

## Brief Report

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# Impact of Implementing and Lifting COVID-19 Lockdown on Study and Physical Activity Patterns Among Youths in China

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## Abstract

**Objective:** The youths' study and physical activity (PA) patterns may have been affected by lockdown measures due to COVID-19. This study aimed to reveal how youths' study and PA patterns had changed after implementing and lifting COVID-19 lockdown in China.

**Methods:** The COVID-19 Impact on Lifestyle Change Survey (COINLICS) was used, where 10082 youth participants voluntarily reported their study and PA patterns in the 3 periods before, during, and after COVID-19 lockdown. PA was measured as the weekly frequency of engaging in active transport for commuting/errands, leisure-time walking, leisure-time moderate-/vigorous-intensity physical activity (MVPA), and moderate-/vigorous-intensity housework (MVH); study patterns were measured as the daily average study time and the major study modes. We assessed differences of these variables across educational levels, sex, and periods.

**Results:** The significant decreases were generally observed during lockdown in the frequency of active transport for commuting/ errands (1.3 to 0.2 days/ week), leisure-time walking (1.0 to 0.2 days/ week), leisure-time MVPA (0.7 to 0.3 days/ week), and MVH (2.3 to 2.0 days/ week), with heterogeneities existing between sexes and across educational levels, except for the increase in MVH engagement among graduate students, especially female (1.5 to 2.4 days/ week). Rebounds were observed in the frequency of all activities except MVH after lifting lockdown (2.0 to 1.9 days/ week). The average study time generally increased during lockdown, with more youths studying for 1 - 4 hours/ day and less studying for < 1 hour/ day, and further increased after lockdown. A main shift of study modes has been from in-class to online study after implementing lockdown.

**Conclusions:** The youths' PA level have generally decreased, and study patterns significantly changed during and after lockdown in China. Our results would inform policymakers and educational administrators of the declined PA levels and changed study patterns among youths during COVID-19 lockdown for better policy making. In - class and/ or extracurricular PA programs could be designed to counteract those effects under cooperation of youths' parents.

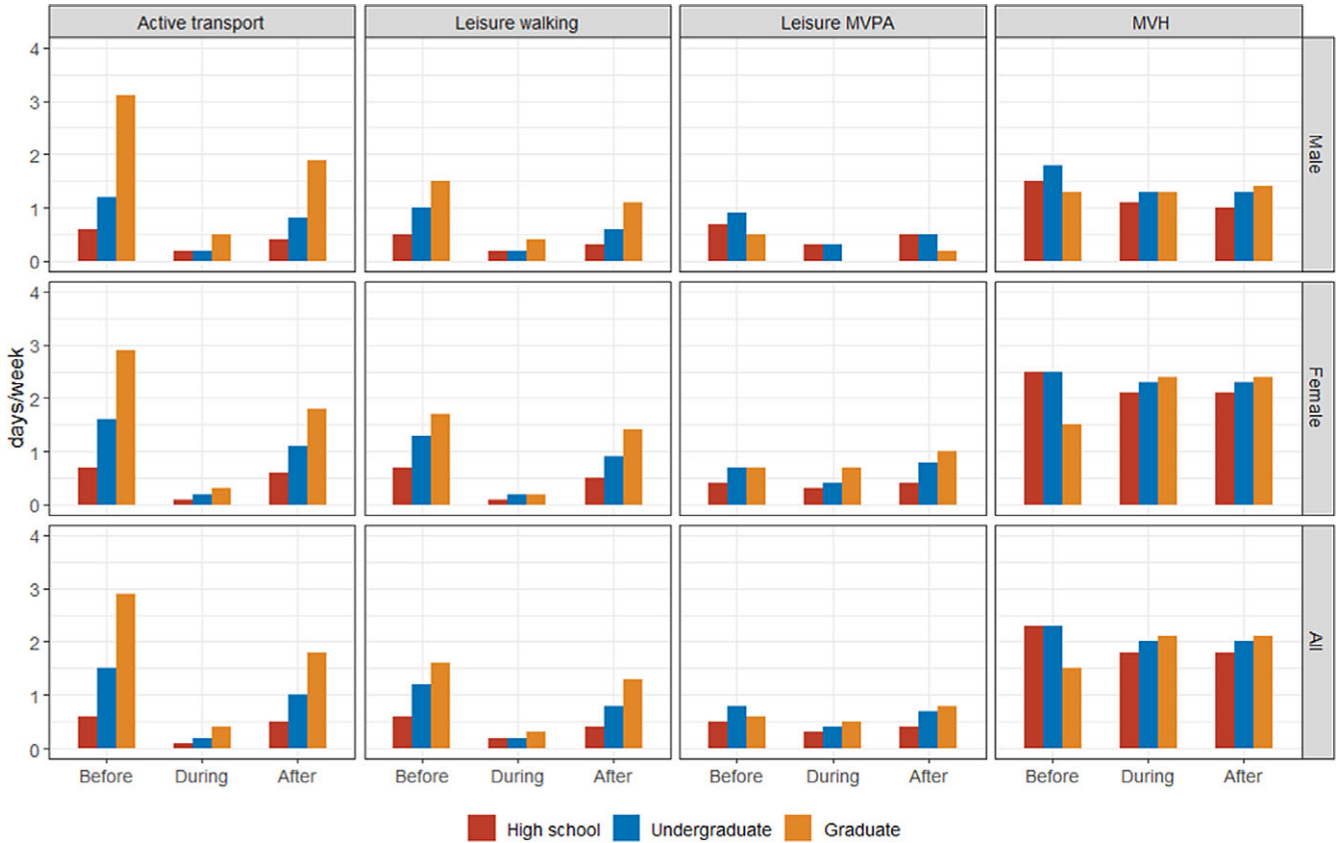
## Introduction

The Coronavirus disease 2019 (COVID-19) pandemic and subsequent lockdown measures for containing COVID-19 have affected human behavior and health at all ages.<sup>1,2</sup> The youth is one of the most vulnerable populations as the two major parts of their lives, study modes and physical activity (PA), may have been severely affected by lockdown measures, including school closure and 'stay-at-home' restrictions.<sup>3</sup> Such influences could lead to both short-term and long-term effects in their academic achievements (also future career paths) and health status.

This study aimed to reveal how the youth's study modes and PA patterns have changed through the COVID-19 epidemic in China, based on a large-sample national online survey. Our results would inform policymakers and educational administrators of the changed study and PA patterns among youths during COVID-19 lockdown for better policy making. Moreover, school administrators should be informed of those changes, so in-class and/or extra-curricular PA programs could be designed to counteract them. The youths' parents should also be aware of these changes, to better cooperate with school administrators for maximizing the effects of, for example, PA promotion programs, or to remind the youths of staying more active than usual while being at home.

## Methods

This study was based on the COVID-19 Impact on Lifestyle Change Survey (COINLICS), a national retrospective survey distributed via social media platforms in early May 2020 using a snowball sampling method.<sup>4-7</sup> More than 10000 youth participants at three educational levels



**Figure 1.** The participating youths' physical activity patterns before, during, and after COVID-19 lockdown by sex and educational level (MVPA: moderate-/vigorous-intensity physical activity; MVH: moderate-/vigorous-intensity housework).

(high school, college, and graduate school) in China have voluntarily reported their basic socio-demographic information and routine lifestyles in the months before (December 23, 2019 to January 23, 2020), during (January 24 to February 23, 2020), and after the COVID-19 lockdown (April 8 to May 8, 2020). The study was approved by the Sichuan University Medical Ethical Review Board (KS2020414).

This study focused on changes in four weekly PA patterns and two study patterns. PA patterns were measured using the International Physical Activity Questionnaire (IPAQ)-long form.<sup>8</sup> The frequency of engaging in active transport (i.e., walking and cycling) for commuting/ errands, leisure-time walking, leisure-time moderate-/ vigorous-intensity physical activity (MVPA), and moderate-/ vigorous-intensity housework (MVH) was reported as days/week (only counting outings that had lasted at least 10 minutes). Study patterns were measured as the daily average study time (hours/day) and the major study modes (in-class, online, or self-study).

We calculated the weekly frequency of PA and the percentages of categorized study time and modes. The paired *t*-tests and  $\chi^2$  tests were used for PA and study variables, respectively, to evaluate the significance of differences across educational levels, between sexes, and among three stages. All statistical analyses were performed using R 3.6.2 (R Foundation for Statistical Computing, Vienna, Austria) and statistical significance was declared if  $P < 0.05$ .

## Results

A total of 10082 youths responded to the survey, among which 71.7% were females and 95.3% were Hans, with a mean age of 20.

No significant differences were in the age and ethnic constitution between males and females. About 70% were undergraduate students, with 28% and 2.3% being high school and graduate students, respectively, and 63.2% lived in non-urban areas.

During the COVID-19 lockdown, the significant decreases were observed in the frequency of engaging in active transport for commuting/errands (1.3 to 0.2 days/ week), leisure-time walking (1.0 to 0.2 days/ week), leisure-time MVPA (0.7 to 0.3 days/ week), and MVH (2.3 to 2.0 days/ week) (Figure 1). Heterogeneities existed to different extents between sexes and across educational levels. For example, high school, undergraduate, and graduate students experienced decreases to different extents in the engagement of active transport for commuting/ errands (0.6 to 0.1, 1.5 to 0.2, and 2.9 to 0.4, respectively), leisure-time walking (0.6 to 0.2, 1.2 to 0.2, and 1.6 to 0.3, respectively), and leisure-time MVPA (0.5 to 0.3, 0.8 to 0.4, and 0.6 to 0.5, respectively); the level of MVH engagement decreased in only high school (2.3 to 1.8) and undergraduate students (2.3 to 2.0), and increased in graduate students (1.5 to 2.1), but with significant increases observed in only female (1.5 to 2.4) rather than male graduate students. After the lockdown was lifted, rebounds were observed in the frequency of engaging in active transport for commuting/errands (0.2 to 0.9 days/ week), leisure-time walking (0.2 to 0.7 days/ week), and leisure-time MVPA (0.3 to 0.7 days/ week), although still significantly lower than their corresponding levels before lockdown; a continuing decrease was only observed in the frequency of MVH (2.0 to 1.9 days/ week).

The average study time generally increased during lockdown (with more youths studying for 1 - 4 hours/ day and less studying

**Table 1.** The participating youths' study patterns before, during, and after COVID-19 lockdown by sex and educational level

Variable	Percentage									
	High school students			Undergraduate students			Graduate students			All
	Male (n = 678)	Female (n = 2146)	Total (n = 2824)	Male (n = 2106)	Female (n = 4918)	Total (n = 7024)	Male (n = 68)	Female (n = 166)	Total (n = 234)	Grand total (n = 10082)
<b>Average study time (hours/day)</b>										
<b>Before lockdown (reference group for 'During lockdown' and 'After lockdown')</b>										
<1h	<b>22.9</b>	<b>24.5</b>	<b>24.1</b>	<b>21.3</b>	<b>23.7</b>	<b>23.0</b>	<b>17.7</b>	<b>14.5</b>	<b>15.4</b>	23.1
1 - 4h	<b>47.3</b>	<b>42.4</b>	<b>43.5</b>	<b>44.9</b>	<b>43.8</b>	<b>44.1</b>	<b>26.5</b>	<b>33.1</b>	<b>31.2</b>	43.7
5 - 8h	<b>23.0</b>	<b>25.6</b>	<b>25.0</b>	<b>26.4</b>	<b>25.8</b>	<b>26.0</b>	<b>32.3</b>	<b>40.4</b>	<b>38.0</b>	26.0
> 8h	<b>6.8</b>	<b>7.5</b>	<b>7.4</b>	<b>7.4</b>	<b>6.7</b>	<b>6.9</b>	<b>23.5</b>	<b>12.0</b>	<b>15.4</b>	7.2
<b>During lockdown</b>										
<1h	<b>22.3</b>	<b>17.9***</b>	<b>18.9***</b>	<b>19.5*</b>	<b>21.8***</b>	<b>21.1***</b>	<b>25.0</b>	<b>20.5**</b>	<b>21.8**</b>	20.5***
1 - 4h	<b>48.4</b>	<b>39.9***</b>	<b>41.9***</b>	<b>49.2*</b>	<b>50.4***</b>	<b>50.1***</b>	<b>30.9</b>	<b>46.4**</b>	<b>41.9**</b>	47.6***
5 - 8h	<b>23.6</b>	<b>34.7***</b>	<b>32.0***</b>	<b>24.5*</b>	<b>23.1***</b>	<b>23.5***</b>	<b>27.9</b>	<b>27.1**</b>	<b>27.3**</b>	26.0***
>8h	<b>5.7</b>	<b>7.5***</b>	<b>7.1***</b>	<b>6.8*</b>	<b>4.7***</b>	<b>5.3***</b>	<b>16.2</b>	<b>6.0**</b>	<b>9.0**</b>	5.9***
<b>After lockdown</b>										
<1h	<b>12.8</b>	<b>9.2***</b>	<b>10.1***</b>	<b>11.6*</b>	<b>6.5***</b>	<b>8.0***</b>	<b>17.6</b>	<b>13.3**</b>	<b>14.5**</b>	8.7***
1 - 4h	<b>36.7</b>	<b>27.6***</b>	<b>29.8***</b>	<b>39.3*</b>	<b>31.3***</b>	<b>33.7***</b>	<b>22.1</b>	<b>46.4**</b>	<b>39.3**</b>	32.8***
5 - 8h	<b>38.2</b>	<b>48.7***</b>	<b>46.1***</b>	<b>38.1*</b>	<b>48.1***</b>	<b>45.1***</b>	<b>39.7</b>	<b>32.5**</b>	<b>34.6**</b>	45.1***
>8h	<b>12.3</b>	<b>14.5***</b>	<b>14.0***</b>	<b>11.0*</b>	<b>14.2***</b>	<b>13.2***</b>	<b>20.6</b>	<b>7.8**</b>	<b>11.6**</b>	13.4***
<b>Main study mode</b>										
<b>Before lockdown (reference group for 'During lockdown' and 'After lockdown')</b>										
In-class study	<b>20.6</b>	<b>18.0</b>	<b>18.7</b>	<b>30.9</b>	<b>35.9</b>	<b>34.4</b>	<b>20.6</b>	<b>26.5</b>	<b>24.8</b>	29.8
Online study	<b>38.8</b>	<b>43.2</b>	<b>42.1</b>	<b>40.4</b>	<b>32.7</b>	<b>35.0</b>	<b>26.5</b>	<b>23.5</b>	<b>24.4</b>	36.7
Self-study	<b>40.6</b>	<b>38.8</b>	<b>39.2</b>	<b>28.7</b>	<b>31.4</b>	<b>30.6</b>	<b>52.9</b>	<b>50.0</b>	<b>50.8</b>	33.5
<b>During lockdown</b>										
In-class study	<b>1.5***</b>	<b>0.3***</b>	<b>0.6***</b>	<b>2.5***</b>	<b>0.5***</b>	<b>1.1***</b>	<b>2.9***</b>	<b>1.2***</b>	<b>1.7***</b>	1.0***
Online study	<b>64.6***</b>	<b>72.5***</b>	<b>70.6***</b>	<b>71.5***</b>	<b>65.8***</b>	<b>67.5***</b>	<b>50.0***</b>	<b>48.2***</b>	<b>48.7***</b>	68.0***
Self-study	<b>33.9***</b>	<b>27.2***</b>	<b>28.8***</b>	<b>26.0***</b>	<b>33.7***</b>	<b>31.4***</b>	<b>47.1***</b>	<b>50.6***</b>	<b>49.6***</b>	31.0***
<b>After lockdown</b>										
In-class study	<b>29.0***</b>	<b>0.9***</b>	<b>7.7***</b>	<b>11.3***</b>	<b>5.3***</b>	<b>7.1***</b>	<b>16.2***</b>	<b>6.6***</b>	<b>9.4***</b>	7.3***
Online study	<b>60.5***</b>	<b>86.7***</b>	<b>80.4***</b>	<b>78.3***</b>	<b>87.3***</b>	<b>84.6***</b>	<b>42.6***</b>	<b>51.2***</b>	<b>48.7***</b>	82.6***
Self-study	<b>10.5***</b>	<b>12.4***</b>	<b>11.9***</b>	<b>10.4***</b>	<b>7.4***</b>	<b>8.3***</b>	<b>41.2***</b>	<b>42.2***</b>	<b>41.9***</b>	10.1***

\*Values under a given variable were shown in **bold**, if the difference across educational levels (high school students, undergraduate students, graduate students) within the overall population (total) or within a given sex (male, female) was significant; shown in *italic*, if the difference between sexes within a given educational level was significant; and marked by asterisks, if the difference during or after COVID-19 within a given educational level and sex (relative to 'before lockdown') was significant (\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ ).  $P$ -values were based on  $\chi^2$  tests.

for < 1 hour/ day), especially high school students, and further increased after lockdown, especially high school, and undergraduate students (Table 1). A main shift of study modes has been mainly from in-class to online study after implementing lockdown measures, with the percentage of conducting online study nearly doubled (from 36.7% to 68.0%); compared to undergraduate and graduate students, a larger percentage of high school students who mainly self-studied before lockdown also started online study. More self-studying high school and undergraduate students shifted to the online study after lockdown was lifted; about 6% of the youths were seen to resume in-class study.

## Discussion

In this nationwide survey among youths in China, we observed significant decrease in the frequency of engaging in active transport for commuting/ errands, leisure-time walking, MVPA, and MVH during lockdown, with heterogeneities existing between sexes and across educational levels. After the lockdown was lifted, rebounds were observed in the frequency of all activities except MVH, which

had further decreased. The average study time generally increased during lockdown, especially high school students, and further increased after lockdown, especially high school, and undergraduate students. A main shift of study modes has been mainly from in-class to online study after implementing lockdown. More self-studying high school and undergraduate students shifted to the online study after lifting lockdown.

The COINLICS has successfully accumulated a large sample size in the targeted population promptly for drawing strong conclusions, which is of particular importance in the context of public health emergencies.<sup>9</sup> Our findings demonstrated the unique changing patterns of PA and studying in China, which have supported our hypotheses that social distancing and stay-at-home orders issued in many cities might reduce PA opportunities; also, school closure has changed the youth's study modes and hence may further aggravate PA decreases.

There were some limitations in this study. First, COINLICS generated a convenience sample that may not be perfectly representative of the Chinese youth. Also, recalling what have happened about 2 - 4 months ago may be subject to recall bias.

However, questions on each activity at three stages were placed next to each other, so their answers could reasonably be treated as good indicators for their lifestyle changes.<sup>10</sup> Second, variation in understanding the same questions among different individuals, especially across different educational levels, might affect the comparability of results among different educational groups. Third, the applicability of the IPAQ form to the current context need to be further evaluated.

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