

Myopia Incidence and Lifestyle Changes Among School Children During the COVID-19 Pandemic: a Population-based Prospective Study

Xiu Juan Zhang^{1*}, PhD; Stephanie S.L. Cheung^{1,2*}, MRCSEd; Hei-Nga Chan¹, PhD; Yuzhou Zhang¹, MSc; Yu Meng Wang¹, PhD; Benjamin Hon Kei Yip⁴, PhD; Ka Wai Kam^{1,3}, FCOphth; Marco Yu⁶, PhD; Ching-Yu Cheng⁶, MD PhD; Alvin L. Young^{1,3}, FCOphth; Mike Y.W. Kwan⁷, FHKAM(Paed); Patrick Ip⁵, Dip Med; Kelvin K. Chong^{1,3}, FCOphth; Clement C. Tham^{1,2,3,9}, FCSHK; Li Jia Chen^{1,3,9}, PhD; Chi Pui Pang^{1,9}, Dphil; Jason C. Yam^{1,2,3,8,9}, FCOphth

1. Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, Hong Kong SAR
2. Hong Kong Eye Hospital, Kowloon, Hong Kong SAR
3. Department of Ophthalmology and Visual Sciences, Prince of Wales Hospital, Hong Kong SAR
4. Jockey Club School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong SAR
5. Department of Paediatrics and Adolescent Medicine, LKS Faculty of Medicine, The University of Hong Kong, Hong Kong SAR
6. Singapore Eye Research Institute, Singapore National Eye Centre, Singapore.
7. Department of Paediatrics and Adolescent Medicine, Princess Margaret Hospital, Hong Kong SAR
8. Department of Ophthalmology, Hong Kong Children's Hospital, Hong Kong SAR
9. Hong Kong Hub of Paediatric Excellence, The Chinese University of Hong Kong, Hong Kong SAR

*Joint first authors

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Supplementary Table 1. Pandemic control measures in Hong Kong during COVID-19

Measures	Effective Date
<i>Reducing the flow and contacts of people in Hong Kong</i>	
<ul style="list-style-type: none"> School closures Flexible work arrangements for employees 	<ul style="list-style-type: none"> January 25, 2020 to September 22, 2020; December 2, 2020 to now January 26, 2020 to March 11, 2020; March 23, 2020 to May 4, 2020; July 20, 2020 to August 24, 2020; December 2, 2020 to now
<i>Social distancing</i>	
<ul style="list-style-type: none"> Prohibition on public and group gatherings Closing country park barbecue sites and campsites Closing all indoor and outdoor leisure facilities, library and performance venues Limiting operation hours and service capacity for dine-in services at restaurants and bars 	<ul style="list-style-type: none"> March 28, 2020 to now March 28, 2020 to now March 23, 2020 to May 30, 2020; July 15 2020 to October 29, 2020; December 2, 2020 to now February 2020 to now
<i>Border control</i>	
<ul style="list-style-type: none"> Limited and controllable passenger clearance services between Hong Kong and mainland China Compulsory quarantine of persons arriving in Hong Kong Restrictions on entering Hong Kong 	<ul style="list-style-type: none"> January 26, 2020 to now February 8, 2020 to now March 25, 2020 to now
<i>Infection control</i>	
<ul style="list-style-type: none"> Suspend visitation in all public hospitals 	<ul style="list-style-type: none"> January 2020 to now

Supplementary Table 2. Definition and calculation for Outdoor Time, Screen Time, and Total Near Work Time

Categories	Items
Outdoor time	Outdoor for sports Outdoor for leisure*
Reading and writing time	Doing paper homework Reading and Writing Drawing and coloring
Screen time	Watching TV Using computer Electronic game / using smartphone or tablet PC for leisure Using smartphone or tablet PC for learning
Total near work time	Reading and writing time Screen time without time for watch TV, VCDs or online videos

*Include walking, leisure bike riding, playing in the park and picnicking

Average number of daily hours=(weekday daytime hours × 5 + weekend daytime hours × 2) ÷ 7

Diopter-hours = (study hours + leisure reading hours) × 3 + video game or home computer work hours × 2 + television hours × 1

Supplementary Table 3. Comparison of Baseline Demographic and Ocular Parameters Between the COVID-19 Cohort and pre-COVID-19 Cohort

Baseline Parameters	COVID-19 Cohort	pre-COVID-19 Cohort	<i>p</i>
Sample size	709	1084	
Age, mean (SD), yrs	7.25 (0.92)	7.29 (0.75)	0.30
Sex, (male, %)	372 (52.47)	542 (50)	0.28
Body mass index, mean (SD)	16.03(2.66)	15.89 (2.55)	0.26
Axial Length, mean (SD), mm	22.98 (0.83)	23.02 (0.91)	0.47
SER, mean (SD), D	0.32 (1.16)	0.34 (1.49)	0.49
Children myopia rate, (No, %)	133 (18.76)	198 (18.27)	0.98
Outdoor time (SD), per day, hours	1.27 (1.12)	1.35 (0.54)	0.12
Screening time (SD), per day, hours	2.45 (2.32)	2.39 (0.96)	0.59
Reading time (SD), per day, hours	2.03 (1.32)	2.11(0.53)	0.16

SER: Spherical Equivalent Refraction

Supplementary Table 4. Comparison of Baseline Demographic and Ocular Parameters Between Children who Followed up and Lost follow-up in the COVID-19 Cohort

Baseline Parameters	Follow-up (N=709)	Lost Follow-up (N=214)	<i>p</i>
Age, mean (SD), yrs	7.25 (0.92)	7.33 (0.95)	0.27
Sex, (male, %)	372 (52.47)	110 (51.4)	0.78
Height, mean (SD), cm	122.09 (7.69)	121.96 (6.83)	0.81
Weight, mean (SD), kg	24.14 (6.00)	24.04 (5.88)	0.82
Body mass index, mean (SD)	16.03 (2.66)	16.00 (2.61)	0.88
Axial Length, mean (SD), mm	22.98 (0.83)	22.98 (2.61)	0.98
SER, mean (SD), D	0.32 (1.16)	0.45 (1.55)	0.26
Children myopia rate, No. (%)	133 (18.75)	38 (17.9)	0.73

SER: Spherical Equivalent Refraction

Supplementary Table 5. Comparison of Baseline Demographic and Ocular Parameters Between Children who Followed up and Lost follow-up in the pre-COVID-19 Cohort

Baseline Parameters	Follow-up (N=1084)	Lost Follow-up (N=347)	<i>p</i>
Age, mean (SD), yrs	7.29 (0.75)	7.31 (0.63)	0.66
Sex, (male, %)	542 (50.00)	164 (47.40)	0.4
Height, mean (SD), cm	123.15 (6.96)	123.65 (6.79)	0.24
Weight, mean (SD), kg	24.26 (5.33)	24.50 (5.62)	0.48
Body mass index, mean (SD)	15.89 (2.55)	15.58 (2.41)	0.26
Axial Length, mean (SD), mm	23.01 (0.89)	23.05 (0.87)	0.5
SER, mean (SD), D	0.36 (1.44)	0.22 (1.33)	0.1
Children myopia rate, (No, %)	198 (19.00)	78 (22.90)	0.12

SER: Spherical Equivalent Refraction.

Supplementary Table 6. Outdoor Time and Near Work Time at Baseline and 3-year Follow-up Before COVID-19 Pandemic in the Pre-COVID-19 Cohort

	Baseline	At 3-year Follow-up	Differences	<i>p</i>
	Mean (SD)	Mean (SD)	Mean (SD)	
Outdoor time(per day, hours)	1.35 (0.54)	1.18 (0.92)	-0.17 (0.93)	0.01*
Outdoor for sports	0.84 (0.35)	0.69 (0.67)	-0.15 (0.73)	0.01*
Outdoor for leisure	0.51 (0.32)	0.57 (0.68)	0.06 (0.53)	0.17
Diopter*hour	10.61 (6.94)	11.04 (7.23)	0.43 (7.15)	0.46
Total near work time(per day, hours)	3.72 (2.50)	3.97 (2.640)	0.25 (2.85)	0.23
Reading and writing time	2.11 (0.53)	2.16 (1.14)	0.05 (1.17)	0.49
Doing paper homework	1.36 (0.40)	1.32 (0.82)	-0.04 (0.82)	0.45
Reading	0.42 (0.31)	0.43 (0.45)	0.01 (0.48)	0.75
Drawing and writing	0.33 (0.26)	0.39 (0.39)	0.06 (0.37)	0.03*
Screen time	2.67 (0.96)	2.75 (1.13)	0.08 (0.82)	0.48
Watching TV	1.06 (0.51)	0.94 (0.73)	-0.12 (0.68)	0.02*
Using computer	0.57 (0.43)	0.48 (0.35)	-0.09 (0.45)	0.01*
Electronic game/ using smartphone or tablet PC for leisure	0.77 (0.46)	0.81 (0.62)	0.04 (0.65)	0.37
Using smartphone or tablet PC for learning	0.27 (0.49)	0.52 (0.56)	0.25 (0.58)	<0.001*

Pairwise t tests were used to test the differences of outdoor time and near work time before and during the COVID-19 pandemic

*Significant level was set at 0.05

Supplementary Table 7. Comparison of Myopia Incidence between COVID-19 and pre-COVID-19 cohorts

	Beta (95% CI)	Adjusted RR(95%CI)
Cohort		
pre-COVID-19	Reference	Reference
COVID-19	-0.107(-0.205, -0.010)	0.898(0.815, 0.990)
Age		
6-year	Reference	Reference
7-year	-0.021(-0.028, 0.070)	1.022(0.973, 1.073)
8-year	-0.014(-0.036, 0.063)	1.014(0.965, 1.065)
Gender		
Female	Reference	Reference
Male	0.002(-0.037, 0.042)	1.002(0.994, 1.003)
Cohort duration	0.011(-0.021,-0.044)	1.012(0.979, 1.045)

The relative risk regression model(log-binomial model) is used and adjusted by age, gender, parental myopia, total near work time, outdoor time.

The observed indicator of non-myopia at the end of the follow up duration as the independent variable (Y).

RR is risk ratio and alpha level is 0.05

Supplementary Table 8. Comparison of Myopia Incidence in COVID-19 cohort over 8-month with Annual Myopia Incidence in 2004 Hong Kong Cohort

Age Group	COVID-19 cohort		2004 HK Cohort ¹⁶		p-value
	N	8-month Incidence	N	One-year Incidence	
6	224	18.05%	650	10.62%	0.005*
7	236	22.16%	886	13.13%	<0.001*
8	249	18.08%	985	14.84%	0.21
Total	709	19.44%	2521	13.15%	<0.001*

Chi-square was used to compare the incidence between the two cohorts

Supplementary Table 9. Comparison of Myopia Incidence and Changes of Spherical Equivalent and Axial Length Between the COVID-19 Cohort and pre-COVID-19 Cohort

	COVID-19 Cohort	pre-COVID-19 Cohort
Follow-up time, mean (SD), months	7.89 (2.30)	37.54 (3.12)
Incidence of myopia, n (%)	112/576 (19.44)	324/886 (36.57)
Changes of SER, mean (SD, range), D	-0.50 (0.51), (-2.00 to 0.50)	-1.27 (1.34), (-5.63 to 1.00)
Changes of axial length, mean (SD, range),mm	0.29 (0.35), (-0.41 to 0.91)	0.88 (0.49), (-0.59 to 2.10)
Estimated annual incidence of myopia, n (%)	171/576 (29.68)	103/886 (11.63)
Estimated changes of SER per year, D	-0.80	-0.41
Estimated changes of axial length per year, mm	0.45	0.28

SER: Spherical Equivalent Refraction

Supplementary Table 10. Comparison of SE progression and AL elongation in COVID-19 cohort over 8-month with other similar age population-based studies over 1-year

Study	Location	Study Design	Age, years (Grade level) at baseline	SE progression		AL elongation	
				mean (SD)	p-value*	mean (S.D.)	p-value*
Present study (COVID-19 Cohort) (2020)	Hong Kong	Population-based cohort N= 709	6-8	-0.50 (0.51) D		0.29 (0.35) mm	
Li et al (2019) ¹⁷	Shanghai, China	School-based cohort N = 452	6-8	-0.27 (0.80) D	<0.001*	0.27 (0.28) mm	0.31
Liao et al (2019) ¹⁸	Guangzhou, China	Population-based cohort N = 490	7-8	-0.31 (0.48) D	<0.001*	0.27 (0.20) mm	0.25
Hsu et al (2016) ¹⁹	Taipei, Taiwan	Population-based cohort N = 3256 N = 4662	7-8 (grade 2)	-0.42 (0.85) D	0.02*	NA	NA

* Compare with COVID-19 Cohort.

T-tests were used to test for the differences in SER changes and AL changes between our study and other related studies for the additional analysis.

The included studies met the criteria: (1) population-based study with age range between 6 to 8 years old; (2) majority of the subjects are Chinese; either cycloplegic annual SER progression or AL elongation is mentioned in the articles; (4) the study was conducted in an urban city.

Supplementary Figure 1. Participants Recruitment of Pre-COVID-19 and COVID-19 Cohorts from the ongoing Hong Kong Children Eye Study

