ORIGINAL ARTICLE

Progression of Myopia Among Youngsters Due to Increase Screen Time during Covid-19

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ABSTRACT

Objective: To determine the progression of myopia due to increased screen time during Covid 19.

Study Design: A Comparative cross-sectional study

Place and Duration of Study: It was conducted in the Ophthalmology Department of a tertiary care hospital from December 2019 to June 2022.

Material and Methods: There were 202 patients. Myopic patients with a spherical equivalent ≤ -0.5D were included. A history of daily screen time, the type of smart digital device and time spent in outdoor activities before and during Covid 19 was recorded. Previous myopic corrections and present corrections were recorded. The magnitude of myopic progression was calculated. Data was analysed by SPSS version 27. Paired t-test and an independent t-test were applied.

Results: There were 117 (57.9%) males. Mean age was 13.97±4.19 SD years. Students were 179 (88.6). More than one gadget was used by 156 (77.2%) patients with a mean follow-up of 12.41 ± 4.02 SD months. Mean pre-covid myopia in the right eye was 2.75 ± 2.02 D and left eye was 2.83 ± 2.14 D. Mean myopia during covid in the right eye was 3.36 ± 2.12 D and left eye was 3.45 ± 2.26 D with a *p-value* 0.001. The majority of the patients had mild progression of myopia i.e. 134 (66.3%) and 132 (65.3%) in the right and left eye respectively.

Conclusion: The progression of myopia is related to an increase in screen time among youngsters during covid 19. There was mild myopia progression in most of the patients. Progression was more marked in females as compared to males and in students as compared to employed.

Key Words: *Myopia, COVID-19, Screen time, Progression, Lockdown*

INTRODUCTION

Myopia is one of the most common refractive errors throughout the world. Prevalence of myopia has significantly increased in the last few years and it is estimated that half of the global population will be myopic by 2050.[1] The primary reasons for myopic shift are the prolonged and excessive near work.[2] Several studies have reported the progression of myopia due to excessive near work.[3,4]

It has been reported in research, that not only genetic factors but also certain environmental variables like decreased time spent in outdoor physical activities and more with near work are responsible for the increased prevalence and progression of myopia in industrialized nations.[5,6]

The use of electronic devices for a longer time has been related to the increased risk of developing myopia among children.[7] A new form of excessive near-work has been introduced in the form of smart digital devices, which are used by children continuously without any breaks. It has been reported that watching smartphones leads to 30% increased risk of myopia and further unrestrained use of computers will ascent it to 80%.[8]

Smaldone et al reported before Covid 19 that myopic children spent 0.95 hours a day using a computer as compared to non-myopic children who spent 0.69 hours.[9] It has also been reported that the risk of developing myopia was 2.6 times higher among children who spent more time for near work and less time for outdoor activities.[10]

The screen time recommended by the American Academy of Optometrists among 2-5-year-old children was one hour a day.[11]

In 2019 corona virus (COVID-19) pandemic spread worldwide and had serious implications for public health.[12] Aggressive measures were taken to stop the spread of disease and strict lockdowns were imposed which led to the closure of educational institutes and offices. An online working and teaching system was introduced. This resulted in a marked increase in usage of smart digital devices like smartphones, laptops, tablets and computers. Eventually, the screen time and near work increased and outdoor activities were markedly reduced. All these factors led to the onset and progression of myopia.[13] According to UNESCO (United Nations Educational Scientific and Cultural Organization) schools were closed in about 160 countries leading to 87% student population of the world being confined to home.[14]

To the best of our knowledge, limited studies have been done on this subject in our country. Only one study has cited an increase in the magnitude of myopia.[15] Our study will help to determine the status of myopia progression during COVID-19 due to an increase in screen time and generate local data in this context. The objective of this study was to determine the progression of myopia due to the increase in screen time during COVID-19 among youngsters.

MATERIAL AND METHOD

This was a comparative cross-sectional study, conducted in the outpatient department of Ophthalmology Karachi Medical & Dental College and Abbasi Shaheed Hospital and outpatient departments of two private Setups (Raza Eye Clinic and Fatimiya Hospital) from December 2019 till June 2022. The study was approved by the ethical review board of Karachi Medical and Dental College, Hospital and adheres to the tenets of the Declaration of Helsinki. The sample size was calculated using Raosoft sample size for demographic studies. Keeping the population size of 1000,000 confidence interval of 90%, margin of error 5%, and hypothesized frequency (p) 62.4% the calculated sample size was 202.[16]

All patients of myopia with the spherical equivalent of -0.5 D or more, myopic astigmatism up to -1.00 diopters, ages between 5-25 years, using electronic gadget every day and have previous documented refraction records, at least with one follow up were included in the study.

All patients with a previous history of any ocular surgery, any retinal pathology, pseudophakia, aphakia, squints, myopia associated with collagen vascular diseases, keratoconus, corneal opacity, dystrophy, amblyopia, and those who were not willing to be a part of the study were excluded from the study.

Data was collected using a nonprobability consecutive sampling technique from the Outpatient department of a public hospital and 2 private setups. Informed consent was taken from children above 12 years and from parents of children younger than 12 years of age. A detailed history regarding daily screen time in hours, type of smart digital device, as smartphone, tablet, laptop and television, and time spent in outdoor activities in hours was asked and recorded on a pre-designed pro forma. Refraction was done using an autorefractor and confirmed by retinoscopy under cycloplegic conditions. The best corrected visual acuity was recorded with the help of the Snellen chart. Previous myopic corrections and present corrections were recorded on the pro forma. The magnitude of myopic progression was calculated from the difference between the two records. Average refraction of eyes was taken to analyze the final progression of myopia. The myopic astigmatism was converted to a spherical equivalent for analyzing the results.

Progression was graded as no progression if the difference of records is 0 diopter, mild progression with a difference of 1 diopter, moderate progression with a difference of 1-2 diopters, and severe progression with a difference greater than 2 diopters.[16]

Youngsters were defined as ages between 5 to 25 years of age. The patients' records from December 2019 to July 2020 were taken as pre covid, and from August 2020 onward as the covid era.

Data was collected and analyzed on SPSS version 20. Frequencies with percentages were computed for categorical variables like age, gender, previous myopic correction and present myopic correction. Mean and Standard deviation were calculated for continuous data. A paired t-test was used to compare the myopia progression, daily screen time and outdoor activity before and during covid 19. Independent t-test and ANOVA were applied to determine the difference between right and left eye disease status with various independent variables. Frequencies with percentages for disease progression on the basis of no progression, mild, moderate and severe were seen in the right and left eye. The p-value of less than 0.05 was considered significant.

RESULTS

The total number of patients in this study was 202. The mean age of the patients was 13.97 ± 4.19 SD years. The minimum age of the patients reported was 5 years and the maximum was 25 years. The median age was 13.5 years and the interquartile range was 11.7-16.0 years. The male patients were 117 (57.9%). Most of the patients were students 179 (88.6%) and employed were 23 (11.4%). More than one gadget was used by 156 (77.2%) patients. The mean follow-up time was 12.41 ± 4.02 SD months. Mean pre-covid screen time was 3.05 ± 1.5 SD hours and mean outdoor activity was 1.6 ± 1.01 SD hours. The mean covid screen time was 6.6 ± 1.91 SD hours and the mean outdoor activity during covid was 0.42 ± 0.30 SD hours. The demographic characteristics of the patients are given in table 1.

TABLE 1: Demographic features of the patients

Variable	**Frequency n (%)**
Total no of patients	202
Mean Age	13.97+4.19 SD
5-8 years	19 (9.4)
9-16 years	139 (68.8)
17-25 years and above	44 (20.79)
Gender	
Male	117 (57.9)
Female	85 (42.1)
Student	179 (88.6)
Employed	23 (11.4)
Smart Digital Device Used	
Smart Phone	25 (12.4)
Tablet	10 (5.0)
Laptop	8 (4.0)
DeskTop	3 (1.5)
More than one gadget	156 (77.2)
Screen time pre covid	3.05 ± 1.5 hours
Screen time covid	6.6 ± 1.91 hours
Outdoor activity pre covid	1.6 ± 1.01 hours
Outdoor activity covid	0.42 ± 0.30 hours
Mean follow up	12.41=4.02
Minimum follow up	months
Maximum follow up	6 months
	24 months

The comparisons of the means of screen time, and the duration of outdoor physical activities pre covid and during COVID-19 is statistically significant with a p-value of <0.001. The mean pre-covid myopia in the right eye was -2.75 ± 2.02 diopters (D) and in the left eye was -2.83 ± 2.14 D. The mean myopia during covid in the right eye was -3.36 ± 2.12 and left eye was -3.44 + 2.26 with a significant p-value (<0.001). The comparisons of the means are given in table 2 with a 95% confidence interval (CI).

There was no significant association between various age ranges and the stage of myopia in the right and left eye respectively as the *p-value* is insignificant. There is a significant progression of myopia in females -1.04 ± 0.55 SD (95% CI: 0.92-1.1) as compared to males -0.67 ± 0.55 SD (95% CI: 0.57-0.77) in the right eye with a p-value less than 0.001. In the left eye myopia progression in females is -1.1± 0.66 SD (95% CI: 0.92-1.26) and in males is -0.81 ± 0.54 SD (95% CI: 0.71-0.91) with a significant p-value. The myopia progression is significant in the left eye of students -0.94 ± 0.60 (95% CI: 0.86-1.03) as compared to the left eye of the employed participants -0.86 ± 0.69 (95% CI: 0.56-1.16). There is no significant progression of myopia in the right eye of students as compared to the employed. Table 3 shows the association between the progression of myopia and various factors like age, gender and working status.The progression of myopia as mild, moderate, and severe in the right eye and left eye pre covid and during COVID-19 is given in table 4. There was mild myopia progression seen in 134 (66.3%) patients and no progression was seen in 52 (25.7%) patients in the right eye. In the left eye, mild progression was seen in 132 (65.3%) patients and no progression was seen in the 42 (20.8%) patients.

TABLE 2: Change in eye characteristics before and after covid

Characteristics	Mean ± SD	95% CI	p –value *
Screen time pre-covid	3.05 ± 1.59	2.84-3.28	<0.001
Screen time covid	6.68 ± 1.91	6.42-6.9	
Outdoor activities pre-covid	1.63 ± 1.01	1.49-1.77	<0.001
Outdoor activities covid	0.42 ± 1.01	0.30-0.50	
Myopia right eye pre-covid	2.75 ± 2.02	2.47-3.03	<0.001
Myopia right eye covid	3.36 ± 2.12	2.53-3.13	
Myopia left eye pre-covid	2.83 ± 2.15	3.07-3.65	<0.001
Myopia left eye covid	3.45 ± 2.26	3.13-3.76	
Difference in right eye	0.61 ± 0.51	0.54-0.68	0.806
Difference in left eye	0.66 ± 0.508	0.59-0.73	

*****Paired t-test was applied p values less than 0.05 were considered significant

TABLE 3: Mean difference with change in eye conditions before and after covid

Characteristics	Myopia in the Right Eye			Myopia in the Left Eye		
	Mean ±SD	**95% CI**	**p-value**	**Mean ±SD**	**95% CI**	**p-value**
Age						
5- 8 years	1.5±0.57	0.58-2.4		0.89±0.55	0.49-1.60	
9-16 years	0.74±0.54	0.56-0.92	0.015 *	0.75±0.53	0.59-0.94	0.058 *
17-25 years	0.80±0.45	0.70-0.89		01±0.48		
Gender						
Male	0.67 ± 0.55	0.57-0.77	<0.001#	0.81±0.54	0.71-0.91	<0.001#
Female	1.04 ± 0.55	0.92-1.1		1.1± 0.66	0.92-1.26	
Working status						
Student Employed	0.83± 0.58	0.75-0.92	0.08#	0.94±0.60	0.86-1.03	0.03#
	0.78±0.59	0.52-1.04		0.86±0.69	0.56-1.16	

Independent t- test *Anova

TABLE 4: Frequency of disease progression in right and left eye

Grade of progression	Right eye (%)	Left eye (%)
No progression	52 (25.7)	42 (20.8)
Mild	134(66.3)	132 (65.3)
Moderate	14 (6.9)	26 (12.9)
Severe	2 (1.0)	2 (1.0)

The graphical illustration of the progression of myopia in the right and left eye is given the fig 1.

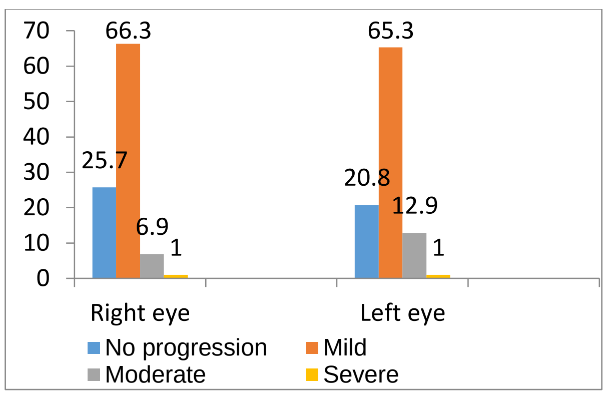

Fig 1: Graphical presentation of myopia progression in right and left eye

DISCUSSION

The COVID-19 pandemic began in December 2019 and swept widely over every continent. It led to the lockdown which affected all aspects of life including businesses, education and, public health as well.[12] Educational institutes were closed for more than a year and the educational system was shifted to an online mode which involved the use of multiple digital gadgets. This resulted in increased screen time which doubled the excessive near work, markedly reduced outdoor activities and resulted in the progression of myopia.[13]

The exact mechanism for the progression of myopia due to smart digital devices is not known but it has been postulated that excessive accommodation, convergence and peripheral defocusing may lead to axial elongation by stimulating the growth of the eyeball thus increasing the myopia.[17]

An increase in outdoor activities is thought to lessen myopia as opposed to prolonged near work. It has been proposed that exposure to ultraviolet light during outdoor activities leads to the production of dopamine which inhibits the growth of eyeballs thus reducing the progression of myopia.[18]

Our study comprised of 202 myopic patients with an increase in screen time during covid 19. Their pre-covid and covid refractions were compared and progression of myopia was determined. The mean pre-covid myopia in the right eye in our study was 2.75 ± 2.02 diopters (D) and the mean covid myopia was 3.36 ± 2.12 D. In the left eye pre covid myopia was 2.83 ± 2.15 and the mean covid myopia was 3.45 ± 2.26. Amit et al reported mean pre-covid myopia 4.57 ± 2.70 D and covid myopia of 5.12 ± 2.70 D in their study.[16]

The majority of patients had mild progression of myopia (≥ I diopter) which was seen in 134 (66.3%) right eyes and in 132 (65.3%) left eyes and belonged to the younger age group (9-16 years). A similar study conducted by Shah et al also reported myopia progression among all age groups and the majority of patients were between 13-19 years.[15] Amit et al reported that 62.4% of children showed myopia progression during the pandemic. They also reported rapid myopia progression among children older than 10 years of age which is quite similar to our study.[16] Higher rates of myopia progression (0.50 ± 0.51 D) were also reported by Xhang et al and Ma et al (0.98 ± 0.52 D) during the pandemic.[19,20] The reason for the rapid progression of myopia in younger age groups could be that children of this age group may be more involved in the usage of digital devices for educational purposes and entertainment.

The mean pre-covid screen time in our study was 3.05 ± 1.59 hours/day that increased to 6.68 ± 1.91 hours per day during covid while the mean time for outdoor activity reduced from 1.63 ± 1.01 hours/day to 0.42 ± 0.90 **/**day during covid. Xhang et al reported that increase in screen time from 2.45 to 6.89 hours/day and a reduction in outdoor activities from 1.27 to 0.41 hours/day during COVID-19 which is quite similar to our study.[19] Ma reported an average pre-covid screen time of 0.6 hours per day that increased to 5.24 hours per day during Covid.[20] Their pre-COVID screen time was much less as compared to our study as according to the recommendation of the Chinese government that screen time should be less than one hour per day to control myopia.[20] But their post-covid screen time is quite similar to our study. Another study by Hansen reported that excessive screen time of over three hours per day is associated with an increase in prevalence and progression of myopia.[21] A Chinese study has also reported that an increase in screen time, excessive near work and reduced outdoor activities are responsible for the onset and progression of myopia.[15] Amit et al conducted a similar study including 133 school-going children and reported increase in screen time of >4 hours/day in 68.9% of children and 96.7% of children used smartphones for online classes. According to them, the number of students who used smartphones for online classes for more than two hours increased from 2.3% to 15.1%. They reported that about 45.9% of children had a myopia progression of ≥ 1 dioptre during covid.[18] Imtiaz et al reported a high occurrence and progression of myopia among smartphone users.[22]

A similar study from Saudi Arabia reported myopia progression ≥1 diopter during covid among 74.2% of patients with ages between 6-14 years. The majority of the patients in their study had a daily screen time of about 4-6 hours. There were 88% patients who had a daily outdoor activity time of ≤2 hours daily and they had 45% risk of myopia progression. Smartphones were used by 62% of the patients during COVID-19 for online classes as the majority of the participants belonged to low socioeconomic income groups.[23]

About 77% of patients were using multiple digital gadgets during covid. The mean age of the participants in our study was 13.97±4.19 SD and there was a slight male preponderance (57.9%). The above-mentioned study from Saudi Arabia reported a mean age of 11 ± 2.4 SD years and 47% of male patients.[22]

It was observed in our study that myopia progression was seen more in younger age groups 5-7 years of age as compared to older age groups, among females as compared to males and students as compared to employed people. Lisa et al also reported greater progression of myopia in younger age groups and among females.[24]

The strength of this study is the number of patients collected from different centres. This study is one of the few, conducted in the country to document the progression of myopia in Pakistani children. Now it is the responsibility of the policymakers, parents, educators, and medical experts to halt the prevalence and progression of myopia in our nation's youth.

One of the study's limitations is the patient follow-up. To assess the long-term consequences of increased screen usage due to home confinement in COVID 19 on the progression of myopia, longer follow-up would have given a comprehensive impact. Ocular biometry data was missing in our study. Axial length measurement would contribute to an improved understanding of excessive near work on axial length.

CONCLUSION

The findings of our study support that the progression of myopia is related to an increase in screen time and reduced outdoor activity among youngsters during COVID 19. There was mild myopia progression in most of the patients but no significant difference is notable between the two eyes. Progression was more marked in female gender as compared to males and more marked in students as compared to employed.

Conflict of interest: None

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