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Review Article

# Digital Screen Time and Myopia: A Review

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## Abstract

Myopia, characterized by the inability to see distant objects clearly, has witnessed a substantial increase in prevalence, particularly in urban areas with a strong emphasis on education and screen-based activities. This article delves into the epidemiological aspects of the connection between screen time and myopia, considering genetic, environmental, and behavioural factors in the development of this visual condition.

We begin by examining global and regional trends in myopia prevalence, highlighting alarming projections that suggest a myopia epidemic, especially in regions like India. The role of genetics and environmental factors in myopia development is explored, emphasizing the need for a comprehensive understanding of the multifaceted nature of this condition.

The impact of digital screen time on myopia is a focal point of our discussion, particularly in the context of the COVID-19 pandemic, which witnessed a surge in screen usage. We present findings from various studies that establish a strong association between increased screen time, near work activities, and the onset and progression of myopia. These studies underscore the need for effective strategies to mitigate the potential risks associated with excessive screen usage, especially among children and adolescents.

Furthermore, we address the broader health implications of heightened screen time, emphasizing the importance of considering screen-related behaviours as a multifaceted health concern in the younger generation. In conclusion, this article offers insights into the intricate relationship between screen time and myopia, calling for continued research, awareness campaigns, and evidence-based interventions to safeguard eye health and overall well-being.

***Keywords:*** *Myopia; Near Work Activities; Screen Time; Digital Devices*

## Introduction

The escalating prevalence of myopia, colloquially known as near-sightedness, has become a global concern, particularly in urban settings characterized by intensive educational demands and the pervasive influence of screen-based activities. This article delves into the intricate epidemiological dimensions of the connection between screen time and myopia, considering the multifaceted nature of this relationship, encompassing genetic, environmental, and behavioural factors.

Myopia's prevalence, influenced by genetic predisposition, environmental factors, and various behaviours, is experiencing a troubling surge. In this context, the impact of screen time on myopia development emerges as a critical topic of investigation. Amid the COVID-19

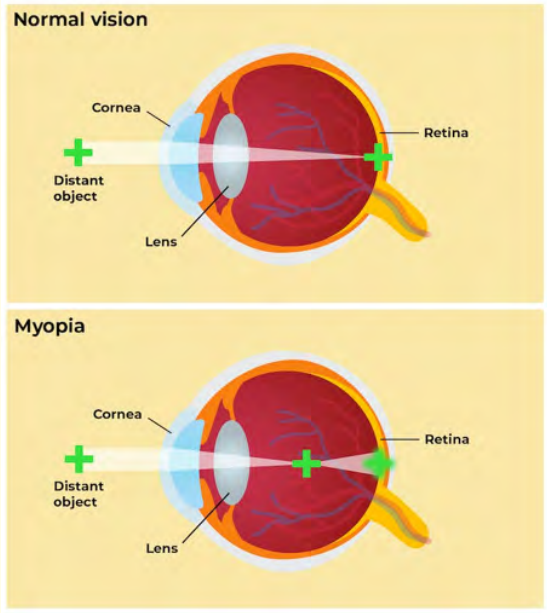


***Figure 1:*** *In people with myopia, light focuses in front of the retina rather than on it, so distant objects appear blurry. Anurag Papolu/ The Conversation, CC BY-SA.*

pandemic, which witnessed a substantial surge in screen usage, understanding the implications of heightened digital device exposure on myopia becomes paramount. This article explores the evolving landscape of myopia epidemiology, shedding light on the pressing need for comprehensive strategies to address the multifaceted impact of screen time on eye health, particularly among children and adolescents.

| Topic | Key Findings and References |
|---|---|
| Global Myopia Prevalence Projection | - In 2000, 1.406 billion people had myopia. By 2050, it could increase to 4.758 billion (49.8% of the world population) [1]. |
| Myopia Prevalence in Urban India | - Myopia prevalence among urban Indian children increased from 4.44% in 1999 to 21.15% in 2019. - Projections suggest 48.14% in 2050 [2]. |
| Multifactorial Nature of Myopia | - Genetics and environmental factors contribute to myopia. - Modern lifestyles with prolonged near work activities can contribute [3]. |
| Educational Demands and Myopia | - Correlation between myopia prevalence and intense educational demands [4]. |
| Mechanisms of Myopia Development | - Excessive near-work activities can lead to elongation of the eyeball, a key factor in myopia development [6]. |
| Recent Research on Screen Time | - Screen time and near work activities are associated with myopia [7,8]. |
| Genetics and Myopia | - High genetic predisposition and university-level education increase myopia risk [10]. |
| Molecular Genetics of Myopia | - Many genes and genomic regions are associated with myopia [11]. |
| Genetic and Environmental Interactions | - Genetic factors play a role in familial myopia, mediated by various factors [12]. |
| Epidemiological Dimensions of Myopia | - Over 70 genetic loci associated with myopia. Genetics and environment interact [13]. |

| | |
|---|---|
| Screen Time and Myopia During COVID-19 | - Increased screen time during the pandemic associated with myopia onset and progression [14]. |
| Digital Screen Time Among Children | - Children are immersed in digital screens from an early age [15]. |
| Impact on Children During the Pandemic | - COVID-19 led to a surge in screen time among children [16]. |
| Screen Time and Myopia Risk | - Increased screen time associated with higher myopia risk [16]. |
| Long-lasting Effects of Increased Screen Time | - Myopia prevalence remained elevated post-pandemic [17]. |
| Screen Time and Myopia Progression | - Screen time linked to myopia development and progression [18]. |
| Lifestyle Choices and Myopia | - Myopia associated with more screen time and less outdoor activity [15]. |
| Broader Health Implications | - Increased screen time has broader health implications [20] |

***Table:*** *Summary of myopia and screen time epidemiological insights.*

## Epidemiology of screen time and myopia connection

The epidemiology of myopia is intricately linked to screen time and its impact on eye health. Multiple studies have examined this connection, shedding light on the prevalence and potential future trajectories of myopia, particularly in India.

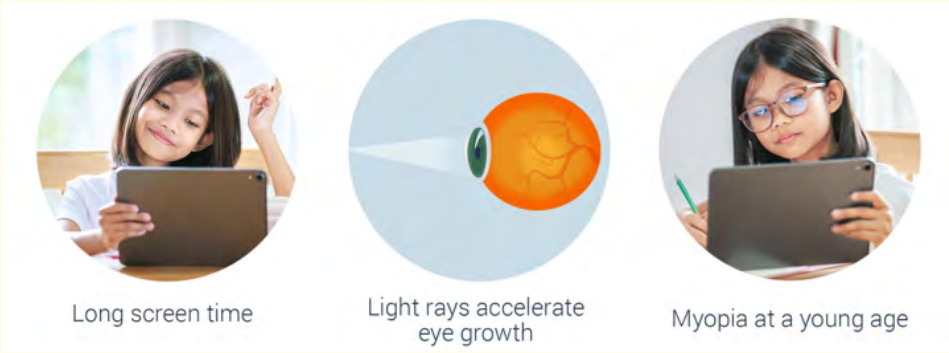


***Figure 2:*** *Light rays accelerate eye growth.*

## Global myopia prevalence projection

A study by Holden., *et al*. (2016) estimated the global prevalence of myopia and its projected increase. In 2000, approximately 1.406 billion people worldwide had myopia, with projections indicating that by 2050, this number could rise to 4.758 billion people (49.8% of the world population) [1]. These projections underscore the significant global burden of myopia.

## Myopia prevalence in urban India

Priscilla and Verkicharla (2021) conducted a study to predict myopia prevalence in urban Indian children. Their findings revealed a concerning trend: myopia prevalence among 5 to 15-year-old urban children increased from 4.44% in 1999 to 21.15% in 2019 [2]. Projections based on a yearly increase of 0.8% (equivalent to 4.05% every five years) indicated that myopia prevalence could reach 31.89% in 2030, 40.01% in 2040, and 48.14% in 2050 [2]. Importantly, the generational effect of myopia was identified, leading to an overall increase in myopia prevalence across all age groups by 10.53% over the next three decades (2020 to 2050) [2]. This suggests the

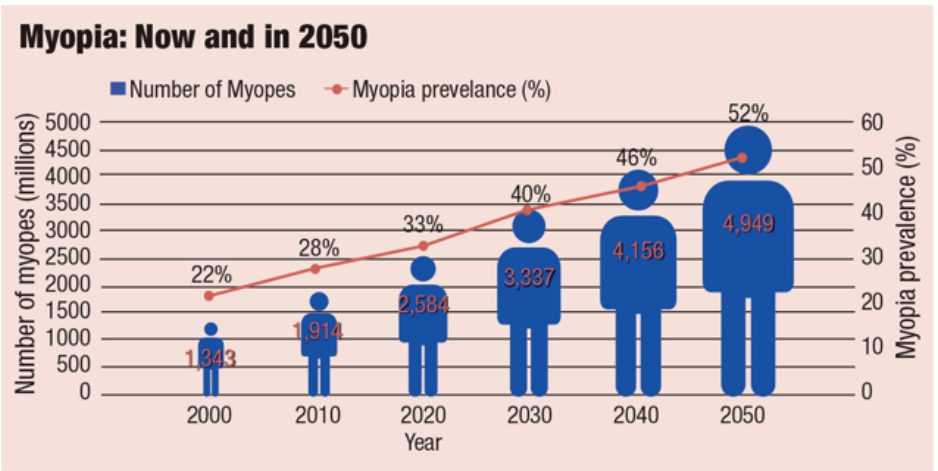


***Figure 3:*** *The WHO estimates 52% of the world's population will be myopic by 2050, up from just 22% in 2000. Adapted from: The Report of the Joint World Health Organization-Brien Holden Vision Institute Global Scientific Meeting on Myopia.*

possibility of a myopia epidemic in India, similar to the situation in East Asian countries, if no active interventions and lifestyle changes are implemented to counteract myopia.

## Multifactorial nature of myopia

Baird., *et al*. (2020) explored the multifactorial nature of myopia, emphasizing its genetic and environmental influences [3]. Their study defined myopia and highlighted its prevalence, with 80 - 90% of young adults in parts of East and Southeast Asia affected by myopia [3]. The authors stressed the multifactorial aspects of myopia, pointing to contributions from genetics and environmental factors. They highlighted modern lifestyles, including prolonged periods of near-work activities like education, as potential contributors to myopia [3]. Baird., *et al*. (2020) also underscored the global impact of myopia, particularly at high levels of severity, which can lead to sight-threatening diseases like glaucoma and retinal detachment [3]. The study's characterization of myopia as an 'epidemic' highlights the urgency of addressing its prevalence as a major public health concern [3].

## Screen time and myopia connection

Numerous research endeavors have delved into the intricate connection between the amount of time spent in front of screens and the development of myopia, shedding invaluable light on the environmental factors contributing to this vision disorder.

## Educational demands and myopia

Morgan and Rose (2005) made a noteworthy discovery by establishing a significant correlation between the prevalence of myopia and the international educational performance of individuals, underscoring the potential influence of intense educational demands on the emergence of myopia [4]. French and Morgan (2014) further accentuated the multifaceted nature of myopia, underscoring the imperative need to recognize screen time as one of the contributing elements to its development [5].

### Mechanisms of myopia development

The mechanisms underlying the progression of myopia are intricate and encompass various facets. One plausible pathway involves the excessive demands imposed by activities requiring close proximity to the eyes, such as reading or extended screen usage, which can ultimately result in the elongation of the eyeball, a key factor in myopia development [6].

### Recent research on screen time and myopia

Recent investigations have meticulously examined the nexus between screen time and the advancement of myopia. Lanca., *et al*. (2022) conducted an extensive study involving schoolchildren, unearthing associations between screen time, near work activities, and the onset of myopia. Their findings served to underscore the profound impact that screen time can have on the development of myopia [7]. Similarly, Zhong., *et al*. (2021) undertook a comprehensive exploration into the influence of daily screen time and outdoor activities, particularly during the unprecedented circumstances of the COVID-19 pandemic. Their research yielded valuable insights into the intricate relationship between screen time and myopia [8].

### Multifaceted nature of myopia development

To delve into this topic further, it is essential to consider the multifaceted nature of myopia development, which involves a complex interplay of genetic, environmental, and behavioural factors.

### Genetics and myopia

Verhoeven., *et al*.'s pivotal study in 2013 explored the synergy between genetics and education in influencing the risk of myopia. The researchers examined two population-based cohorts of European descent, leading to the intriguing discovery of gene-environment interactions. Notably, their findings revealed that individuals with a high genetic predisposition to myopia, who also attained a university-level education, faced a significantly elevated risk of developing myopia. This discovery underscores the pivotal role of education in mediating the impact of genetics on myopia development, offering crucial insights into the multifaceted nature of this visual condition [10].

### Molecular genetics of myopia

Li and Zhang's comprehensive study in 2017 provides invaluable insights into the molecular genetics of myopia. The study emphasizes the central significance of genetic factors in the etiology of myopia. Utilizing diverse research methodologies such as linkage analysis, association studies, and sequencing, their research identifies a plethora of genes and genomic regions that are intricately associated with myopia. This systematic review effectively bridges the gap between genetics and myopia, providing a robust foundation for future research endeavours aimed at unravelling the complex molecular mechanisms that underlie this condition [11].

### Genetic and environmental interactions

Jacobi., *et al*.'s work in 2005 offers a genetic perspective on myopia, shedding light on the intricate interplay between genetic and environmental factors that contribute to its emergence. Their study highlights the prevalence of genetic factors in familial cases of myopia, often following inheritance patterns that adhere to Mendelian principles. Furthermore, the research explores the roles played by various mediators, including cytokines, neurotransmitters, and transcription factors, in the development of myopia. This comprehensive examination of genetic and environmental interactions enriches our understanding of the multifaceted nature of myopia [12].

### Epidemiological dimensions of myopia

Yu., *et al*.'s comprehensive review in 2011 delves into the epidemiological dimensions of myopia. It underscores the alarming escalation in the prevalence of this visual condition and its intricate relationship with genetic factors. With the identification of more than 70 genetic

loci associated with myopia, the paper highlights the profound significance of genetic research in comprehending and addressing myopia. This extensive review offers a holistic perspective on the genetic underpinnings of myopia and its far-reaching implications for public health, reinforcing the notion that myopia is a complex interplay between genetics and environment [13].

## Screen time and myopia during COVID-19

In a world dominated by digital screens, our work, education, and entertainment have been revolutionized. However, the growing dependence on digital devices, particularly during the COVID-19 pandemic, has sparked concerns about their potential impact on the development of myopia. In this section, we will thoroughly explore the role of digital screen time in relation to myopia and its far-reaching implications for eye health.

## Impact of the COVID-19 pandemic

The COVID-19 pandemic ushered in significant changes in our daily routines, with lockdown measures leading to a substantial increase in digital device usage, especially among individuals, including children. Wong., *et al*. (2020) conducted a comprehensive review to assess the repercussions of heightened digital device usage during this period on myopia and to provide recommendations for mitigating potential adverse effects on myopia control [14]. Their review incorporated a wide range of studies that investigated digital device usage, near work activities, and outdoor time concerning the onset and progression of myopia. The findings underscored a strong association between increased digital screen time, extensive near work engagements, and limited outdoor activities with the onset and progression of myopia. Furthermore, the research suggested that these behaviours could continue to pose a risk both during and beyond the COVID-19 pandemic. This highlights the critical importance of raising awareness among parents, children, and governmental agencies to effectively mitigate these potential risks.

## Digital screen time among children

Digital screen time has seamlessly integrated into the lives of children, significantly shaping their daily routines and behaviours [15]. The proliferation of digital devices, including smartphones, tablets, computers, and televisions, has given rise to a generation of children who are immersed in digital experiences from a very early age [16]. This societal shift carries substantial implications for children's health and overall well-being, with particular concerns extending to their visual health.

## Impact on children during the pandemic

The COVID-19 pandemic led to an unprecedented surge in digital screen time among children and adolescents, as remote learning became the norm worldwide [16]. Multiple studies conducted during this period consistently reported a significant increase in screen time for children and adolescents, thereby shedding light on the potential risks associated with prolonged exposure to digital screens [16]. These risks encompass a spectrum of health issues, including adverse effects on eye health and overall well-being.

## Pandemic-related increase in screen time

The increase in digital screen time during the pandemic has raised concerns about its potential contribution to the development and exacerbation of myopia, particularly among younger individuals. Prolonged screen use, combined with extensive near work activities and reduced time spent outdoors, is thought to be a significant factor in myopia progression. These behavioural changes, often driven by the demands of remote learning and increased leisure screen time during lockdowns, have sparked a need for comprehensive strategies to address the potential impact of digital screen time on eye health.

## Screen time and myopia risk

Understanding the intricate relationship between screen time and myopia requires a multifaceted approach that encompasses epidemiological, behavioural, and physiological factors. As digital technology continues to evolve and integrate further into our lives, it is

imperative to stay vigilant, conduct rigorous research, and implement evidence-based interventions to safeguard eye health, particularly in the younger generation.

### Impact beyond myopia

Research has unveiled the discernible impact of increased digital screen time on both eye health and general well-being, with a specific focus on its association with myopia [16]. As children dedicated more of their time to screens, concerns began to mount regarding the potential repercussions for their vision. The evidence consistently points to a concerning trend: the more time children spend engrossed in digital screens, the higher their risk of developing myopia [16]. Myopia, a global public health concern, has witnessed a significant surge in its prevalence, particularly in regions such as East and Southeast Asia [17].

### Long-lasting effects of increased screen time

A study conducted in Hong Kong offered a glimpse into the lasting effects of increased screen time during the COVID-19 pandemic. It revealed that myopia prevalence among children remained elevated even after pandemic-related restrictions were lifted, underscoring the enduring impact of heightened screen usage [17]. What's more, the study identified younger children and those from low-income families as being at a higher risk of developing myopia during the pandemic, emphasizing the necessity for targeted interventions [17].

### Screen time and myopia progression

Another investigation in Turkey delved into the intricate relationship between digital screen time and myopia development during the COVID-19 pandemic [18]. The findings were striking increased digital screen time was linked to a myopic shift in children with previously normal vision and myopic progression in those who were already diagnosed with myopia [18]. These results underscore the pivotal role played by screen time in not only the initiation but also the advancement of myopia.

### Lifestyle choices and myopia

Furthermore, a study conducted in Spain took a holistic approach by analysing the vision of children aged 5 to 7 and connecting the findings to their lifestyle choices. This analysis considered both the daily hours spent on digital devices and the extent of daily outdoor exposure [15]. The study uncovered a significant correlation: children with myopia tended to have more screen time and less outdoor activity compared to their peers without myopia [15].

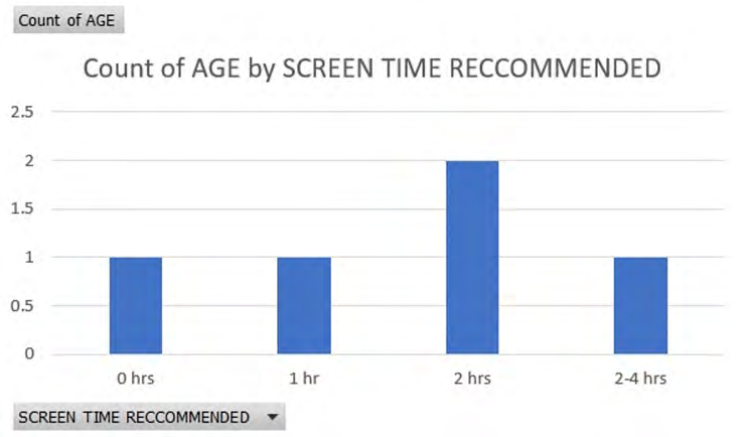


***Figure 4:*** *Screen time recommended as per age.*

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*Source: American Academy of Child and Adolescent Psychiatry.*

### Broader health implications

Beyond its impact on myopia, the escalation in screen time has broader health implications that extend beyond eye health. A systematic review and meta-analysis focused on myopia progression during the COVID-19 pandemic, further affirming the substantial influence of increased screen time on children's vision [19]. Additionally, a comprehensive literature review underscored the adverse effects of excessive screen time on physical and psychological well-being [20]. These findings underscore the imperative of addressing screen time as a multifaceted health concern in children and adolescents.

## Conclusion

In conclusion, the surge in myopia prevalence, especially in urban areas with a strong emphasis on education and screen-based activities, presents a growing public health concern. The epidemiological intricacies of the connection between screen time and myopia underscore the multifaceted nature of this visual condition. Genetic predisposition, environmental influences, and behavioral factors all play vital roles in the development of myopia.

The COVID-19 pandemic accelerated the adoption of digital devices, resulting in increased screen time for individuals, including children and adolescents. This heightened exposure has been linked to the onset and progression of myopia. As the evidence continues to mount, it is clear that comprehensive strategies, awareness campaigns, and evidence-based interventions are urgently needed to mitigate the potential risks associated with excessive screen usage and to safeguard the holistic well-being of the younger generation.

Addressing the complex interplay between genetics, environment, and behavior is essential to tackling the myopia epidemic effectively. Further research, innovative interventions, and public health initiatives are crucial steps toward ensuring that screen time enhances our lives without compromising our vision and overall health.

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