Rates of Myopia Development in Young Chinese Schoolchildren During the Outbreak of COVID-19

Yin Hu, MD; Feng Zhao, MD, PhD; Xiaohu Ding, MD, PhD; Sheng Zhang, MD; Zhouyue Li, MD, PhD; Yangfeng Guo, MD; Zhibin Feng, MD; Xianghua Tang, MD; Qian Li, MD; Lan Guo, MD, PhD; Cyong Lu, MD, PhD; Xiao Yang, MD, PhD; Mingguang He, MD, PhD

IMPORTANCE During the outbreak of COVID-19, outdoor activities were limited and digital learning increased. Concerns have arisen regarding the impact of these environmental changes on the development of myopia.

OBJECTIVE To investigate changes in the development of myopia in young Chinese schoolchildren during the outbreak of COVID-19.

DESIGN, SETTING, AND PARTICIPANTS In this observational study, 2 groups of students from 12 primary schools in Guangzhou, China, were prospectively enrolled and monitored from grade 2 to grade 3. Comparisons between the exposure and nonexposure groups were made to evaluate any association between environmental changes during the COVID-19 outbreak period and development of myopia. The exposure group received complete eye examinations in November and December 2019 and November and December 2020. The nonexposure group received examinations in November and December 2018 and November and December 2019.

MAIN OUTCOMES AND MEASURES Changes in cycloplegic spherical equivalent refraction (SER), axial length (AL) elongation, and myopia incidence from grade 2 to grade 3.

RESULTS Among the 2679 eligible students in grade 2 (mean [SD] age, 7.76 [0.32] years; 1422 [53.1%] male), 2114 (1060 in the nonexposure group and 1054 in the exposure group) were reexamined in grade 3. Compared with the period from November and December 2018 to November and December 2019, the shift of SER, AL elongation, and myopia incidence from grade 2 to grade 3 from November and December 2019 to November and December 2020 was 0.36 D greater (95% CI, 0.32-0.41; \( P < .001 \)), 0.08 mm faster (95% CI, 0.06-0.10; \( P < .001 \)), and 7.9% higher (95% CI, 5.1%-10.6%; \( P < .001 \)), respectively. In grade 3 students, the prevalence of myopia increased from 13.3% (141 of 1060 students) in November and December 2019 to 20.8% (219 of 1054 students) in November and December 2020 (difference [95% CI], 7.5% [4.3%-10.7%]; \( P < .001 \)); the proportion of children without myopia and with SER greater than −0.50 D and less than or equal to +0.50 D increased from 31.1% (286 of 919 students) to 49.0% (409 of 835 students) (difference [95% CI], 17.9% [13.3%-22.4%]; \( P < .001 \)).

CONCLUSIONS AND RELEVANCE In this study, development of myopia increased during the COVID-19 outbreak period in young schoolchildren in China. Consequently, myopia prevalence and the proportion of children without myopia who were at risk of developing myopia increased. Future studies are needed to investigate long-term changes in myopia development after the COVID-19 pandemic.
In December 2019, a novel coronavirus epidemic emerged in China and became a worldwide pandemic within several months. In response to the COVID-19 outbreak, many governments ordered strict quarantine and lockdown measures. Home confinement was imposed on an unprecedented scale. Schools and universities were closed nationwide and online courses were delivered. Following these efforts, the pandemic was effectively contained in China, as well as in some other areas of the world, by September 2020. However, factoring in the prolonged execution time of the measures, concerns have arisen over their collateral impact on children's health. Specifically, there have been concerns that reduced outdoor activities and increased digital screen time might worsen the global burden of myopia.

Based on a cross-sectional design and refraction without cycloplegia, Wang et al recently provided evidence on changes in distribution of refraction after the outbreak of COVID-19 in schoolchildren in China. Compared with previous years, the spherical equivalent refraction (SER) among Chinese children aged 6 to 8 years was approximately 0.3 D more myopic and the prevalence of myopia increased by around 10% to 16% in 2020. In children 9 years and older, the differences appeared to be negligible. The study results indicated that it is likely only young schoolchildren, being in the critical period of myopia development, were sensitive to certain environmental changes during this period.

Using longitudinal data on cycloplegic refraction and axial length (AL), the present study investigated changes in the development of myopia in young schoolchildren in China during the COVID-19 outbreak period. Myopia incidence, SER change, and AL elongation from grade 2 to grade 3 were calculated and compared between November and December 2018 to November and December 2019 and November and December 2019 to November and December 2020. Distribution of refractive errors in grade 3 students in November and December 2020 was determined and compared with that in November and December 2019.

Methods

Study Population

An ongoing prospective study was launched in November 2018, aimed at determining the distributions and annual changes in refraction and AL in Chinese schoolchildren. The study was approved by the Sun Yat-Sen University School of Public Health institutional review board and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or guardians after the study purposes and contents were explained in school seminars. No compensation or incentives were offered for participation.

The present study analyzed a subset of these data, aiming to evaluate the association between environmental changes during the COVID-19 outbreak period and development of myopia in young schoolchildren. The same approval and consent apply to the present study.

In November and December 2018, the study invited all grade 1 and grade 2 students from 12 primary schools in Guangzhou to participate. The schools were randomly selected from the primary schools in the Panyu and Huadu districts, which are socioeconomically ranked fourth and eighth, respectively, among the 11 districts of the city according to 2018 census data. The response rate was 75.8% (3365 of 4437), and 3176 students were successfully assessed for eligibility. A total of 132 students were excluded because of history of ocular surgery or having ocular disorders such as tropia and amblyopia (Figure 1). Follow-up examinations were performed annually in November and December. As of December 2020, 3 visits had been completed.

Participants were classified into 2 groups: the exposure group included 1572 students in grade 1 in November and December 2018 who were assessed from grade 2 (November and December 2019) to grade 3 (November and December 2020) during the COVID-19 pandemic, and the nonexposure group included 1472 students in grade 2 in November and December 2018 who were assessed from grade 2 (November and December 2018) to grade 3 (November and December 2019) prior to the pandemic period (Figure 1). Data for the exposure group, who experienced the COVID-19 pandemic during the period from grade 2 to grade 3, were analyzed and compared with the data for the nonexposure group who were in grade 2 to grade 3 prior to the pandemic. Students with unsuccessful cycloplegic refraction or who reported receiving orthokeratology treatment at the follow-up visits were removed from analysis.

Measurements

Field examinations were performed in each school on weekdays during the school day. All ocular examinations were conducted using standardized protocols by a group of trained ophthalmologists and optometrists (Y.H., F.Z., Z.L., Z.F., X.T.). Equipment was calibrated at the beginning of each examination session.

At each visit, uncorrected visual acuity was evaluated using the Early Treatment Diabetic Retinopathy Study chart with tumbling E optotypes (Precision Vision). The cover-uncover...
test was performed at both near and distance to identify tropia. Slitlamp and direct ophthalmoscopy were used to detect abnormalities in the anterior and posterior segments. AL was measured by noncontact partial-coherence laser interferometry (IOLMaster 500; Zeiss).

Cycloplegic autorefraction was performed using a desktop autorefractor (KR8800; Topcon Corp). Cycloplegia was induced by using 3 drops of 1% cyclopentolate, instilled 5 minutes apart. Refractive measurement was taken after complete cycloplegia (absence of light reflex and a dilated pupil at least 6 mm in diameter). For children with uncorrected visual acuity worse than 20/20 in either eye, cycloplegic subjective refraction was also performed and best-corrected visual acuity was determined.

Definitions

SER was calculated as spherical power +1/2 cylindrical power using data obtained from the cycloplegic autorefractometer. Myopia was defined as SER of −0.50 D or less, emmetropia was defined as SER greater than −0.50 D and less than +2.00 D, and hyperopia was defined as SER of +2.00 D or greater. Specifically, children with emmetropia and SER greater than −0.50 D and less than or equal to +0.50 D (lower than the age-normal) were identified to estimate the future development of myopia, and children with myopia and with SER less than −1.80 D (lower than the age-specific fifth population centile) were identified to estimate the future development of high myopia.

Data collected at 2 consecutive visits in grade 2 and grade 3 (November and December 2019 and November and December 2020 visits for the exposure group and November and December 2018 and November and December 2019 visits for the nonexposure group) were used for the longitudinal analysis. The incidence of myopia was calculated as the proportion of students with myopia who did not have myopia at the previous visit. Five refractive categories were defined as follows:

- Students with hyperopia at both visits.
- Students who developed hyperopia and demonstrated emmetropia at the second visit.
- Students with emmetropia at both visits.
- Students without myopia at the first visit (SER greater than −0.50 D) and with myopia at the second visit.
- Students with myopia at both visits.

Figure 1. Flowchart of Students Included in Analysis

- 4437 Students in grades 1 and 2 at 12 primary schools surveyed in November and December 2018
- 1261 Excluded
- 1072 No parental consent
- 131 With unsuccessful cycloplegia
- 58 Other
- 3176 Assessed
- 132 Excluded
- 72 With tropia
- 49 With amblyopia
- 3 With history of ocular surgery
- 8 With other ocular conditions
- 3044 Eligible students
- Exposure group
  - 2018 Visit
    - 1572 Grade 1 students analyzed
    - 365 Excluded
    - 213 Lost to follow-up
    - 146 From 1 school not examined because of the outbreaks of influenza and COVID-19
    - 5 With unsuccessful cycloplegia
    - 1 Underwent orthokeratology
  - 2019 Visit
    - 1207 Grade 2 students analyzed
    - 1054 Grade 3 students analyzed
    - 1060 Grade 3 students analyzed
    - 2020 Visit
    - 150 Lost to follow-up
    - 3 Underwent orthokeratotomy
- Nonexposure group
  - 2018 Visit
    - 1472 Grade 2 students analyzed
    - 853 Grade 4 students assessed
    - 207 Lost to follow-up
    - 2 From 1 school not examined because of the outbreaks of influenza and COVID-19
    - 2 Underwent orthokeratology
  - 2019 Visit
    - 1060 Grade 3 students analyzed
    - 83 Assessed
    - 72 Excluded
    - 131 With unsuccessful cycloplegia
    - 49 With amblyopia
    - 3 With history of ocular surgery
    - 8 With other ocular conditions
    - 132 Excluded
    - 72 With tropia
    - 49 With amblyopia
    - 3 With history of ocular surgery
    - 8 With other ocular conditions
    - 365 Excluded
    - 213 Lost to follow-up
    - 146 From 1 school not examined because of the outbreaks of influenza and COVID-19
    - 5 With unsuccessful cycloplegia
    - 1 Underwent orthokeratotomy
  - 2020 Visit
    - 207 Lost to follow-up
    - 2 From 1 school not examined because of the outbreaks of influenza and COVID-19
    - 2 Underwent orthokeratology
therewasnoadjustmentto
P
value<.01wasconsideredstatisticallysignificant.

P
withintheexposuregroup.Two-tailed
evaluate annual changes within the nonexposure group or
exposureandexposuregroups,andpaired
P
forALinthegrade2measurement;
theSupplement. There was no sex difference between the
characteristics of the included students are in the eTable in
ber and December 2019) eligible for analysis. Demographic
and 1060 from the nonexposure group examined in Novem-
exposure group examined in November and December 2020

After 1 year, 2121 of the 2679 grade 2 students (79.2%) were

A flowchart of the students included in the analysis is shown
in Figure 1. A total of 2679 students (mean [SD] age, 7.76
[0.32] years; 1422 [53.1%] male) were available for analysis.
Among them, 1207 were in the exposure group examined in
November and December 2018 and 1422 [53.1%] male) were available for analysis. For comparisons, t test or y² test was
applied as appropriate to examine differences between the
non-
exposure and exposure groups, and paired t test was used to
evaluate annual changes within the nonexposure group or
within the exposure group. Two-tailed P values were used and
there was no adjustment to P values for multiple analyses. A
P value <.01 was considered statistically significant.

Results
A flowchart of the students included in the analysis is shown
in Figure 1. A total of 2679 students (mean [SD] age, 7.76
[0.32] years; 1422 [53.1%] male) were available for analysis.
Among them, 1207 were in the exposure group examined in
November and December 2018 and 1472 were in the nonex-
posure group examined in November and December 2018.
After 1 year, 2121 of the 2679 grade 2 students (79.2%) were
reexamined. Among them, 5 reported receiving orthokeratol-
yogy treatment and 2 reported unsuccessful cycloplegic
refraction, leaving 2114 grade 3 students (1054 from the exposure group examined in November and December 2020 and
1060 from the nonexposure group examined in November
and December 2019) eligible for analysis. Demographic
characteristics of the included students are in the eTable in
the
Supplement. There was no sex difference between the
exposure group and nonexposure group, and the mean (SD)
age of the nonexposure group was 0.05 (95% CI, 0.03-0.08)
to 0.08 (95% CI, 0.06-0.11) years greater than that of the
exposure group.

Table 1 demonstrates the mean SER, AL, and prevalence
of refractive errors in grade 2 students in November and De-

result groups was 0.35 D (95% CI, 0.25-0.45) more myopic
than in the exposure group (Table 2). Consequently, the mean SER in grade 3 students in the exposure

Table 1. Spherical Equivalent Refraction, Axial Length, and Prevalence of Refractive Errors in Grade 2 Students in November and December 2018 (Nonexposure Group) and November and December 2019 (Exposure Group)

<table>
<thead>
<tr>
<th>Refraction-related parameter</th>
<th>Nonexposure group (n = 1472)</th>
<th>Exposure group (n = 1207)</th>
<th>Difference (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SER, D</td>
<td>0.82 (1.06)</td>
<td>0.86 (0.94)</td>
<td>0.03 (-0.04 to 0.11)</td>
<td>.41</td>
</tr>
<tr>
<td>AL, mm</td>
<td>23.03 (0.75)</td>
<td>22.92 (0.74)</td>
<td>-0.11 (-0.16 to -0.05)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Prevalence, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myopia</td>
<td>115 (7.8)</td>
<td>85 (7.0)</td>
<td>-0.8 (-2.8 to 1.2)</td>
<td></td>
</tr>
<tr>
<td>Emmetropia</td>
<td>1262 (85.7)</td>
<td>1041 (86.3)</td>
<td>0.5 (-2.1 to 1.2)</td>
<td></td>
</tr>
<tr>
<td>Hyperopia</td>
<td>95 (6.5)</td>
<td>81 (6.7)</td>
<td>0.3 (-1.6 to 2.1)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Change in Spherical Equivalent Refraction, Axial Length Elongation, and Myopia Incidence From Grade 2 to Grade 3 During the Periods From November and December 2018 to November and December 2019 (Nonexposure Group) and November and December 2019 to November and December 2020 (Exposure Group)

<table>
<thead>
<tr>
<th>Parameter associated with myopia development</th>
<th>Nonexposure group (n = 1060)</th>
<th>Exposure group (n = 1054)</th>
<th>Difference (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in SER, D</td>
<td>-0.31 (0.46)*</td>
<td>-0.67 (0.56)*</td>
<td>-0.36 (-0.41 to -0.32)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Change in AL, mm</td>
<td>0.22 (0.21)*</td>
<td>0.31 (0.24)*</td>
<td>0.08 (0.06 to 0.10)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Myopia incidence, No./total No. (%)</td>
<td>74/992 (7.5)</td>
<td>151/986 (15.3)</td>
<td>7.9 (5.1 to 10.6)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: AL, axial length; SER, spherical equivalent refraction.

Statistical analysis
Statistical analysis was performed using Stata version 15.0
(StataCorp). For all analyses, data from the right eyes were
used because of high correlation between the right and left eyes
using pairwise Pearson correlation (r, 0.93 for SER and 0.97
for AL in the grade 2 measurement; P < .001). Descriptive
statistics were performed. Means with SDs and numbers with per-
centages were reported. For comparisons, t test or y² test was
applied as appropriate to examine differences between the non-
exposure and exposure groups, and paired t test was used to
evaluate annual changes within the nonexposure group or
within the exposure group. Two-tailed P values were used and
there was no adjustment to P values for multiple analyses. A
P value <.01 was considered statistically significant.

© 2021 American Medical Association. All rights reserved.

Spherical Equivalent Refraction, Axial Length Elongation, and Myopia Incidence in Grade 2 Students During the Outbreak of COVID-19

The proportion of grade 3 students with myopia more
severe than −1.80 D was 5.4% (57 of 1054) in November and
December 2018 (exposure group). SER and prevalence of myopia were
not different between the 2 groups. The mean AL was 0.11 mm
(95% CI, 0.05-0.16) shorter in the exposure group.

From grade 2 to grade 3, students in the exposure group
experienced 0.36 D (95% CI, 0.32-0.41; P < .001) more my-
opic shift of SER and 0.08 mm (95% CI, 0.06-0.10; P < .001)
greater AL elongation than those in the nonexposure group.
Incidence of myopia was 7.9% (95% CI, 5.1-10.6; P < .001) higher
in the exposure group than in the nonexposure group (Table 2). Consequently, the mean SER in grade 3 students in the exposure

Table 3

Table 3. Comparison of the Prevalence of Myopia Between Grade 3 Students in November and December 2018 and November and December 2019

<table>
<thead>
<tr>
<th>Parameter associated with myopia development</th>
<th>Nonexposure group (n = 1060)</th>
<th>Exposure group (n = 1054)</th>
<th>Difference (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in SER, D</td>
<td>-0.31 (0.46)*</td>
<td>-0.67 (0.56)*</td>
<td>-0.36 (-0.41 to -0.32)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Change in AL, mm</td>
<td>0.22 (0.21)*</td>
<td>0.31 (0.24)*</td>
<td>0.08 (0.06 to 0.10)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Myopia incidence, No./total No. (%)</td>
<td>74/992 (7.5)</td>
<td>151/986 (15.3)</td>
<td>7.9 (5.1 to 10.6)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: AL, axial length; SER, spherical equivalent refraction.

* P < .001 using paired t test.

Abbreviations: AL, axial length; SER, spherical equivalent refraction.
December 2020, while that in November and December 2019 was 3.6% (38 of 1060) (Table 3).

Figure 2 displays the changes in SER and AL from grade 2 to grade 3 in children in different refractive categories. Increased myopic shift of SER and AL elongation during the period from November and December 2019 to November and December 2020 were observed in students with emmetropia at both visits and those with myopia at both visits. While in students with hyperopia at both visits, students who developed hyperopia and demonstrated emmetropia at the second visit, and students without myopia at the first visit and with myopia at the second visit, changes in SER and AL were not different between the periods from November and December 2018 to November and December 2019 and November and December 2019 to November and December 2020.

Discussion

In this study, we reported changes in the development of myopia from grade 2 to grade 3 during the COVID-19 outbreak period in China. Compared with the period from November and

<table>
<thead>
<tr>
<th>Refraction-related parameter</th>
<th>Nonexposure group (n = 1060)</th>
<th>Exposure group (n = 1054)</th>
<th>Difference (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SER, D, mean (SD)</td>
<td>0.55 (1.16)</td>
<td>0.20 (1.15)</td>
<td>−0.35 (−0.45 to −0.25)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>AL, mm, mean (SD)</td>
<td>23.25 (0.78)</td>
<td>23.23 (0.79)</td>
<td>−0.02 (−0.08 to 0.05)</td>
<td>.64</td>
</tr>
<tr>
<td>Prevalence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myopia</td>
<td>141 (13.3)</td>
<td>219 (20.8)</td>
<td>7.5 (4.3 to 10.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Emmetropia</td>
<td>880 (83.0)</td>
<td>809 (76.7)</td>
<td>−6.3 (−9.7 to −2.9)</td>
<td></td>
</tr>
<tr>
<td>Hyperopia</td>
<td>39 (3.7)</td>
<td>26 (2.5)</td>
<td>−1.2 (−2.7 to 0.3)</td>
<td></td>
</tr>
<tr>
<td>Proportion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individuals without myopia, SE &gt;−0.50 and ≤+0.50 D, No./total No. (%)</td>
<td>286/919 (31.1)</td>
<td>409/835 (49.0)</td>
<td>17.9 (13.3 to 22.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Total population, SE &lt;−1.80 D</td>
<td>38 (3.58)</td>
<td>57 (5.41)</td>
<td>1.8 (0.1 to 3.6)</td>
<td>.04</td>
</tr>
</tbody>
</table>

Abbreviations: AL, axial length; SER, spherical equivalent refraction.
December 2018 to November and December 2019, SER increased 2-fold toward myopia during the period from November and December 2019 to November and December 2020. AL elongation sped up about 1.4-fold, and the incidence of myopia doubled. Corresponding to the accelerated progression, cross-sectionally, we found a 0.35-D myopic shift in SER in grade 3 students from November and December 2019 to November and December 2020. The shift was comparable with the noncycloplegic data reported in Wang et al.\textsuperscript{5} The prevalence of myopia in grade 3 in November and December 2020 increased by 7.5%, matching findings from a study in Taiwan\textsuperscript{9} that showed changes in the prevalence of myopia (defined as SER of −0.25 D or less) in grade 3 during a 6-year period (from 42.7% in 2010 to 50.0% in 2016).

While it is evident that the development of myopia accelerated in young Chinese schoolchildren during the COVID-19 outbreak, some may argue that the acceleration would fade after the spread of the pandemic was under control. In our study sample, nearly half of the children without myopia in grade 3 in November and December 2020 demonstrated SER greater than −0.50 D and less than or equal to +0.50 D, compared with the proportion of approximately 30% in November and December 2019. Because these children are deemed to be at risk of developing myopia,\textsuperscript{6} we are concerned that the incidence of myopia may remain high over the next few years. Moreover, behavior changes, including reduced time outdoors and increased digital learning, may persist beyond the period of the pandemic,\textsuperscript{2} heightening the risk of a prolonged acceleration in the progression of myopia.

Given the strong association between early-onset myopia and development of high myopia,\textsuperscript{10,11} the doubled myopia incidence found in the children in this study might arouse concern regarding future increases in incident high myopia. In our preliminary analysis of the proportion of at-risk children in grade 3, a relative increase of around 50% was found in November and December 2020 compared with November and December 2019 (5.4% vs 3.6%). This indicates that environmental changes during the COVID-19 outbreak, which had an impact on the development of myopia in young schoolchildren in this study, might also worsen the burdens on the health care system for myopia control and on future high myopia.

We observed that a myopic shift (eg, more negative SER) in refractive parameters during the COVID-19 pandemic was only observed in students in the exposure group who had emmetropia at both examinations or who had myopia at their first examination, while in students who initially had hyperopia, differences in development of refractive parameters between the exposure and nonexposure groups were not observed. Previous epidemiological studies have demonstrated an association between gene-environment interaction and myopia.\textsuperscript{12-14} Factoring in similar environmental risk factors for all children during the pandemic outbreak period, we speculate that the differential effect of the environmental change is conditional on individual genetic predisposition.

This study found that, although environmental changes during the COVID-19 outbreak period substantially increased incident myopia in the study population, the amount of SER and AL change among children with incident myopia (ie, students without myopia at the first visit and with myopia at the second visit) were not affected. Previous studies reported that the maximum changes in refraction and AL were demonstrated just 1 year before the onset of myopia.\textsuperscript{15,16} Combining this evidence, we speculate that during this phase of disease development, changes in SER and AL might have achieved their maximum values and adding on environmental risks would not promote further change.

Limitations
This study had limitations. The study only examined changes in children from grade 2 to grade 3. Because most instances of myopia develop after children enter primary school,\textsuperscript{17} it would be more informative if data on children of other grades were evaluated. However, results from Wang et al\textsuperscript{5} indicate that age-specific refractive changes in response to environmental changes during the COVID-19 pandemic were similar among young schoolchildren, and older children appeared to be insensitive to the alteration. Therefore the current study provided longitudinal data on cycloplegic refraction and axial elongation for younger schoolchildren.

This study did not collect data on ocular biometric parameters, including corneal curvature, anterior chamber depth, and lens thickness. Thus, changes in the development of these ocular components could not be investigated. Because the development of myopia in schoolchildren is mostly owing to excessive axial elongation,\textsuperscript{15,18} we inferred with caution that the environmental changes during the pandemic outbreak period would barely alter the development of ocular components except for axial elongation. Moreover, we were unable to evaluate detailed environmental changes during the pandemic outbreak period, limiting the interpretation of the results of the study.

Conclusions
In this study, the development of myopia accelerated in young Chinese schoolchildren during the outbreak of COVID-19. This acceleration resulted in a doubled myopic shift of SER from grade 2 to grade 3 as well as a doubled incidence of myopia. The proportion of children without myopia at risk of developing myopia increased significantly in grade 3 in November and December 2020. The findings reported in this study need to be validated and generalized. The long-term impact of environmental changes during the COVID-19 outbreak period warrants further investigations with longer observation.
Concept and design: Hu, Zhang, Y. Guo, Lu, Yang, He.
Acquisition, analysis, or interpretation of data: Hu, Zhao, Ding, Zhang, Z. Li, Feng, Tang, Q. Li, L. Guo, Lu, Yang, He.
Drafting of the manuscript: Hu, Z. Li, Tang, Lu.
Critical revision of the manuscript for important intellectual content: Zhao, Ding, Zhang, Y. Guo, Feng, Q. Li, L. Guo, Lu, Yang, He.
Statistical analysis: Hu, Ding, Zhang, Z. Li, Tang, Lu.
 Obtained funding: Hu, Zhang, Lu, Yang.
Administrative, technical, or material support: Zhao, Z. Li, Y. Guo, Feng, Lu.
Supervision: Y. Guo, Lu, Yang, He.

Conflict of Interest Disclosures: None reported.

Funding/Support: This work was supported by the Science and Technology Program of Guangzhou (grant 201803010062), the National Natural Science Foundation of China (grants 82070994 and 81900089), and the Natural Science Foundation of Guangdong (grant 2017A030313755).

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript, and decision to submit the manuscript for publication.

REFERENCES

Another Insight Into COVID-19–Associated Nearsightedness

David C. Musch, PhD, MPH

In a May 2020 Letter to the Editor, Pellegrini et al1 noted the possibility that prolonged home confinement due to the COVID-19 pandemic could result in more myopia development and worsening of preexisting myopia among children.

The authors termed this quarantine myopia and observed that this would represent a serious public health concern owing to myopia-associated visual disability that would particularly affect children in low- and middle-income countries and the known sight-threatening complications in later life associated with high myopia. In an article from July 2020, Wang et al2 reviewed studies that evaluated the association of myopia onset and progression with digital device use, near work, and outdoor time and concluded that these direct associations could result in increased myopia development and progression not only during the COVID-19 pandemic, but also beyond if behaviors such as increased use of digital devices continued after COVID-19. Recommendations were made to mitigate these factors for parents, schools, eye care professionals, and government agencies, which were promoted in a September 2020 article by Wong.3

We now have supportive evidence from several studies documenting what was considered a possibility has indeed happened. Wang et al4 evaluated cycloplegic refractive error values from annually performed screenings of 123 535 children aged 6 to 13 years from 10 elementary schools in Shandong, China. During the 5 years preceding the COVID-19 pandemic, mean spherical equivalent refraction (SER) values were relatively stable within all age groups, whereas in the June 2020 screenings that took place when schools reopened after 5 months of home confinement, the mean SER reflected a myopic shift of about −0.3 diopters (D) and the prevalence of myopia (defined as a SER of −0.50 D or less) was substantially higher, especially among younger children. A second report relied on information from the 2019 and the June 2020