cause irreversible vision loss.

9.11 Cataracts

- **Description:** Myopia is associated with an increased risk of early-onset cataracts, particularly posterior subcapsular cataracts that form at the back of the lens.
- **Symptoms:** Blurred vision, glare, halos around lights, and difficulty seeing in low-light conditions.
- **Impact:** Cataracts can further degrade vision, and surgery may be required earlier than usual.

10. PERIPHERAL RETINAL DEGENERATION

- **Description:** The peripheral retina may develop areas of thinning and degeneration, such as lattice degeneration, due to the stretching of the eye.
- **Symptoms:** Often asymptomatic but increases the risk of retinal tears and detachment.
- **Impact:** Regular monitoring is needed to prevent progression to more severe retinal issues.

11. PROLONGED EFFECTS IF JUVENILE MYOPIA IS LEFT UNTREATED

11.1 Progressive Vision Loss

- **Description:** Continued elongation of the eyeball can lead to worsening of

myopia, requiring increasingly strong corrective lenses.

- **Impact:** High myopia can lead to substantial vision impairment, affecting daily activities, education, and employment prospects.

11.2 Increased Risk of Ocular Diseases

- **Description:** High myopia is associated with an increased lifetime risk of developing ocular conditions such as glaucoma, retinal detachment, and maculopathy, as described above.
- **Impact:** These conditions can cause permanent vision loss if not detected and treated early.

11.3 Reduced Quality of Life

- **Description:** Visual impairment can limit a person's ability to perform everyday tasks, participate in activities, and maintain independence, particularly in severe cases.
- **Impact:** Psychological effects, including anxiety and depression, may arise due to the limitations imposed by poor vision.

11.4 Impact on Academic and Professional Performance

- **Description:** Children with untreated myopia may struggle in school due to difficulty seeing the board or reading from a distance, impacting their academic performance.
- **Impact:** Poor academic outcomes can affect future educational and career opportunities.

11.5 Health Education

1. Understand Myopia: Nearsightedness causes blurry distance vision; it often runs in families.
2. Watch for Signs: Squinting, sitting close to screens, and trouble seeing the board are common signs.
3. Get Regular Eye Exams: Early detection and regular check-ups help manage myopia effectively.
4. Use Corrective Lenses: Ensure your child wears glasses or contacts as prescribed.
5. Encourage Outdoor Time: At least 2 hours of outdoor play daily can slow myopia progression.
6. Limit Screen Time: Balance screen use with breaks (20-20-20 rule) to reduce eye strain [18]

11.6 As Per World Health Organization (WHO) Guidelines: [6]

- Children under 2 years: No screen time except for video chatting with family and friends.
- Children 2-4 years: Limit screen time to 1 hour per day.
- Children 5-18 years: Limit recreational screen time to 2 hours per day.

A longitudinal study from the **Sydney Myopia Study** demonstrated that children who spent more than **2 hours daily outdoors** had a significantly lower risk of developing myopia compared to those with less than 1 hour of outdoor exposure. The study emphasized the importance of **exposure to natural light** and the opportunity to focus on distant objects during outdoor activities [21].

The Avon Longitudinal Study also found that spending time outdoors between the ages of 3 to 9 was associated with a reduced incidence of myopia by ages 10 to 15. This effect was particularly pronounced in children who spent less time engaged in near work, such as reading or using digital devices [22].

7. **Healthy Diet:** Include fruits, veggies, and omega-3 rich foods to support eye health.
8. **Support Your Child:** Boost their confidence in wearing glasses; involve them in choosing frames.
9. **Recognise Warning Signs:** Sudden vision changes or flashes need immediate medical attention.
10. **Adhere to Follow-Up Visits:** Regular monitoring helps adjust treatment and manage progression.

12. RECENT RESEARCHES

Study aimed to predict the prevalence of myopia among urban Indian children and examine the generational impact over the next three decades. Using data from 1999 to 2019, the study highlighted a significant increase in myopia cases among 5-15-year-old children, rising from 4.44% in 1999 to 21.15% in 2019. The research predicts that if trends continue, the prevalence could reach 48.14% by 2050. Factors

contributing to this increase include urbanization, lifestyle changes, and higher educational pressures. The study emphasizes the need for nationwide public health strategies to address the growing myopia epidemic in India, similar to trends observed in East Asian countries [1].

This study assessed the awareness and attitudes of Indian parents regarding childhood myopia. It found that while parents recognized myopia as a common vision problem, there was limited awareness about its progression and available management strategies such as low-dose atropine drops and orthokeratology. The study emphasized the role of healthcare providers in educating parents on the importance of early intervention and lifestyle modifications to slow myopia progression. Enhancing parental knowledge can improve adherence to myopia control measures, ultimately reducing the burden of myopia in Indian children [23].

List 1. Preventive measure recommendation rationale supporting data [6]

Increased Outdoor Activities	At least 2 hours of outdoor play daily.	Exposure to natural light regulates eye growth and reduces the risk of myopia.	Sydney Myopia Study: lower myopia incidence.
Screen Time Management	Limit recreational screen time according to WHO guidelines: - Ages 0-2: No screen time - Ages 2-4: 1 hour/day - Ages 5-18: 2 hours/day	Prolonged screen time increases near work, which is associated with a higher risk of myopia.	WHO Guidelines, meta-analyses on screen time impact.
Ergonomic Study Habits	Follow the 20-20-20 rule: Every 20 minutes, take a 20-second break to look 20 feet away.	Frequent breaks reduce eye strain and prevent excessive elongation of the eye.	Eye care guidelines for reducing strain.
Balanced Near Work	Minimize prolonged close-up tasks like reading or digital device use.	Continuous near work is a risk factor for myopia, especially in children.	Longitudinal studies linking near work to myopia.
Proper Lighting	Ensure adequate lighting for reading and other near tasks.	Poor lighting leads to eye strain, which can exacerbate myopia development.	Studies on lighting and visual health.
Regular Eye Exams	Regular vision screenings, especially for high-risk children (e.g., with myopic parents).	Early detection allows timely intervention to slow myopia progression.	Ophthalmology best practices.
Parental Awareness	Educate parents about myopia risks and preventive strategies.	Awareness increases adherence to lifestyle changes and treatment, improving outcomes.	Public health campaigns on parental education.
Pharmacological Intervention	Low-dose atropine drops (in consultation with an eye specialist).	Atropine slows myopia progression by affecting retinal signals and reducing eye elongation.	ATOM1 & ATOM2 trials showing efficacy of atropine.

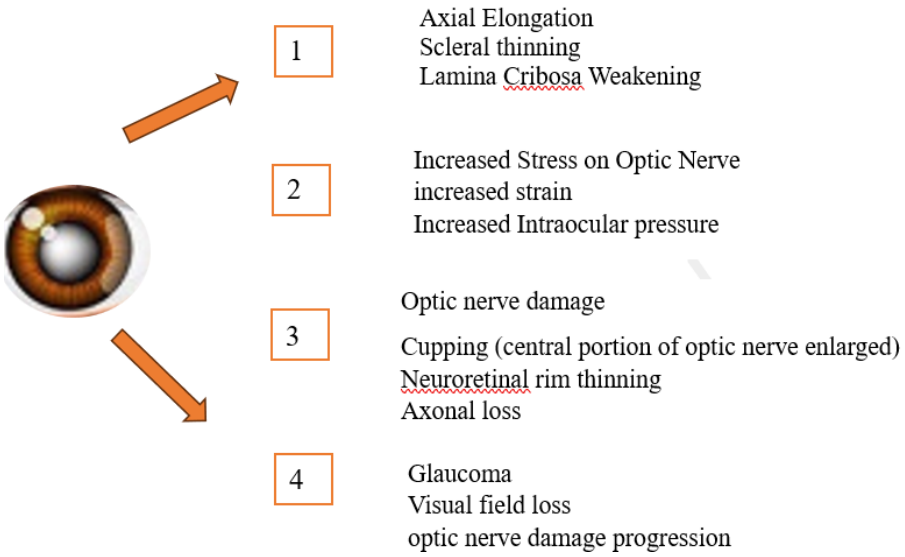


Fig. 9. Pathophysiology of Juvenile Myopia Leading to Glaucoma

Fig. 10. Health Education

This meta-analysis reviewed the prevalence and treatment strategies for myopia among Indian schoolchildren over the past four decades. It identified a significant increase in myopia prevalence, highlighting a need for improved management approaches. The study supports the use of evidence-based treatments such as low-dose atropine and lifestyle modifications to slow myopia progression. It also underscores the importance of integrating myopia control strategies into routine pediatric eye care, emphasizing that proactive treatment can mitigate future complications associated with high myopia [19].

A new, promising intervention in myopia control is low-level red light therapy (LLRLT). A 2021 study published in the British Journal of Ophthalmology showed that daily exposure to low-level red light for 3 minutes significantly slowed the progression of myopia in school-aged children. The treatment works by stimulating the retina, which may inhibit the excessive elongation of the eye. However, further studies are needed to confirm the long-term benefits and safety of this novel therapy. [24]

Research in South India explored the impact of gene variants like Membrane Frizzled-Related Proteins (MFRP) and VSX2 on the axial lengths of the eye, a key factor in myopia development. The study highlighted the variable influence of these genes on eye growth and myopia progression, suggesting that genetic susceptibility interacts with environmental factors [25].

A Prospective cohort study on Progression of Myopia in School-Aged Children After COVID-19 Home Confinement. To investigate the impact of home confinement during the COVID-19 pandemic on the progression of myopia in school-aged children.on School-aged children from primary schools in China. A total of 123,535 children aged 6 to 8 years. Visual Acuity Tests: Conducted to measure the degree of myopia. Questionnaires: Used to collect data on screen time, outdoor activities, and other lifestyle factors. Results stated Increased Myopia

Prevalence: The prevalence of myopia increased significantly from 36.7% in 2019 to 43.7% in 2020 among children aged 6 to 8 years. Screen Time: There was a notable increase in screen time during the home confinement period, which correlated with the progression of myopia. Outdoor Activity: Reduced outdoor activity was associated with a higher incidence of myopia progression. The study concluded that home confinement during the COVID-19 pandemic led to a significant increase in the prevalence of myopia among school-aged children. Increased screen time and reduced outdoor activities were identified as major contributing factors. Study recommended Implement strategies to reduce screen time and encourage outdoor activities among children.Consider interventions such as low-dose atropine eye drops, orthokeratology, and peripheral defocus contact lenses to manage myopia progression. Educate parents on the importance of regulating screen time and promoting outdoor activities for their children [26].

The Association Between Screen Time Exposure and Myopia in Children and Adolescents: A Meta-Analysis Systematic review and meta-analysis. Aimed To systematically review epidemiological evidence on the associations between screen time exposure and myopia in children and adolescents, and to quantitatively evaluate summary effect estimates from existing literature. With sample as Children and adolescents aged 3 months to 33 years from various studies.Sample Size 19 eligible studies, including 14 high-quality studies and 5 moderate-quality studies. Databases: PubMed, Embase, and Web of Science. Assessment: Newcastle Ottawa Scale (NOS) checklist for risk of bias.Statistical Analysis: Summary odds ratios (ORs) and 95% confidence intervals (CIs) using random or fixed-effect models [27].
Results stated Significant Correlation: There was a statistically significant correlation between high screen time and myopia. The pooled ORs with 95%CIs were 2.24 (1.47–3.42) for cross-sectional studies and 2.39 (2.07–2.76) for cohort studies. Device Type Impact: Screen time from computers had the most significant impact on myopia (categorical: OR = 8.19, 95%CI: 4.78–14.04; continuous: OR = 1.22, 95%CI: 1.10–1.35), while smartphones showed no significant association. The study concluded that screen time exposure is significantly associated with myopia in children and adolescents, with computer use having the most substantial impact. Recommends parental Role: Parents should monitor and limit their children's screen time, especially on computers. Encouraging regular breaks and promoting outdoor activities can help mitigate the risk of myopia. Study also concludes with solution stating providing parents with information and resources about the risks of myopia and the importance of limiting screen time. encouraging parents to create structured schedules that balance screen time with outdoor activities and breaks [28-30].

13. CONCLUSION

Juvenile myopia is a growing public health issue, especially in countries like India, where urbanization and increased educational demands contribute to its rising prevalence. This review emphasizes the importance of early detection, lifestyle modifications, and treatment options to prevent long-term complications like retinal detachment and glaucoma. Public health strategies, including parental education, increased outdoor time for children, and the use of corrective lenses and pharmacological treatments such as low-dose atropine, are crucial to managing and slowing myopia progression. Collaboration between healthcare providers and policymakers is vital to mitigating the impact of this vision condition on future generations.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1. Bing image generator
2. Microsoft Copilot

CONSENT

It's not applicable.

ETHICAL APPROVAL

It's not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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