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Artikel Penelitian

Myopic Progression of Children in RSUP Dr. M. Djamil During COVID-19 Pandemic

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A B S T R A C T

Abstrak

LatarBelakang: Miopia adalah rabun jauh yang terjadi karena bayangan dari objek yang terletak jauh difokuskan di depan retina ketika mata tidak berakomodasi. Miopia disebabkan terutama oleh ukuran aksial mata yang terlalu panjang. Pembatasan aktivitas saat pandemi COVID-19 meningkatkan faktor risiko miopia, yakni kurangnya aktivitas *outdoor* dan meningkatnya aktivitas melihat dekat (*screentime*), terutama pada anak-anak usia sekolah.

Objektif: Penelitian ini bertujuan untuk mengetahui progresivitas miopia pada anak saat pandemi COVID-19.

Metode: Penelitian ini merupakan penelitian analitik observasional dengan pendekatan *kohort retrospektif* mengenai progresivitas miopia pada anak berdasarkan perbedaan *spherical equivalent* (SE) dari 34 pasien dari sebelum (September 2019-Februari 2020) dan akhir (September 2021-Februari 2022) pandemi COVID-19 di RSUP Dr. M. Djamil menggunakan metode *Wilcoxon Signed Rank Test.* Data merupakan data sekunder berupa rekam medik.

Hasil: Hasil penelitian ini menemukan perburukan SE mayoritas terjadi pada anak yang mempunyai jenis kelamin perempuan (47,0%), memiliki riwayat miopia pada orang tua (67,6%), lama aktivitas *outdoor* 2 jam atau lebih (61,7%), dan durasi *screentime* lebih dari 5 jam (79,4%); dengan perubahan SE derajat lambat (61,7%). Median SE sebelum dan akhir pandemi COVID-19 berturut-turut adalah -4,00 (-16,00 – -0,25) D dan -4,62 (-17,00 – -0,25) D pada mata kanan; -3,00(-10,75 – -0,25) D dan -3,25 (-10,75 – -0,25) D pada mata kiri; keduanya memiliki nilai p<0,001.

Kesimpulan: Kesimpulan penelitian ini adalah anak-anak mengalami perburukan miopia saat pandemi COVID-19.

Kata kunci: Anak-anak, COVID-19, miopia, progresivitas, s*pherical equivalent*

Abstract

Background: *Myopia (nearsightedness) is an eye condition when a far object reflection is focused in front of the retina without accommodation, so far object cannot be seen clearly. The elongation of the eye's axial length primarily causes myopia. Lack of outdoor activities and excessive near work (screentime) during home confinement during the COVID-19 pandemic have increased the risk of myopia development, primarily in school children.*

Objective: *This study aims to see children's myopic progression during the COVID-19 pandemic.*

Methods: *This research was an observational analytic study by a retrospective cohort about children's myopic progression based on the difference between the spherical equivalent (SE) of 34 patients in RSUP Dr. M. Djamil from before (September 2019–February 2020) followed up to late (September 2021–February 2022) of COVID-19 pandemic from their medical records.*

Results: *The results showed that myopic progression majorly occurredin children who were females (47.0%), had myopic parents (67.6%), ≥ 2 hours of outdoor activity (61.7%), > 5 hours of screentime (79.4%); with slow annualized myopic progression (61.7%). The median of SE from before and late the COVID-19 pandemic are -4.00 (-16.00 – -0.25) D and -4.62 (-17.00 – -0.25) D in right eye*; -3,00(-10,75 – -0,25) D and -3,25 (-10,75 – -0,25) D in left eye; both p<0,001.

Conclusion: *Children did have myopia worsening during the COVID-19 pandemic.*

Keywords: *Children, COVID-19, myopia, progression, spherical equivalent*

What is already known?

Lack of outdoor activity and excessive near work during home confinement during the COVID-19 pandemic has increased the risk of myopia development in children.

What does this study add?

Indeed, there was significant myopia worsening in children as RSUP Dr. M. Djamil patients during the COVID-19 pandemic.

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Introduction

Myopia prevalence will increase to 49.8% of the global population in 2050.[1]Estimated 312 million individuals will be myopia in 2020, including the age group under 19 years.[2] In East and Southeast Asia, 80-90% of high school children reported myopia.[3]Indonesia has a myopia prevalence of 48.1% in the age group 21 years and over. In Riau, one of the provinces of Indonesia, 26.1% of the population had myopia, and this number was more significant than the whites and smaller than Singapore's myopia prevalence.[4]

To see a far object, the normal eyes do not have to accommodate to focus the object's reflection on the retina. Unlike myopia, the eyes focus the reflection in front of the retina instead, so the object is seen as blurry.[5,6] Clinically, Myopia is defined as the eye needs a negative lens or spherical equivalent (SE) of at least -0.5 diopter (D) to see a far object in 6/6 or 20/20 visual acuity,[5] where moderate myopia is beyond -3 D,[6] and high myopia is at least -5 D.[7] Primarily, myopia is caused by eye excessive axial elongation, especially in children.[5] It is influenced by genetics,[8-10] gender,[11,12] lack of outdoor activity,[13-15] and excessive nearwork.[16-18]

Children with myopic parents were consistently reported to have a high prevalence of myopia,[9] and were a risk factor for myopia development.[19] It is due to the hereditary variety of genes that control extracellular matrices (ECM) of the sclera. These genes: LAMA2 gene,[20] MYP3 genes,[21] MMP2 gene, [22] cause scleral remodeling so that the eye axial length can be elongated.

Females tend to have an earlier onset of myopia than males.[23] Some argue that they are more susceptible to myopia development due to changes in estrogen levels and the onset of puberty.[11,12] Estrogen has been found to increase MMP2 and/or MMP9 regulation in the ECM of sclera,[24] so it influences the scleral remodeling in myopia development.[25]

Lack of outdoor activity, especially during home confinement during the COVID-19 pandemic, was a risk factor for myopia.[16-18] Increasing light intensity to eyes during outdoor activity increases retinal transmitter dopamine release,[13] so it could inhibit eye growth.[14] A study found that doing outdoor activity for at least 2 hours a day could protect the eye from developing myopia during the COVID-19 pandemic.[15]

Excessive digital screen time (near work), such as on a computer or mobile phone, was strongly related to myopic progression.[26] Increasing myopic progressions or myopic worsening in school children during the COVID-19 pandemic were also strongly associated with excessive screen time due to online learning.[27,28] The more excess screentime, the worse the myopia.[27] The explanation of excessive near work that could cause excessive eye elongation is theoretically due to excessive accommodation. Excessive accommodation in children leads to inadequate accommodation and causes object reflection to focus on the back of the retina. If this mechanism occurs often, it may stimulate the eye's axial length to elongate to compensate for the object reflection to focus back on the retina.[29,30]

Wang *et al.* have found that significant SE is worsening during the COVID-19 pandemic rather than before that the period of 2015 to 2019 had stable SE. It statistically indicated that there are substantial myopic progressions during the COVID-19 pandemic.[16]

Based on this background presentation, the researcher is interested in conducting research about the myopic progression of children in RSUP Dr. M. Djamil during the COVID-19 pandemic.

Methods

This research is an observational analytic study by a retrospective cohort about children's myopic progression based on the difference between spherical equivalent (SE) of patients in RSUP Dr. M. Djamil Padang from before (September 2019–February 2020) followed up to late (September 2021–February 2022) of COVID-19 pandemic. The data was collected from the

patient's medical records that also accounted for the amount of time from the first to second eye examination (as in the defined time intervals as mentioned before), gender, parents' myopic history, the amount of time to spend in outdoor activity and screentime during COVID-19 pandemic. This research was conducted in January 2023.

The sample size was 34 subjects, defined by the total sampling technique with a minimum of 18 subjects. The samples' criteria are population aged 8 to 17 years; myopia; never history of other eye diseases, eye trauma, and eye surgery. Individuals with a history of other eye diseases, a history of eye trauma, and a history of eye surgery are excluded.

Specific variable definitions are made. The severity of myopia is categorized into mild (SE is -3.0 D or below), moderate (SE is higher than -3.0 D to lower than -5.0 D), and high (SE is -5.0 D or higher). Annualized myopic progressions are categorized into none (SE change rate is 0 per year), slow (SE change rate is lower than -0.5 D per year), moderate (SE change rate is -0.5 D to -1.0 D per year), and fast (SE change rate is higher than -1.0 D per year). Myopic parents are categorized into (+) if the patient does have a myopic father or myopic mother and (-) if the patient does not have a myopic father and myopic mother.

To test the SE difference of the two defined time intervals, this study used the Wilcoxon Signed-Rank Test with a p-value <0.05 accounted as a significant result.

This research has had ethical approval from the Health Research Ethics Committee of RSUP Dr. M. Djamil Padang (No: LB.02.02/5.7/120/2023).

Results

These study subjects are 34 children aged 8 to 17 years with myopia in both eyes.

Table 1. Annualized Myopic Progression

Annualized Myopic Progression	OD		OS	
	n	%	n	%
None	6	17.6	8	23.5
Slow	21	61.7	22	64.7
Moderate	6	17.6	3	8.8
Fast	1	2.9	1	2.9
Total	**34**	**100**	**34**	**100**

From Table 1, Children were mostly in slow myopic progression annually (61.7% OD, 64.7% OS) during the COVID-19 pandemic. The proportion of children that had myopic progression and those that did not are 27:6 in right eyes and 26:8 in left eyes.

Table 2. Myopia Severity

Myopia Severity	OD		OS	
	n	%	n	%
Before Pandemic				
Mild	14	41.2	17	50.0
Moderate	7	20.6	10	29.4
High	13	38.2	7	20.6
Late of Pandemic				
Mild	14	41.2	15	44.1
Moderate	5	14.7	8	23.5
High	15	44.1	11	32.4
Total	**34**	**100**	**34**	**100**

Table 2 shows that before the COVID-19 pandemic, children mainly had mild myopia, but the number of children with high myopia increased during the later pandemic.

Table 3. Variables vs. Annualized Myopic Progression

Variables	Annualized Myopic Progression				Total n (%)
	None n (%)	Slow n (%)	Moderate n (%)	Fast n (%)	
Gender					
Male	4 (11.7)	8 (23.5)	4 (11.7)	0	16 (47.0)
Female	2 (5.8)	13 (38.2)	2 (5.8)	1 (2.9)	18 (52.9)
Myopic Parents					
(+)	4 (11.7)	17 (50.0)	5 (14.7)	1 (2.9)	27 (79.4)
(-)	2 (5.8)	4 (11.7)	1 (2.9)	0	7 (20.5)
Outdoor Activity (hrs/day)					
<2	2 (5.8)	3 (8.8)	3 (8.8)	0	8 (23.5)
≥2	4 (11.7)	18 (52.9)	3 (8.8)	1 (2.9)	26 (76.4)
Screentime (hrs/day)					
≤5	1 (2.9)	1 (2.9)	0	0	2 (5.8)
>5	5(14.7)	20(58.8)	6(17,6)	1 (2.9)	32 (94.1)

Table 3 is represented by the right eye. Myopic progression majorly occurred in children who were females (47.0%), had myopic parents (67.6%), ≥ 2 hours of outdoor activity (61.7%), > 5 hours of screentime (79.4%), with slow annualized myopic progression (61.7%).

Table 4. SE difference before & late of the Pandemic

SE	Before Pandemic Median (min-max) (D)	Late of Pandemic Median (min-max) (D)	*p-value*
OD	-4.00 (-16.00 – -0.25)	-4.75 (-17.00 – -0.25)	<0.001
OS	-3.12 (-10.87 – -0.25)	-3.62 (-11.25 – -0.25)	<0.001

Table 4 shows significant differences in SE before and late the COVID-19 pandemic (p<0.05), tested by the Wilcoxon Signed-Rank Test. The difference in SE medians was -0.75 D on the right eyes and -0.5 D on the left eyes.

Discussion

Based on **Table 1**, during the COVID-19 pandemic, most of the children in this study were annually in slow myopic progression, followed by moderate and fast progression. The proportion of children who had myopic progression and those who did not are 27:6 in the right eye and 26:8 in the left eye. This indicates that the COVID-19 pandemic has worsened the myopia of the children. According to Hsu *et al.* research in 2017, children in grade 2 primary school mostly have slow myopic progression annually, followed by moderate and fast progression.[31] Aslan and Sahinoglu-Keskek in 2022 have also found the same pattern in the children that have the same age criteria as this RSUP Dr. M. Djamil study during the COVID-19 pandemic.[15]

Table 2 shows that the number of children with high myopia was increased. This finding strengthens the evidence that myopia in children has worsened during the COVID-19 pandemic. Xu *et al.*[32]have also found an increasing number of children (between the ages of 7 and 18 years) with high myopia during the COVID-19 pandemic. Moderate and high myopia among school children also increased during the COVID-19 pandemic in Shenzen[33] and Suqian[34], China.

The number of right and left eyes are not equal, either from annualized myopic progression **(Table 1)** or myopia severity **(Table 2)**. It shows that some children had anisometropia.[35,36] This can lead to amblyopia development if each of those children had a right and left eye SE difference of more than 2.5 D.[6,37] Amblyopia is depression of visual acuity due to lack of visual stimulation in the children's visual development. An anisometropic child tends to receive visual stimulation and make visual perception from which eye has the better refraction or visual acuity. Consequently, the eye with the worst refraction or visual acuity loses its vision because the brain ignores its signal or stimulation. The right and the left cooperation becomes lost.[6,35-37]

Females mostly had myopia and myopic progression during the COVID-19 pandemic **(Table 3)**. Females were often reported as myopic more than males.[23] Females also have the onset of myopia earlier than males, even during the COVID-19 pandemic.[16] However, gender as a risk factor is weak.[19] The explanation about how gender could influence myopia development is not fully understood.[16] Some argue that females are more susceptible to myopia development due to changes in estrogen levels and the onset of puberty.[11,12]

Aslan and Sahinoglu-Keskek,[15] Wang *et al.*,[16]and Picotti *et al.*[18] have also found that females mostly had myopic progression during the COVID-19 pandemic. Chen *et al.* got the same result, but the SE difference between males from 2019 and 2020 is higher than females.[34] The opposite result came from a study by Ma *et al.* in 2021 that shows myopia is mainly by males.[38]

Table 3 also shows that during the COVID-19 pandemic, females mostly had slow annual myopic progression, followed by moderate and fast progression. This is compatible with what Aslan and Sahinoglu-Keskek have found.[15]

Based on **Table 3,** myopic children who had myopic parents were more numerous than those who did not. Myopic progressions were also mostly had by children with myopic parents. The most were slow annual progression, followed by moderate and fast progression **(Table 3)**. Indeed, Children with myopic parents were consistently reported to have a high prevalence of myopia,[9] and were a strong risk factor for myopia development.[19] It is due to a hereditary variety of genes that cause scleral remodeling, so the eye axial length can be elongated.[20,21,22]

The result in **Table 3** contradicts the understanding of outdoor activity as a protective factor against myopia development. **Table 3** shows that myopia and myopic progression were caused mainly by those with 2 hours or more outdoor activity per day rather than those with less. It is suspected that screentime, myopic parents, and gender had more prominent influences on myopic progressions during the COVID-19 pandemic and outmatched the protective factor of outdoor activity.

Table 3 also shows that most of those who had myopia and myopic progressions had more than 5 hours of screen time per day during the COVID-19 pandemic. The most were slow annual progression. Indeed, excessive digital screen time (near work), such as on a computer or mobile phone, was strongly related to myopic progression.[26] Increasing myopic progressions or myopic worsening in school children during the COVID-19 pandemic were also strongly associated with excessive screen time due to online

learning.[27,28] The more excess screentime, the worse the myopia.[27]

Table 4 shows significant differences in SE before and late of the COVID-19 pandemic ($p<0.05$), tested by the Wilcoxon Signed-Rank Test. This states that myopic progressions are significantly occurring among children in RSUP Dr. M. Djamil. These findings are compatible with numerous studies.[15,16,18,28,39]

There is an Inability to ensure the consistency of outdoor activity time and screen time for each child during the COVID-19 pandemic. Reading or screen-watching distances are confounding variables that are not assessed. This study also could not evaluate the myopic progressions of each child in years before the COVID-19 pandemic, so the myopic progressions in years before and during the COVID-19 pandemic of each child could not be compared. Therefore, those are the limitations of this study, and further research is needed to solve those limitations.

Conclusion

There was significant myopia worsening in children as RSUP Dr. M. Djamil patients during the COVID-19 pandemic. The protective factor of outdoor activity has been suspected to be outmatched by gender, myopic parents, and screentime as the risk factors. The annual myopic progression of children was mostly slow.

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