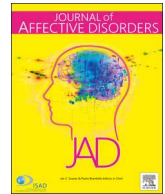




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Research paper

An investigation of mental health status of children and adolescents in china during the outbreak of COVID-19



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ABSTRACT

Objective: : The sudden outbreak of Coronavirus Disease 2019 (COVID-19) has had a dramatic effect on the mental health of the public. In the present study, we demonstrated the psychological effects on children and adolescents associated with the epidemic .

Methods: : By using convenience sampling method, questionnaires, such as Spence Child Anxiety Scale, Child Depression Inventory and Coping style Scale, were distributed to participating 359 children and 3254 adolescents online.

Results: : The anxiety levels of children and adolescents were (23.87 ± 15.79) and (29.27 ± 19.79), respectively. 22.28% respondents were suffering from depressive symptoms. Seven significant factors associated with increased levels of anxiety, including female, resident in urban regions, emotion-focused coping style. Nine factors associated with increased levels of depression, such as smartphone addiction (OR 1.411, 95% CI 1.099–1.180), Internet addiction (OR 1.844, 95% CI 1.209–2.811), and resident in Hubei province (OR 3.107, 95% CI 1.252–7.708). Two additional factors associated with decreased levels of depressive symptoms: hours spend on Internet per day before the epidemic (OR 0.652, 95% CI 0.609–0.697) and tendency to apply problem-focused coping style (OR 0.937, 95% CI 0.923–0.951).

Conclusion: : Our findings indicate that the COVID-19 outbreak has had a significant psychosocial impact on children and adolescents. Findings of current levels of anxiety and depression not only highlight the need to address emotional distress for children and adolescents during the epidemic but also provide researchers with scientific fundamentals to formulate targeted interventions based on the significant influencing factors.

Introduction

Since the outbreak of the COVID-19 at the end of 2019, a series of effective epidemic preventive and control strategies have been developed and conducted by the Chinese government to curb the spread of the virus. The general public, especially the high-risk group (e.g., elderly people with chronic underlying diseases, children, and others with lower immunologic function), are suggested to stay indoors in quarantine at home, which is recognized as the best way to eliminate chances of being infected. However, due to the long period of separation from the outside world, the impact of multi-channel negative information, excessive fears of being infected, and even the shame and guilt for the infection, many people across China, particularly residents at the epicenter of the outbreak in Wuhan, are experiencing fear, loneliness, panic, anxiety and depression amid the coronavirus outbreak (Duan and Zhu, 2020; Xiang et al., 2020). These negative physical and psychological costs have also been reported in previous

studies, such as suicide, substantial anger and sleep disorders (Barbisch et al., 2015; Rubin and Wessely, 2020; Wang et al., 2019). For children and adolescents, due to the lower incidence of infection and mortality than adults, professionals were less focusing on the unique clinical features of COVID-19 and mental health status in children (Ma et al., 2020). Furthermore, evidence has shown that children and adolescents who experienced disasters might suffer from greater stress and trauma because of the lack of development of proper emotional reactions and coping techniques (Lazarus PJ, 2003; Roussos et al., 2005). When emotional support and spiritual guidance from family members, teachers, as well as other significant peers and adults in their lives could not be met due to home confinement, deferred back-to-school and lifestyle changes, it adversely affected the mental health of children and adolescents (Sprang and Silman, 2013).

Additionally, according to the latest data from the China's National Health of Commission, the overall situation in the Chinese mainland is somewhat coming to a plateau (National Health Commission of

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China, 2020a). The number of new confirmed cases has dropped dramatically, but authorities are warning that strict prevention measures should stay in place to prepare for a potential comeback of the virus. Therefore, in order to effectively cooperate with the government's epidemic prevention work, more than 220 million children and adolescents were confined at home and informed to postpone the start of the spring semester until further notice (Wang et al., 2020). Meanwhile, online studying courses which was delivered by TV broadcasts and the Internet have been opened gradually to students to guarantee their needs of learning, according to a guideline released by the China's Ministry of Education (Ministry of Education of China, 2020). However, due to lack of monitoring and evaluation of students participating in online courses, the inefficiency of the experience of these courses, unstable network signals, and often no networks in remote rural areas, many parents, students, and teachers have complained of the poor effectiveness of online learning. These effects can be compacted by adverse consequences of reduced vision, as well as unconscious smartphone/Internet addiction, and may further contribute to mental distress in children and adolescents.

Here, we assessed the current status of mental health issues among children and adolescents affected by the epidemic and analyzed its influencing factors to provide scientific guidance to psychological professionals and the government in formulating targeted policies.

Methods

Participants

This study was designed as a cross-sectional online questionnaire survey that was administered during the spread of COVID-19 in China. We developed the online questionnaires on the official website of "Questionnaire Star," which is recognized as a professional online questionnaire survey, evaluation, and voting platform. A set of self-rating questionnaires were distributed to children and adolescents who ranged from Grade One in primary school to Grade Three in high school (aged from 7 to 18 years) in mainland China by employing convenient sampling method. With the help of directors in Education Bureau, we distribute e-questionnaires to teachers and told them the purpose, significance and announcements of this survey in details. Then, they assigned it to school-students and their guardians. Before completing questionnaires, all participants and their guardians were debriefed on the study purpose and contents. Once consented, participants began filling out the set of questionnaires online. We also included our email addresses and phone number to the first page of questionnaires so that participants could consult and interact with us at any time.

Measurements

The set of questionnaires involved in this study were mainly composed of seven sections.

- *Sociodemographic characteristics* were self-designed and included questions regarding sex, age, place of residence, number of siblings, region, family status, education level, and number of electronics owned.
- *COVID-related questions* were developed by our research team and assessed the current situation of the respondents' family members involved in anti-epidemic work, the degree of concerns about the epidemic, the implementation of the precaution and control measures, the impact of the epidemic on their course of study and graduation, as well as the electronic products/Internet use patterns before and during the epidemic.
- *The Chinese Version of Spence Child Anxiety Scale (SCAS)* is a 44-item self-report Likert's scale that measures anxiety in children and adolescents (Zhao et al., 2012). Spence (Spence, 1997) first developed it by using community samples, and it has since been used

widely in other countries (Essau et al., 2011). This study evaluated the anxiety status of participants affected by the epidemic on a 6-factor scale, including items such as separation anxiety, physical injury fear, social phobia, panic disorder, obsessive disorder, and generalized anxiety.

- *The Child Depression Inventory (CDI)* is a 27-item self-report measure designed to evaluate the severity of depressive symptoms in children and adolescents (Kovacs and Beck, 1977) and has demonstrated satisfactory levels of reliability and validity in the Chinese population (Wang et al., 2015). In general, the total score of CDI is 19 or higher can be identified as possessing clinical depressive symptoms, while scores of 12–18 indicate subclinical depression, and scores of 12 or lower are considered normal (Stewart and Sun, 2007). In this study, we classified respondents with clinical depressive symptoms with scores 19 or higher.
- *The Short Version of Smartphone Addiction Scale (SV-SAS)* is a 10-item self-rated developed by Kwon et al., 2013 and is recognized as a valid screening tool for the prevalence of smartphone addiction. It uses cut-off points by sex, where 31 and 33 classify "excessive smartphone uses in male and female users," respectively.
- *The Internet Addiction Scale (IAS)* consists of 20 items derived from the DSM-IV-TR (Cooper, 2001) [Diagnostic and statistical manual of mental disorders (4th edition, text revised)] in order to identify diagnostic criteria of pathological gambling and the degree of pre-occupation and compulsiveness to go online. According to Young (Young, 1998), three types of Internet-user groups were identified as Internet addicts (scores of 70 or higher), possible Internet addicts (scores 40–69), and non-addict (39 or lower). In this study, we defined participants with Internet addiction with scores 70 or higher.
- *The Coping Style Scale (CSS)* was developed by Chen et al. in 2000 based on the theory of social interaction and self-regulation and measures middle school students' competence in coping with stress (Chen et al., 2000; Folkman et al., 1986). This 36-item self-rate scale can be divided into two subscales of problem-focused coping and emotion-focused coping. The former consists of three dimensions, including solving problems, seeking social support, and positive rationalizations, while the later contains four dimensions, including endurance, avoidance, expressing emotions, and fantasy/denial.

Statistical analysis

All data were analyzed using SPSS (Version 18.0, SPSS Inc., Chicago). Apart from descriptive statistics and frequency analysis of demographic characteristics and COVID-related information, t-test and analysis of variance (ANOVA) were used to analyze the difference in levels of respondents' anxiety. Moreover, multiple linear regression and bivariate logistic regression analyses were used to assess the association between outcome variables (the reported level of anxiety and clinical depressive symptom) and potential predictors (e.g. concerns related to the epidemic, smartphone/internet addiction, and coping style) while adjusting for other identified explanatory variables. In the process of running models, the forward stepwise selection algorithm was used, and variables in the model were screened based on significance levels of the Wald inclusion test statistic being less than 0.05. Moreover, Pearson's correlation analysis was performed to analyze the associations among SCAS, CDI, smartphone/Internet addiction, and coping style, and the statistical significance level was set at 0.05.

Results

The sample size of our survey recruited online included 3613 Chinese students. As Table 1 shows, the study participants comprised 1812 males (50.15%) and 1801 females (49.85%) collected from 20 provinces in mainland China. However, considering that Hubei is the hardest-hit place of this epidemic, we classified the sample sources by residential areas, namely 27 (0.75%) in Hubei Province and 3586

Table 1
Participant sociodemographic characteristics (N = 3613).

Variables	No. (%)
Sex	
Male	1812 (50.15%)
Female	1801 (49.85%)
Age (years)	
7–12	359 (9.94%)
13–18	3254 (90.06%)
Residential areas	
Hubei Province	27 (0.75%)
Others	3586 (99.25%)
Region	
Urban	1799 (49.79%)
Rural	1814 (50.21%)
Only child status	
Yes	1813 (50.18%)
No	1800 (49.82%)
Family status*	
Nuclear family	2477 (68.56%)
Extended family	870 (24.08%)
Single-parent family	197 (5.45%)
Etc. (e.g. step-family)	69 (1.91%)
Education level*	
Primary school	218 (6.03%)
Secondary school-fresh	1949 (53.94%)
Secondary school-repeated	54 (1.49%)
High school-fresh	1374 (38.03%)
High school-repeated	18 (0.51%)
Have electronic devices	
Yes, and possess and use it independently	2941 (81.40%)
Yes, but shared with other siblings	242 (6.70%)
No	430 (11.90%)
At what age started owning electronic devices (years)	
≤ 6	128 (4.01%)
7–12	1554 (48.82%)
13–18	1501 (47.17%)

* Nuclear family denotes living with parents, and extended family represents living with parents and grandparents. 'repeated' represents students failed the high school/college entrance examination and had to return to secondary/high school again for resuming their study, while 'fresh' means students have not yet taken the above-mentioned examinations.

(99.25%) from other regions. Respondents were mainly from nuclear families (68.56%), extended families (24.08%), and single-parent families (5.45%). The sample comprised children aged 7–12 years (9.94%) and adolescents aged 13–18 years (90.06%) and who were in primary school (6.03%), secondary school (55.43%), or high school (38.54%). Among them, 54 (1.49%) and 18 (0.51%) who failed the high school/college entrance examination and had to return to secondary/high school again for resuming their study, respectively. Additionally, there were 128 (4.01%) respondents who already had electronics before 7-year-old. Furthermore, an in-depth analysis of 3183 respondents who possessed electronic devices showed that the average age at which they started owning electronic devices was 12.14 ± 2.66 years, and the highest rate of smartphone penetration was 90.76% (2889/3183), followed by computer 30.19% (961/3183) and tablets 26.99% (859/3183).

After analyzing the information related to the epidemic (Table 2), 173 (4.71%) respondents reported that their family members were involved in the anti-epidemic work, and 49 (28.32%) of them were health care professionals (e.g., frontline doctors and nurses). A total of 20 (0.55%) of the participants stated that their family members, friends, or other acquaintances had been infected with coronavirus. In all, 91.06% of respondents clearly reported concerns about this epidemic, and almost the same proportion (93.86%) reported that they have strictly implemented protective measures (e.g., wear mask, wash hands, or avoid public places and crowds). Moreover, 1976 (54.69%) and 1288 (35.65%) participants reported that the epidemic has affected their learning and graduation, respectively. Average time per day spent on

Table 2
Reported information and emotional distress related to COVID-19 (N = 3613).

Variables	No. (%)
Family members involved in anti-epidemic work	
Father only	57 (1.50%)
Mother only	47 (1.30%)
Parents	37 (1.02%)
Relatives	32 (0.89%)
None	3443 (95.29%)
Occupation of the family member who involved in anti-epidemic work	
Medical personal	49 (28.32%)
Non-medical-staff	124 (71.68%)
Family member or friend infected with coronavirus	
Yes	20 (0.55%)
No	3593 (99.45%)
Degree of concern about the epidemic	
Very concerned	2109 (58.37%)
Concerned	1181 (32.69%)
Average	300 (8.30%)
Not concerned	15 (0.42%)
Very unconcerned	8 (0.22%)
Implementation of the precaution and control measures	
Strictly enforced	3391 (93.86%)
Sometimes	204 (5.65%)
Occasionally	16 (0.44%)
Never	2 (0.05%)
Learning affected by the epidemic	
Yes	1976 (54.69%)
No	1637 (45.31%)
Graduation affected by the epidemic	
Yes	1288 (35.65%)
No	2325 (64.35%)
Average time per day spend on Internet before the epidemic	
≤ 1 h	1275 (35.29%)
1–3 h	1406 (38.92%)
3–5 h	566 (15.67%)
≥ 5 h	366 (10.12%)
Average time per day spend on Internet during the epidemic	
≤ 1 h	432 (11.96%)
1–3 h	1116 (30.89%)
3–5 h	996 (27.57%)
≥ 5 h	1069 (29.58%)
The main purpose spent online before the epidemic*	
Study	2063 (57.10%)
Entertainment	1001 (27.71%)
Surf the Internet	468 (12.95%)
Etc.	81 (2.24%)
The main purpose spent online during the epidemic	
Study	2830 (78.33%)
Entertainment	519 (14.36%)
Surf the Internet	211 (5.84%)
Etc.	53 (1.47%)
Willingness to engage in medicine	
Always	1590 (44.00%)
A little uncertain after the epidemic	277 (7.67%)
Very willingly after the epidemic	677 (18.74%)
Never	1069 (29.59%)
Clinical depressive symptoms	
Yes (≥ 19)	805 (22.28%)
No (< 19)	2808 (77.72%)
Smartphone addiction	
Female with smartphone addiction (≥ 31)	372 (10.30%)
Male with smartphone addiction (≥ 33)	472 (13.06%)
Female without smartphone addiction (< 31)	1420 (39.30%)
Male without smartphone addiction (< 33)	1349 (37.34%)
Internet addiction	
Yes (≥ 70)	218 (6.03%)
No (< 70)	3395 (93.96%)

Internet during the epidemic was also much longer than before, whereas study, as the main reason for internet use, became more significant during the epidemic. After conducting surveys on the willingness to engage in medicine in the future, we found that more people (18.74%) were determined to work in healthcare than those (7.67%) who were a little uncertain after the outbreak.

Table 3The level of anxiety and coping style for all respondents during the outbreak of COVID-19 ($N = 3613$).

Variables	Children			Adolescent		
	Male	Female	Overall	Male	Female	Overall
SCAS						
Total score of SCAS	21.68 ± 14.76	25.88 ± 16.47	23.87 ± 15.79	25.56 ± 19.32	33.09 ± 19.54	29.27 ± 19.79
Separation anxiety	4.40 ± 3.33	4.91 ± 3.56	4.67 ± 3.45	3.46 ± 3.23	4.98 ± 3.56	4.21 ± 3.48
Physical injury fear	3.93 ± 2.76	5.46 ± 3.35	4.73 ± 3.17	3.23 ± 3.02	4.95 ± 3.12	4.08 ± 3.18
Social phobia	4.15 ± 3.24	5.31 ± 3.68	4.75 ± 3.51	5.60 ± 4.03	6.88 ± 3.98	6.23 ± 4.06
Panic disorder	2.81 ± 3.45	3.05 ± 3.88	2.94 ± 3.67	4.25 ± 5.00	5.53 ± 5.09	4.88 ± 5.08
Obsessive disorder	2.58 ± 2.98	2.94 ± 3.07	2.77 ± 3.03	4.41 ± 3.84	4.87 ± 3.85	4.63 ± 3.85
Generalized anxiety	3.81 ± 2.96	4.20 ± 3.09	4.01 ± 3.03	4.61 ± 3.49	5.88 ± 3.71	5.24 ± 3.65
CSS						
Problem-focused coping	52.94 ± 11.31			55.32 ± 12.38		
Emotion-focused coping	37.63 ± 9.75			36.97 ± 10.98		

Abbreviation: SCAS, The Chinese Version of Spence Child Anxiety Scale; CSS, Coping Style Scale.

Among all respondents, 805 (22.28%) and 218 (6.03%) of them had scores above the threshold for clinical depressive symptoms (19 or higher) and Internet addiction (70 or higher). As for SAS, due to the gender differences in cutoff values for smartphone addiction, it was found that the prevalence rates of smartphone addiction in male and female respondents were 10.30% and 13.06%, respectively (Table 2). Additionally, as shown in Table 4, we analyzed the current situation of the respondents' anxiety level and coping style by variables of gender and age, and the results showed that the anxiety levels of adolescents were significantly higher than those of children ($F = 62.07, P < 0.01$), and the total scores of SCAS for females were significantly higher than those of males ($F = 10.59, P < 0.01$). The anxiety levels of males and females in each group of children and adolescents are listed in Table 3.

In Table 4, results of ANOVA and t-test analyses showed that there were 18 variables had significant difference in SCAS scores (levels of anxiety) ($P < 0.05$). Additionally, in order to further analyze the significant factors associated with the level of respondent' anxiety, we conducted multiple linear regression analysis and obtained the following factors to construct a multiple linear regression model of anxiety: clinical depression levels, implementation of the precaution and control measures, sex, family member or friend was infected with coronavirus, occupation of the mother involved in the epidemic, region (e.g., rural, urban), and emotion-focused coping style, which accounted for 31.0% of the total variance (Table 5).

As shown in Table 6, logistic regression analysis identified nine factors as being significantly associated with increased levels of respondents' clinical depressive symptoms: smartphone addiction (OR 1.411, 95% CI 1.099–1.180), Internet addiction (OR 1.844, 95% CI 1.209–2.811), resident in Hubei province (OR 3.107, 95% CI 1.252–7.708) and urban areas (OR 1.324, 95% CI 1.025–1.709), family members or friends infected with coronavirus (OR 3.736, 95% CI 1.009–13.833), graduation affected by the epidemic (OR 1.310, 95% CI 1.019–1.685), levels of separation anxiety (OR 2.074, 95% CI 1.348–3.193), physical injury fear (OR 2.126, 95% CI 1.503–3.007), and emotion-focused coping style (OR 1.090, 95% CI 1.077–1.104). However, there were two factors significantly associated with decreased levels of clinical depressive symptoms: the average time per day spend on Internet before the epidemic (OR 0.652, 95% CI 0.609–0.697) and problem-focused coping style (OR 0.937, 95% CI 0.923–0.951).

Finally, results of Pearson's correlation analysis revealed that the level of respondents' anxiety (SCAS scores) was significantly positively correlated with clinical depressive symptoms (CDI scores) ($r = 0.581, p < 0.01$), smartphone addiction ($r = 0.399, p < 0.01$), Internet addiction ($r = 0.441, p < 0.01$) and emotion-focused coping style ($r = 0.358, p < 0.01$), but negatively correlated with problem-focused coping style ($r = -0.085, p < 0.01$). Moreover, the level of respondents' clinical depressive symptoms was significantly correlated with smartphone addiction ($r = 0.398, p < 0.01$), Internet addiction ($r = 0.492, p < 0.01$), problem-focused coping style ($r = -0.343, p < 0.01$), and

emotion-focused coping style ($r = 0.345, p < 0.01$) (Table 7).

Discussion

Anxiety symptoms are the most common clinical diagnoses in children and adolescents and can act as a significant risk factor for contributing to other psychiatric disorders in adulthood. Moreover, it may worsen by facing the increasingly complex social milieu, and being a cause of impairments in various life domains and can increase societal costs for families (Bodden et al., 2008; Essau et al., 2008). Similarly, clinical depressive symptoms in children and adolescents are common and recurrent diseases associated with memory impairments (Günther et al., 2004), poor interpersonal relationships (Lam et al., 2003), and even high-risk suicidal behaviors (Yorbik et al., 2015). With the sudden outbreak and rapid spread of COVID-19 at the end of 2019, the mental health of children and adolescents in China has been put at risk. According to the results of our investigation, we found that levels of anxiety in children and adolescents during the epidemic were much higher than before (Zhao et al., 2012). As shown in Table 3, the overall scores of five dimensions (including separation anxiety, physical injury fear, social phobia, panic disorder, and generalized anxiety) were higher than before the outbreak, especially the fears of physical injury in children and social phobia in adolescents. This finding may be due to the fact that at the initial stage of the outbreak, protective and therapeutic responses were not yet in place, and the surge in the number of confirmed cases and deaths led children to become excessively concerned about physical damage to themselves and their family caused by exposure to coronavirus. In addition, Dong et al. (Dong et al., 1994) reported that Chinese adolescents demonstrated higher levels of social-evaluative fears than adolescents in western countries. Moreover, negative reports on domestic and foreign social media regarding COVID-related discrimination and unfair treatment of Chinese people, as well as rumors and misinformation around origins of the infectious disease may be an important reason for worsening their social phobia and other mental disorders (Calisher et al., 2020). The findings were in line with previous research indicating that anxiety, depression, and feelings of helplessness can be worsened by SARS-related social discrimination in public places (Zheng et al., 2005).

Having a family member or friend infected with coronavirus was also significantly associated with increases in anxiety levels. This may be due to the fact that respondents are concerned about the health of the infected and simultaneously afraid of being a suspected or confirmed case, given their level of direct contact. We suggest that the increased awareness of infection control in respondents is consistent with their psychological state of anxiety, thereby reducing the risk of infection. In traditional Chinese culture, fathers often assume the role of breadwinners, while mothers tend to perform the bulk of housework and childcare and have more emotional interaction with their children (Lee, 2002). This appeared to be an important factor affecting the

Table 4
Results of *t*-test/ANOVA analysis of the level of respondents' anxiety during the outbreak of COVID-19 (*N* = 3613).

Variables		SCAS ($\bar{x} \pm s$)	<i>t</i> / <i>F</i>	<i>P</i> Value
Sex	Male	25.18 ± 18.97	3.882	0.048
	Female	32.34 ± 19.36		
Age (years)	7–12	23.87 ± 15.79	23.955	<0.001
	13–18	29.27 ± 19.79		
Region	Urban	31.08 ± 20.21	15.878	<0.001
	Rural	26.41 ± 18.47		
Only child status	Yes	26.99 ± 18.82	4.535	0.033
	No	30.48 ± 20.01		
Family status	Nuclear family	28.03 ± 19.15	4.433	0.004
	Extended family	29.76 ± 20.23		
	Single-parent family	32.37 ± 20.17		
	Etc. (e.g. step-family)	30.75 ± 18.72		
Education level	Primary school	22.71 ± 0.40	6.931	<0.001
	Secondary school-fresh	29.64 ± 20.05		
	Secondary school-repeated	32.04 ± 20.04		
	High school-fresh	28.31 ± 19.04		
	High school-repeated	26.00 ± 24.45		
Owning electronics devices	Yes, independently	28.62 ± 19.25	7.710	<0.001
	Yes, shared with other siblings	33.12 ± 21.67		
	No	27.07 ± 19.53		
	Medical personal	19.31 ± 13.38		
Non-medical-staff	29.52 ± 20.81			
Family member or friend infected with coronavirus	Yes	44.15 ± 34.89	28.027	<0.001
	No	28.65 ± 19.35		
Degree of concern about the epidemic	Very concerned	36.75 ± 37.85	4.276	0.002
	Concerned	31.88 ± 20.75		
	Average	29.63 ± 18.75		
	Not concerned	27.77 ± 19.50		
	Very unconcerned	26.20 ± 28.29		
Implementation of precaution and control measures	Strictly enforced	41.94 ± 33.08	6.718	<0.001
	Sometimes	33.30 ± 20.43		
	Occasionally	28.40 ± 19.30		
	Never	18.50 ± 19.49		
Graduation affected by the epidemic	Yes	32.86 ± 20.55	16.125	<0.001
	No	26.45 ± 18.50		
Average time per day spent on Internet before the epidemic	≤1 h	25.16 ± 18.49	32.790	<0.001
	1–3 h	28.93 ± 18.56		
	3–5 h	32.75 ± 20.02		
	≥5 h	34.19 ± 22.85		
Average time per day spent on Internet during the epidemic	≤1 h	21.84 ± 18.02	32.790	<0.001
	1–3 h	27.03 ± 18.04		
	3–5 h	29.07 ± 18.40		
	≥5 h	32.97 ± 21.41		
Willingness to engage in medicine	Always	27.79 ± 20.09	3.043	0.028
	A little uncertain after the outbreak	30.83 ± 19.88		
	Very willingly after the outbreak	29.83 ± 18.93		
Clinical depressive symptoms	Yes	28.89 ± 18.77	211.383	<0.001
	No	46.84 ± 22.71		
Smartphone addiction	Yes	23.54 ± 14.85	43.228	<0.001
	No	38.63 ± 21.80		
Internet addiction	Yes	25.72 ± 17.67	88.916	<0.001
	No	47.20 ± 27.42		
		27.55 ± 18.25		

Abbreviation: SCAS, The Chinese Version of Spence Child Anxiety Scale.

anxiety level of the respondents, who believed that if their mother was not medical staff, this exposed them to insufficient and non-standardized protections, as well as a weaker social support network within their mothers' work environment. Given that the outbreak originated in a highly dense urban area, and there have been subsequently many

more deaths in this area, it could be the case that anxiety levels of urban residents are higher than those of rural areas. Significant sex differences in anxiety levels have been reported in many studies (Essau et al., 2008; Li et al., 2008), potentially resulting in women being more sensitive to the stressful events of COVID-19 and correspondingly expressing stronger concerns and fears.

This study also revealed that the prevalence of clinical depression symptoms in children and adolescents was 22.28% during the COVID-19 outbreak, which was much higher than the generally estimated 13.2% (Stewart and Sun, 2007) in China and 2%–6% (Phillips et al., 1999) in Western countries. Results of regression analysis (Table 6) and Pearson's correlation analysis (Table 7) showed that levels of clinical depression symptoms were significantly associated with anxiety. Evidence has shown that anxiety disorders and depression demonstrate higher overlap in symptomatology, clinical instability, and treatment (Lonigan et al., 1994). It has been estimated that roughly 25%–50% of depressed youth display comorbid anxiety disorders and about 10%–15% of anxious youth have depression (Axelson and Birmaher, 2001). This suggests that attention should be paid to the proper medication and psychological interventions.

Due to the significant number of confirmed patients, as well as the relative shortage of medical resources and first-line medical staff, the rate of mortality in Hubei province is higher (4.9%) than the national mortality rate (2.1%) (National Health Commission of China, 2020b). Moreover, a series of effective prevention and control measures (e.g., cities on lockdown, traffic controls, postponed semesters) in Wuhan (the capital of Hubei province) were implemented more strictly and lasted longer than other regions, leading to the interviewed children and adolescents experiencing greater isolation and for a longer period of time. These factors may explain why living in residential areas was a significant factor affecting depression levels of the respondents. Moreover, we also found that students' graduation being affected by the epidemic was significantly associated with increases in depression. Chinese students may be particularly academically motivated, particularly in successfully completing entrance examinations (Essau et al., 2008) that will determine the quality of higher education and job prospects. Given the current state of the epidemic however, students are taking classes online at home, which may have controversial results due to poor efficiency in managing online courses, visual impairment in students, and instability in internet signals.

During the epidemic, 29.58% respondents reported that they spent more than five hours per day online, which could be a potential risk factor for addiction to the Internet or smartphones. Studies have shown that smartphone/Internet overuse may lead to mental or behavioral problems, causing poor performance in study, decreased real-life social interaction, neglecting personal life, relationship disorders, and mood dysfunction (Kahraman and Demirci, 2018; Soni et al., 2017). Psychopathological screening studies on Internet addicts have shown that anxiety disorders are the most common diagnoses in this group (Liu et al., 2011), and adverse consequences in sleep disturbances/decreased sleep quality caused by electronic media use at night have been shown to be significantly associated with depressive symptoms (Lemola et al., 2015). In contrast, we observed that respondents spend much less time online pre-outbreak than they did during the outbreak (Table 2), which can also explain the significant correlation between the average time per day spend on Internet before the epidemic was significantly associated with the decrease of levels of depressive symptoms.

Review of the literature has revealed that stress-coping theory posits a broad framework of problem-focused and emotion-focused coping strategies (Herman and Tetric, 2009). Problem-focused strategies tend to concentrate efforts towards fixing a stressful problem, while emotion-focused strategies concentrate on minimizing the emotional outcomes of the problem using strategies such as endurance, avoidance, or venting to someone else. It has been reported that greater degrees of ruminative coping instead of actively seeking for solutions were related

Table 5
Factors associated with the anxiety levels of respondents during the COVID-19 outbreak (N = 3613).

Model	Unstandardized Coefficients		Standardized Coefficients	t	P Value
	B	SE			
(constant)	25.362	12.616		2.010	0.046
Clinical depressive symptom	10.956	3.530	0.215	3.103	0.002
Implementation of precautions measures	-26.382	4.925	-0.367	-5.357	<0.001
Sex	6.902	2.563	0.172	2.693	0.008
Family member or friend infected with coronavirus	44.045	8.000	0.402	5.506	<0.001
Occupation of the mother involved in the epidemic	9.178	3.381	0.171	2.714	0.007
Region	-8.683	2.815	-0.201	-3.085	0.002
Emotion-focused coping	0.376	0.119	0.198	3.157	0.002

NOTE: $F = 5.300$, $p < 0.01$, $R^2 = 0.383$, $Adjusted R^2 = 0.310$.

Stepwise selection procedure was employed to select the model from levels of depression, smartphone/Internet addiction and subscales of coping style scale, as well as variables listed in Table 4 which had statistical difference in levels of anxiety (total scores of SCAS).

Table 6
Factors associated with the presence of depression for children and adolescent during the COVID-19 outbreak (N = 3613).

Variables	Frequency n (%) of respondents		Odds Ratio (95%CI)
	Depressed	Non-depressed	
Smartphone addiction			
No	458(16.53%)	2313(83.47%)	1
Yes	349(41.45%)	493(58.55%)	1.411 (1.099–1.180)
Internet addiction			
No	672(19.79%)	2723(80.21%)	1
Yes	133(61.01%)	85(38.99%)	1.844 (1.209–2.811)
Residential areas			
Others in China	789 (22.00%)	2797(78.00%)	1
Hubei Province	16(59.26%)	11(40.74%)	3.107 (1.252–7.708)
Region			
Rural	314(17.31%)	1500(82.69%)	1
Urban	491(27.29%)	1308(72.71%)	1.324 (1.025–1.709)
Family member or friend infected with coronavirus			
No	793(22.07%)	2800(77.93%)	1
Yes	12(60.00%)	8(40.00%)	3.736 (1.009–13.833)
Graduation affected by the epidemic			
No	416(17.89%)	1909(82.11%)	1
Yes	389(30.20%)	899(69.80%)	1.310 (1.019–1.685)
Average time per day spent on Internet before the epidemic			
≤ 1 h	204(16.00%)	1071(84.00%)	1
1–3 h	298(21.19%)	1108(78.81%)	0.414 (0.389–0.441)
3–5 h	162(28.62%)	404(71.38%)	0.477 (0.449–0.506)
≥ 5 h	141(38.52%)	225(61.48%)	0.652 (0.609–0.697)
Separation anxiety	NA	NA	2.074 (1.348–3.193)
Physical injury fear	NA	NA	2.126 (1.503–3.007)
Problem-focused coping	NA	NA	0.937 (0.923–0.951)
Emotion-focused coping	NA	NA	1.090 (1.077–1.104)

NOTE: Forward stepwise selection procedure was employed to select the model from variables listed in Table 1 (the sociodemographic characteristics), Table 2 (contents of the COVID-related information), as well as levels of anxiety and its six dimensions, smartphone/Internet addiction, and subscales of coping style scale.

Abbreviation: NA, not applicable.

Table 7
The results of Pearson's correlation analysis among the total scores of each assessment tool (r).

Variables	SCAS	CDI	Smartphone addiction	Internet addiction	Problem-focused coping	Emotion-focused coping
SCAS	1.000					
CDI	0.581**	1.000				
Smartphone addiction	0.399**	0.398**	1.000			
Internet addiction	0.441**	0.492**	0.790**	1.000		
Problem-focused coping	-0.085**	-0.343**	-0.070**	-0.126**	1.000	
Emotion-focused coping	0.358**	0.345**	0.411**	0.521**	0.145**	1.000

** $p < 0.01$

NOTE: 'r' represents Pearson Correlation Coefficient. SCAS, the Chinese Version of Spence Child Anxiety Scale; CDI, the Child Depression Inventory.

to high levels of depressive symptoms, while problem-focused and distractive coping style was negatively associated with depression (Li et al., 2006). We also observed that a problem-focused coping style was closely related to decrease in clinical depression, while an emotion-focused coping style was negatively associated with the increase in depression.

Conclusions

This study investigated the mental health status of children and adolescents in mainland China during the epidemic of COVID-19. Specifically, we examined anxiety and depression and investigated the related influencing factors. The findings of this study not only remind researchers and government officials should be more concerned about the mental health of children and adolescents who are often neglected in the wake of the outbreak due to their comparatively lower mortality than elderly adults, but also provide a scientific basis for the formulation of targeted psychological interventions.

Limitations

This study also has several limitations. First, data collection was completed by distributing questionnaires to children and adolescents online. The results and conclusions may be influenced by the degree of understanding and cooperation of the respondents, especially the younger children who need help of their guardians. Second, the stylized answer forms of those questionnaires are convenience for statistics, but it limits the response of subjects and let them fail to express their subjective views on relevant issues. Third, due to the fact that the epidemic situation in Hubei was not fully controlled during the investigation period, it was difficult to collect data and the sample size was relatively small in this region, which limited the applicability and generalization of the results. Therefore, in follow-up studies, we plan to increase the sample size (especially in Hubei and other hard-hit regions), employ face-to-face surveys, qualitative interview methods, follow-up studies, and collect responses from primary guardians so as to further improve the study design and the scientific nature of the results.

Declaration of Competing Interest

None.

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Author Statement

No conflict of interest exists in the submission of this manuscript, and manuscript is approved by all authors for publication. I would like to declare on behalf of my co-authors that the work described was original research that has not been published previously.

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