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Short communication

# Anxiety, depression, and PTSD symptoms among high school students in china in response to the COVID-19 pandemic and lockdown

Chengqi Cao [a,b], Li Wang [a,b,*], Ruojiao Fang [a,b], Ping Liu [c], Yajie Bi [c], Shu Luo [c], Emma Grace [d], Miranda Olff [e,f]

[a] Laboratory for Traumatic Stress Studies, CAS Key Laboratory of Mental Health, Institute of Psychology, Chinese Academy of Sciences, Beijing, China
[b] Department of Psychology, University of Chinese Academy of Sciences, Beijing, China
[c] People's Hospital of Deyang City, Deyang, Shichuan, China
[d] Department of International Psychology, The Chicago School of Professional Psychology, Washington DC, USA
[e] Department of Psychiatry, Amsterdam University Medical Centers Location AMC, Amsterdam Public Health, Amsterdam, the Netherlands
[f] ARQ National Psychotrauma Center, Diemen, the Netherlands

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ABSTRACT

*Aims:* This study aimed to investigate the prevalence of anxiety, depression and PTSD symptoms, and associated risk factors among a large-scale sample of adolescents from China after the pandemic and lockdown.
*Method:* A total of 57,948 high school students took part in an online survey from July 13 to 29, 2020. The mental health outcomes included anxiety, depression and PTSD symptoms. Risk factors included negative family relationships, COVID-19 related exposure, and a lack of social support.
*Results:* The prevalence of anxiety, depression and PTSD symptoms was 7.1%, 12.8%, and 16.9%, respectively. COVID-19 related exposure significantly linked to the mental health outcomes (all $p < .001$). The most important predictors for the mental health outcomes were family relationship and social support (all $p < .001$).
*Conclusion:* The pandemic may have long-term adverse mental health consequences among adolescents. Adverse family relationships and lack of social support could be the major risk factors for the post-pandemic mental health outcomes of adolescents.

## 1. Introduction

Coronavirus disease 2019 (COVID-19) which was announced as a pandemic by the World Health Organization (WHO) on March 2020 (World Health Organization, 2021) has swept the world more than one year, and substantially impacted the lives of people around the world. The pandemic and associated public health measures such as nationwide or regional lockdowns were linked with increased stressful events and limited social interactions, and thus could lead to many mental health problems such as anxiety, depression and posttraumatic stress disorders (PTSD) (Xiong et al., 2020). Given that adolescence is a developmental stage that seems especially sensitive to stress exposures and social interaction (Berger et al., 2021), the effect of the pandemic on adolescent mental health has garnered great concern. High prevalence rates of anxiety, depression and PTSD symptoms were reported among adolescents during the pandemic in cross-sectional studies (Zhang et al., 2020; Murata et al., 2021). Longitudinal studies with data collected before and during the pandemic further confirmed the association between the pandemic and increased symptoms of mental health problems (Giannopoulou et al., 2021; Hawes et al., 2021). It was proposed that the pandemic would contribute to both short- and long-term adverse consequences on the mental health of adolescents (Singh et al., 2020). The extant studies were almost all conducted during the pandemic, and thus only informed the current and short-term effect of the pandemic. It is critical to investigate the long-term mental health outcomes of the pandemic among adolescences, especially post the pandemic and lockdown. Findings from these studies would contribute to the current knowledge about the effect of the pandemic on adolescent mental health, and guide refining pandemic-related mental health policy and developing more sophisticated intervention programs for adolescents. To address the research gap, this study aimed to investigate the prevalence of anxiety, depression and PTSD symptoms, and associated risk factors among a large-scale sample of adolescents from China post the pandemic and lockdown.

* Corresponding author at: Institute of Psychology, Chinese Academy of Sciences, 16 Lincui Road, Beijing 100101, China.
*E-mail address:* wangli1@psych.ac.cn (L. Wang).

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**Table 1**
Univariate logistic regression analyses of effects of demographic variables, social support, and COVID-19 related exposure on symptoms of anxiety, depression and PTSD ($N = 57{,}984$).

| Variables | Overall | | Anxiety | | | Depression | | | PTSD | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n*(%) | *n*(%) | OR(95% CI) | *p* | *n*(%) | OR(95% CI) | *p* | *n*(%) | OR(95% CI) | *p* |
| Overall | | 4097(7.1) | | | 7393 (12.8) | | | 9810 (16.9) | | |
| Gender | | | | | | | | | | |
| Male | 28089 (48.4) | 1443(5.1) | 1 | | 2677(9.5) | 1 | | 3760 (13.4) | 1 | |
| Female | 29895 (51.6) | 2654(8.9) | 1.80 (1.68–1.92) | <.001 | 4716 (15.8) | 1.78 (1.69–1.87) | <.001 | 6050 (20.2) | 1.64 (1.57–1.72) | <.001 |
| School type | | | | | | | | | | |
| Junior | 41158(71.0 | 2994(7.3) | 1 | | 4885 (11.9) | 1 | | 7042 (17.1) | 1 | |
| Senior | 16826 (29.0) | 1103(6.6) | 0.89 (0.83–0.96) | .002 | 2508 (14.9) | 1.30 (1.24–1.37) | <.001 | 2768 (16.5) | 0.95 (0.91–1.00) | .055 |
| Area of residence | | | | | | | | | | |
| Urban | 23527 (40.6) | 1453(6.2) | 1 | | 2651 (11.3) | 1 | | 3395 (14.4) | 1 | |
| Rural | 34457 (59.4) | 2644(7.7) | 1.26 (1.18–1.35) | <.001 | 4742 (13.8) | 1.26 (1.20–1.32) | <.001 | 6415 (18.6) | 1.36 (1.30–1.42) | <.001 |
| Only Child | | | | | | | | | | |
| No | 29935 (51.6) | 2340(7.8) | 1 | | 4243 (14.2) | 1 | | 5629 (18.8) | 1 | |
| Yes | 28049 (48.4) | 1757(6.3) | 0.79 (0.74–0.84) | <.001 | 3150 (11.2) | 0.77 (0.73–0.81) | <.001 | 4181 (14.9) | 0.76 (0.72–0.79) | <.001 |
| Parent's marital status | | | | | | | | | | |
| Married | 46740 (80.6) | 3993(6.4) | 1 | | 5464 (11.7) | 1 | | 7456 (16.0) | 1 | |
| Unmarried | 11244 (19.4) | 1104(9.8) | 1.59 (1.48–1.71) | <.001 | 1929 (17.2) | 1.56 (1.48–1.66) | <.001 | 2354 (20.9) | 1.40 (1.33–1.47) | <.001 |
| Family relationship (Quarrel/Violence/ Detachment) | | | | | | | | | | |
| No | 52786 (91.0) | 2811(5.3) | 1 | | 5376 (10.2) | 1 | | 7804 (14.8) | 1 | |
| Yes | 55198(9.0) | 1286 (24.7) | 5.84 (5.43–6.29) | <.001 | 2017 (38.8) | 5.59 (5.25–5.95) | <.001 | 2006 (38.6) | 3.62 (3.41–3.85) | <.001 |
| Lacking support | | | | | | | | | | |
| No | 52675 (90.8) | 2505(4.8) | 1 | | 4831(9.2) | 1 | | 7070 (13.4) | 1 | |
| Yes | 5309(9.2) | 1592 (30.0) | 8.58 (7.99–9.21) | <.001 | 2562 (48.3) | 9.24 (8.69–9.82) | <.001 | 2740 (51.6) | 6.88 (6.48–7.30) | <.001 |
| COVID–related exposure | 1.1(1.4) [a] | | 1.28 (1.25–1.30) | <.001 | | 1.27 (1.25–1.29) | <.001 | | 1.43 (1.41–1.45) | <.001 |

OR = odds ratio; CI = confidence interval; PTSD = posttraumatic stress disorder
[a] numbers out and in parentheses are mean and SD of scores on the scale of COVID-related exposure, respectively.

## 2. Methods

### 2.1. Participants and procedure

Although the outbreak of COVID-19 was first reported in China, the pandemic was controlled after two months depending on strict public health measures and adequate health care resources. The Deyang city in Sichuan province implemented stringent lockdown measures from the end of January to the end of March, 2020, including school closure and home confinement as there were 18 officially confirmed COVID-19 cases. The lockdown measures were gradually lifted on early April, 2020, and school resumption was on early May, 2020 in this city.

The survey was organized by local education and health departments between July 13 and July 29, 2020 for the purpose of assessing pandemic-related mental health needs, and guiding further development of effective mental health strategies. A Wechat quick response code for online questionnaires was sent by high school teachers to the guardian's cellular telephone, and students were encouraged to complete the questionnaires after the electronic informed consent was confirmed by both guardian and student. The research protocol was reviewed and approved by the ethics committee of People's Hospital of Deyang City.

Almost all junior and senior high school students took part in the survey. A total of 1941 (3.2%) participants were excluded from analyses due to missing data, leaving the final effective sample of 57,984 students from 131 schools. The mean age of the final sample was 14.8 years (SD=1.6, range: 11–20 years). The detailed demographic data of the sample are summarized in Table 1.

### 2.2. Measures

Anxiety and depression symptoms were assessed with the Chinese versions of the 7-item Generalized Anxiety Disorder (GAD-7) (Spitzer et al., 2006) and the 9-item Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001). Each item of GAD-7 and PHQ-9 is rated using a four-point Likert scale (0 = "not at all" to 3 = "extremely"), to reflect the severity of a particular symptom during the past two weeks. The cutoffs used to screen probable positive cases for anxiety and depression were GAD-7 score $\geq 10$ and PHQ-9 score $\geq 10$, respectively. Cronbach's αs for GAD-7 and PHQ-9 were .91 and .91, respectively.

PTSD symptoms were assessed with the PTSD subscale of the Global Psychotrauma Screen for Teenagers (GPS-T) (Grace et al., 2021). Five items for GPS-T were answered in "Yes" (1) or "No" (0) format. A cutoff of $\geq 3$ has been recommended to screen probable positive cases for PTSD. Cronbach's α for GPS-T was .80.

Family relationship was assessed with a single yes or no question,

**Table 2**
Multivariate logistic regression analyses of factors significantly associated with symptoms of anxiety, depression and PTSD ($N$ = 57,984).

| Variables | Anxiety OR(95% CI) | $p$ | Depression OR(95% CI) | $p$ | PTSD OR(95% CI) | $p$ |
|---|---|---|---|---|---|---|
| Gender | | | | | | |
| Male | 1 | | 1 | | 1 | |
| Female | 1.63(1.52–1.75) | <.001 | 1.65(1.57–1.75) | <.001 | 1.57(1.49–1.64) | <.001 |
| School type | | | | | | |
| Junior | 1 | | 1 | | – | – |
| Senior | 0.86(0.80–0.93) | <.001 | 1.36(1.28–1.44) | <.001 | - | - |
| Area of residence | | | | | | |
| Urban | 1 | | 1 | | 1 | |
| Rural | 1.05(0.97–1.12) | .237 | 1.09(1.03–1.15) | .003 | 1.14(1.09–1.20) | <.001 |
| Only Child | | | | | | |
| No | 1 | | 1 | | 1 | |
| Yes | 0.94(0.87–1.01) | .070 | 0.87(0.82–0.92) | <.001 | 0.88(0.84–0.92) | <.001 |
| Parent's marital status | | | | | | |
| Married | 1 | | 1 | | 1 | |
| Unmarried | 1.12(1.03–1.21) | .008 | 1.17(1.09–1.25) | <.001 | 1.12(1.06–1.19) | <.001 |
| Family relationship (Quarrel/Violence/Detachment) | | | | | | |
| No | 1 | | 1 | | 1 | |
| Yes | 3.58(3.30–3.89) | <.001 | 3.66(3.41–3.93) | <.001 | 2.42(2.26–2.59) | <.001 |
| Lacking support | | | | | | |
| No | 1 | | 1 | | 1 | |
| Yes | 5.62(5.21–6.08) | <.001 | 6.33(5.93–6.76) | <.001 | 4.81(4.51–5.12) | <.001 |
| COVID–related exposure | 1.17(1.15–1.20) | <.001 | 1.19(1.17–1.21) | <.001 | 1.38(1.36–1.40) | <.001 |

OR = odds ratio; CI = confidence interval; PTSD = posttraumatic stress disorder

"Are there frequent quarrels, physical violence, or emotional detachment among your family members during the past month". COVID-19 related exposure was measured with five yes (1) or no (0) questions including: being quarantined due to suspected infection, people close to you being quarantined due to suspected infection, people close to you being diagnosed as COVID-19 patient, having to live alone due to the pandemic, being upset due to lacking interaction with people close to you, your family losing livelihood due to the pandemic. By summing item responses, a total exposure score was calculated. Social support was measured with the social support item of the GPS-T.

### 2.3. Data analysis

Univariate logistic regression analyses were first employed to evaluate bivariate associations between each mental health outcome and potential risk factor. Variables that were statistically significant in the first analyses were subsequently included in multivariate logistic regression analyses to evaluate independent role of each risk factor for individual mental health outcomes. All analyses were conducted with SPSS version 22.0 for Windows (IBM), and statistical significance was set at $p < .01$ to reduce the likelihood of Type I error.

## 3. Results

The mean score on the GAD-7 was 3.6 (SD = 3.9, range: 0–21), on the PHQ-9 was 4.4 (SD = 4.9, range: 0–27), and on the PTSD subscale of GPS-T was 1.0 (SD = 1.5, range: 0–5). Base on the cutoffs mentioned above, the rate of probable anxiety, depression, and PTSD was 7.1% ($n$= 4097), 12.8% ($n$ = 7393), and 16.9% ($n$= 9810), respectively. Table 1 presents the results of univariate logistic regression analyses. Except the effect of school type (junior vs. senior high school) on PTSD symptoms (OR = 0.95, $p$ = .055), all the other effects of demographic variables, social support, and COVID-19 related exposure on symptoms of anxiety, depression and PTSD were statistically significant (all $p < .01$). The results of multivariate logistic regression analyses are summarized in Table 2. Except the associations between anxiety symptoms and area of residence (urban vs. rural) (OR = 1.05, $p$= .237) and only child (no vs. yes) (OR = 0.94, $p$= .070), all the other selected variables were still significantly associated with mental health outcomes. The most important predictors for the mental health outcomes were family relationship (OR = 3.58 for anxiety, OR = 3.66 for depression, and OR = 2.42 for PTSD, all $p$< .001) and lacking social support (OR = 5.62 for anxiety, OR = 6.33 for depression, and OR = 4.81 for PTSD, all $p < .001$).

## 4. Discussion

To our knowledge, this is the first study to investigate the long-term impact of the COVID-19 pandemic on adolescent mental health with data collected post the pandemic and lockdown. It was found that the rate of anxiety, depression and PTSD symptoms was 7.1%, 12.8%, and 16.9%, respectively. COVID-19 related exposure significantly linked to the mental health outcomes, and family relationship and social support were the most important predictors for the negative mental health outcomes.

The current study found lower rate of anxiety, depression and PTSD symptoms among adolescents than previous studies conducted during the pandemic in China (26.9%, 22.0%, and 21.7% for anxiety, depression, and PTSD, respectively) (Zhang et al., 2020) and in USA (48%, 55%, and 45% for anxiety, for depression, and PTSD, respectively) (Murata et al., 2021). The finding suggests that with the pandemic over and life gradually returning to normal, negative mental health impact of the pandemic on adolescents decreased. However, there still were a portion of adolescents experiencing high level of mental health symptoms, especially symptoms of chronic stressor-related disorders such as depression and PTSD. The significant associations between COVID-19 related exposure and the mental health outcomes support that the pandemic may have a long-term negative effect on adolescent mental health even with the pandemic over. The findings extend the current understandings on the mental health effects of the pandemic on adolescents, highlight the long-term mental health needs of the particular population, and encourage further study to investigate underlying mechanism of the long-term effect to inform the development of mechanistically driven interventions.

It has been documented that adverse family relationship and lacking social support which might be caused or exacerbated by the pandemic associated with anxiety, depression, and PTSD symptoms among adolescents during the pandemic (Guessoum et al., 2020; Gul and Demirci, 2021; Ertan et al., 2020). In this study, we found that the factors were the most important predictors for the negative mental health outcomes even with the pandemic over, which suggests that persistent

intrafamilial adversity and interrupted social support systems could be the major risk factors for the post-pandemic mental health of adolescents. The findings enrich the extant knowledge the main risk factors for the development and maintenance of the pandemic-related mental health problems among adolescents, and inform the potential targets of mental health interventions for the population. Specifically, further mental health strategies aiming to improve long-term mental health outcomes of adolescents should integrate programs targeting to ameliorate family environment and reconstruct social support systems.

Main limitations of this study included cross-sectional design limited the possibility to compare with pre-pandemic data and utilization of self-report measures. Moreover, although using online survey to collect data is suitable in the context of the pandemic and could help for recruiting large-scale samples, the generalizability of the current findings may be limited by respondent bias of online survey. Despite the limitations, the current findings highlight the long-term adverse mental health consequences of the COVID-19 pandemic among adolescents, and inform the development of mental health strategies for adolescents post the pandemic and lockdown.

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## Declaration of Competing Interest

None.

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