

The Myopia Epidemic: Pathogenesis, Risk Factors, and a Call for National Action

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Myopia is considered as a great public health challenge of this century. According to the World Health Organization, nearly half of the world's population will be suffering from myopia by 2050.¹ This is not only going to be a great economic burden, but it will predispose to sight-threatening complications related to high and pathological myopia including maculopathy, rhegmatogenous retinal detachment, glaucoma, and cataract. Myopia progression is caused by excessive axial elongation of the globe and less likely by the changes in corneal curvature and lens power. Retinal defocus is considered as a primary afferent signal which regulates ocular growth after birth.² This leads to release of a series of retinal neuromodulators, especially, dopamine, melatonin, and acetylcholine. They act on the scleral extracellular matrix, altering its biomechanical properties.³ Dopamine is an inhibitor of axial growth and is related to the bright light exposure. Low-light indoor environments contribute to the acceleration of myopia by reduced dopaminergic signalling.³

Genomic studies have identified hundreds of susceptibility loci, affecting signaling, eye development, and connective tissue biology.⁴ The risk of myopia rises threefold if one parent is affected and sixfold when both parents are myopic.⁵ However, current epidemic has unfolded other environmental factors as the contributors. These factors include reduced outdoor activities, excessive near work and uninterrupted screen use.

Children spending less than 1.5 to 2 hours outdoors per day are more prone to myopia progression.⁶ The protection is related to light exposure rather than the nature of the visual task

outdoors. More than two to three hours of sustained near work without breaks activates accommodative stress and peripheral hyperopic defocus resulting in axial growth.⁷ Behavioral interventions constitute a major foundation upon which other myopia prevention strategies are layered. At least two hours of daily outdoor activity in the natural light, the 20-20-20 rule, a reading distance of 30–33 cm, limiting screen time and appropriate indoor lighting are low-risk and low-cost behavioral adaptations.⁷

Among the pharmacological measures, the ATOM2 trial has shown that 0.01% atropine slowed axial elongation over two years.⁸ On the other hand, LAMP study demonstrated that 0.05% atropine offered superior efficacy.⁹ Rebound acceleration can be addressed by gradual tapering upon discontinuation.

The optical approach to myopia control includes Orthokeratology with overnight rigid gas-permeable contact lenses to reshape cornea. Multifocal contact lenses and specially designed spectacle lenses with peripheral added power offer a non-pharmacological alternative for patients with appropriate tear film and ocular surface status. Other options include Repeated low-level red-light (RLRL) therapy which leads to slowing of axial elongation over one to two years.¹⁰

Myopia prevalence is increasing at a great speed and it requires coordinated national responses rather than efforts done at individual levels. Pakistan is also facing a rapidly progressing myopia burden which is aggravated by urbanization, excessive screen exposure, high academic expectations, and unfortunately lack of public awareness. There is lack of school-based vision screening programs resulting in undetected and untreated myopia throughout the critical years. A coordinated national strategy is the need of hour which should include mandatory school-based visual acuity screening, standardized referral pathways, systematic public awareness campaigns especially for parents, teachers, and children regarding modifiable risk factors and outdoor activities. These

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should be made part of school curriculum, and a national myopia registry should be made to monitor epidemiological trends and evaluate intervention outcomes.

Effective measures are also needed for a transition from managing individual patients to public health intervention at national and international level. The ophthalmological society of Pakistan should advocate persistent national strategies to embed eye health into childhood development policy.

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