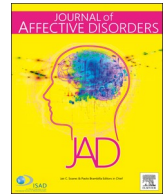




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## Research paper

# The prevalence of behavioral problems among school-aged children in home quarantine during the COVID-19 pandemic in china



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## ABSTRACT

**Background:** To prevent spreading of the COVID-19 infection, many countries have implemented a nationwide school closure. We aimed to assess the prevalence of behavioral problems in school-aged children during home confinement.

**Methods:** We conducted an internet-based survey involving 1264 children (grades 2–6) and their parents from two primary schools between February 25 and March 8, 2020, in Hubei province, China. Behavioral problems were evaluated using the Strengths and Difficulties Questionnaire (SDQ).

**Results:** The prevalence of prosocial behaviors among children was 10.3%, followed by total difficulty (8.2%), conduct problems (7.0%), peer problems (6.6%), hyperactivity-inattention (6.3%) and emotional problems (4.7%). Compared with children who did not exercise, children with psychical activity had a lower hyperactivity-inattention risk (Odds Ratio (OR): 0.44 for 1–2 days/week; OR: 0.56 for more than 2 days/week) and less prosocial behaviors problems (OR: 0.65 for 1–2 days/week; OR: 0.55 for more than 2 days/week). Children of parents with anxious symptoms were associated with increased risks of emotional symptoms and total difficulty (OR: 5.64 and 3.78, respectively).

**Limitations:** We adopted self-report questionnaires and did not collect baseline information before COVID-19 outbreak. The potential self-selection bias inherent in the study should be noted.

**Conclusion:** The prevalence of behavioral problems among school-aged children varied from 4.7% to 10.3% in home quarantine during the COVID-19 outbreak. Taking physical exercise may be an efficient measure to reduce behavioral problems for school-aged children in home confinement.

## 1. Introduction

In December 2019, an outbreak of coronavirus disease 2019 (COVID-19) was detected in Wuhan city (Hubei, China), and has rapidly spread to the world (Zhu et al., 2020). On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus outbreak a pandemic (WHO, 2020a). To prevent spreading of the COVID-19 infection, the Chinese Government has ordered a nation-wide school closure. According to WHO, there are more than 1.5 billion children

and young people affected by nationwide school closures, with up to 90 percent of the world's students (WHO, 2020b). In addition to causing physical damage, COVID-19 also imposed enormous pressure on the mental health of the public. Previous researches had reported the impact of the epidemic on the general public, patients, medical staff, collage students and older adults (Cao et al., 2020; Chen et al., 2020a; Wang et al., 2020a; Yang et al., 2020), but researches about the effect of long-term quarantine on school-aged children are limited.

Behavioral problems in children are a public health concern due to

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the high prevalence (Ghandour et al., 2019). In 2016, there are approximately 2.26 million 6–11 years American children had a current behavioral problem (Ghandour et al., 2019). Epidemiological studies have claimed that children are particularly vulnerable to behavioral difficulties in the pandemic disasters, including hyperactivity, conduct problems, externalizing problems, and general psychological distress (Clark et al., 2020; Dray et al., 2017; Wang et al., 2020b). There are many risk factors that contribute to the emergence of behavioral problems, including environment factors, family factors (Alexandra et al., 2016). When children are confined to their homes, they are physically less active, depressed and bored, unable to in-person contact with their classmates, friends and teachers, and lack of personal space (Brazendale et al., 2017). The joint effect between lifestyle changes and psychosocial stress caused by home confinement could further aggravate the detrimental effects on behavioral development (Wang et al., 2020b). Therefore, it is critical to raise the awareness of identifying potential behavioral impacts among the school-aged children during this unusual period.

Wuhan is the most seriously affected city by the COVID-19 outbreak in China, and in order to control the epidemic, Wuhan was lockdown on January 23, 2020. Since the emergence of COVID-19 coincided with the Spring Festival travel season, high population migration emigrated from Wuhan to its surroundings. One day later, Huangshi city was also lockdown, where is about 85 kms to Wuhan. As of the time of investigation, students in the two cities have been at home for more than one month. In the current study, we assessed the prevalence of behavioral problems using the Strengths and Difficulties Questionnaire (SDQ) among the school-aged children in two primary schools in Wuhan and Huangshi city during the epidemic, and found out related risks and protective factors. As a reliable and valid tool for screening behavioral problems, the SDQ is widely used in education and clinical research for assessing conduct problems, hyperactivity-inattention, peer problems, prosocial behaviors, emotional symptoms and total difficulty (Goodman 1997). We aimed to improve the understanding of the behavioral impact of home confinement on the school-aged children in China and provide better guidance for other countries to cope with the outbreak.

## 2. Methods

### 2.1. Study populations

An internet-based cross-sectional survey was conducted between February 25 and March 8, 2020 in two elementary schools of Wuhan and Huangshi city, Hubei, China, through an online crowdsourcing platform in China (<https://www.wjx.cn/>). In the present study, 2330 children of grades 2–6 and their parents were invited to participant in the study. Parents and children fill in the questionnaire via two different links. After giving detailed informed consent, 1784 children and 1706 parents approved and completed the online questionnaires. Excluding 6 duplicate questionnaires, we then matched the parents and their children, leaving 1264 child-parent pairs eligible for analyses. This study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. The informed consent was obtained from the participants or participant's guardians before the investigation.

### 2.2. Data collection

All participants were invited to provide information on basic characteristics (age, grade, gender, the location of the school), physical activity, and anxious symptoms for parents. Physical activity was defined as light activity (e.g. slow walking) or moderate-to-vigorous physical activity (e.g., brisk walking or jogging) (Kandola et al., 2020) for at least 60 min per day. The symptoms of anxiety for parents were measured using the Self-Rating Anxiety Scale (SAS). The behavioral

problems for children were measured using parent-reported (grades 2–3) and self-reported version (grades 4–6) of the SDQ.

The SAS was designed by William WK Zung in 1971 as self-reported device for evaluating anxious symptoms (Zung, 1971). It contains 20 items and scored on a Likert-type format with four options (1 = “a little of the time,” 2 = “some of the time,” 3 = “a good part of the time,” 4 = “most of the time”). The raw scores were calculated by summing the scores of 20 items and then converted to index scores according to previous research (Zung, 1971). Index scores equal or more than 50 is considered to be clinical significance of anxiety (Zung, 1986).

The SDQ consists 25 items and responses are in a Likert-type scale of 0 to 2 (based on the following replies: “Not true”, “Somewhat true”, “Certainly true”). It has five subscales including conduct problems, hyperactivity-inattention, peer problems and prosocial behaviors, emotional symptoms. All these scales, except prosocial behaviors, are added together to generate a total difficulty score. The SDQ has been introduced and formally adapted to the Chinese language (Du et al., 2008). Cutoff scores are recommended to identify a child with high risk of behavioral problems (conduct problems > 3, hyperactivity problems > 7, peer problems > 5, prosocial behaviors < 5, emotional symptoms > 4 and total difficulties > 16 for grades 2–3; conduct problems > 4, hyperactivity problems > 6, peer problems > 5, prosocial behaviors < 5, emotional symptoms > 5 and total difficulties > 17 for grades 4–6) (Du et al., 2008).

### 2.3. Statistical analysis

In the study, we first showed the distribution of general characteristics and then examined the prevalence of behavioral problems. Categorical variables were expressed as a number (%) and continuous variables were expressed as mean  $\pm$  standard deviation. Next, to test the distribution difference of behavioral problems between the groups, the chi-square test was applied for statistics analysis. Grade (2–3, 4–6) and age (years) (7–9, 10–12) were highly correlated (Spearman correlation coefficients: 0.841). We selected grade variable for further analysis because there were several missing values for age. To explore the potential risk factors that was associated with behavioral problems of the children, statistically significant variables in the chi-square test were included in the multiple logistic regression models. We also conducted the regression analysis stratified by the grade. Results from the logistic regression were presented as odds ratio (OR) and 95% confidence interval (CI). Statistical analysis was performed in SPSS 22.0 (SPSS Inc., Chicago, IL, USA). A *P*-values of less than 0.05 (two-tailed) was considered statistically significant.

## 3. Results

**Table 1** displays the descriptive characteristics in the 1264 participants. Among the participants, 474 (37.5%) children were in Wuhan city, 498 (39.4%) were in grades 2 or 3, and 707 (55.9%) were boys. The average age was 9.81 years old (range 7–12). A percentage of the children (41.8%) took physical exercise more than 2 days a week for over 60 min during the home quarantine. With regard to their parents, 2.2% patients had anxiety symptoms. The prevalence of behavioral problems among the school-aged children were listed in **Table 2**. In the current study, the majority was prosocial behaviors (10.3%), followed by total difficulty (8.2%), conduct problems (7.0%), peer problems (6.6%), hyperactivity-inattention (6.3%), and emotional problems (4.7%).

**Appendixes 1–2** exhibit the distribution difference of behavioral problems in the study, and all significant variables were included for logistical regression analysis in **Table 3**. Comparing with the school-aged children in Huangshi, the children in Wuhan had more risk of peer problems (OR: 2.36, 95% CI: 1.50–3.70) and total difficulty (OR: 1.65, 95% CI: 1.10–2.48). Children in grades 4–6 were found to have more peer problems (OR: 2.50; 95% CI: 1.46–4.27) and less prosocial

**Table 1**  
The descriptive characteristics of the participants.

Variables	n (%) or Mean ± SD
The location of the school	
Huangshi	790 (62.5)
Wuhan	474 (37.5)
Grade	
2–3	498 (39.4)
4–6	766 (60.6)
Gender	
Boy	707 (55.9)
Girl	557 (44.1)
Age (years)	
7–9	9.81 ± 1.44
10–12	667 (52.8)
Missing	567 (44.8)
30 (2.4)	
Number of days with >60 min activity every week	
0	386 (30.5)
1–2 days	350 (27.7)
> 2 days	528 (41.8)
Anxious symptoms for parents	
No	1236 (97.8)
Yes	28 (2.2)

Abbreviations: SD, standard deviation;% , percentage.

**Table 2**  
The scores of SDQ and the prevalence of psychological and behavioral problems among the children.

	Scores (Mean ± SD)	Negative [n (%)]	Positive [n (%)]
The SDQ scale			
Conduct problems	1.80 ± 1.41	1175 (93.0)	89 (7.0)
Hyperactivity-inattention	3.48 ± 2.13	1185 (93.8)	79 (6.3)
Peer problems	2.93 ± 1.65	1180 (93.4)	84 (6.6)
Prosocial behaviors	7.24 ± 2.19	1134 (89.7)	130 (10.3)
Emotional symptoms	1.43 ± 1.69	1205 (95.3)	59 (4.7)
Total difficulty	9.63 ± 4.79	1160 (91.8)	104 (8.2)

Abbreviations: SD, standard deviation; SDQ, The Strengths and Difficulties Questionnaire;% , percentage.

behaviors problems (OR: 0.53, 95% CI: 0.37–0.77) than those in grades 2–3. Comparing with boys, girls were less likely to have peer problems (OR: 0.60, 95% CI: 0.38–0.97). The school-aged children, who regularly had psychical activity during the home quarantine, were less likely to have hyperactivity-inattention and prosocial behaviors problems than those who did not take psychical activity (for hyperactivity-inattention: OR: 0.44, 95% CI: 0.24–0.82 for 1–2days; OR: 0.56, 95% CI: 0.33–0.94 for more than 2 days; for prosocial behaviors problems: OR: 0.65, 95% CI: 0.41–1.04 for 1–2days; OR: 0.55, 95% CI: 0.36–0.85 for more than 2 days, respectively). However, children of parents with anxious symptoms were associated with emotional symptoms (OR: 5.64, 95% CI: 2.18–14.58) and total difficulty (OR: 3.78, 95% CI: 1.56–9.15) than children without anxious parents.

Consider that behavioral problems of the children were examined using parent reported (grades 2–3) and self-reported SDQ version (grades 4–6), we also explored whether the associations between behavioral problems and related factors were different stratified by the grade (Appendix 3). Among children in grades 2–3, similar results were observed between hyperactivity-inattention risk and exercise time (OR: 0.48, 95% CI: 0.21–1.10 for 1–2days; OR: 0.24, 95% CI: 0.08–0.75 for more than 2 days vs. no psychical activity), and between prosocial behaviors problems and exercise time (OR: 0.70, 95% CI: 0.38–1.29 for 1–2days; OR: 0.46, 95% CI: 0.25–0.85 for more than 2 days vs. no psychical activity). Moreover, anxious symptoms in parents were

**Table 3**  
Risk factors for psychological and behavioral problems in the study.

The SDQ scale	OR (95% CI)	P
<b>Hyperactivity-inattention</b>		
Number of days with >60 min activity every week		
0	Ref	
1–2 days	0.44 (0.24, 0.82)	0.010
> 2 days	0.56 (0.33, 0.94)	0.027
<b>Peer problems</b>		
The location of the elementary school		
Huangshi	Ref	
Wuhan	2.36 (1.50, 3.70)	<0.001
Grade		
2–3	Ref	
4–6	2.50 (1.46, 4.27)	0.001
Gender		
Boy	Ref	
Girl	0.60 (0.38, 0.97)	0.036
<b>Prosocial behaviors</b>		
Grade		
2–3	Ref	
4–6	0.53 (0.37, 0.77)	0.001
Number of days with >60 min activity every week		
0	Ref	
1–2 days	0.65 (0.41, 1.04)	0.070
> 2 days	0.55 (0.36, 0.85)	0.006
<b>Emotional symptoms</b>		
Gender		
Boy	Ref	
Girl	1.69 (0.99, 2.89)	0.053
Anxious symptoms for parents		
No	Ref	
Yes	5.64 (2.18, 14.58)	<0.001
<b>Total difficulty</b>		
The location of the elementary school		
Huangshi	Ref	
Wuhan	1.65 (1.10, 2.48)	0.015
Anxious symptoms for parents		
No	Ref	
Yes	3.78 (1.56, 9.15)	0.003

Abbreviations: CI: Confidence interval; OR: Odds ratio; SDQ, The Strengths and Difficulties Questionnaire.

related to increase risks of anxious symptoms (OR: 5.83, 95% CI: 1.10–30.95) and total difficulty (OR: 5.94, 95% CI: 1.32–26.73) in their children.

#### 4. Discussion

In the present study, we conducted an internet-based cross-sectional study to assess behavioral problems among the school-aged children in China during the COVID-19 outbreak by using SDQ. We found that the prevalence of behavioral problems in children varied from 4.7% to 10.3%. In addition, taking physical exercise was a protective factor to reduce behavioral problems for school-aged children in home confinement.

The present study investigated the prevalence of behavioral problems among the school-aged children in home quarantine during the COVID-19 epidemic. We noticed that the scores of SDQ on conduct problems was 1.8, hyperactivity 3.5, peer problems 2.9, prosocial behavior 7.2, emotional symptoms 1.4 and total difficulties 9.6, which is consistent with the findings in previous epidemiological studies (Bell et al., 2019; De Vries et al., 2018; Madsen et al., 2020). In 2008, a cross-sectional study in Shanghai (China) determined the psychological health status among 1217 children (aged 3 to 10) and reported that the mean score of conduct problems was 1.59, hyperactivity 4.49, peer problems 2.71, prosocial behavior 7.16, emotional symptoms 2.09 and total difficulties was 10.89 (Du et al., 2008). Different from prior assumptions, when compared with children without home confinement,

we did not observe obviously increase behavioral problems in children who are defined to home for approximately one month during the COVID-19 outbreak. We conducted a comprehensive literature search on original articles published from 1 December 2019 to 21 September 2020 in PubMed database in English reporting on primary research exploring the psychosocial and behavioral impact of COVID-19 in primary school students. Main findings were extracted in **Appendix 5**. Available evidence from different countries shows that a major disaster may have psychological impact on children such as anxiety (Chen et al., 2020b; Xie et al., 2020), depression (Duan et al., 2020; Yeasmin et al., 2020), panic attacks (Saurabh and Ranjan, 2020), inattention (Jiao et al., 2020; Spinelli et al., 2020; Zhang et al., 2020), irritability (Orgiles et al., 2020; Pisano and Galimi, 2020), and regressive symptoms (Pisano and Galimi, 2020). Although no significant behavioral and emotional symptoms were identified in this study, it is needed for the long-term observation. There is an idea that risk factors operate in a chronically cumulative manner in affecting children's behavior problems the more risk children experience, the worse their problems (Appleyard et al., 2005; Atzaba-Poria et al., 2004). Short term exposure to disaster may be overcome by improved circumstances, but leave the children more vulnerable to any disadvantage experienced at a later stage (Gutman et al., 2019). Therefore, further follow-up on children's behavior are required for more understanding of the long-term effects of home quarantine during the COVID-19 epidemic.

During the long-term home quarantine, taking physical activity has the potentiality to reduce symptoms of hyperactivity-inattention and prosocial behaviors problems in children. The efficacy of exercise in positively influencing the behavioral symptoms experienced by children has been widely reported (Hamer et al., 2009; Sebire et al., 2011). A recent systematic review included 15 related studies to explore the effect of physical activity on social behavior, attention, motor skills and physical fitness in children with attention-deficit/hyperactivity disorder, and found that various types of exercise either moderate- and/or high-intensity activity (e.g. walking, running, jumping rope, and one-leg hopping) was beneficial to the physical and several behavioral performance (Jeyanthi et al., 2019). Several neuroanatomical researches have also confirmed the beneficial effects of physical exercise on children. Regular aerobic exercise could increase the volume of hippocampus (Chaddock et al., 2010a) and basal ganglia (Chaddock et al., 2010b), as well as a high ability to recruit neural resources in frontal and parietal lobes (Chaddock et al., 2012). According to WHO (WHO, 2020c) and National Health Commission of the People's Republic of China (National Health Commission, 2020), children are recommended to have at least 60 min of light-to-moderate physical activity per day during the epidemic. There are other factors that may account for poor behavioral health status in children, such as grade and gender. There were more emotional symptoms and less peer problems among girls than boys, which is consistent with previous researches (Bach et al., 2019; De Vries et al., 2018). Behavioral problems may also vary with age, and more longitudinal design studies are needed to confirm the findings.

In the present study, we conducted the investigation to evaluate of the behavioral impact of home confinement on the school-aged children in China during the COVID-19 epidemic. There are some limitations of this current study. First, this was a cross-sectional study, and we did not collect information about the baseline behavioral problems of children before COVID-19 outbreak. It is recommended to conduct a long-term psychological cohort study for long-term follow-up. Furthermore, the potential self-selection bias inherent in the study should be noted. People who were more concerned about their mental health were more likely to participate in the study. Finally, due to limited resources and time sensitivity during the COVID-19 outbreak, we adopted self-report questionnaires to investigate the psychological and behavioral impact that may not always be aligned with assessment by mental health professionals.

## 5. Conclusions

During the COVID-19 epidemic, the prevalence of behavioral problems in children varied from 4.7% to 10.3%. However, we should be noted that the behavior problems have not been shown yet due to the short observation time of one month. Therefore, paying attention to the long-term home confinement effect on behavior in children and following up are quite necessary. In addition, taking physical exercise may be an efficient measure for children to reduce behavioral problems.

## CRedit authorship contribution statement

Qi Liu and Yu Zhou carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript; Xinyan Xie, Qi Xue, Kaiheng Zhu, Zihao Wan and Hao Wu collected data and carried out the initial analyses. Jijia Zhang and Ranran Song conceptualized and designed the study, collected data, drafted the initial manuscript, reviewed and revised the manuscript and obtained the funding. All authors contributed to and have approved the final manuscript.

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## Declaration of Competing Interest

None.

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No.

## Supplementary materials

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