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Myopia Progression During COVID19 Pandemic at a Tertiary Care Hospital

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ABSTRACT

Purpose: The lockdown due to COVID19 pandemic lead to many countries implementing a population lockdown. This study was designed to investigate myopic changes that occurred during lockdown due to the COVID19 pandemic in Pakistan. **Methods:** A prospective, cross-sectional study, was conducted from patients presenting to the out-patients department with symptoms suggesting a refractive problem. Subjects with a Mean Spherical Equivalent (MSE) level of myopia of at least -0.50DS were included. A second group of subjects that had emmetropia (MSE between -0.25DS and +0.25DS) were recruited. All subjects (including adults) underwent cycloplegic refraction and using objective and subjective techniques, to exclude any pseudo-myopia due to accommodation. **Results:** A total of 900 subjects were enrolled from 4 to 24 years. The myopia group consisted of 473 subjects (256 females) and the emmetropia group consisted of 427 subjects (224 females). There was no statistical difference in the ages of the groups. Both groups showed an increase in their level of myopia, which was statistically higher in the emmetropic group ($p<0.001$). Further analysis was conducted, splitting the subjects into four age groups: 4-8 years; 9-12 years; 13-19 years; and 19-24 years. All age groups showed an increase in the magnitude of myopia, with the oldest age group showed the least increase, which was statistically significant ($p<0.005$). **Conclusions:** An increase in the magnitude of myopia was seen in all subjects and across all age groups, but more so in the younger subjects.

Keywords: Myopia Progression, COVID19, Lockdown, Refractive Changes

INTRODUCTION

A pandemic of the Coronavirus poses a significant threat to children's mental and emotional health (Tambunan *et al.*, 2021). The recent global epidemic of the new Corona virus (SARS-CoV-2) is a worrisome example of the severity posed by a highly dynamic viral strain (Chatterjee & Bhattacharya, 2020). This epidemic has an impact on people's emotional and physical well-being (Khodabakhsh, 2021). The global COVID19 pandemic caused many countries to implement a lockdown and only essential services (such as food retail) were available for people to use. People were advised to work from home where possible and home-schooling was implemented. The lockdown scenario meant that many people were based indoors for long periods with limited access to natural light and an increase in indoor screen-based activities. For children with myopia, this could

cause an increase in their myopic refraction since exposure to daylight is advised to slow down the progression of myopia (Jones *et al.,* 2007; Rose *et al.,* 2008; Wu *et al.,* 2010; Guo *et al.,* 2013, Wu *et al.,* 2013; Isaacs, & Wood, 2016 and Öner *et al.,* 2016). Furthermore, some older teenagers or young adults may have undergone similar changes in their myopia for the same reasons (Dirani *et al.,* 2009; Lu *et al.,* 2009 and Sherwin *et al.,* 2012). This study investigates this possible effect amongst children and young adults in Pakistan during the lockdown imposed in 2020 and through to 2021 when some restrictions were still in place. In Pakistan, a lockdown period came into force in April 2020 and for school and university students this continued until July 2021. The academic year starting in August 2021 allowed a return to face-to-face teaching.

METHODOLOGY

A prospective cross-sectional study was conducted at the Department of Ophthalmology of the Public Sector Tertiary Care Hospital, Islamabad, Pakistan. Patients are triaged upon arrival via the optometry clinic and then are either managed there or referred to the ophthalmology clinic. The patients that are managed by the optometry clinic only are typically those that have a refractive problem or some contact lens patients. The normal clinical practice for a patient that complains of visual symptoms, but a refractive explanation cannot be sought, is for them to be referred for an ophthalmology opinion.

The hospital is a very busy tertiary center and typically will see over one thousand subjects that fit the inclusion criteria (as stated below) per month, so the study sample was collected by using systematic random sampling by calculating the Sample Interval from the monthly data. In total 150 subjects per month were taken as a study sample using a Sample Interval of 7. Recruitment started in April 2020 and lasted for 6 months, which meant that throughout the study a total of 900 subjects were included. Each subject recruited was seen for an initial visit and then around 8 months (minimum interval was 7 months and the maximum interval was 9 months) later for a second visit. For this study, a second visit appointment was conducted between November 2020 and July 2021. Two groups of subjects were identified: those with the myopia of at least -0.50DS Mean Spherical Equivalent (MSE) at the time of the first presentation; and those with emmetropia at the time of the first presentation. Emmetropia was defined as anyone who had an MSE of +0.25 to -0.25DS. Patients with hypermetropia of greater than +0.50 were excluded. Additional exclusion criteria were tropia, history of ocular trauma or surgery, primary corneal ectasia, amblyopia, and high astigmatism (defined as anyone with a refractive error where the cylindrical component was higher than their spherical component or anyone with a cylinder above 2DC). Each subject underwent a detailed refractive examination by the principal investigator (MS). The clinical tests included were uncorrected vision (using a LogMAR chart), retinoscopy, subjective refraction, corrected visual acuity, and cyclo-refraction (including administration of 2 drops of 1% cyclopentolate to each eye).

All subjects also underwent a complete slit-lamp examination of the anterior segment and posterior segment by an ophthalmologist to ensure that there was no co-existing pathology explanation for their symptoms.

Informed consent was taken from the patient or in the case of minors, from their guardian. Ethical approval was granted by the Ethical Review Board of the Hospital. All procedures were undertaken according to the declaration of Helsinki and local ethical approval was awarded for the study.

RESULTS

The age and gender demographics of both groups and the change in refractive error seen over the two visits are displayed in Table 1. In both groups an overall increase in myopia was seen and no subject showed a decrease in the level of myopia between the 2 visits (there were 83 patients that showed either no change in refractive error or a change of only -0.25DS and they have been included in the analysis so as not to bias the results). Table 1 also shows the MSE from visits 1 and 2, plus the uncorrected vision and visual acuity at visit 2.

Table 1: the MSE from visits 1 and 2, plus the uncorrected vision and visual acuity at visit 2

	Myopia group	Emmetropia group
Gender	256 females 217 males	224 females 203 males
Age (years)	16.0±4.2 Range 4.0 to 24.0	14.2±4.7 Range 4.0 to 24.0
MSE at visit 1 (DS)	-1.87±1.40 Range -0.50 to -10.00	0.00±0.03 Range 0.00 to -0.25
MSE at visit 2 (DS)	-2.88±1.69 Range -0.50 to -12.50	-1.28±0.68 Range -0.25 to -3.50
Uncorrected vision (LogMAR) at visit 2	0.87±0.31 Range 1.90 to -0.90	0.53±0.22 Range 1.20 to 0.10
Corrected visual acuity (LogMAR) at visit 2	0.00±0.10 Range 0.90 to 0.00	0.01±0.10 Range 0.90 to 0.00
Increase in myopia (DS) at visit 2	1.02±0.66 Range 0.00 to 5.25	1.22±0.69 Range 0.00 to 3.50

There was no statistical difference (t-test) between the ages of the two groups nor the corrected visual acuity at visit 2 ($p>0.05$). As expected, the uncorrected vision was statistically worse (t-test) in the myopia group, as was the MSE at visits 1 and 2 ($p<0.001$). However, the increase in myopia was statistically higher (t-test) in the emmetropic group ($p<0.001$). Figure 1 shows the mean increase in myopia for the two groups over the two visits.

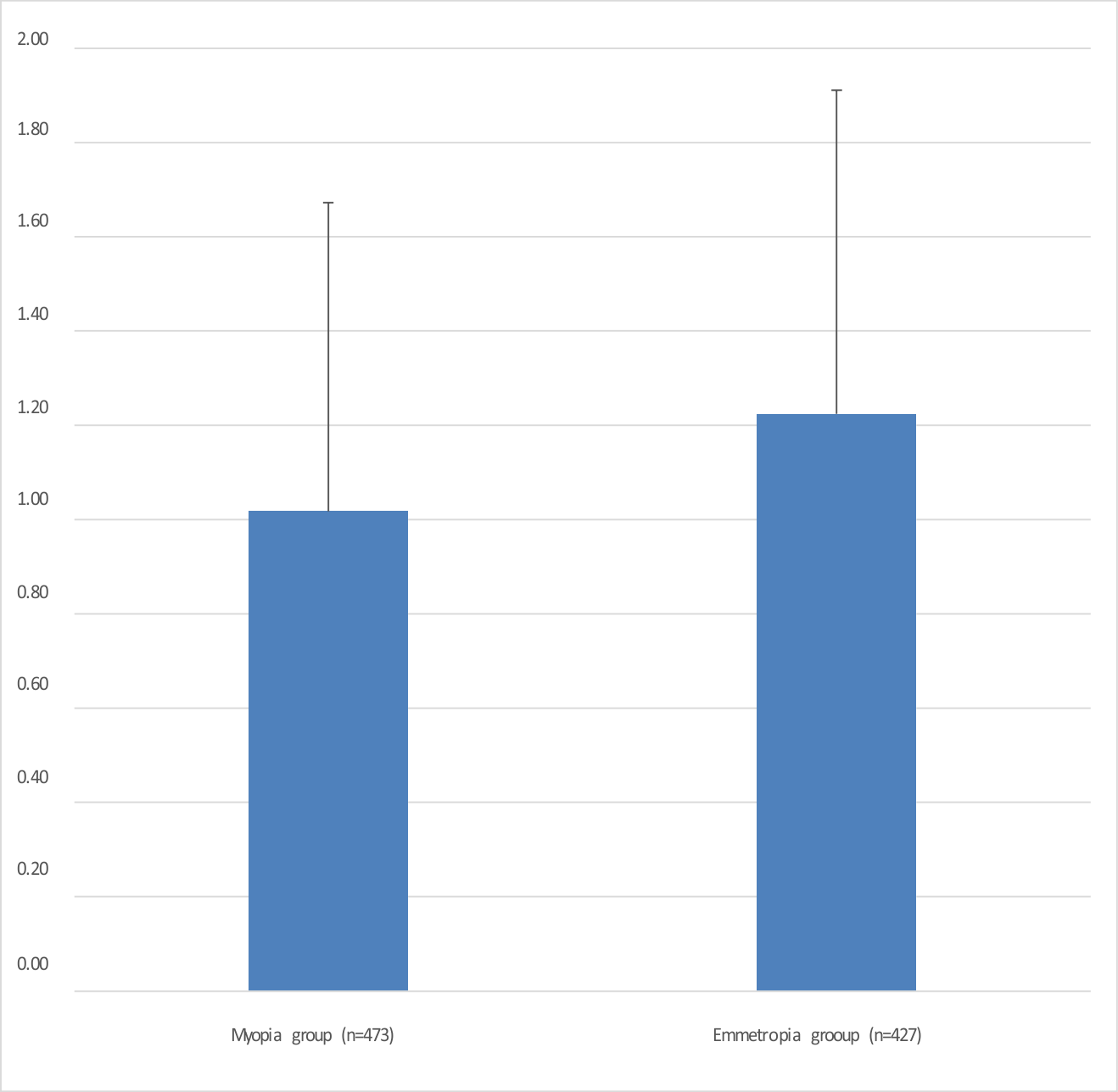

Figure 1: The mean magnitude (and standard deviation) increase in myopia for the two groups over the two visits, in dioptres (DS)

The data was also analysed according to the age of the subjects. Subjects were assigned to 4 groups as shown in Table 2. The age and gender demographics of all four age groups and the change in refractive error seen over the two visits are displayed in Table 2. In all groups an increase in myopia was seen and no subject showed a decrease in the level of myopia between the 2 visits. Table 2 also shows the MSE from visits 1 and 2, plus the uncorrected vision and visual acuity at visit 2.

Table 2: The MSE from visits 1 and 2, plus the uncorrected vision and visual acuity at visit 2

	Group A	Group B	Group C	Group D
Gender	21 females 55 males	80 females 93 males	293 females 190 males	86 females 82 males
Age (years)	6.6±1.2 Range 4.0 to 8.0	10.9±1.1 Range 9.0 to 12.0	15.7±1.85 Range 13.0 to 19.0	21.7±1.4 Range 20.0 to 24.0
MSE at visit 1 (DS)	-0.63±1.56 Range 0.00 to -9.25	-0.73±1.34 Range 0.00 to -6.50	-1.11±1.43 Range 0.00 to -10.00	-1.04±1.11 Range 0.00 to -3.75
MSE at visit 2 (DS)	-1.81±1.67 Range -0.25 to -10.50	-1.86±1.52 Range -0.25 to -7.75	-2.27±1.63 Range -0.50 to -12.50	-1.97±1.17 Range -0.50 to -5.00
Uncorrected vision (LogMAR) at visit 2	0.63±0.26 Range 1.60 to 0.10	0.64±0.31 Range 1.60 to 0.10	0.75±0.34 Range 1.90 to -0.90	0.70±0.31 Range 1.40 to 0.20
Corrected visual acuity (LogMAR) at visit 2	0.06±0.19 Range 0.90 to 0.00	0.02±0.09 Range 0.80 to 0.00	0.02±0.10 Range 0.90 to 0.00	0.00±0.00 Range 0.00 to 0.00
Increase in myopia (DS) at visit 2	1.18±0.64 Range 0.00 to 3.25	1.13±0.67 Range 0.00 to 3.50	1.17±0.71 Range 0.00 to 5.25	0.93±0.60 Range 0.00 to 3.50

There was no statistical difference (Bonferroni adjusted t-test) between the corrected visual acuity at visit 2 ($p>0.05$). All four age groups showed an increase of the level of myopia at visit 2, which was statistically worse (Bonferroni adjusted t-test) than at visit 1 ($p<0.001$). Furthermore, when comparing the change in MSE group D showed the least increase in myopia and it was the only group that showed a statistical difference (Bonferroni adjusted t-test) in the increase of the level of myopia compared to group any other group ($p<0.005$). Figure 2 shows the mean increase in myopia for all four age groups over the two visits.

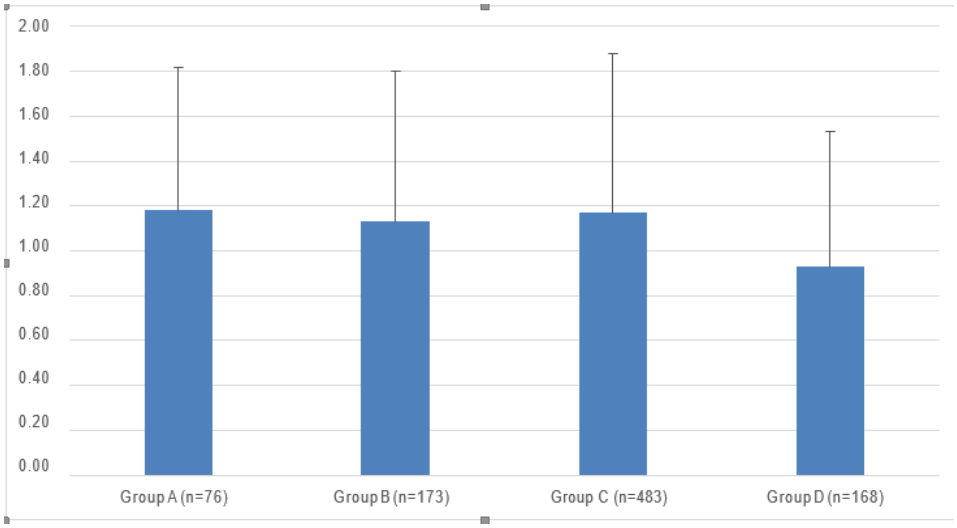

Figure 2: shows the mean magnitude (and standard deviation) increase in myopia for the four age groups over the two visits, in dioptres (DS)

DISCUSSION

It is critical that everyone be educated on the virus because the COVID 19 pandemic has caused severe health concerns throughout the world (Sharma & Jyoti 2020). In 2019, the Coronavirus Disease 2019 (COVID-19) was first discovered in Wuhan, China. The city was cordoned off in an attempt to control the infection. This study aims to learn more about the psychological effects of the pandemic on nursing students (Kishore, Kunjukunju, & Yusof, 2022). COVID-19 coinfection can be life threatening for patients (Nayak, 2022). Diverse types of vaccines against coronavirus has been made to prevent the massive spread of Covid-19 by various countries (Chatki, & Tabassum, 2021). This study shows an increase in myopia for a period of over 7 to 9 months for subjects were initially presented with myopia and those who initially presented with emmetropia. It should be noted that the hospital is a tertiary referral centre and so the presenting patients will, by definition, have an ocular problem. Furthermore, the recruitment of subjects in this study was on the suspicion that there was a refractive problem upon presentation. This means that patients of similar age groups who are not noticing any visual problems are unlikely to present at this hospital, so a control group is not possible, although a repeat of the study is underway with age-matched subjects who did not present with an initial refractive complaint. Nonetheless, a statistically significant increase in myopia was seen of around 1 dioptre in this study. The group that initially presented with myopia showed an increase of myopia of around 50% or compared to their presenting myopia the increase was in the region of 1.5 times. These findings almost match with the study conducted by Wang J. *et al* which reported an increase in myopia from 1.4 to 3 times (Wang *et al.*, 2020). In that study it is possible that the reason for the 3 times increased in myopia could have been the techniques used for measuring the refractive status, which was non-cycloplegic refraction. In the study presented here all subjects underwent a cycloplegic refraction. Other studies have shown a similar myopic shift (Aslan & Sahinoglu-Keskek, 2021). The results of this study are alarming and according to previous studies that showed a lower increase in myopia, the results presented here could deem the subjects as being pathologically myopic as they showed an increase of -0.75DS or more (Aslan & Sahinoglu-Keskek,

2021; Hu *et al.*, 2021; Ma *et al.*, 2021(a); Ma *et al.*, 2021(b); Toro *et al.*, 2022 and Zhang *et al.*, 2021). One study, that had a similar to design to this present study, also found a myopic shift in the magnitude of 1.5 times, with a six-month follow-up (Xu *et al.*, 2021). These findings are consistent with the study conducted by Wang W. *et al* which demonstrated a substantial myopic shift (Wang *et al.*, 2021) and the study by Alvarez-Peregrina et al where a decrease in hyperopic MSE or a movement away emmetropia was seen, suggesting a myopic tendency (Alvarez-Peregrina *et al.*, 2019).

In this present study the subjects were split into age groups dependent upon their stage of life. Group A represented children still in the plastic phase of visual development, group B represented children before they reached secondary school (high school), group C represented those at secondary school (high school) and group D represented those students who were at university. This split did create a very large group C and a smaller group A, but all the groups were large enough for statistical analysis. A sample size calculation (using G-Power) suggested that each group needed to have at least 64 subjects for it to have the correct statistical power and each age group in this study had sufficient power.

These findings are consistent in the literature as it has been reported that, compared with those in Western countries, students in certain Asian countries often perceive greater academic pressure and thus express a higher incidence of myopia (Deng & Pang 2019; Atowa, Wajuihian & Munsamy, 2020; Cao *et al.*, 2020; Eppenberger & Sturm, 2020; Wen *et al.*, 2020 and Lanca *et al.*, 2022). Furthermore, they often spend less time doing outdoor activities and physical exercises (Sánchez-Tocino *et al.*, 2019 and Zadnik, & Mutti, 2019). Effective outdoor promotion activities can reduce the onset of myopia. Home quarantine in the early stage of the COVID-19 outbreak reduced the outdoor activity time for children and adolescents, which might have further contributed to the increased myopic rate. Therefore, the authors suggest that although self-protection and isolation is critical during a pandemic, outdoor activities should be engaged in to prevent myopia during home quarantine periods.

CONCLUSION

The conclusion of the study was that an increase in the magnitude of myopia was seen in all subjects and across all age groups, but more so in the younger subjects during global pandemic COVID-19 and lockdown.

Conflict of Interest

The authors declare that they have no competing interests in writing this article.

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