



# Preschoolers' screen time in China before and during COVID-19 lockdown: a parental survey

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## ABSTRACT

**Objectives** Since COVID-19 first appeared in Wuhan, China, in December 2019, the disease has spread rapidly across the country. To reduce the spread of infection, schools including kindergartens were closed. Prolonged home confinement can affect children's behaviour. Therefore, we investigated the change of preschoolers' total daily screen time during the COVID-19 lockdown in China.

**Design, setting and participants** In the parental survey, 1121 preschoolers, whose parents or grandparents completed an online survey from 1 June 2020 to 5 June 2020, were enrolled.

**Primary outcome** Total daily screen time. Multivariable modelling was performed to identify factors associated with increased screen time.

**Results** The results showed that preschoolers' total daily screen time during lockdown (median 2.5 hours, IQR 2.5 hours) was significantly longer than it was before lockdown (median 1.5 hours, IQR 1.0 hour). Older age (OR 1.26, 95% CI 1.07 to 1.48), higher annual household income (OR 1.18, 95% CI 1.04 to 1.34), and decrease of moderate-vigorous physical activity (OR 1.41, 95% CI 1.20 to 1.66) were independently associated with increased screen time.

**Conclusions** Preschoolers' total daily screen time significantly increased during lockdown.

## INTRODUCTION

By 18 February 2020, China had reported 72 528 confirmed cases of COVID-19 (98.9% of the global total) and 1870 deaths. Most individuals were 30–79 years of age (87%), and 1% were aged 9 years or younger.<sup>1</sup> To address this critical situation and to delay the spread of the virus, China put in place public health emergency measures— isolation, quarantine, social distancing and community containment. Enormous numbers of large gatherings were cancelled. Businesses and schools were closed, isolating individuals at home.<sup>2</sup>

Although these measures are necessary for protecting the population and reducing pressure on the Chinese healthcare system, there are reasons to be concerned because prolonged home confinement could have

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Home confinement reduces the level of physical activity and exposure to daylight.
- ⇒ Home confinement increases sedentary time spent on electronic devices.

## WHAT THIS STUDY ADDS

- ⇒ Preschoolers' total daily screen time significantly increased during COVID-19 lockdown.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Future research needs to consider how to reduce screen time during lockdown. The effects of isolation on children should be taken into account when developing isolation policies.

adverse effects on children's physical and psychological health.<sup>3</sup> Previous studies have shown that home confinement reduces the level of physical activity and exposure to daylight, whereas increases sedentary time spent on electronic devices.<sup>4–6</sup> The American Academy of Pediatrics and the new Canadian 24-hour Movement Guidelines recommend limiting screen time on electronic devices to 1–2 hours of quality programming per day for preschool-aged children.<sup>7,8</sup> However, many children had prolonged screen time. This may be associated with damage to children's eye health.<sup>9</sup> TV viewing in young children has been associated with cognitive and speech delays, aggressive behaviour, decreased academic performance, unhealthy dietary patterns, poor sleep quality, cardiovascular disease and obesity.<sup>10</sup> Screen time also potentially displaces other activities, such as reading, physical activity and imaginative play, all of which are beneficial to children's growth and development.<sup>11</sup>

Previous studies have predominantly focused on the impact of the COVID-19 pandemic on older children or teenagers. To date, only a few studies have drawn attention to the impact of lockdown on Chinese



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**Table 1** Screen time before lockdown and during lockdown among preschoolers (n=1121)

Screen time	Before lockdown	During lockdown	P value
Total, hour/day	1.5 (1.0)	2.5 (2.5)	<0.001
TV and videos viewing, hour/day	1.0 (0.5)	2.0 (2.0)	<0.001
Male	1.0 (0.5)	2.0 (2.0)	<0.001
Female	1.0 (0.5)	1.5 (1.0)	<0.001
3 years old	2.0 (2.7)	2.0 (2.4)	0.055
4 years old	1.0 (0.5)	2.0 (2.0)	<0.001
5 years old	1.0 (0.5)	1.3 (1.0)	<0.001
6 years old	1.0 (0.5)	2.0 (2.0)	<0.001
Touch-screen devices, hour/day	0.5 (0.5)	1.0 (1.5)	<0.001
Male	1.0 (0.5)	1.0 (1.5)	<0.001
Female	0.5 (0.5)	1.0 (1.5)	<0.001
3 years old	1.0 (0.7)	3.5 (3.0)	<0.001
4 years old	1.0 (0.7)	1.0 (1.5)	<0.001
5 years old	1.0 (0.7)	1.0 (1.5)	<0.001
6 years old	1.0 (0.7)	1.0 (1.4)	<0.001
TV, television.			

preschoolers. Therefore, this study aims to examine the change of preschoolers' total daily screen time during the COVID-19 lockdown.

## METHODS

### Participants

Participants completed an anonymous, online survey after reading the written consent form and explicitly agreeing to participate in the survey. The survey was shared via social media for a limited time (from 1 June 2020 to 5 June 2020) and targeted preschoolers from eight randomly selected kindergartens to obtain responders in Chengdu, Sichuan, China was put on a lockdown on 23 January. So variables in the 4 months immediately before and the 4 months immediately after the COVID-19 outbreak were assessed. There was no compensation for participating in the study. From this sample, we excluded 42 participants with missing or abnormal data beyond the standard and super trend, which may be caused by human error and software abnormalities. Data reported in this study were part of a wider research project about the psychological and physical impact of home confinement on preschoolers in China; this study had multiple purposes, and additional data will be presented elsewhere.

### Data collection

A self-administered structured questionnaire was used to collect sociodemographic information on the preschoolers and their families, including age, sex

(male or female), being an only child or not, parents' education (junior high school or less, high school, college or university degree, master's degree and more), marital status (married, divorced or single), maternal work status (regular work, remote work or out of work), relationship between caregivers and children, parenting time, residential location (urban, suburban county, towns or rural area), living space and annual household income. Details of the questionnaire can be found in online supplemental materials.

### Measuring screen time

Questions that directly asked about screen time usage were used to quantify the number of hours spent by each preschooler on TV viewing and touch-screen devices. Touch-screen devices included phones, tablet computers and early education machines. We also asked about the purpose of electronic offerings, such as cartoons, short videos, games, educational programmes, music and chatting. We calculated the difference value between the screen time during isolation and before isolation. The difference value greater than 0 was the increased group, and the difference value less than or equal to 0 was the non-increased group.

### Measuring time spent outdoors and moderate-to-vigorous physical activity

Questions that directly asked about time usage were used to quantify the number of hours spent by each preschooler for moderate-vigorous physical activity (MVPA). MVPA refers to activities such as brisk walking, running, skipping rope, shuttlecock, ball games, swimming and cycling that raise children's heart and breathing rates.

### Statistical analysis

Statistical analyses were performed by using SPSS V.25.0. Continuous variables were described as the means and SD, whereas variables of non-normal distribution were shown as median (M) and IQR. Categorical variables were shown as counts and percentages. To compare the screen time before lockdown and during lockdown, Wilcoxon sign-rank test was used for paired variables. The statistical difference in the distribution of sociodemographic characteristics and lifestyle behaviours between the non-increased group and the increased group was assessed using the  $\chi^2$  test or the Student's t-test. A multivariable logistic regression analysis was performed to identify factors associated with the increased total daily screen time. These variables with statistical significance in the univariable analysis or with clinical significance from previous studies were used as confounding factors to calculate the adjusted ORs (aORs) and the corresponding 95% CIs.<sup>12-14</sup> All tests of hypotheses were two tailed. Statistical significance was defined as a  $p < 0.05$ .

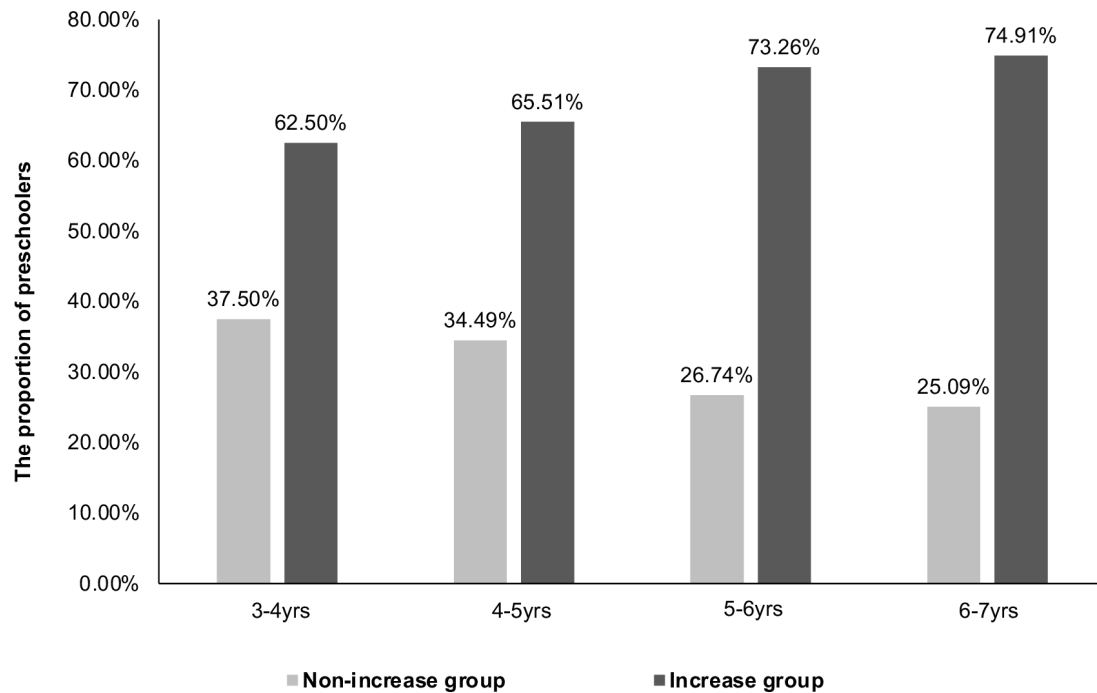


Figure 1 The proportion of preschoolers in the screen time non-increase and increase group among different age groups.

We included the restricted cubic spline (RCS) with 3 knots placed at the 5th, 50th and 90th percentiles to allow nonlinear assumptions between decrease of MVPA and increased screen time.<sup>15</sup> And we plotted the estimated aOR with the 95% CI to show the relationship and its change according to decrease of MVPA. These statistical analyses were performed by using Stata V.15 (Stata).

### Patient and public involvement

Patients and the public were not involved in this study, including the recruitment, data collection, analysis, interpretation and dissemination of the results.

### RESULTS

A total of 1121 participants were included in this study. Of these respondents, 99.3% (1113/1121) were parents, and 0.7% (8/1121) was grandparents. The proportion of children in different age groups were as follows: 3 years old

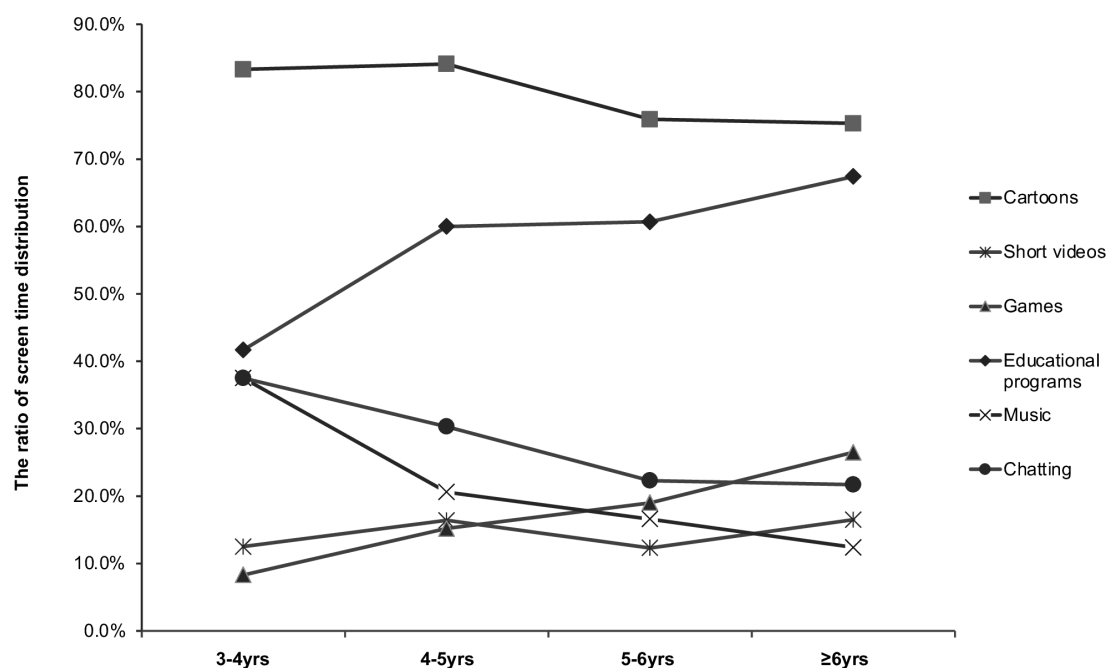


Figure 2 Distribution of total daily screen time for preschoolers of different age groups.

**Table 2** Comparison of sociodemographic characteristics and physical activity between the non-increased group and the increased group

	Changes of screen time		
Variables	Non-increased group (n=331)	Increased group (n=790)	P value
Children			
Males, n (%)	160 (48.3%)	406 (51.4%)	0.351
Age, years	4.7±0.8	4.9±0.8	0.003
Being a single child, n (%)	193 (58.3%)	454 (57.5%)	0.795
Parents			
Paternal age, years	36.5±5.1	36.7±5.0	0.499
Maternal age, years	34.1±4.3	34.4±4.2	0.322
Father's education level, n (%)			
Junior high school and below	26 (7.9%)	44 (5.6%)	0.149
High school	52 (15.7%)	122 (15.4%)	0.910
College or university degree	238 (71.9%)	575 (72.8%)	0.763
Master's degree and above	15 (4.5%)	49 (6.2%)	0.271
Mother's education level, n (%)			
Junior high school and below	18 (5.4%)	45 (5.7%)	0.864
High school	54 (16.3%)	127 (16.1%)	0.921
College or university degree	227 (68.6%)	529 (66.9%)	0.598
Master's degree and above	32 (9.7%)	89 (11.3%)	0.432
Marital status, n (%)			
Married	317 (95.8%)	759 (96.1%)	0.812
Divorced	13 (3.9%)	28 (3.5%)	0.755
Single	1 (0.3%)	3 (0.4%)	1.000
Maternal work status, n (%)			
Regular work	258 (77.9)	606 (76.7%)	0.653
Remote work	36 (10.9%)	103 (13.0%)	0.316
Out of work	37 (11.2%)	81 (10.3%)	0.645
Parenting, n (%)			
Caregivers			
Mother	197 (59.5%)	461 (58.4%)	0.718
Father	16 (4.8%)	50 (6.3%)	0.332
Ancestor	114 (34.4%)	274 (34.7%)	0.938
Nursemaid	3 (0.9%)	2 (0.3%)	0.156
Others	1 (0.3%)	3 (0.4%)	1.000
Reduced maternal parenting time	16 (4.8%)	47 (5.9%)	0.459
Reduced paternal parenting time	16 (4.8%)	51 (6.5%)	0.335
Socioeconomic characteristics			
Living environment			
Urban, n (%)	321 (97.0%)	772 (97.7%)	0.467
Suburban county, n (%)	5 (1.5%)	9 (1.1%)	0.610
Towns, n (%)	3 (0.9%)	7 (0.9%)	1.000
Rural area, n (%)	2 (0.6%)	2 (0.3%)	0.586
Living space class, n (%)			
< 80m <sup>2</sup>	22 (6.6%)	57 (7.2%)	0.647
80–100m <sup>2</sup>	144 (43.5%)	334 (42.3%)	0.705

Continued

**Table 2** Continued

Variables	Changes of screen time		P value
	Non-increased group (n=331)	Increased group (n=790)	
100–150 m <sup>2</sup>	145 (43.8%)	335 (42.4%)	0.665
150–200 m <sup>2</sup>	14 (4.2%)	48 (6.1%)	0.217
≥200 m <sup>2</sup>	6 (1.8%)	16 (2.0%)	0.815
Annual household income, n (%)			
< ¥80 000	75 (22.7%)	97 (12.3%)	0.009
¥80 000–¥150 000	79 (23.9%)	199 (25.2%)	0.640
≥¥150 000	177 (53.4%)	494 (62.5%)	0.005
Physical activities, hour/day			
Decrease of time spent outdoors	1.0 (2.0)	1.5 (1.0)	<0.001
Decrease of MVPA	0.0 (1.0)	1.0 (1.0)	<0.001
MVPA, moderate-vigorous physical activity.			

2.1% (24/1121), 4 years old 38.5% (432/1121), 5 years old 33.4% (374/1121), 6 years old 26.0% (291/1121). The mean age of these preschoolers was 4.8±0.8 years. Age meets assumptions of normality. The sex distribution was 566 (50.5%) males and 555 (49.5%) females. The results showed that preschoolers' total daily screen time during lockdown (M 2.5 hours, IQR 2.5 hours) was significantly longer than that before lockdown (M 1.5 hours, IQR 1.0 hour). The time spent watching TV and videos was also extended by approximately 1.0 hour (M 2.0 hours vs 1.0 hour,  $p<0.001$ ), and the time spent using touch-screen devices expanded by approximately 0.5 hour (M 1.0 hour vs 0.5 hour,  $p<0.001$ ). These results are shown in [table 1](#).

The majority of preschoolers (790, 70.5%) were reported to have increased screen time during lockdown. As the age progressed, more children were observed with increased screen time ([figure 1](#)). Meanwhile, we found that as children get older, they spend more time for educational programmes and playing games ([figure 2](#)). Notably the screen time for cartoons were consistently the longest, fluctuating between 75.3% and 84.1%. The second longest screen time were for educational programmes, dramatically increased from 41.7% among 3 years old group to 67.4% among 6 years old group.

The comparison of socioeconomic characteristics, parental factors, physical activity and parenting relationships of the preschoolers between non-increased screen time and increased screen time groups is shown in [table 2](#). Significant differences were observed in children's age, annual household income, decrease of time spent outdoors and decrease of MVPA ( $p<0.05$ ) between two groups. There were no statistical differences in sex, whether the child was an only child or had siblings, parents' age, parents' education, parents' marital status, parenting time, maternal work status, residential location, living space or caregivers.

Decrease of time spent outdoors was not included in the multivariate analysis, due to its association with screen time. Age, annual household income, decrease of MVPA, male, being a single child, maternal age, parental age, mother's education level, father's education level, marital status, maternal work status, caregivers, reduced maternal parenting time, reduced parental parenting time, living environment and living space class were used as confounding factors. After multivariable adjustments, we found that older age (OR 1.26, 95% CI 1.07 to 1.48), higher annual household income (OR 1.18, 95% CI 1.04 to 1.34) and decrease of MVPA (OR 1.41, 95% CI 1.20 to 1.66) were associated with increased screen time ([table 3](#)). We use RCS to graph the relationship between increased screen time and decrease of MVPA ([figure 3](#)). Increased odds of screen time increase were observed with decrease of MVPA.

## DISCUSSION

The COVID-19 pandemic has caused huge changes in people's lifestyle, health and social relationships.<sup>11</sup> In this study, we investigated the changes of preschoolers' screen time before and during the COVID-19 lockdown, and the accompanied potential health impact on preschoolers in Southwest China. As expected, during the lockdown the preschoolers' total daily screen time was markedly increased, approximately two times longer than before. Importantly, it was suggested that the preschoolers with increased screen time were associated with age, annual household income and decrease of MVPA.

### Screen time increased during lockdown

The results showed that preschoolers' total daily screen time, including television viewing and touch-screen devices, had expanded from 1.5 hours before isolation to 2.5 hours during lockdown. Most preschoolers' (70.5%, 790/1121) screen time increased compared with before



**Table 3** Related factors for screen time increase of preschoolers during COVID-19 lockdown by a multivariable model adjusting for covariates

Variables	$\beta$	SE	Wals	P value	aOR (95% CI)
Age	0.23	0.08	7.44	0.006	1.26 (1.07 to 1.48)
Annual household income	0.16	0.07	6.23	0.013	1.18 (1.04 to 1.34)
Decrease of MVPA	0.34	0.08	17.15	0.000	1.41 (1.20 to 1.66)

Adjusted for: age, annual household income, decrease of MVPA, male, being a single child, maternal age, parental age, mother's education level, father's education level, marital status, maternal work status, caregivers, reduced maternal parenting time, reduced parental parenting time, living environment and living space class.

aOR, adjusted OR; MVPA, moderate-vigorous physical activity.

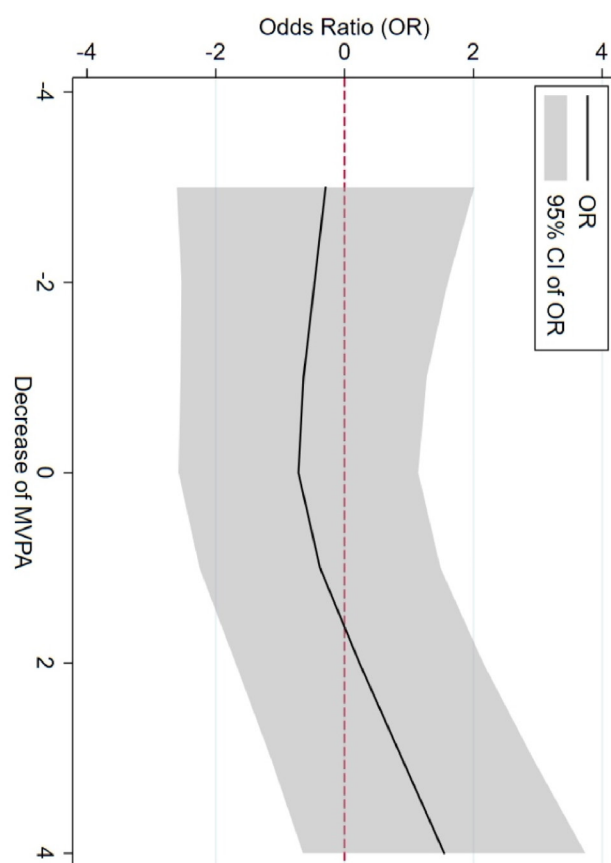
isolation. Similar results were observed in other research findings. A study of 1033 participants in China also reported that 70% of adults spent more time looking at screens after the COVID-19 outbreak.<sup>16</sup> Furthermore, Pišot *et al* conducted a study in 9 European countries and

found that approximately 65% of the 4108 participants reported increased screen time during the pandemic.<sup>17</sup> Guidelines recommend  $\leq 2$  hours of recreational screen time/day for 5–17 year olds, while limiting screen time to  $< 1$  hour/day for 2–4 years old.<sup>7,8</sup> Isolation has pushed preschoolers' screen time far beyond the recommended limits.

### Associated factors of increased screen time

We found that the screen time of 3-year-old children did not increase, and older age was associated with the increased total daily screen time. Nowadays, many kindergartens have adopted many forms of screen-based instruction while children cannot return to school physically.<sup>18</sup> Studies during the ongoing COVID-19 pandemic noted that there was an increase in screen time among children, not only for educational purposes but also for leisure activities.<sup>19,20</sup> In our study, the older children learn and play games more, and the younger children listen to music and do other things more often. Therefore, risky aspects of screen use such as non-educational screen content, unsupervised screen use and rule-less screen use should be avoided for older children, which have many potential negative effects on children's eye health.

Some studies reported that children from lower socio-economic backgrounds are more likely to have screens (including television and video games) and decreased accessibility to opportunities for physical activity, and these factors jointly increase their daily screen time.<sup>21–24</sup> But in this study, better annual household income was related to the increased screen time. In addition, after multivariable regression analysis, MVPA was associated with the increased screen time. MVPA and low levels of sedentary behaviour are critical to achieve higher motor competence and higher health-related quality of life.<sup>25,26</sup> However, our results indicate a downward trend in MVPA levels, similar to other studies.<sup>27,28</sup> Parental limitations due to 'shelter-at-home' recommendations and working from home may be a barrier to keeping children physically active.<sup>22</sup> In a study of 97 South Korean parents, 94% described a reduction in their children's daily physical activity during the COVID-19 pandemic.<sup>28</sup> Playing video



**Figure 3** Curves of the association between increased screen time and decrease of moderate-vigorous physical activity (MVPA). Adjusted for: age, annual household income, decrease of MVPA, male, being a single child, maternal age, parental age, mother's education level, father's education level, marital status, maternal work status, caregivers, reduced maternal parenting time, reduced parental parenting time, living environment and living space class.

games had replaced most outdoor and parent–child activities. Screen time also potentially displaces other activities, such as reading, physical activity and imaginative play, all of which are beneficial to children’s growth and development.<sup>29</sup> In short, during the isolation period, children’s screen time should be reduced, and some indoor MVPA should be increased.

## Strength and limitations

This is a parental survey assessing the daily screen time change among preschoolers during the COVID-19 pandemic. A notable strength of this study is the large sample with targeted preschoolers from eight randomly selected kindergartens. The large sample size and multievaluation indicators make a reliable conclusion. The current study has several limitations. First, our study was regional survey, rather than national survey. A national study with a larger sample could strengthen our conclusions and make the conclusion more generalisable. Moreover, investigating preschool children’s experiences was limited by asking their parents or grandparents rather than involving the children directly. There may have been a bias in the parents who responded to the survey. Self-reported data are subject to recall bias and social desirability. Potential recall bias may affect the accuracy of this study. Another limitation is that we did not use validated measures and scales. Despite these limitations, our findings highlight that preschoolers’ total screen time exceeds recommendations and even most previous estimates.

In summary, we found that preschoolers’ total daily screen time significantly increased during lockdown. It is recommended to strengthen children’s eye care during the COVID-19 pandemic.

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**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants and was approved by the medical ethics committee of West China Second University Hospital. Participants gave informed consent to participate in the study before taking part.

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