Myopia progression in children during COVID-19 home confinement in Argentina

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Abstract

Purpose: To determine whether the progression of myopia in children was faster during school closures and home confinement during the COVID-19 pandemic.

Methods: This was a case series study collecting retrospective data on refractive error for 2018 and 2019 in consecutive myopic patients attending regular checkups for their spectacle prescription from September to December 2020. Inclusion criteria were age from 5 to 18 years, and spherical equivalent between -0.50 and -6.00 diopters for the three examinations. Patients receiving any treatment for arresting myopia progression were excluded. Cycloplegic spherical equivalent in both eyes was recorded for 2018, 2019 and 2020. Annualized mean progressions over the two periods 2018-2019 and 2019-2020 were calculated.

Results: At the 2020 visit after confinement, mean age of the 115 enrolled patients was 11.89 ± 3.68 years and 60% were girls. The mean annualized progression for the right eyes in 2018-2019 was -0.43 ± 0.52 D and -0.58 ± 0.53 D in 2019-2020 during the period that included home confinement (p=0·012, Wilcoxon text), an increase of 32%. The median values of progression for these two periods were -0.27 D and -0.53 D.

Conclusion: Annual progression rates over the period that included strict pandemic home confinement were higher than in the previous year, in contrast to the general slowing of progression as children get older.

Key words: myopia progression, COVID-19, pandemic, confinement, school children.

Progresión de la miopía en la infancia durante el confinamiento del COVID-19 en la Argentina

Resumen

Objetivo: Determinar si la progresión de la miopía en niños es más rápida durante el cierre de escuelas y el confinamiento en el hogar durante el período de pandemia por COVID-19.

Métodos: Se trata de un estudio de serie de casos que recoge datos retrospectivos sobre el error refractivo en 2018 y 2019 de pacientes miopes consecutivos que acudieron a controles regulares para su prescripción de gafas desde septiembre a diciembre de 2020. Los criterios de inclusión para los tres exámenes fueron edad de 5 a 18 años y equivalente esférico entre -0,50 y -6,00 dioptrías. Se excluyeron los pacientes que recibieron algún tratamiento para detener la progresión de la miopía. Se registró el equivalente esférico corroborado con cicloplejico en ambos ojos para 2018, 2019 y 2020. Se calcularon las progresiones medias anualizadas durante los dos períodos 2018-2019 y 2019-2020.

Resultados: En la visita de 2020 después del confinamiento, la edad media de los 115 pacientes registrados fue de 11,89 ± 3,68 años y el 60% era niñas. La progresión anualizada media para el ojo derecho en 2018-2019 fue -0,44 ± 0,52 D y -0,58 ± 0,53 D en 2019-2020 durante el período que incluyó el confinamiento domiciliario (p=0 012, texto de Wilcoxon), y un aumento de 32%. Los valores medianos de progresión para estos dos períodos fueron -0,27 D y -0,53 D.

Conclusión: Las tasas de progresión anual durante el período que incluyó el confinamiento domiciliario estricto por la pandemia fueron más altas que en el año anterior, en contraste con la desaceleración general de la progresión a medida que los niños crecen.

Palabras clave: progresión de la miopía, COVID-19, pandemia, confinamiento, niños.

Progressão da miopia na infância durante o confinamento de COVID-19 na Argentina

Resumo

Objetivo: Determinar se a progressão da miopia em crianças é mais rápida durante o fechamento de escolas e o confinamento em casa durante o período de pandemia por COVID-19.

Métodos: Trata-se de um estudo de série de casos que coleta dados retrospectivos sobre o erro refrativo em 2018 e 2019 de pacientes míopes consecutivos que compareceram a controles regulares para prescrição de óculos de setembro a dezembro de 2020. Os critérios de inclusão para os três exames foram: idade entre 5 e 18 anos e um equivalente esférico entre -0,50 e -6,00 dioptrias. Pacientes que receberam qualquer tratamento para interromper

a progressão da miopia foram excluídos. O equivalente esférico corroborado com cicloplégico foi registrado em ambos os olhos para 2018, 2019 e 2020. As progressões médias anualizadas foram calculadas durante os dois períodos 2018-2019 e 2019-2020.

Resultados: Na visita de 2020 após o confinamento, a idade média dos 115 pacientes registrados era de 11,89 ± 3,68 anos e 60% eram meninas. A progressão média anualizada para o olho direito em 2018-2019 foi -0,44 ± 0,52 D e -0,58 ± 0,53 D em 2019-2020 durante o período que incluiu confinamento domiciliar (p = 0,012, texto de Wilcoxon) e um aumento de 32 %. Os valores medianos de progressão para esses dois períodos foram -0,27 D e -0,53 D.

Conclusão: As taxas de progressão anual durante o período que incluiu confinamento domiciliar estrito para a pandemia foram maiores do que no ano anterior, em contraste com a desaceleração geral da progressão conforme as crianças crescem.

Palavras chave: progressão da miopia, COVID-19, pandemia, confinamento, crianças.

Introduction

Myopia is a major cause of vision loss in adults internationally, due to widespread lack of correction and uncorrectable pathological high myopia[1]. It has been predicted that nearly half of the world's population will be myopic by 2050[2], a fact that needs urgent international action[3]. Since the onset of myopia, and perhaps also myopia progression, are associated with less outdoor exposure and more intense nearwork[4-5], this study aimed to investigate whether the school closures and home confinement due to the COVID-19 pandemic in Argentina in 2020 were associated with an increased progression of myopia, potentially increasing the burden of myopia.

In 2020, children in Argentina went to school for only two weeks; schools were closed and children were confined to their homes[6]. During the 6 months from 21 March to 21 September (Autumn and Winter) children were not allowed to play outside. Children could not visit their grandparents who constituted an at risk population, and could not visit cousins or friends. Birthday parties and other familial meetings were discouraged. Children had to stay at home and study or play with siblings or parents. Children did not return to face-to-face classes for the rest of the academic year. After these 6 months, home confinement was progressively relaxed, allowing children to go outdoors for up to one hour per day. This is very different to what normally happens. In Argentina, in most cases school lasts for only 4 hours a day on weekdays, and children play outside for 4 or more hours a day as the climate is warm, with only 4 weeks per year of cold weather, with low annual rainfall rates[7]. The present study collected retrospective data on refractive change in consecutive myopic patients attending regular patient-initiated checkups for their spectacle prescription, to investigate possible changes in progression rate.

Material and methods

This was a retrospective study of a series of consecutive myopic cases. The data were obtained by 16 ophthalmologists in public or private practice settings, who completed a simple online Google Form questionnaire. All consecutive myopic patients (-0.50 to -6.00 diopters) between 5 and 18 years of age who requested consultations from September to December 2020 were included. The following data had to be recorded: age, gender, date of examination and cycloplegic spherical equivalent refraction of the prescription of both eyes in the years 2018, 2019 and 2020. There had to be at least 8 months or more between each of the three different examinations. The input spherical equivalent of each eye for each year was the subjective refraction, confirmed by cycloplegic refraction to exclude myopic spasm.

Refractive data for 2018 and 2019 were extracted from medical records at the time of examination in 2020. The study enrolment was scheduled during the 4 months at the end of the year 2020, in which, as patients came consecutively for new prescriptions, a subjective refraction was performed, with cycloplegic autorefractometry

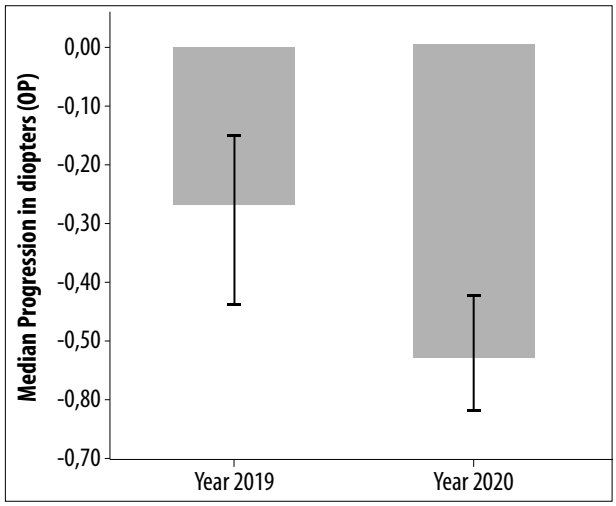

Figure 1. Significant difference in median rates of annualized progression in diopters for right eyes in 2019 and 2020 ($p = 0.012$, Wilcoxon test).

Table 1. Mean annualized progression in right and left eyes by year in diopters (median; SD).

Progression 2019-2018	-0.43 D (-0.27 D; 0.52 D)	-0.40 D (-0.25 D; 0.57 D)
Progression 2020-2019	-0.58 D (-0.53 D; 0.53 D)	-0.57 D (-0.38 D; 0.59 D)
Percentage increase in progression	34.8%	42.5%

confirmation. Patients and their families gave verbal informed consent in which "they accepted that their prescription data would be used for statistical purposes because of the pandemic, keeping their identity confidential", following the precepts of the Helsinki Declaration. The Ethics Committee of the Argentinian Council of Ophthalmology gave approval for this study.

Patients who did not have the 3 subjective refractions confirmed by cycloplegia were excluded as well as those undergoing treatment for myopia control with diluted atropine drops or with especial lenses. Also those with astigmatism greater than 3.00 diopters, patients with a single eye, with diabetes, Down, Marfan or Stickler syndromes, or any associated eye disease (e.g.: keratoconus, cataract, retinal disease or glaucoma) were excluded. The statistical analysis was carried out with the total number of valid cases collected over the 4 months of recruitment.

Progression was calculated as the change in spherical equivalent between observations in 2018-2019, and 2019-2020. The progression was annualized taking into account the exact dates of refractive exams, dividing it by the number of days between both examinations and multiplying by 365. Mean annual progressions were calculated and compared. The annual progressions during 2019 and 2020 are presented as means ± standard deviations and also as median values (due to asymmetric distributions). Student *t*- and Wilcoxon tests were performed, with a value of $p< 0.05$ taken as the cut-off for statistical significance. Figures were made with SPSS version 25 (IBM, USA).

Results

From September to December 2020, 115 consecutive patients (60% girls) fitting the inclusion criteria were included in the database. At the 2020 visit, mean age was 11.89 ± 3.68 years. The mean spherical equivalent of right and left eyes in the 2020 visit was similar (-3.62±1.74 D versus -3.48±1.98 D, $p = 0{\cdot}478$). The mean follow up was 56.02 weeks in 2018-2019 and 61.95 weeks in 2019-2020, statistically significantly different (Student *t* test, $p<0.001$). After adjustment for the different follow-up periods, mean annualized progression for 2018-2019 (the year before the COVID restrictions) was significantly lower than that in 2020. Figure 1 shows the difference in median annual progressions (-0.27 diopters vs. -0.53 diopters for the right eyes) ($p = 0.012$ Wilcoxon test, table 1).

Discussion

The progression of myopia was significantly increased from 2018-2019 to 2019-2020, a period that included the COVID-19 control measures. Since it is known that more time spent outside limits axial elongation and myopic shifts in refraction, at least in pre-myopes[8-9], reductions in time outdoors may have contributed to this effect on progression during the pandemic. In addition, confinement to the family home and online learning may have increased levels of nearwork, perhaps including increased use of electronic devices[10]. Changes of this kind could lead to increased axial elongation and seem to have increased progression of myopia in this clinical sample.

In Argentina, the strict COVID control restrictions lasted for 8 months, with schools closed, home-schooling by video conference, suspension of extracurricular activities and outdoor or indoor sports, closing of gyms and recreational spaces, and home confinement. It is important to note that the prevalence of myopia in Argentina is very low by international standards. Our estimates are that at the end of primary school, the prevalence of myopia is only about 4% in Argentina, probably due to the short school day, low academic pressure and the large amount of time that children spend outdoors[11]. The change in behavior induced by the closure of schools and home confinement is thus likely to have been large. The impact of lockdown measures in countries with high academic pressures and limited time outdoors under normal circumstances may be less dramatic.

These results give substance to the concerns that have been raised about the deleterious effects of COVID-19 control measures on the development of myopia in children. In our sample recruited from myopic patients, we cannot address the question of whether there are effects on incident myopia. A recent school-based paper from China has reported increases in overall myopic shifts in refraction and myopia prevalence[12]. Our results cannot be directly compared to theirs, because we have examined refractive change in myopes, or myopia progression, rather than myopic shifts in refraction in the general population. Wang *et al.* reported that the impact of lockdown declined with age, and suggested that this might be due to a greater sensitivity to environmental change in younger children[12]. We suggest that the relative change in behavior associated with COVID-19 lockdown may decline as children's behavior is increasingly constrained by educational pressures, particularly in East Asian education systems that have produced an epidemic of myopia, also needs to be considered. Another recent paper has been published about lockdown increasing not only myopia progression but also incidence of new cases in a large population sample of Chinese children[13]. More research in this area is expected.

Taken together, these results suggest that both myopic shifts in refraction in non-myopes and myopia progression in myopes can be accelerated during COVID-19 lockdown, but that the magnitude of the change may depend on how restricted children's behavioral patterns are during normal schooling. The recruitment method we have used should be generalizable to clinical or hospital records in other countries to determine to what extent myopia progression has changed in different locations.

In conclusion, we have found significantly increased myopia progression during the pandemic confinement in 2020 in Argentinian children. We stress the need to develop modifications to measures that impose school closures and home confinement to minimize effects on refractive development.

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