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Original Research Article

The Association between Digital Screen Time and Myopia among Children of Age Group 5 Year to 15 Year Presenting at a Tertiary Care Medical Centre

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Abstract

Introduction: The WHO recommends no sedentary screen time (such as watching TV or videos, playing computer games) for children <2 years and limits sedentary screen time to no more than 1 hour (less is better) for children older than 2 years but younger than 5 years. The American Academy of Paediatrics (AAP) has also endorsed similar screen time restrictions. There are no screen-time cut-offs specifically recommended for older children or adolescents by either or any other government/country health guidelines.

Aim and Objectives: To estimate the prevalence of myopia in preschool and school going population and its associations with Digital screen time among the study subjects.

Material and Methods: This study was conducted as a hospital based cross sectional study to estimate the prevalence of myopia and its correlation with Digital screen time. This study was conducted at field area of tertiary medical center of Delhi-NCR region. The study was carried out from August 2021 to August 2022.

Result: The proportion of myopia was more in 5-8 years age group which was 14(50%) of the total number of myopic subjects. When compared with the total population of the age group of 5-8 years, the percentage of the myopic subjects was 9.52 %. When compared within the age group of 9-11 years, the proportion of myopic subjects in total myopic population was 9(32.1%), and when compared with the total respective population of age group of 9-11 years the proportion was 13.6%. When compared within the age group of 12-15 years, the proportion of myopic subjects in total myopic population was 5(17.9%), and when compared with the total respective population of age group of 12-15 years the proportion was 10.64%.

Conclusions: In this study we found that there was a strong association between increased digital screen time and myopia. Other factors such as presence of myopia in one or both parents, and increased prevalence in myopia with the increase in age were also observed as considerable factors.

Keywords: Myopia, Screen Time, Digital, Vision.

Introduction

Technological impacts on our society have completely altered the way that people operate. Changes in technology can be traced throughout history and have all had long-lasting impacts on the world as we know it today. Technological advancements really picked up the pace since the advent of the steam engine during the industrial revolution. These technological advances have started to revolutionize the way that people work, travel, communicate, learn, and more. The invention of the cell phone in 1983 by Motorola was no different. While Alexander Graham Bell is still credited with the first invention of the telephone, it was Michael Douglas that took the idea of the telephone and created a world where people can communicate at anytime and anywhere. Instead of calling a place, callers were now calling specific people. While the cell phone created many advantages for global communication and trade, it still has some potentially negative implications on lifestyles that cannot be ignored [1].

The WHO recommends no sedentary screen time (such as watching TV or videos, playing computer games) for children <2 years and limits sedentary screen time to no more than 1 hour (less is better) for children older than 2 years but younger than 5 years. The American Academy of Paediatrics (AAP) has also endorsed similar screen time restrictions. There are no screen-time cut-offs specifically recommended for older children or adolescents by either the or any other government/country health guidelines [2].

Myopia has become an important public health issue worldwide, especially in Asian countries, and is a major cause of correctable visual impairment. The increasing prevalence of myopia is thought to be linked to the environment, such as intensive education, more near work, and less time spent outdoors . Several studies have reported that near work is a vital contributor to myopia, but the exact reasons why near work exacerbates myopia are not well understood. This has attracted the interest of many researchers, and they have tried to determine the possible mechanisms by which periods of prolonged near work could result in myopia [3].

Myopia, also known as near sightedness, is caused by an increase in eye length or corneal curvature and this condition causes light from distant objects to focus in front of the retina. Light focused in front of the retina results in blurry vision while looking at far away objects but clear vision while looking at close objects [4].

Screen time increases every year. In 2018, 5% of children aged 5 to 7 years worldwide already owned a mobile phone and 42% had their own tablet [5] Furthermore, the average screen time use in children aged between 8 and 12 has been increasing 49 min a day over the last 3 years with an average screen time per day of 4 h and 18 min in 2016 up to 5 h and 7 min in 2019. This increase in screen time has visual implications. In this way, there is a growing concern about the risks that both, the increase in screen time and the reduction of time spent outdoors by children as a result of this changed lifestyle, could pose [6].

Considerable computer screen viewing can lead to eye fatigue, blurred vision, eye dryness, headaches, and discomfort. Such symptoms can be a result of glare, poor lighting or improper viewing setting. Studies have associated close screen viewing (in video games) to development of myopia in ages 1–13-year-old. A study of 3–10 year-olds elaborated on the effects of video games on vision. The participating children who were playing video games more than 30 min almost every day experienced headaches and dizziness and eye strain. Transient diplopia and refractive errors (e.g., short-sightedness) appeared mostly in the dominant eye, eventually resulting in loss of fusion. The

absence of stereopsis was observed related only to video game time and not to other digital media devices. Additionally, the presence of eyelid tics was explained as a direct result of the high level of brain stimulation occurring during video game playing [7].

While the impact of cell phone screens on myopia over time is still unknown, there has been literature that might suggest a possible connection. This study examines the idea that increased screen time over the last few decades has had an impact on the prevalence and increased myopia over time.

Aim and Objectives

1. To estimate the prevalence of myopia in pediatric population of age group 5-15 year coming to tertiary care medical centre.
2. To find the association of myopia with Digital screen time among the study subjects.

Materials and methods

This study was conducted as a hospital based cross sectional study to estimate the prevalence of myopia and its correlation with Digital screen time. This study was conducted at field area of tertiary medical center of Delhi-NCR region. The study was carried out from August 2021 to August 2022. The study population were comprised of both boys and girls as preschool and school going children between age group of 3 years to 12 years coming to pediatric department.

Inclusion criteria

1. All children between age group of 5 years to 15 years.
2. Those parents who give informed consent.

Exclusion criteria

1. Subject with history of significant ocular pathology other than myopia.
2. Other severe medical condition like DM/HTN.
3. All baby born before 34 weeks of gestation.

Screening of vision

Vision screening was done with the help of experienced Optometrist and resident of department of ophthalmology in the hospital under the supervision of investigator. Snellen's chart for distant vision was used for testing visual acuity. The right eye was tested first for visual acuity followed by the left eye, each time occluding the fellow eye. If the child wore spectacles, visual acuity was tested both with and without spectacles. If vision on screening was not 6/6, then cycloplegic refraction under Homatropine was done. The data obtained after testing visual acquity of participants with Snellen's chart was then converted into equivalent on LogMAR visual acuity chart as follows:

Data collection and methods

General data regarding the age, sex, address, history related to refractive error was collected by interviewing the child and parent, followed by entering the information taken in the pre-tested semi- structured questionnaire by the investigator, followed by the screening of vision of the child. A short counselling supported by charts, posters and audio-visual tapes regarding eye health education was given to children after general and ophthalmic examination.

Observations

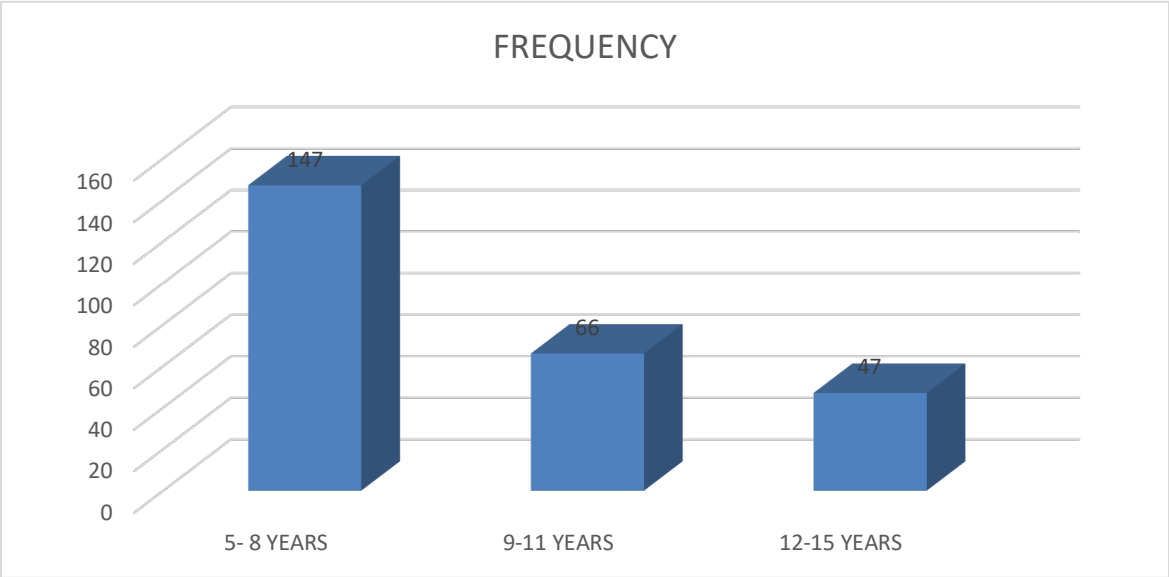

Figure 1: Distribution of Participants According to Age Group

In this study 260 participants were included. Majority of 147(56.54%) participants were included in the age group between 5-8 years and the remaining distribution was 66(25.4%) in 9-11 years and 47(18.8%) in 12-15 years. The minimum age was 5 years and maximum age was 15 years.

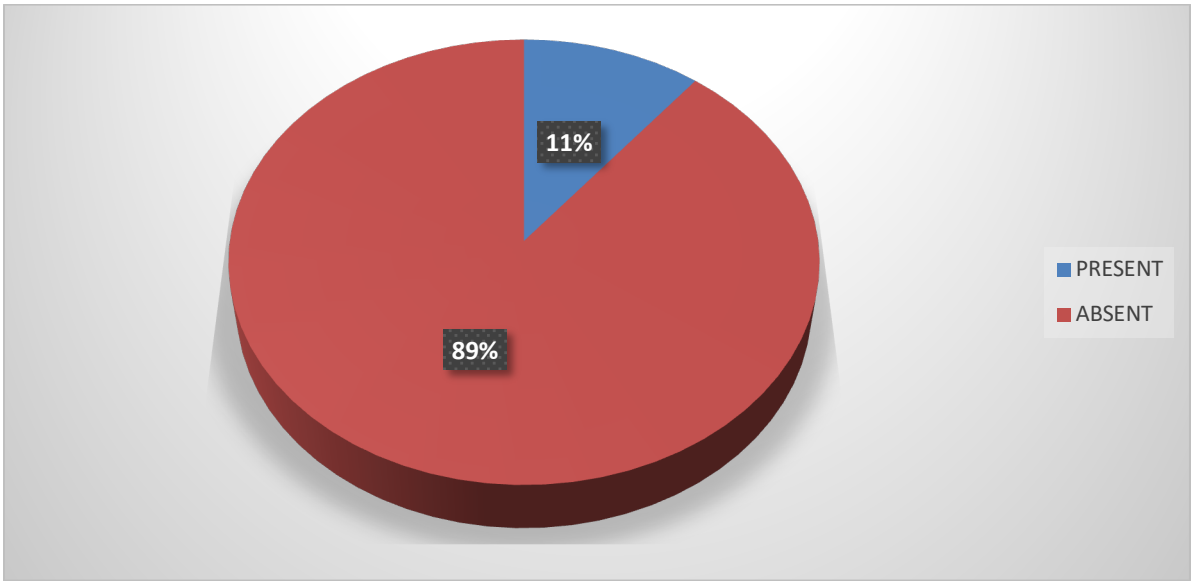

Figure 2: Distributions of Participants According to Myopia

In this study, myopia was present in 28(10.8%) participants whereas, absent in 232(89.2%) participants.

Table 1: Distribution and Association of Age with Myopia

Age Group	Myopia			
	Present	**Absent**	**% of myopic of total subjects**	**Total**
5- 8 Years	14 (50%)	133(57.33%)	5.36	147(56.54%)
9-11 Years	9(32.1%)	57 (24.57%)	3.47	66 (25.4%)
12-15 Years	5(17.9%)	42 (18.10%)	1.92	47 (18.08%)
Total	28	232		260
	Chi-Square Value-22.4; P-Value-0.001; Significant			

Age group was checked for association with myopia. The proportion of myopia was more in 5-8 years age group which was 14(50%) of the total number of myopic subjects. When compared with the total population of the age group of 5-8 years, the percentage of the myopic subjects was 9.52 %. When compared within the age group of 9-11 years, the proportion of myopic subjects in total myopic population was 9(32.1%), and when compared with the total respective population of age group of 9-11 years the proportion was 13.6%. When compared within the age group of 12-15 years, the proportion of myopic subjects in total myopic population was 5(17.9%), and when compared with the total respective population of age group of 12-15 years the proportion was 10.64%. Among the group with no myopia the age group 5-8 years had 133(57.33%) non myopic subjects, age group 9-11 years had 57(24.57%) non myopic subjects and age group of 12-15 years had 42(18.10%) non myopic subjects. The prevalence of myopia was highest (13.6%) in age group of 9-11 years and minimal (9.52%) in age group of 5-8 years. This difference in distribution of age was statistically significant. Age was significantly associated with myopia with P value <0.001.

Table 2: Distribution and Association of Gender with Myopia

Gender	Myopia		
	Present	**Absent**	**Total**
Boy	13(46.4%)	123 (53%)	136 (52.3%)
Girl	15 (53.6%)	109 (47%)	124 (47.7%)
Total	28	232	260
Chi-Square Value-0.43; P-Value-0.51; Not Significant			

The proportion of boys in myopia and non-myopia group were 46.4% and 53% respectively. The proportion of females in myopia and non-myopia group was 53.6% and 47% respectively. This difference was not statistically significant. Gender was not significantly associated with myopia.

Table 3: Mean number of Time (in minutes)/day spent on TV/DVD (Passive Watching from Distance)

Age Range	Myopic patients	Non myopic patients	P Value
5-8 years	123.14±19.21	102.95±18.49	<0.05
9-11 years	123.59±3.04	110.73±5.97	<0.05
12-15 years	90.0±16.33	83.38±7.21	<0.05

Table show the comparison between the mean time (in minutes)/day spent while watching TV/DVD from distance in age groups of 5-8 years, 9-11 years,12-15 years between the myopic subjects and non-myopic subjects. There was a statistically significant difference ($p<0.05$) of

screen time on passive watching from distance in all the age groups, when compared between myopic and non-myopic subjects.

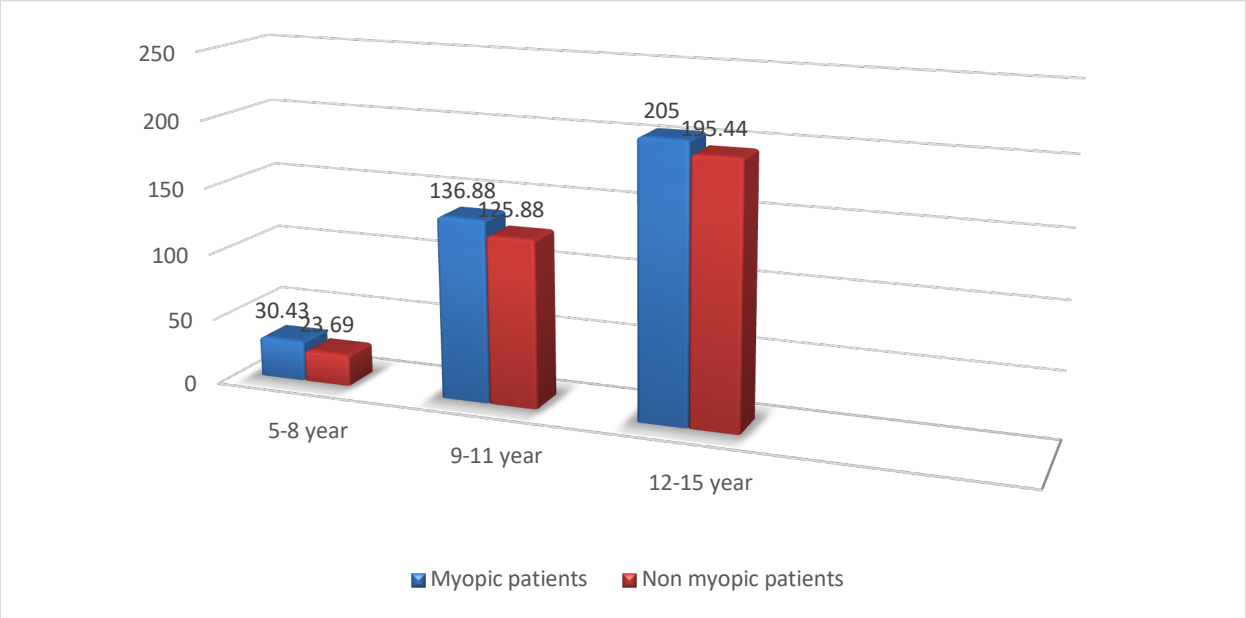

Figure 3: Mean number of Time (in minutes)/day spent on Computer/laptop (near passive watching)

Fig show the comparison between the mean time (in minutes)/day spent while passively watching computer/laptop from nearby in age groups of 5-8 years,9-11 years,12-15 years between the myopic subjects and non-myopic subjects. There was a statistically significant difference ($p<0.01$) of screen time on passive watching from distance in all the age groups, when compared between myopic and non-myopic subjects.

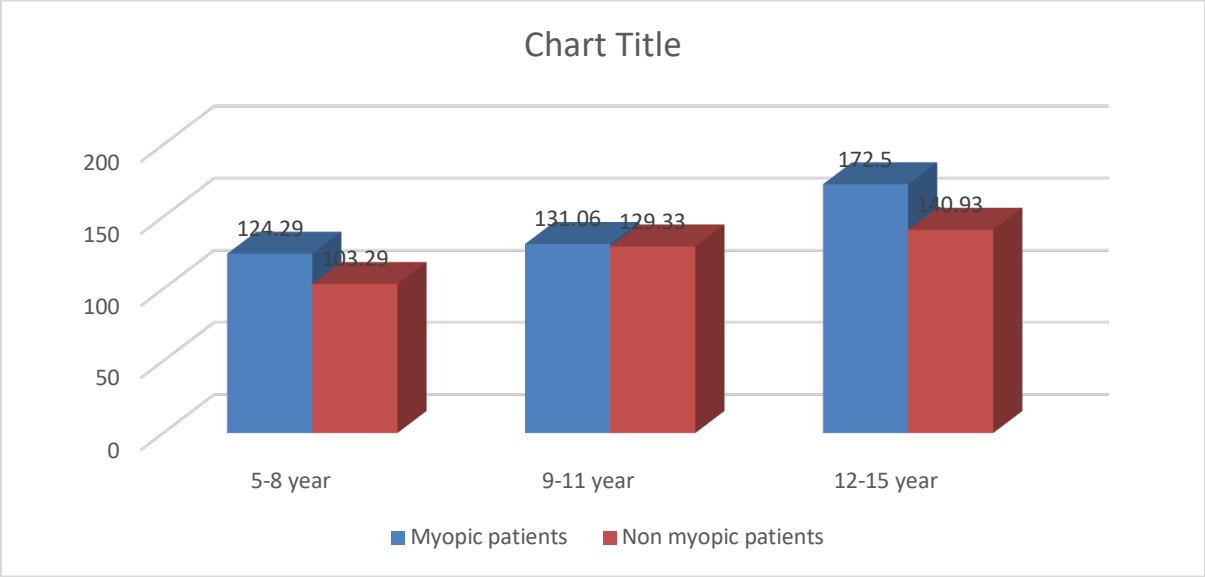

Figure 4: Mean number of Time (in minutes)/day spent playing mobile/Tablet (near active watching)

Figure 4 show the comparison between the meantime (in minutes)/day spent while actively playing on mobile/tablet from nearby in age groups of 5-8 years, 9-11 years, 12-15 years between the myopic subjects and non-myopic subjects. There was a statistically significant difference ($p<0.01$) of screen time while actively playing on mobile/tablet from nearby in age groups of 5-8 years and 12-15 years, when compared between myopic and non-myopic subjects, there was no statistically significant difference ($p>0.05$) of screen time in myopic and non-myopic subjects of age group 9-11 years.

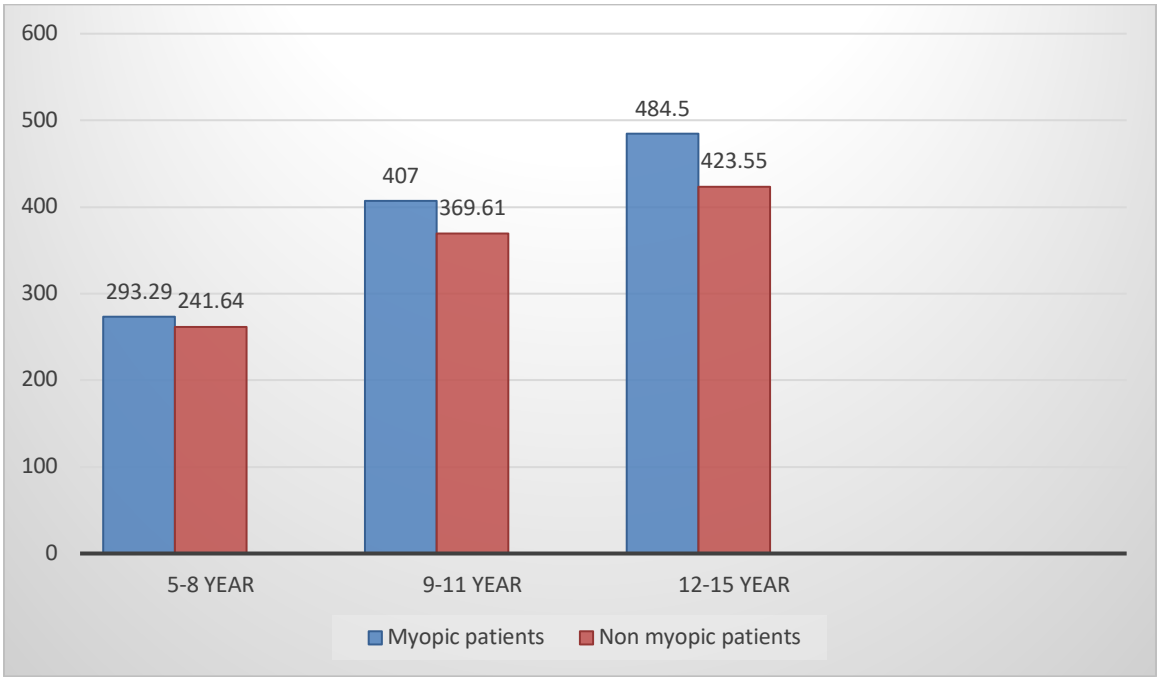

Figure 5: Mean number of Time (in minutes)/day spent as total screen time

Figure 3 show the comparison between the mean time (in minutes)/day spent as total digital screen time in age groups of 5-8 years, 9-11 years,12-15 years between the myopic subjects and non-myopic subjects. There was a statistically significant difference ($p<0.01$) between the mean time (in minutes)/day spent as total digital screen time in age groups of 5-8 years, 9-11 years,12-15 years between the myopic subjects and non-myopic subjects.

Discussion

In this study 260 participants were included. Majority of 147(56.54%) participants were included in the age group between 5-8 years and the remaining distribution was 66(25.4%) in 9-11 years and 47(18.8%) in 12-15 years. The minimum age was 5 years and maximum age was 15 years. Mean age in a study by Hansen *et al*. 2020 [8] was 16.6 years. Mean age was 10.87 years (SD 2.00) in a study by Chi-wai Do *et al* (2020) [9]. In a study by Cristina Alvarez-Peregrina *et al* (2020) [6] the average age of participants was 6.16 ± 0.78 years. The mean age of all subjects was 24.35 ± 1.80 years in a study by Xintong Liang *et al* (2020) [3].

The proportion of myopia was more in 5-8 years age group which was 14(50%) of the total number of myopic subjects. When compared with the total population of the age group of 5-8 years, the percentage of the myopic subjects was 9.52%. When compared within the age group of 9-11years, the

proportion of myopic subjects in the total myopic population was 9(32.1%), and when compared with the total respective population of age group of 9-11 years the proportion was 13.6%. A study by Jiaxing Wang *et al* (2021) [10] found that the myopic shift of SER appeared to be associated with an increase in the prevalence of myopia (SER≤−0.5D) in child age ranging between 6 to 8 years in 2020 compared with previous years. The prevalence of myopia in this age group in 2020 was 21.5% at 6 years, 26.2% at 7 years, and 37.2% at 8 years. In a study by Dorian Tricard *et al* (2021) [11] the rate of myopia progression was essentially linear with time within age groups, the most rapid progression being observed for children aged 7–9 and 10–12 years at baseline (–0.43 D and –0.42 D).

The proportion of boys in myopia and non-myopia group were 46.4% and 53% respectively. The proportion of females in the myopia and non-myopia group was 53.6% and 47% respectively. This difference was not statistically significant. A study by Nermin Küçer *et al* (2009) [12] observed that in users of mobile phones, women significantly ($p < 0.05$) complained more often of inflammation in the eyes than men. In a study by Kathryn A. Rose *et al* (2008) [13] in the year 1 sample, the mean SER in girls was more hyperopic (1.34 D) than that in boys (1.19 D). In a study by Pei-Chang Wu *et al* (2013) [14] the SERs was not significantly associated with gender (P 0.794). In a study by Dorian Tricard *et al* (2021) [11] average progression of myopia was higher among girls (–0.35 D) than among boys (–0.32 D).

In 5-8 years of age group, mean amount of time/day spent on TV/DVD of myopic patients was 123.14±19.21 minutes, whereas it was 102.95±18.49 minutes for non-myopic subjects. In a study by Merriet YA *et al* (2019) [15] out of 52 cases with visual impairment, 20 watched TV for <2hours/day, 12 for 2-4 hours/day and 6 for >4hours/day. The association between the initial age of screen exposure and preschool myopia was Analysed and out of the total participants presented that compared to pre-schoolers without screen exposure, those initially exposed during the early developmental years of life had a statistically significant higher risk of myopia. A study by Hongyu Guan *et al* (2019) [16] recorded 19.9% subjects with myopia who watched TV for 31–60 minutes and 19.8% who watched TV for > 60 minutes had myopia. A study by Shengxin Liu *et al* (2019) [17] on children aged 6–14 years in urban areas of Tianjin reported that time spent using tablets and watching television was not significantly associated with the abnormal myopic SER.

In the present study Mean amount of Time (in minutes)/day spent on computer/Laptop were studied and compared. In 5-8 years of age group, mean time spent on computer/laptop in myopic patients was 30.43±2.88 minutes, whereas it was 23.69±6.68 minutes for non-myopic subjects. In a study by Kathryn A. Rose *et al* (2008) [13] there was no overall association of near work activities, including homework, reading, handheld computer/ laptop use and mean SER in the year 1 sample (P 0.08), although a significant association with mean SER was observed in children whose parents were not myopic (P 0.004). A recent meta-analysis by Huang HM *et al* (2015) [18] found that more time spent on near work activities was associated with higher odds of myopia [OR 1.14, 95% confidence interval (CI) 1.08–1.20] and that the odds of myopia increased by 2% (OR 1.02, 95% CI 1.01–1.03) for every 1-diopter-h more of near work per week. In a study by Hongyu Guan *et al* (2019)(16), 16.5% children out of 15,493 children with no history of computer use had myopia.2,634 children used computer for 1–30 minutes of which 22.4% children had myopia. 809 children used computer for > 60 minutes of which 23.5% had myopia.

In the present study mean amount of Time/day spent on mobile/Laptop were studied and compared. In 5-8 years of age group, mean amount of Time (minutes)/day spent on mobile/Laptop in myopic patients was 124.29±4.19 minutes, whereas it was 103.29±6.04 minutes for non-myopic subjects. In a study by Chi-wai Do *et al* (2020) [9] time spent on smartphones at baseline was negatively and significantly associated with the SER of both eyes at baseline and 1-year follow-up. In the same study time spent on tablets was insignificantly associated with baseline SER but significantly associated with SER at 1-year follow-up (both p< 0.05), with participants who spent 2–3 h per day on tablets having had the most negative SER (−2.30 D for the right eye and −2.21 D for the left eye), that is, having the most negative refractive error. In a study by Merrie*et al* (2019) [15] subjects who had mobile exposure for more than 2 hours, reported 7.5% cases of poor vision/visual impairment; whereas those who had mobile exposure for less than 2 hours reported less cases (6.6%) of poor vision. A study by Luoming Huang *et al* (2019) [18] found that 84.57% cases who had mobile exposure for >3 hours developed myopia and 88.03% cases who had mobile exposure for <3hours developed myopia. A study by Joowon Kim *et al* (2016) [19] found higher prevalence rates for ocular symptoms were observed in groups with greater exposure to smartphones ($p < 0.05$). Longer daily smartphone use was associated with a higher likelihood of having multiple ocular symptoms (5–7 symptoms out of 7 symptoms; $p = 0.005$).

In the present study mean amount of Time/day spent on distant active watching was observed and compared. In 5-8 years of age group, mean amount of Time/day spent on distant active watching in myopic patients was 13.86±3.67 minutes, whereas it was 12.89±2.36 minutes for non-myopic subjects. In a study by Kathryn A. Rose *et al* (2008) [13] small working distance activities such as watching television, playing videogames and using computers, were not associated with mean SER in either the year 1 (P 0.7) or the year 7 (P 0.8) sample. In a study by Yosef Antehun Merrie *et al* (2019) [15] 32.3% children watched TV at a distance of <2 m, 38.3% watched tv at 2–4 m, 28% watched at >4 m.

In the present study 5-8 years of age group, mean time of myopic patients was 293.29±64.88 minutes, whereas it was 241.64±51.77 minutes for non-myopic subjects. In 9-11 years of age, the mean time/day for total screen time was 407.00±9.4 minutes for myopic and 369.61±33.87 minutes for non-myopic subjects. In a study by Ritvija Dixit *et al* (2016) [20] myopia was seen in 34.3% cases, whose total screen time was <3 hrs, 33.6% cases whose screen time was 3-5 hrs, and 28.8% of those who used screen for >5 hrs. A study by Cristina Alvarez-Peregrina *et al* (2020) [6] observed that the number of hours spent in near vision and the use of electronic devices increases significantly with age, with this number being higher in children aged 7 years (OR:1.02; CI:0.99-1.94; $p < 0.05$). Thus, older children spend more time on devices, especially those with excessive screen time > 3 h. Clear association was seen between the excessive use of electronic devices and the increased prevalence of myopia (OR: 1.10; CI: 1.07-1.13; $p \leq 0.001$).

Conclusions

In this study we found that there was a strong association between increased digital screen time and myopia. Other factors such as presence of myopia in one or both parents, and increased prevalence in myopia with the increase in age were also observed as considerable factors. Although effective pharmacological and optical measures are used to lessen the progression of myopia, but

the most important factor is the timely diagnosis of the refractive error. The increasing prevalence of myopia should encourage paediatrician, ophthalmologists, schools and most importantly parents to pay attention to the risk factors. This should be in special considerations to the fact of one or both parents having myopia. Other factors such as increased indoor activities, lack of daylight exposure, particularly in view of increased use of digital media refractive error should be considered at early ages so that the Myopia can be timely diagnosed and treated.

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