



Impact of Digital Devices on Myopic Individuals

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Authors' contributions

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

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ABSTRACT

Background: Today's generation has all been using a more significant deal of time on their digital devices, whatever it may be. It leads to a surge in cases of myopia in the population, especially in the Asian population. The average screen time usage has increased significantly, especially during pandemic situations. Digital devices also contain a spectrum of rays and blue light, damaging the retina and disturbing eye health. This has caused a trend of increasing myopic cases in the young generation. Risk factors and prevention of using digital devices should be known to the public for better care of their eyes.

Objective: To study various articles on the association between digital device usage and myopia in the young population. Based on the results of various studies, conclude and discuss the risk factors of myopia and how it can be minimized in the young generation.

Methodology: Various articles were reviewed during the study; recent papers published in the last five years were considered due to the pandemic effect. There is an increase in average screen time, which further needs to be studied to understand the individuals' situation better. Various methodologies in the published articles have been studied or identified risk factors of myopia.

Conclusion: Due to various advancements and behavioral changes in the population of developed countries and developing countries, there is an increase in the sedentary lifestyle of most of the population, which is leading to the increased usage of digital gadgets, which in turn maximize the tendency to develop myopia in the population.

Keywords: Myopia; myopia risk factors; digital devices; screen time.

1. INTRODUCTION

Myopia, short-sightedness, or near-sightedness, is a refractive error. The visual image focuses in front of the retina, leading to a defective vision of the distant objects. Myopia is becoming more frequent worldwide, and it is thought to be the most common cause of vision impairment in affluent countries without optical correction [1]. By 2050, Myopia is expected to affect close to five billion people globally, making it a significant community health issue with considerable educational, economic, and social implications [2]. India, like other countries of Asian continents, has seen a surge in the incidence and prevalence of myopia [3]. Myopia has also begun to appear at an earlier age than its prior onset, which is concerning because younger children have a faster rate of advancement and are likely to attain a greater degree of short-sightedness [4,5]. Later in life, this can remarkably raise the chance of progressing into various vision-threatening disorders such as glaucoma, cataract, myopic maculopathy, and retinal detachment [6].

Urbanization, reduced outdoor time, disturbed or delayed sleep, increased duration of studies, and uninterrupted reading or close work are all adduced as possible effects in the etiology of myopia, which involves an interaction between environmental and behavioral, and genetic factors [2,7-12]. Digital devices are now an additional possible environmental predisposing factor for myopia in young individuals and children [13]. Smartphones, tablets, iPhones, and computers are employed in both the home and the classroom from such a young age, further increasing the cause [14].

In 2018, 95% of American teenagers reported owning or having smartphones, making them the fastest increasing smartphone users [15,16]. Smartphones are currently the most common gadgets for 9–16-year-old in Ireland to access the internet daily, while 85 percent of young people (aged 12-15 years) in Great Britain use one daily [17,18]. Computer use has been recognized as a risk factor for near-sightedness in several studies done to date [19-24]. According to one study, myopia is closely associated with computer screen working distance nearby [21]. Smartphone users' working distance is often significantly less than computer users [25]. As a result, it's possible that

prolonged and increased exposure to a digital screen(esp. smartphones) could be a cause for the development of myopia and its advancement, particularly at a blooming young age [2]. However, there is limited published research on the link between myopia and the use of digital gadgets [2]. Self-reported assessment for digital devices is likely to be ineffective in predicting objective behavior of smartphones, but then neoteric research concentrated on these assessments to address the impact on ocular health based on the duration spent on the digital devices. The design of this study was to see if there was any correlation between ametropia/refractive status and self-reported analysis and assessment by keeping a tab on smartphone usage among children and young adults. Students' perceptions of digital technology and smartphones as a risk factor for myopia were also thoroughly investigated [26-30].

1.1 Rationale

The rationale of the above article is in context to the new environmental factor exposed to the young generation, i.e., digital media. The long hours spent on digital devices have various risk factors in maintaining eye health. The emphasis has been given to minimizing the risk factors in various ways to maintain eye health and prevent myopia in the younger generations.

1.2 Objective

After reviewing various studies between (Jan 2016- Dec 2021) focused on the association of prolonged usage of digital devices on myopia.

2. METHODS

Numerous articles of different origins were compiled from papers published in journals like PubMed, Web of scholars, Scopus between January 2016 to December 2021 using the keywords 'Myopia', Myopia risk factors,' 'Screen time,' 'Digital devices. All published articles, including original research, meta-analysis, and systematic reviews with searches restricted to the English language. The reference lists of the publications obtained were examined, and relevant studies were also examined. Studies based on the individual using digital devices (smartphones, tablets, laptops, computers, etc.) were considered.

3. RESULTS

Following are the pictorial interpretations of the various studies compiled in one place. These results contain the rate of increase in myopia due

to digital devices and the average usage of digital devices hours per capita of the population. These data will establish the relations between the increase in digital device usage and myopia.

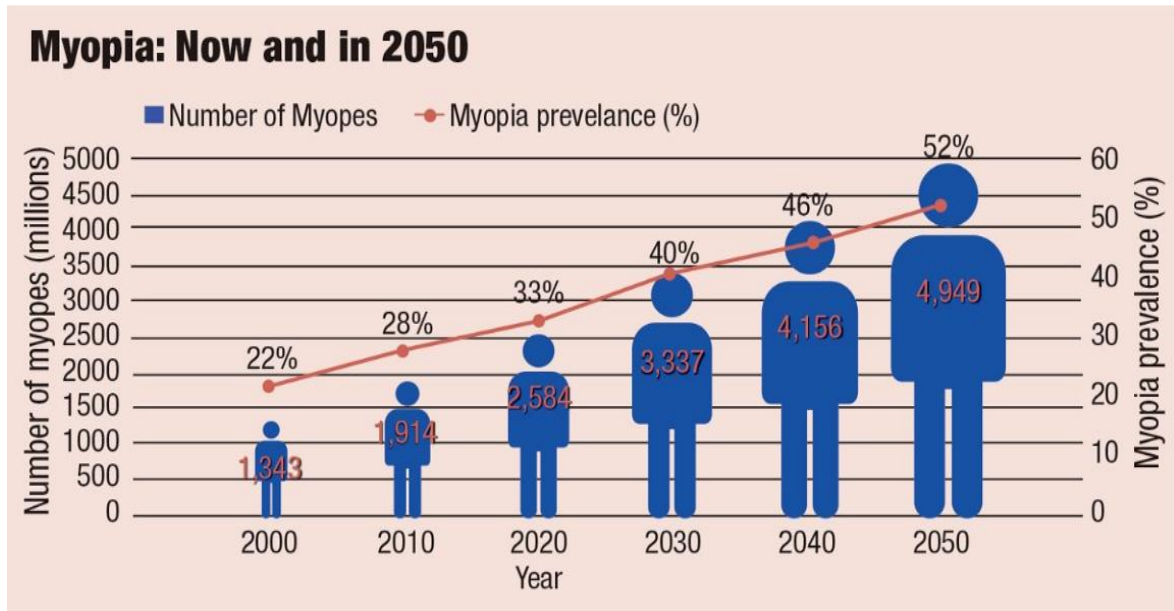


Fig. 1. Myopia syndrome

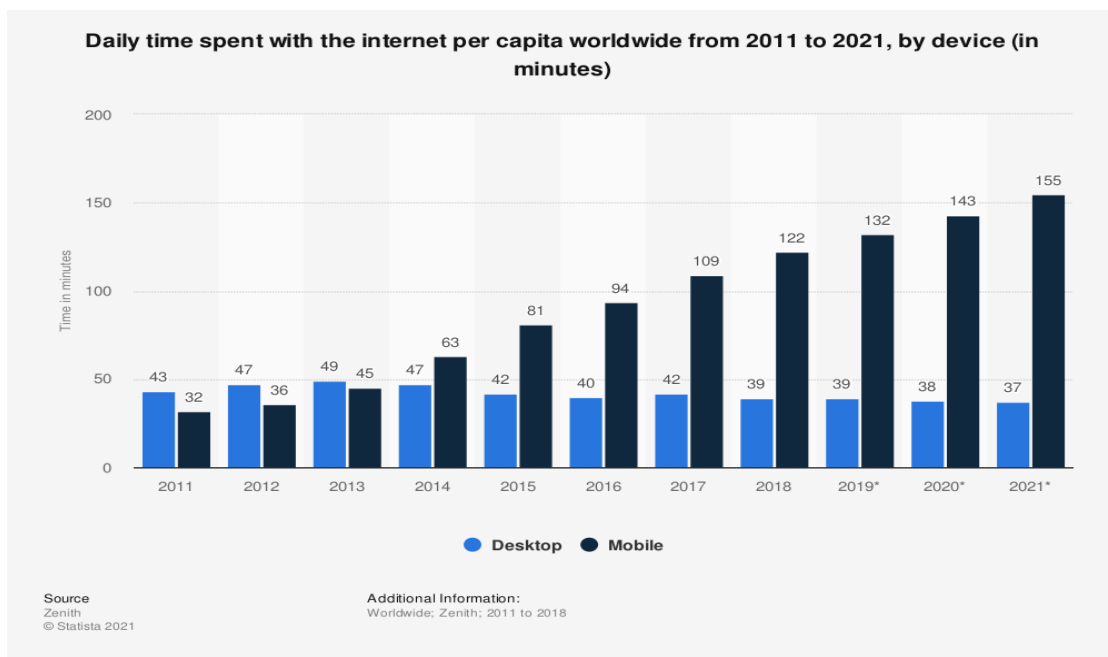


Fig. 2. Daily time spent with internet per capita

4. DISCUSSION

The objective of this systematic review and meta-analysis was to integrate all of the relevant evidence on the association between digital screen time and myopia. This study suggests that there really may be an apparent link between screen usage and myopia prevalence or advancement. The studies in various research papers have concrete evidence of an association between myopia and usage of digital devices at a young age. The systematic research includes many youngsters from Asia, indicating that this region had a higher frequency of myopia. Study has been conducted among myopic and non-myopic candidates with variation in age, average usage time, gender. The correlation has barely visible in statistical analysis in myopia caused by the usage of digital devices. The style of living among new generations has changed over the evolution of technologies. Smartphone usage pattern among children has changed drastically over time [7,14]. With the World Wide Web introduction in the 1990s, people began to utilize computers more frequently. Smartphone/tablet use, on the other hand, is relatively recent, having begun around ten years ago with the introduction of the first smartphone [31]. The use of mobile devices has expanded dramatically during the last decade. In 2014, 22% of people had a smartphone; by 2019, that number had risen to 37% [32]. Youngsters are starting to use cellphones at a younger age (22 percent start at three years old or younger), and one in three children (1–6 years old) use smartphones for between 1 and 2 hours per day [33,34,35].

In 1980, there was a rise in myopia prevalence worldwide, although there is no such presence of computers or any means of digitalization for the community. Then in the subsequent years over a decade, that is in the year 1900, there is a gradual increase in the myopia cases in the world population, then there come the computers in the household devices, then almost after a decade in the year 2000, Saw et al. proposed that there is a link between increased duration spent on computer and myopia incidences but Mutti et al. proved otherwise. Half a decade later, with the achievements in technology and development, the first of a kind, i.e., the smartphone was launched in the year 2007, with various new facilities such as screen touch, etc., but in the same year, a paper published by Jones et al. proposed negative results on the correlation between the use of digital devices

and myopia incidences. In the following year, the same negative results were published by Ip et al., in 2009 and Lu et al., in 2009. Jones- Jordan et al. proposed the correlation to be possible in the year 2011 but in the next year in 2012 said otherwise. Then almost seven years later, in the year 2014, smartphone penetration was about twenty -two percent, then it is seen that there is an increase in the myopic individuals and the time to develop also seems to be a lot earlier than in the last one or two decades. Then in the year 2015, Chu et al. and Li et al. said that the relationship between the use of digital devices and myopia could not be established. Still, in the same year, Saxena et al. proved otherwise. Again in the year 2017, Saxena et al. proposed that with the use of digital devices for approximately 1-2 hours per day, there seems to surge in myopia incidences in relation to the former. In 2019 smartphone penetration is about 37 % in the community, which leads to thinking that the surge in the prevalence and incidence of myopia is closely related to the use of digital gadgets.

Myopia has been more prevalent for decades, and the near sight of smartphones is one of the risk factors of myopia. Smartphone usage is different from converting various factors that affect the eye's health, which needs to be investigated separately. The factors are the distance of the smartphone from the eye, the screen's brightness, the contrast of the screen, the resolution of the device, and the spectrum of light originating from the screen.

Moreover, smartphone addiction among childradolescentslescents has increased considerably, reducing time spent in other time works. The average usage time has been 4 hours 42 min from 2 hours 31 min [36,37]. As well as sales of smartphones demonstrate the increase in ownership of smartphones these days [38]. This huge jump is now one of the environmental risk factors of myopia. The studies indicate that students spend more time in gaming, social media, and other non-important tasks than time spent on their study compared to the pre-smartphone era [15]. Moreover, 99% of students currently own a smartphone. The reports say that myopic children spend 40 minutes more on smartphones than to-myopic children, and adults spend 45minutes more on a computer than non-myopic adults. This establishes the straightforward correlation between smartphone usage and myopia. Statistical analysis of the questionnaire prepared

to investigate the brightness, contrast of the screen, and distance between eyes concludes that these factors play a significant role in disturbing eye health [2]. Its effect can also be on the near-sightedness of the eye. The blue light originating from digital devices greatly impacts the eye's health.

However, there are some differences in the data collected in screen usage time between myopes and non-myope significant difference is in the short duration found in the data individuals reported. These data collected from individuals are unreliable; Thus, they are underestimated and do not imply the actual screen time usage. In a few reports, usage time has been collected over a long period by recording actual screen usage time. The findings of those reports can be more trusted and indicate the actual behavior of digital screens on eye health. There are some gender-based differences in some myopic populations. But studies further concluded that genders did not significantly correlate with myopia, limiting it to some populations [39-44].

These significant developments need the consideration of current links between myopia and screen time, particularly in children and in locations where the prevalence of myopia was low before the arrival of digital devices. However, there hasn't been any conclusive evidence of this link. One reason for the lack of a link could be that there isn't enough screen time exposure as a risk factor to modify myopia prevalence. Because smart digital gadgets have only been available for a short period, the available evidence may be restricted. We discovered no evidence of a recent increase in near-work activity. The belief that a smartphone is suitable for the eye does not limit smartphone usage. This behavior was more seen in the myopes, knowing the facts that smartphones could damage their eyes, they continued using smartphones [2]. Covid has pushed the education and work on digital screens, adding the screen usage time. This new change will make users accept these digital platforms in the long term. Changes in the behavioral aspects of children due to the adoption of these technologies could not be ignored. Various other factors could also start myopia, which needs to be further studied. The usage of digital devices on the bed can disturb sleep; the correlation between myopia and lack of sleep needs further study. The importance of study includes a study on the impact of smartphones individually and the other digital devices such as television,

computers, and laptops. One of the study's strengths is the extensive literature review, which assisted in establishing the relationship between myopia and digital devices [2].

5. LIMITATION OF STUDY

There are various limitations of the study in reports. Some of the reports have been conducted on the Asian population. There need to be in diversified populations for the actual findings to be accurate. Several study reports claim other risk factors such as other near vision tasks to be caused death by myopia; a clear perspective cannot be drawn between screen exposure and myopia. In most of the study screen time was reported by the individuals or their parents. Individuals generally underestimate their screen usage time up to 40 percent. This will lead to inaccurate results. This limitation could be overcome by installing specialized applications that record screen time usage. This real-time data can produce accurate results that can help establish correlation. In further studies, individuals who participated need to be followed till they develop any refractive disorders or progressive myopia. This will make sure nothing has been missed in the study. No proper eye checkups were performed during the study. It was based on self-reporting, which produced inaccurate results. If eye checkups by optometrist were performed for verification, then the results could be much validated and accurate. The outdoor activities have not been captured, which needed to be captured as screen exposure time affects the time spent outdoors. Further studies should incorporate the outdoor light exposure levels that a person undergoes. Other objective factors such as screen viewing angle, brightness, contrast, ambient lights, and face to screen proximity need further study. The study based on usage of categorized digital screens needs to be performed as an individual has various types of screen exposure like theatre, TV screens, and other types of screens. It might be possible that myopia's reading behavior and other risk factors have changed over time. So, these need to be investigated further.

6. CONCLUSION

The surge in myopia prevalence has continued for decades and is not a new phenomenon. This surge was also there in the pre-smartphone era, and we cannot blame the smartphone as the only risk factor of myopia. The ongoing generations

are the first to be experiencing this digital growth. The studies show a comprehensive correlation between digital media usage and myopia. The average screen usage time has escalated substantially in these years. Thus, the smartphone has become additional risk factor for myopia. Smartphone usage has been affecting eye health and sleep quality. This study indicates that a detailed investigation is needed to find the fundamental risk factors. There are few conflicting reports on the association, which is evident as smartphones are recent developments. Research needs to be conducted in a mixed population for accurate results. These findings will benefit the children, parents, teachers, etc.

DISCLAIMER

The products used for this research are commonly and are predominantly used in our research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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