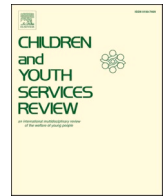




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## Knowledge, attitudes, and practices towards COVID-19 among primary school students in Hubei Province, China

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### ABSTRACT

This study was aimed to investigate the knowledge, attitudes, and practices (KAP) towards coronavirus disease 2019 (COVID-19) among school-aged children in the Hubei province when children were being confined to their homes. The questionnaire included questions of KAP about COVID-19, depressive and anxiety symptoms scales. Multivariable generalized linear regressions models were applied to estimate the unstandardized regression coefficients ( $\beta$ ) of KAP. The awareness rates about COVID-19 were 70.1%–99.5% for all 1650 valid questionnaires. 37.2% of the participants quite worried about being infected with COVID-19. Approximately 96% of them washed hands in certain situations, while 85.6% of them washed hands after coughing or sneezing. Compared to the students without depressive symptoms, those who had depressive symptoms scored lower of total KAP, knowledge, attitudes, and practice. The findings suggest that primary students had a relatively good awareness of COVID-19 during the epidemic, as well as optimistic attitudes and appropriate practices. However, some items of appropriate practices still needed to be enhanced.

### 1. Introduction

Since December 2019, an increasing number of patients of the coronavirus disease 2019 (COVID-19) have been identified in Wuhan city, Hubei province, which is already a global pandemic. In response to the rapidly spreading of COVID-19 infection throughout China, Wuhan city was sealed off on January 23, 2020. Huangshi city, which is 85 km away from Wuhan city, was lockdown on January 24, 2020. Until July 11, 2020, the epidemic has caused 12,498,722 infections and 560,215 death worldwide (<https://coronavirus.jhu.edu/map.html>).

To control the spreading of COVID-19 infection, governments have ordered a nation-wide school closure and required students to restrict at home. The outbreak had caused nationwide school closures and affected 1,067,590,512 learners (<https://zh.unesco.org/themes/education-emergencies/coronavirus-school-closures>) up to July 10, 2020. During home restriction, children are not encouraged to have any public

activities. Although the confinement may quell the outbreak, it perhaps diminished the resilience of family and individuals and increased the possibility for adverse reactions, like depression and anxiety symptoms (Xie et al., 2020).

The knowledge, attitudes, and practices (KAP) of infectious diseases would greatly affect whether people could follow the control measures (Tachfouti, Slama, Berraho, & Nejari, 2012; Zhou et al., 2019). Reducing the fear of the population toward infectious diseases was vital for controlling transmission (Person, Sy, Holton, Govert, & Liang, 2004). Experience of fighting the severe acute respiratory syndrome (SARS) virus showed that knowledge and attitudes towards SARS would influence the level of panic emotion of the population (Wenzel & Edmond, 2003; Xie, Zheng, Xie, & Wang, 2005), which could lead to the stigmatization and discrimination of specific populations (Budhwani & Sun, 2020). Person et al. found that targeted health education materials of the disease outbreaks contributed to mitigating fear, stigmatization, and

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discrimination (Person et al., 2004). Previous studies showed that undergraduate students in China understood the COVID-19 related knowledge, and had positive attitude and proactive practice during the outbreak (Peng et al., 2020). Not only for undergraduate students, healthcare workers and the populations around the world also had relatively good level of the knowledge and optimistic attitudes and good practices of COVID-19 (Puspitasari, Yusuf, Sinuraya, Abdulah, & Koyama, 2020). However, few researches have investigated the KAP of COVID-19 among primary students, who were also been influenced by this epidemic. Furthermore, public health emergencies may affect the mental health status of the public. Mass home-confinement directives might reveal numerous emotional outcomes, including anxiety, depression and fear (Pfefferbaum & North, 2020). Researches indicated that mental health of the general public was affected, when we compared to that before the outbreak of COVID-19 (Dong & Bouey, 2020; Vindegaard & Benros, 2020). Evaluating the direct and the indirect effects of the outbreak towards mental health of the students is highly needed to optimize interventions on the mental health.

To improve the targeted management and health education of COVID-19 among students in countries affected by the disease, it is an urgent need to understand the awareness of students about COVID-19. In this study, we investigated the KAP towards COVID-19 among students in two primary schools in Wuhan and Huangshi city, Hubei Province, during the outbreak of COVID-19.

## 2. Methods

### 2.1. Participants

The information of this cross-sectional epidemiological study was described previously (Xie et al., 2020). In brief, this school-based study was conducted between February and March 2020 through an online questionnaire survey platform (<https://www.wjx.cn/>), which is widely used in China (Gao et al., 2020; Zhang et al., 2020). We sent the survey link and a statement to the schools included in this survey, and then the headteachers of schools distributed them to the cellular telephone of the guardians. The students completed the survey after their guardian had consented. The request of students to independently complete the survey were shown in the electronic questionnaires and the statement. The participants were students of grades 2–6 in the two elementary schools in Wuhan city and Huangshi city, Hubei Province by convenience sampling. Wuhan was the first city to seal off on January 23, 2020. While Huangshi was following lockdown on January 24, 2020. Since the Lunar New Year approached, many people returned to Huangshi from Wuhan, which caused an outbreak of COVID-19 in Huangshi. This study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. There were no disclose information that might identify a particular person. All procedures performed in studies involving human participants were following the 1964 Helsinki declaration and its later amendments.

### 2.2. Measures

Online questionnaires included questions on the demographic characteristics of participants (gender, grade, location of school), knowledge about COVID-19 with 12 questions (e.g. “Which are more likely the host of COVID-19?”), attitudes towards COVID-19 with 2 questions (e.g. “Do you worried about being infected with COVID-19?”), and practices in 12 questions during the outbreak of COVID-19 (e.g. “Which of the following situation you will wash your hands?”) (Detailed questions were showed in Table S1), as well as the depression and anxiety symptoms. Students who answered all the questions of one item with the correct answer were classified as answering the item correctly.

### 2.3. Assessment of depression symptom

Depression symptom was measured by the Children’s Depression Inventory-Short Form (CDI-S) (Ahlen & Ghaderi, 2017). This questionnaire consisted of 10 items with each item rated from 0 to 2. This scale asks respondents to rate the severity of each symptom of depression, with excellent reliability and validity in the Chinese population (Guo et al., 2012; Guo et al., 2015; Li et al., 2019). The total score ranges from 0 to 20, and higher scores indicate more depressive symptomatology. The scores of CDI-S  $\geq 4$  indicates depression symptom with acceptable values for sensitivity (77%) and specificity (82%) in the detection of depressed children (Allgaier et al., 2012).

### 2.4. Assessment of anxiety symptom

The Screen for Child Anxiety Related Emotional Disorders (SCARED) is a 41-item self-report, which is one of the best-studied of anxiety disorder screening instruments in youth (Birmaher et al., 1999; Birmaher et al., 1997). We used the SCARED child version in this study which has developed the norms in Chinese urban children (Wang, Su, & Zhu, 2002). The children rated each symptom on a 3-point likert scale: 0 (rarely), 1 (sometimes), 2 (often). The total scores ranged from 0 to 82. The cut-off score for differentiating between children with and without an anxiety disorder is accepted as 23 (Wang et al., 2002).

### 2.5. Statistical analysis

The assessment of KAP was described as categorical frequencies and scored, respectively. The scoring method of questions of KAP was summed in Table S1. For quantitative variables, mean and standard deviation (SD) were calculated, and percentages for categorical variables. T-tests or Mann-Whitney U tests, as appropriate, for continuous variables, and chi-square tests for categorical variables. Generalized linear regressions models (GLM) and logistic regressions models were used to test unstandardized regression coefficients ( $\beta$ ) and odds ratios (ORs) and their 95% confidence intervals (CIs) for KAP and basic information. We further analyses by stratified the location of the school. Results were statistically analyzed with SPSS for Windows 22.0 (IBM). All *P* values were two-tailed with a significance level at 0.05.

## 3. Results

A total of 1650 children completed the survey (Table 1). Among the 12 questions of knowledge about COVID-19, the awareness rates were 70.1%–99.5% (Table 2). Findings suggested that students had lower

**Table 1**  
Characteristics of participants.

Characteristic	Participants, n (%)
Gender	
Male	934 (56.6)
Female	716 (43.4)
Location of school	
Huangshi	1070 (64.8)
Wuhan	580 (35.2)
Grade	
Grade 2	354 (21.5)
Grade 3	310 (18.8)
Grade 4	368 (22.3)
Grade 5	266 (16.1)
Grade 6	352 (21.3)
Children’s Depression Inventory–Short Form	
Depressive symptoms	370 (22.4)
No depressive symptoms	1280 (77.6)
Screen for Child Anxiety Related Emotional Disorders	
Anxiety symptoms	311 (18.8)
No anxiety symptoms	1339 (81.2)
Total	1650 (100.0)

**Table 2**  
Summary of the knowledge, attitudes, and practices questions for participants.

Items	Contents	Correct answer n (%)
<b>Knowledge of COVID-19</b>		
K1	Which are more likely the host? During the outbreak, about food, it should be noted that?	1156 (70.1)
K2	Do not eat sick poultry.	1511 (91.6)
K3	Purchase chilled poultry meat from standard markets and fully cook the poultry meat, eggs and milk.	1460 (88.5)
K4	Separate the cutting boards and knives for raw and cooked foods.	1330 (80.6)
K5	Washing hands between handling the raw and cooked foods. Which of the following prevention is true?	1484 (89.9)
K6	Eating exotic animals.	9 (0.5)
K7	Wearing a mask when go out.	1608 (97.5)
K8	Washing hands frequently.	1635 (99.1)
K9	Ventilating the house frequently.	1559 (94.5)
K10	Visiting the relatives and friends.	34 (2.1)
K11	Gathering for amusement.	5 (0.3)
K12	Disinfection the house.	1592 (96.5)
<b>Attitudes towards the outbreak of COVID-19</b>		
A1	Do you worried about being infected with COVID-19? Quite worried	613 (37.2)
	Moderately worried	409 (24.8)
	Slightly worried	286 (17.3)
	Rarely worried	219 (13.3)
	Not at all worried	123 (7.5)
A2	What is your attitude towards the COVID-19 epidemic? Quite optimistic	837 (50.7)
	Moderately optimistic	623 (37.8)
	Indifferent	26 (1.6)
	Moderately pessimistic	92 (5.6)
	Quite pessimistic	72 (4.4)
<b>Practices during the outbreak of COVID-19</b>		
	Which of the following situation you will wash your hands?	
P1	After using the bathroom.	1590 (96.4)
P2	After getting home.	1569 (95.1)
P3	After coughing or sneezing.	1413 (85.6)
P4	Before having a meal.	1590 (96.4)
P5	After touching the object outside home	1593 (96.5)
P6	I would not wash my hands on purpose.	5 (0.3)
	What have you done during the outbreak?	
P7	Sharing the information of COVID-19 with others.	858 (52.0)
P8	Reminding my family members to wear masks.	1449 (87.8)
P9	Convince my family members not to go out or gathering.	1408 (85.3)
P10	Ventilating the house frequently.	1429 (86.6)
P11	Washing hands frequently.	1546 (93.7)
P12	None of the above	77 (4.7)

awareness levels in the terms of the suspected host (70.1%), separating the cutting boards and knives for raw and cooked foods (80.6%) and purchasing chilled poultry meat from standard markets and fully cooked the poultry meat, eggs and milk (88.5%). Still, 2.1% (34) of students thought visiting relatives and friends during the outbreak was right.

About 50.7% (837) were quite optimistic towards the COVID-19 epidemic, while 37.2% (613) of the participants quite worried about being infected with COVID-19. About 93.7% (1546) of students washed hands frequently during the outbreak of COVID-19, and 95.1%–96.5% of them would wash their hands after using the bathroom or touching the object outside the home. However, only 85.6% of them chose to wash hands after coughing or sneezing. Whereas 4.7% (77) of them did nothing during the epidemic, including frequent hand-washing. Besides, only 52.0% (858) of students used to share information about COVID-19 with others. The average scores of total KAP, knowledge, attitudes, and practices for all students were 24.35 ± 3.11, 11.05 ± 1.13, 4.54 ± 1.76, and 8.76 ± 1.65, respectively (Table 3).

Total KAP scores of students towards COVID-19 were significantly associated with gender, grade, and whether they had depressive and

**Table 3**  
Scores of all knowledge, attitudes, and practices questions of participants.

	Total KAP scores (max = 30)	Knowledge scores (max = 12)	Attitudes scores (max = 8)	Practices scores (max = 10)
Overall	24.35 ± 3.11	11.05 ± 1.13	4.54 ± 1.76	8.76 ± 1.65
Gender				
Male	24.20 ± 3.27	11.02 ± 1.17	4.51 ± 1.82	8.68 ± 1.77
Female	24.54 ± 2.88	11.10 ± 1.07	4.58 ± 1.67	8.86 ± 1.49
Location of school				
Huangshi	24.42 ± 3.06	11.15 ± 1.08	4.52 ± 1.71	8.75 ± 1.68
Wuhan	24.23 ± 3.20	10.88 ± 1.19	4.58 ± 1.84	8.76 ± 1.61
Grade				
Grade 2	24.34 ± 3.08	11.18 ± 1.10	4.50 ± 1.69	8.66 ± 1.74
Grade 3	24.46 ± 2.99	11.10 ± 1.13	4.45 ± 1.78	8.91 ± 1.47
Grade 4	23.95 ± 3.35	10.97 ± 1.25	4.35 ± 1.72	8.64 ± 1.75
Grade 5	24.49 ± 3.12	10.97 ± 1.14	4.65 ± 1.82	8.86 ± 1.60
Grade 6	24.57 ± 2.96	11.03 ± 0.98	4.77 ± 1.78	8.77 ± 1.65
Depressive symptoms				
No	24.71 ± 2.90	11.15 ± 1.06	4.68 ± 1.69	8.88 ± 1.56
Yes	23.09 ± 3.46	10.72 ± 1.29	4.06 ± 1.89	8.32 ± 1.88
Anxiety symptoms				
No	24.58 ± 3.04	11.08 ± 1.10	4.69 ± 1.73	8.81 ± 1.62
Yes	23.38 ± 3.21	10.94 ± 1.25	3.91 ± 1.74	8.53 ± 1.77

Scores were shown as mean ± standard deviation.

KAP: K for knowledge; A for attitudes; P for practices.

max: Maximum score for the items.

Depressive symptoms were measured by the Children’s Depression Inventory-Short Form.

Anxiety symptoms were measured by The Screen for Child Anxiety Related Emotional Disorders.

anxiety symptoms (Table 4). Girls had significant higher KAP scores than boys ( $\beta = 0.014$ , 95%CI: 0.001, 0.027,  $P = 0.032$ ). Compared with students in grade 2, students in grade 6 had higher KAP scores ( $\beta = 0.021$ , 95%CI: 0.001, 0.040,  $P = 0.044$ ) and attitudes scores ( $\beta = 0.065$ , 95%CI: 0.012, 0.117,  $P = 0.015$ ). Students with depressive symptoms had lower scores in terms of total KAP, knowledge, attitudes, and practice scores than those without depressive symptoms (all  $P$ -values < 0.05). Students had anxiety symptoms had significantly lower overall KAP and attitudes scores than students without anxiety symptoms ( $\beta$  for KAP =  $-0.029$ , 95%CI:  $-0.047$ ,  $-0.012$ ,  $P = 0.001$ ;  $\beta$  for attitudes =  $-0.120$ , 95%CI:  $-0.166$ ,  $-0.074$ ,  $P < 0.001$ ).

Stratified analyses suggested that students in Wuhan had different awareness levels with students in Huangshi, as well as attitudes (Table S2, Table S4). Among the students in Huangshi and Wuhan, scores for total KAP and attitudes of students towards COVID-19 were significantly different between students with or without depressive and anxiety symptoms (Table S5). We also found the significant associations between total KAP, knowledge, attitudes, and practice scores with the depressive symptoms among students in Huangshi. The  $\beta$ s for total KAP, knowledge, attitudes and practice scores were  $-0.060$  (95%CI:  $-0.081$ ,  $-0.039$ ),  $-0.033$  (95%CI:  $-0.049$ ,  $-0.016$ ),  $-0.082$  (95%CI:  $-0.140$ ,  $-0.025$ ), and  $-0.067$  (95%CI:  $-0.103$ ,  $-0.030$ ), respectively.

**Table 4**  
Multivariable GLM for participants – knowledge, attitudes, and practices of COVID-19.

	Total KAP		Knowledge		Attitudes		Practices	
	β (95%CI)	P-value	β (95%CI)	P-value	β (95%CI)	P-value	β (95%CI)	P-value
Gender								
Male	ref		ref		ref		ref	
Female	<b>0.014(0.001, 0.027)</b>	<b>0.032</b>	0.006(-0.004, 0.017)	0.225	0.006(-0.028, 0.040)	0.729	0.021(-0.001,0.043)	0.059
Location of school								
Huangshi	ref		ref		ref		ref	
Wuhan	-0.004(-0.017, 0.010)	0.584	<b>-0.022(-0.033, -0.011)</b>	<b>&lt;0.001</b>	0.032(-0.004, 0.067)	0.084	0.006(-0.017,0.029)	0.620
Grade								
Grade 2	ref		ref		ref		ref	
Grade 3	0.009(-0.012, 0.029)	0.401	-0.006(-0.022, 0.011)	0.510	-0.012(-0.065, 0.042)	0.668	0.032(-0.003,0.066)	0.073
Grade 4	-0.009(-0.029, 0.011)	0.372	<b>-0.017(-0.032, -0.001)</b>	<b>0.038</b>	-0.014(-0.066, 0.038)	0.591	0.004(-0.029,0.037)	0.812
Grade 5	0.012(-0.010, 0.033)	0.289	-0.014(-0.031, 0.003)	0.104	0.029(-0.027, 0.085)	0.317	0.028(-0.009,0.064)	0.134
Grade 6	<b>0.021(0.001, 0.040)</b>	<b>0.043</b>	-0.007(-0.023, 0.009)	0.406	<b>0.064(0.012, 0.117)</b>	<b>0.016</b>	0.023(-0.011,0.057)	0.180
Depressive symptoms								
No	ref		ref		ref		ref	
Yes	<b>-0.061(-0.077, -0.044)</b>	<b>&lt;0.001</b>	<b>-0.037(-0.050, -0.023)</b>	<b>&lt;0.001</b>	<b>-0.071(-0.115, -0.027)</b>	<b>0.002</b>	<b>-0.065(-0.093,-0.037)</b>	<b>&lt;0.001</b>
Anxiety symptoms								
No	ref		ref		ref		ref	
Yes	<b>-0.029(-0.047, -0.012)</b>	<b>0.001</b>	0.000(-0.014, 0.014)	0.966	<b>-0.119(-0.165, -0.072)</b>	<b>&lt;0.001</b>	-0.011(-0.040,0.019)	0.476

β (95% Wald CI) was derived from generalized linear regression (Gamma distribution). Depressive symptoms were measured by the Children’s Depression Inventory-Short Form. Anxiety symptoms were measured by The Screen for Child Anxiety Related Emotional Disorders. ref: reference.

**4. Discussion**

This study was conducted in the middle stage of the COVID-19 outbreak in the Hubei province, which was the epi-center of the epidemic in China. We investigated the KAP about COVID-19 in the students from two primary schools. Nearly one third did not think that the wild animals were more likely the host of virus and 1 in 5 participants did not know the cutting boards and knives for raw and cooked foods should be separated. Around 79.3% of the subjects worried about infected with COVID-19 whereas 88.5% of students felt optimistic towards the COVID-19 epidemic. Most of the subjects could do the correct practice.

Knowledge is a prerequisite for forming positive attitudes and promoting positive behaviors (McEachan et al., 2016). The correct answer rates were ranged from 70.1% to 99.5%, which were similar to those in the study about the COVID-19 knowledge of Chinese residents (70.2%–98.6%) (Zhong et al., 2020). More information about COVID-19 basic science is expected to be strengthened in health education. For instance, only 70.1% of students knew the host of the virus. This may due to the fact that COVID-19 had not been spreading for a long time and the risk of blending facts with misinformation via Internet was present. Health authorities in China could carry out targeted public information campaigns to promote the spread of accurate knowledge about COVID-19 among primary students. Considering that the new media may be the primary source of information on COVID-19, prioritizing the use of new media could quickly disseminating COVID-19 related knowledge. The provinces and municipalities in China have enforced compulsory face mask policies in public areas during the investigation period (Feng et al., 2020). Around 97.5% of the students thought that wearing a mask when went out was necessary, while only 66.6% of the Chinese workers in Li’s study agreed that wearing medical face masks was effective in protecting against COVID-19 (Li et al., 2020). This phenomenon may be caused by the fact that the participants between two studies were from different provinces in China. Only 8.0% of the participants in Li’s study were from Hubei province, while our study was based on two cities in Hubei province. Girls and students in grade 6 showed higher total KAP scores when compared to boys and students in grade 2. This trend was consistent with previous studies about the KAP of COVID-19 in the

Chinese population (Liu et al., 2020; Zhou et al., 2019). Such differences may be caused by the cognition differences between sex and educational level (Allegrini et al., 2019; Hyde, 2016). Better-educated students could process information more quickly and boys had higher risk-taking tendency.

We found that students had great confidence in winning the battle against COVID-19, even in fear of infected with COVID-19. Zhong also found that 97.1% of Chinese residents had confidence that China can win the battle against COVID-19 and 90.8% believed that COVID-19 would finally be successfully controlled (Zhong et al., 2020). It may be related to the timely multifaceted interventions implemented by the Chinese government such as cordons sanitaire, traffic restriction, home confinement, and closure of entertainment venues and unnecessary public places, which were proved to effectively control the COVID-19 outbreak (Pan et al., 2020). People of all ages are generally susceptible to COVID-19 and no vaccine is available for COVID-19 till now (Sohrabi et al., 2020). Prevention is still an important way to prevent infected with COVID-19. We found that 93.7% of the students in our study washed hands frequently, which was similar to other investigation (95.4%) (Taghrir, Borazjani, & Shiraly, 2020). The majority of the students in our study showed high compliance with the suggested practice. Unfortunately, around 14.4% of the students did not wash hands after coughing or sneezing and 13.4% did not ventilate the house frequently. This phenomenon may be partly attributed to poor parental supervision. Promotional materials, suitable to the primary students such as the animations, and parental supervision may improve students’ behavior. Such information could be transmitted via various channels such as CCTV and the official website of the National Health Commission of China.

Our results also showed that mental health problems were significantly associated with lower KAP scores. Mental health is part of the mission of addressing communicable disease (Safran, 2009). When the extent of the pandemic and its eventual impact on health are uncertain, mental health problems such as anxiety and depression occur (Stein, 2020). Mental health problems could hinder acquiring and retaining information about COVID-19 prevention thereby deepening the feeling of uncertainty. It is recommended to make the most of the online mental health services widely established in China (e.g. WeChat-based

resources and free electronic books published by the Chinese Association for Mental Health), which may alleviate the adverse psychological impacts and psychiatric symptoms of the students and finally facilitate the improvement of KAP levels of COVID-19 (Liu, Sun, & Wang, 2020). These findings also suggested that the COVID-19 KAP scores may be greatly increased if the health education programs were specifically designed for students with potential mental health problems. Our study also has some limitations. The survey was conducted in only one province of China, which may have limited generalizability in other provinces. In addition, this study was conducted online, the students might be influenced by other people around. The measurement of KAP may be imprecise due to the tight schedule and the limited number of items. The factors associated with KAP levels of COVID-19 was also limited, such as the number of infected people around students and household income. Studies in larger samples and more comprehensive items are needed.

## 5. Conclusions

Our findings suggested that the majority of primary students (more than 80%) have acquired the knowledge of COVID-19, and they still had some knowledge misconceptions during the COVID-19 outbreak. They showed optimistic attitudes, and appropriate practices towards COVID-19 during the COVID-19 outbreak. Some specific items still needed to be enhanced. We also identified some factors associated with KAP scores, which may be useful for the recognition of the target population for COVID-19 health education. With the COVID-19 well controlled in China, students are back to school step by step. Improving the level of KAP of the COVID-19 is essential to the prevention of the rebounding of the COVID-19 epidemic since a resurgence in contagion could be possible as late as 2024 (Kissler, Tedijanto, Goldstein, Grad, & Lipsitch, 2020).

## CRedit authorship contribution statement

**Qi Xue:** Conceptualization, Methodology, Investigation, Formal analysis, Software, Writing - original draft. **Xinyan Xie:** Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft. **Qi Liu:** Investigation, Formal analysis, Visualization, Investigation, Formal analysis, Visualization. **Yu Zhou:** Formal analysis, Investigation. **Kaiheng Zhu:** Investigation. **Hao Wu:** Investigation. **Zihao Wan:** Investigation. **Yanan Feng:** Investigation. **Heng Meng:** Conceptualization, Investigation, Conceptualization, Investigation. **Jiajia Zhang:** Conceptualization, Methodology, Software. **Pengxiang Zuo:** Conceptualization, Writing - review & editing, Supervision, Resources. **Ranran Song:** Conceptualization, Data curation, Writing - review & editing, Supervision, Funding acquisition.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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The funding source had no role in study design, the collection, analysis and interpretation of data, in the writing of the article and in the

decision to submit the article for publication.

## Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.chilgyouth.2020.105735>.

## References

- Ahlen, J., & Ghaderi, A. (2017). Evaluation of the children's depression inventory-short version (CDI-S). *Psychological Assessment*, 29(9), 1157–1166. <https://doi.org/10.1037/pas0000419>
- Allegrini, A. G., Selzam, S., Rimfeld, K., von Stumm, S., Pingault, J. B., & Plomin, R. (2019). Genomic prediction of cognitive traits in childhood and adolescence. *Molecular Psychiatry*, 24(6), 819–827. <https://doi.org/10.1038/s41380-019-0394-4>
- Allgaier, A., Frühe, B., Pietsch, K., Saravo, B., Baethmann, M., & Schulte-Körne, G. (2012). Is the children's depression inventory short version a valid screening tool in pediatric care? a comparison to its full-length version. *Journal of Psychosomatic Research*, 73(5), 369–374. <https://doi.org/10.1016/j.jpsychores.2012.08.016>
- Birmaher, B., Brent, D. A., Chiappetta, L., Bridge, J., Monga, S., & Baugher, M. (1999). Psychometric properties of the screen for child anxiety related emotional disorders (SCARED): A replication study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 38(10), 1230–1236. <https://doi.org/10.1097/00004583-199910000-00011>
- Birmaher, B., Khetarpal, S., Brent, D., Cully, M., Balach, L., Kaufman, J., et al. (1997). The screen for child anxiety related emotional disorders (SCARED): Scale construction and psychometric characteristics. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36(4), 545–553. <https://doi.org/10.1097/00004583-199704000-00018>
- Budhwani, H., & Sun, R. (2020). Referencing the novel coronavirus as the “Chinese virus” or “China virus” on Twitter: COVID-19 stigma. *Journal of Medical Internet Research*, 2(5), Article e19301. <https://doi.org/10.2196/19301>
- Dong, L., & Bouey, J. (2020). Public Mental Health Crisis during COVID-19 Pandemic, China. *Emerging Infectious Diseases*, 26(7), 1616–1618. <https://doi.org/10.3201/eid2607.200407>
- Feng, S., Shen, C., Xia, N., Song, W., Fan, M., & Cowling, B. J. (2020). Rational use of face masks in the COVID-19 pandemic. *Lancet Respiratory Medicine*, 8(5), 434–436. [https://doi.org/10.1016/S2213-2600\(20\)30134-X](https://doi.org/10.1016/S2213-2600(20)30134-X)
- Gao, Z., Ying, S., Liu, J., Zhang, H., Li, J., & Ma, C. (2020). A cross-sectional study: Comparing the attitude and knowledge of medical and non-medical students toward 2019 novel coronavirus. *Journal of Infection and Public Health*, 13(10), 1419–1423. <https://doi.org/10.1016/j.jiph.2020.06.031>
- Guo, J., Chen, L., Wang, X., Liu, Y., Chui, C. H. K., He, H., et al. (2012). The relationship between Internet addiction and depression among migrant children and left-behind children in China. *Cyberpsychology, Behavior, and Social Networking*, 15(11), 585–590. <https://doi.org/10.1089/cyber.2012.0261>
- Guo, J., Ren, X., Wang, X., Qu, Z., Zhou, Q., Ran, C., et al. (2015). Depression among migrant and left-behind children in china in relation to the quality of parent-child and teacher-child relationships. *PLoS ONE*, 10(12), Article e145606. <https://doi.org/10.1371/journal.pone.0145606>
- Hyde, J. S. (2016). Sex and cognition: Gender and cognitive functions. *Current Opinion in Neurobiology*, 38, 53–56. <https://doi.org/10.1016/j.conb.2016.02.007>
- Kissler, S. M., Tedijanto, C., Goldstein, E., Grad, Y. H., & Lipsitch, M. (2020). Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science*, 368(6493), 860–868. <https://doi.org/10.1126/science.abb5793>
- Li, J., Zhang, W., Chen, W., Yuan, H., Zhang, S., Tian, M., et al. (2019). Applications of the Chinese version of the primary care PTSD screen for DSM-5 (PC-PTSD-5) for children. *Journal of Affective Disorders*, 254, 109–114. <https://doi.org/10.1016/j.jad.2019.05.021>
- Li, Z. H., Zhang, X. R., Zhong, W. F., Song, W. Q., Wang, Z. H., Chen, Q., et al. (2020). Knowledge, attitudes, and practices related to Coronavirus disease 2019 during the outbreak among workers in China: A large cross-sectional study. *PLOS Neglected Tropical Diseases*, 14(9), Article e0008584. <https://doi.org/10.1371/journal.pntd.0008584>
- Liu, B., Sun, H., & Wang, W. (2020). Cognition, attitude and behavior for COVID -19 among medical students. *Medical Education Research and Practice*, 28(02), 214–217. <https://doi.org/10.13555/j.cnki.c.m.e.2020.02.009>
- Liu, S., Yang, L., Zhang, C., Xiang, Y. T., Liu, Z., Hu, S., et al. (2020). Online mental health services in China during the COVID-19 outbreak. *Lancet Psychiatry*, 7(4), e17–e18. [https://doi.org/10.1016/S2215-0366\(20\)30077-8](https://doi.org/10.1016/S2215-0366(20)30077-8)
- McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. (2016). Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Annals of Behavioral Medicine*, 50(4), 592–612. [https://doi.org/10.1016/S2215-0366\(20\)30077-8](https://doi.org/10.1016/S2215-0366(20)30077-8)
- Pan, A., Liu, L., Wang, C., Guo, H., Hao, X., Wang, Q., et al. (2020). Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. *JAMA*, 323(19), 1–9. <https://doi.org/10.1001/jama.2020.6130>
- Peng, Y., Pei, C., Zheng, Y., Wang, J., Zhang, K., Zheng, Z., et al. (2020). A cross-sectional survey of knowledge, attitude and practice associated with COVID-19 among undergraduate students in China. *BMC Public Health*, 20(1), 1292. <https://doi.org/10.1186/s12889-020-09392-z>

- Person, B., Sy, F., Holton, K., Govert, B., & Liang, A. (2004). Fear and stigma: The epidemic within the SARS outbreak. *Emerging Infectious Diseases*, *10*(2), 358–363. <https://doi.org/10.3201/eid1002.030750>
- Pfefferbaum, B., & North, C. S. (2020). Mental health and the Covid-19 pandemic. *New England Journal of Medicine*, *383*(6), 510–512. <https://doi.org/10.1056/NEJMp2008017>
- Puspitasari, I. M., Yusuf, L., Sinuraya, R. K., Abdulah, R., & Koyama, H. (2020). Knowledge, attitude, and practice during the COVID-19 pandemic: A review. *Journal of Multidisciplinary Healthcare*, *13*, 727–733. <https://doi.org/10.2147/JMDH.S265527>
- Safran, M. A. (2009). Achieving recognition that mental health is part of the mission of CDC. *Psychiatric Services (Washington, D. C.)*, *60*(11), 1532–1534. <https://doi.org/10.1176/appi.ps.60.11.1532>
- Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., et al. (2020). World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International Journal of Surgery*, *76*, 71–76. <https://doi.org/10.1016/j.ijssu.2020.02.034>
- Stein, M. B. (2020). EDITORIAL: COVID-19 and anxiety and depression in 2020. *Depression and Anxiety*, *37*(4), 302. <https://doi.org/10.1002/da.23014>
- Tachfouti, N., Slama, K., Berraho, M., & Nejjar, C. (2012). The impact of knowledge and attitudes on adherence to tuberculosis treatment: A case-control study in a Moroccan region. *Pan African Medical Journal*, *12*, 52.
- Taghrir, M. H., Borazjani, R., & Shiraly, R. (2020). COVID-19 and Iranian medical students; a survey on their related-knowledge, preventive behaviors and risk perception. *Archives of Iranian Medicine*, *23*(4), 249–254. <https://doi.org/10.34172/aim.2020.06>
- Vindegard, N., & Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain, Behavior, and Immunity*, *89*, 531–542. <https://doi.org/10.1016/j.bbi.2020.05.048>
- Wang, K., Su, L., & Zhu, Y. (2002). Norms of the screen for child anxiety related emotional disorders in Chinese urban children. *Chinese Journal of Clinical Psychology*, *10*(4), 270–272. <https://doi.org/10.16128/j.cnki.1005-3611.2002.04.009>
- Wenzel, R. P., & Edmond, M. B. (2003). Managing SARS amidst uncertainty. *New England Journal of Medicine*, *348*(20), 1947–1948. <https://doi.org/10.1056/NEJMp030072>
- Xie, X., Xue, Q., Zhou, Y., Zhu, K., Liu, Q., Zhang, J., et al. (2020). Mental health status among children in home confinement during the coronavirus disease 2019 outbreak in Hubei Province, China. *JAMA Pediatrics*, e201619. <https://doi.org/10.1001/jamapediatrics.2020.1619>
- Xie, X., Zheng, R., Xie, D., & Wang, H. (2005). Analysis on psychological panic phenomenon of SARS. *Beijing Daxue Xuebao Ziran Kexue Ban/acta Scientiarum Naturalium Universitatis Pekinensis*, *41*(4), 628–639. <https://doi.org/10.13209/j.0479-8023.2005.082>
- Zhang, Y., Cao, X., Wang, P., Wang, G., Lei, G., Shou, Z., et al. (2020). Emotional “inflection point” in public health emergencies with the 2019 new coronavirus pneumonia (NCP) in China. *Journal of Affective Disorders*, *276*, 797–803. <https://doi.org/10.1016/j.jad.2020.07.097>
- Zhong, B., Luo, W., Li, H., Zhang, Q., Liu, X., Li, W., et al. (2020). Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. *International Journal of Biological Sciences*, *16*(10), 1745–1752. <https://doi.org/10.7150/ijbs.45221>
- Zhou, X., Zhang, Y., Shen, C., Liu, A., Wang, Y., Yu, Q., et al. (2019). Knowledge, attitudes, and practices associated with avian influenza along the live chicken market chains in Eastern China: A cross-sectional survey in Shanghai, Anhui, and Jiangsu. *Transboundary and Emerging Diseases*, *66*(4), 1529–1538. <https://doi.org/10.1111/tbed.13178>