

Evaluation on potential detriments from lockdown-related isolation to mental health among school-aged youth in central China

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Research Article

Keywords: lockdown, coronavirus disease, children, adolescents, mental health, social isolation

Posted Date: March 9th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1423289/v1>

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Abstract

Background: Home isolation is a generally effective strategy for coronavirus disease control during lockdown periods. This study is to determine the potential adverse consequences of home isolation to mental health among school-aged youth after lifting of major lockdown measures in central China.

Methods: This cohort study assessed the mental health of school-aged children and adolescents enrolled in Wuhan city and nearby areas in Hubei province, China, from July 1 to August 31, 2020. Post-lockdown responses to anxiety, depression, sleep disturbances and post-traumatic stress symptoms were assessed in online questionnaire-based surveys. Participants' scores for the Zung self-rated anxiety scale, the Patient Health Questionnaire-9, the self-rating scale of sleep and the post-traumatic stress disorder self-rating scale (PTSS) were analyzed.

Results: Questionnaire responses of 730 school children were collected. Among the participants, 6.25% of them had scores above thresholds for PTSS, 5.81% had anxiety, and 48.84% had depression. All subjects reported that they experienced sleep disturbances. Subjects who had anxiety might have a high risk for developing depression [OR: 16.07, $p=0.008$, 95%CI (2.08-123.94)] and PTSS [OR: 12.97, $p<0.001$, 95%CI (5.41-31.11)]. Both depression [OR: 17.35, $p=0.006$, 95%CI (2.28-131.87)] and PTSS [OR: 14.18, $p<0.001$, 95%CI (6.00-33.47)] were risk factors for developing anxiety among participants. Interestingly, higher educational levels of primary caregivers were a risk factor for developing depression [OR: 1.62, $p=0.005$, 95%CI (1.16-2.28)] in the participants, but a protective factor against PTSS [OR: 0.47, $p=0.048$, 95%CI (0.23-0.99)].

Conclusions: The local youth had less than expected degree of increases in their self-reported PTSS and anxiety, after exiting lockdown-related isolation. As a result of a combination of compensatory mechanisms including internet-based home-schooling and increased intra-familial interactions, home isolation did not affect the mental health of local school-aged youth to an extent as great as expected.

Trial registration: The Registration number of this trial is ChiCTR2000033054.

Background

The ongoing global pandemic of coronavirus disease has a devastating impact on human health and society in multiple dimensions(1, 2). Urban lockdown measures requiring home isolation, which first began in China, early 2020, and continue worldwide, have been deemed some of the effective strategies for disease control in the absence of clear anti-viral treatment options(3). To enforce social distancing during lockdowns, for example, most social and school-based activities that otherwise occupy youth's lives become highly restricted. School children and adolescents (aged range: 7–17) undergo critical developmental periods in which the foundation for their long-term emotional health is being established via dynamic interactions. Typically, they rely heavily on peer connections for emotional support. When such emotional support from family members, teachers, and other significant peers and adults in their

lives could not be accessed or compensated under circumstances of lockdowns and lifestyle changes, the mental health of school-aged children and adolescents can be adversely affected(4).

During childhood and adolescence, the central nervous system is within a stress-sensitive developmental window with respect to fear regulation(5). The occurrence of any stressful challenges during such critical developmental periods can set off short- and long-term physiological and behavioural perturbations(6, 7). Childhood psychological reactions can be broadly classified into internalising problems (e.g., anxiety, depression, withdrawal state and somatic complaints), and externalising problems (e.g., irritable states, aggression, and disruptive behavioural responses). Recently studies on lockdown-related behaviour have reported steep increases in anxiety and depression(8) and compromised sleep quality and sleep stabilisation in children(9).

Emergent psychological ramifications triggered by lockdown-related isolation, particularly in children, have attracted intense research interest(10, 11), but the long-term effects therein are still poorly understood. Given the profound effects and unprecedented scale of isolation on paediatric health during massive lockdowns, we undertook the present study to better understand the crucial factors shaping psychological reactions, resilience and mental status of young children and adolescents following epidemic-related lockdowns. Here, we conducted a survey (between July and August, 2020) on the status of mental health among school-aged children and adolescents who had gone through home isolation, approximately three months after end of the peak epidemic period (i.e., December 2019 to April, 2020) in central China(12). Specifically, this study aimed to examine the levels of anxiety, depression, perceived stress and sleep quality in young children and adolescents, determine any variability in susceptibility among different age groups, and analyse the factors influencing the recovery in mental health among affected young individuals.

Although the youth had suffered relatively less as coronavirus infection target groups during the epidemic periods, effects of lockdown-imposed home isolation on their health recovery processes needs to be scrutinized. As adults, they bear the long-term socio-economic and psychosocial consequences of the epidemic(13). This study thus offers fresh insights into the long-term psychological health problems seeded by lockdown-related isolation, with relevance to interventions for future health crises in affected children and adolescents.

Methods

Participants and research ethics

A cross-sectional, online questionnaire-based survey was conducted between July and August, 2020, approximately three months after the lifting of region-wide home isolation measures (January to April, 2020) in central China (encompassing Wuhan city [population 8.47 million], and its surrounding areas in Hubei province [population 57.8 million]). Questionnaires were maintained on the official website of "Questionnaire Star" (www.wjx.cn) and made accessible to participants through WeChat, a smart-phone-

based social network application with high circulation volume. The study adopted a snowball sampling approach to collecting questionnaires remotely, targeting school children and adolescents aged 7 to 17. Before completing the questionnaires, young participants and their guardians were asked to give their informed consent with regard to the purpose and contents of the study. Participants filled out the set of questionnaires online freely. Help from their guardians was encouraged, where appropriate. All subjects were given the option of interacting with the researchers freely through email addresses and phone numbers provided on the end page of the questionnaires. The research ethics committee of the Wuhan Mental Health Centre, Tongji Medical College of Huazhong University of Science & Technology, Wuhan, China, has approved the study protocols and procedures for informed consent (KY20200108). The Registration number of this trial is ChiCTR2000033054.

Measurements

The set of questionnaires involved in this study was composed mainly of five sections, namely:

Sociodemographic characteristics included questions on age, sex, place of residence, situations of primary caregivers, and participants' conditions.

The Zung self-rated anxiety scale assessed anxiety (SAS)(14), a self-administered scale, with each item being measured on a 4-point scale, from "none of the time" to "most of the time." This questionnaire has been widely used in Chinese populations with satisfactory psychometric properties(15). A total score > 49 indicates anxiety. Cronbach's alpha for SAS in this study was 0.82.

Depression was assessed by the Patient Health Questionnaire-9 (PHQ-9)(16). The questionnaire has nine items, with scores for each item ranging from "0" (not at all) to "3" (nearly every day). The PHQ-9 score > 9 had high sensitivity and specificity for significant depression(16). Cronbach's alpha for PHQ-9 in this study was 0.92.

Sleep disturbance was estimated by the self-rating scale of sleep (SRSS)(17). The scale comprises ten items assessing maladaptive sleep-related beliefs. The items are rated on a 5-point Likert scale with "1" indicating no difficulty and "5" severe difficulty. A total score > 10 indicates sleep disturbance. Cronbach's alpha for SRSS in this study was 0.77.

Post-traumatic stress symptoms (PTSS) were assessed with the post-traumatic stress disorder self-rating scale (PTSD-SS)(18), consisting of 24 items on a 5-point rating scale from 1 (not at all) to 5 (extremely). Scores for the items were summated for a total score of 50, which suggests PTSS. Higher scores suggest higher levels of PTSS. In this study, Cronbach's alpha for PTSS was 0.92.

Statistical analysis

All data were analysed by Stata SE 15 (StataCorp LLC, USA). Characteristics of the samples were summarised by using descriptive statistics. *Chi*-square test and Wilcoxon rank-sum test were performed to analyse any differences between school-aged children and adolescents. An ANCOVA general linear model was constructed to further confirm the aforementioned differences, with adjustments for

prespecified covariates found in previous analyses. Bivariate logistic regression analyses by Stata were performed to determine any association between outcome variables (e.g., anxiety, depression and PTSS) and potential risk factors. Three variable selection methods (i.e., forward, backward, and stepwise) were chosen in the multivariate model to build a model for screening potential risk factors, which has the following inclusion and exclusion criteria: type I error = 0.1 based on likelihood ratio tests; individual and independent effects of all predictors estimated and compared by odds ratio; and corresponding 95% confidence interval (CI). A statistical significance level of $p < 0.05$ was used for all variables. Measurement data were expressed as mean \pm standard deviation (SD).

Results

Questionnaire responses were initially collected from approximately 730 participants. After excluding duplicate IDs and incomplete questionnaires, the study included a total of 688 valid questionnaires; the valid response rate was thus 94.2%. As shown in Table 1, the school-aged participants comprised 330 children (47.97%) and 358 adolescents (52.03%) collected from mainland China. Proportions of the sexes were broadly even, with 338 males (49.13%) and 350 females (50.87%). As Wuhan underwent the most massive city-wide lockdown in mainland China in early 2020, we classified sample sources by residential areas, which gives a distribution of 379 (55.09%) responses from Wuhan city and 309 (44.91%) from non-Wuhan areas. Primary caregivers of the participants were generally well-educated, with 376 (54.65%) of them having a bachelor's or higher degree. Fifty-one (7.41%) participants' primary caregivers were medical staff involved in anti-epidemic work. Most of the participants had not been directly (e.g., 6 participants or 0.87% reported prior laboratory confirmed viral infection) or indirectly exposed to coronavirus (e.g., 19 participants or 2.767% with family members confirmed with viral infection). Slightly less than one-tenth or 6.25% of the participants ($n = 43$) and 5.81% ($n = 40$) of them had scores above the thresholds for PTSS (50 or higher) and anxiety (50 or higher), respectively. However, nearly half of the subjects ($n = 336$, 48.84%) had scores above the threshold for depression (10 or higher). Furthermore, all subjects reported that they experienced sleep disturbances.

Table 1
Descriptive Statistics Analysis on Participant Characteristics

Demographics	Mean (Standard Deviation) / Frequencies (%)
Full valid sample, 688 ^a	
Age, years	13.68 ± 2.75
Age group	
Children (< 14)	330 (47.97%)
Adolescents (> 13)	358 (52.03%)
Sex	
Males	338 (49.13%)
Females	350 (50.87%)
Residence	
Wuhan city	379 (55.09%)
Non-Wuhan areas	309 (44.91%)
Educational level of primary caregivers	
Less than bachelor's degree	312 (45.35%)
Bachelor's degree or higher	376 (54.65%)
Occupation of primary caregivers	
Non-medical staff	637 (92.59%)
Medical staff	51 (7.41%)
Primary caregivers	
Non-parents	57 (8.28%)
Parents	631 (91.72%)
Comorbidities	
No	662 (96.22%)
Yes	26 (3.78%)
Families being virally infected	
No	669 (97.24%)

^a Baseline results are based on the full sample.

Demographics	Mean (Standard Deviation) / Frequencies (%)
Yes	19 (2.76%)
Self being virally Infected	
No	682 (99.13%)
Yes	6 (0.87%)
Needing psychological counselling	
No	587 (85.32%)
Yes	101 (14.68%)
Post-traumatic stress disorder self-rating scale	
Non-post-traumatic stress symptoms (total score < 50)	645 (93.75%)
Post-traumatic stress symptoms (total score > 49)	43 (6.25%)
Zung self-rated anxiety scale	
Non-anxiety (total score < 50)	648 (94.19%)
Anxiety (total score > 49)	40 (5.81%)
Patient health questionnaire (PHQ-9)	
Non-depression (total score < 10)	352 (51.16%)
Depression (total score > 9)	336 (48.84%)
Self-rating scale of sleep (SRSS)	
Non-sleep disturbance (total score < 10)	0 (0.00%)
Sleep disturbance (total score > 9)	688 (100.00%)
Severity of sleep disturbance	16.17 ± 4.70
^a Baseline results are based on the full sample.	

As shown in Table 2, children and adolescents reported similar situations in psychological assessment, except that adolescents experienced more severe sleep disturbances ($p < 0.01$). ANCOVA analysis was performed to verify differences in the scores of SRSS between school-aged children and adolescents, with adjustments for sex ($p = 0.03$, Table 2), education levels of the subjects' primary caregivers ($p < 0.01$, Table 2) and comorbidities ($p < 0.01$, Table 2). The differences in SRSS scores were found to be very robust ($p < 0.001$, Table 3). Our results suggest that the more severe sleep disturbances observed in adolescents were not due to sex differences, primary caregivers' education level or subjects' comorbidities

in children and adolescents. Subsequently, the school-aged children and adolescents' datasets were combined for further analysis.

Table 2
Comparison of General Characteristics between Children and Adolescents

Factor	Children (<i>n</i> = 330)	Adolescents (<i>n</i> = 358)	<i>p</i> value
Sex			
Males	177 (53.6%)	161 (45.0%)	0.03 ^{a*}
Females	153 (46.4%)	197 (55.0%)	
Residence			
Wuhan city	193 (58.5%)	186 (52.0%)	0.09 ^a
Non-Wuhan areas	137 (41.5%)	172 (48.0%)	
Educational level of primary caregivers			
Less than bachelor's degree	111 (33.6%)	201 (56.1%)	< 0.01 ^{a*}
Bachelor's degree or higher	219 (66.4%)	157 (43.9%)	
Occupation of primary caregivers			
Non-medical staff	302 (91.5%)	335 (93.6%)	0.31 ^a
Medical staff	28 (8.5%)	23 (6.4%)	
Primary caregivers			
Non-parents	28 (8.5%)	29 (8.1%)	0.89 ^a
Parents	302 (91.5%)	329 (91.9%)	
Comorbidities			< 0.01 ^{a*}
No	325 (98.5%)	337 (94.1%)	
Yes	5 (1.5%)	21 (5.9%)	
Families being virally infected			
No	320 (97.0%)	349 (97.5%)	0.82

Abbreviations: IQR, interquartile range.

^a Baseline results based on the full sample.

^b Baseline results based on the full sample.

* Baseline results based on the full sample.

Factor	Children (<i>n</i> = 330)	Adolescents (<i>n</i> = 358)	<i>p</i> value
Yes	10 (3.0%)	9 (2.5%)	
Self being virally Infected			
No	328 (99.4%)	354 (98.9%)	0.69
Yes	2 (0.6%)	4 (1.1%)	
Needing psychological counselling			
No	283 (85.8%)	304 (84.9%)	0.83 ^a
Yes	47 (14.2%)	54 (15.1%)	
Post-traumatic stress disorder self-rating scale			
Non-post-traumatic stress symptoms (total score < 50)	314 (95.2%)	331 (92.5%)	0.16 ^a
Post-traumatic stress symptoms (total score > 49)	16 (4.8%)	27 (7.5%)	
Zung self-rated anxiety scale			
Non-anxiety (total score < 50)	317 (96.1%)	331 (92.5%)	0.05 ^a
Anxiety (total score > 49)	13 (3.9%)	27 (7.5%)	
Patient health questionnaire (PHQ-9)			
Non-depression (total score < 10)	177 (53.6%)	175 (48.9%)	0.22 ^a
Depression (total score > 9)	153 (46.4%)	183 (51.1%)	
Self-rating scale of sleep (SRSS)			
Severity of sleep disturbance, median (IQR)	14.0 (12.0, 17.0)	16.0 (13.0, 19.0)	< 0.01 b*
Abbreviations: IQR, interquartile range.			
^a Baseline results based on the full sample.			
^b Baseline results based on the full sample.			
* Baseline results based on the full sample.			

Table 3
Differences in SRSS Scores Between Children and Adolescents

Age group	<i>n</i>	Mean (SD)	Adjusted difference		<i>Effect size (SMD)</i>
			Mean (95%CI)	p-value	
Children	330	15.45 (4.47)	1.26 (0.55,1.98)	< 0.001	0.02 (0.00,0.04)
Adolescents	358	16.83 (4.82)			

Abbreviations: SD, standard deviation; CI, confidence interval; SMD, standardized mean difference.

Additionally, we conducted bivariate logistic regression analyses to determine how certain variables may act as factors to influence psychological outcomes as measured in the total scores. Variables with significant variances ($p < 0.05$) (See Table S1-S2) were enrolled in regression analysis models as potential factors. The results obtained are as presented in Table 4. Specifically, the variables concerning sex, residence (Wuhan city or not), and epidemic exposure (“directly” for infection with coronavirus; “indirectly” for familial infection with coronavirus, involving primary caregivers who are medical staff) had no association with the subjects’ psychological consequences (i.e., anxiety, depression and PTSS). Although all subjects experienced sleep disturbances (with adolescents being more affected), sleep disturbances was not a risk factor for the subjects’ psychological consequences in terms of anxiety [OR: 1.16, $p < 0.001$, 95%CI (1.09–1.25)], depression [OR: 1.20, $p < 0.001$, 95%CI (1.15–1.26)], and PTSS [OR: 1.08, $p = 0.024$, 95%CI (1.01–1.15)]. Subjects who experienced anxiety had a higher risk for depression [OR: 16.07, $p = 0.008$, 95%CI (2.08-123.94)] and PTSS [OR: 12.97, $p < 0.001$, 95%CI (5.41–31.11)]. Both depression [OR: 17.35, $p = 0.006$, 95%CI (2.28-131.87)] and PTSS [OR: 14.18, $p < 0.001$, 95%CI (6.00-33.47)] were the risk factors of anxiety in the children and adolescents. Interestingly, higher educational levels of primary caregivers appeared to be a risk factor of depression [OR: 1.62, $p = 0.005$, 95%CI (1.16–2.28)]. However, the same variable was found a protective factor for PTSS [OR: 0.47, $p = 0.048$, 95%CI (0.23–0.99)].

Table 4
Binary Logistic Regression Models for Risk Factor Analysis

Risk factors	Odds Ratio	Std. Error.	Z	p-value	95%CI
Risk factors for anxiety					
Depression	17.35	17.95	2.76	0.006	2.28-131.87
Sleep disturbance	1.16	0.04	4.41	0.000	1.09–1.25
PTSS	14.18	6.21	6.05	0.000	6.00-33.47
Constant	0.00	0.00	-7.20	0.00	0.00–0.00
Risk factors for depression					
PTSS	2.33	1.19	1.66	0.097	0.86–6.34
Sleep disturbance	1.20	0.03	7.73	0.000	1.15–1.26
Educational level of primary caregivers	1.62	0.28	2.81	0.005	1.16–2.28
Anxiety	16.07	16.75	2.66	0.008	2.08-123.94
Diagnosed with other conditions	2.92	1.62	1.93	0.054	0.98–8.69
Constant	0.02	0.01	-8.10	0.000	0.01–0.05
Risk factors for PTSS					
Sleep disturbance	1.08	0.04	2.26	0.024	1.01–1.15
Educational level of primary caregivers	0.47	0.18	-1.98	0.048	0.23–0.99
Depression	2.22	1.06	1.67	0.096	0.87–5.68
Diagnosed with other conditions	2.33	1.40	1.41	0.159	0.72–7.57
Anxiety	12.97	5.79	5.74	0.000	5.41–31.11
Constant	0.02	0.012	-5.09	0.000	0.00-0.09
Abbreviations: CI, confidence interval.					

Discussion

Worldwide prevalence of anxiety and depressive disorders among children according to the Diagnostic and Statistical Manual (DSM) and International Statistical Classification of Diseases and Related Health Problems (ICD) was estimated to be 6.5 and 2.6%, respectively(19). In this study, only 5.81% of the youth was found to have anxiety after school resumption, while 48.84% of them had depression. Our findings differ from those of a previous Chinese study conducted among school students one month immediately after the lockdown, which reported a higher rate of anxiety (18.9%) but a lower rate of depression (22.6%) (20). In a study on adults six weeks after lockdown in India, 52.7% of the subjects had depression and

14% of them had anxiety(21). A study on adults in Malaysia found that 21.8% had depression and 31.6% had anxiety three weeks after the lifting of lockdown measures(22). In addition, a recent systematic review identified three studies that reported prevalence rates of depression during the Coronavirus Disease among Chinese children and adolescents ranging from 22.6 to 43.7%(23). Such discrepancies might have arisen from the use of disparate assessment tools. Moreover, criteria for DSM and ICD were not used in the current study; the young participants instead reported their symptoms with an emphasis on their perspectives about how they felt before outbreaks of the coronavirus epidemic.

All subjects reported some degree of sleep disturbances. In this aspect, adolescents were more severely affected than younger children. Locally, social media and instant messages have become popular tools for social support. Adolescents may be keen on online interactions for virtual support from peers while under isolation during the epidemic. In comparison, children may have less access to such tools and rely more on direct contact with families for social support. Recent evidence has suggested a consistent association between sedentary screen time and poor sleep(24).

Prevalence of PTSS in children and adolescents was 6.25%, which was much lower than that of PTSD (12.8%) one month after Covid-19 outbreaks in China(25), and lower than that of PTSD (41%) reported by Covid-19 disease patients three months after discharge(26). Prevalence of PTSD in the sampled youth population was 14.4% two weeks after Covid-19 outbreaks surged in China in 2020(27). Anxiety was found to be a high-risk factor for PTSS [OR: 12.97, $p < 0.001$, 95%CI (5.41–31.11)]. From a theoretical perspective of anxiety sensitivity, a child can avoid anxiety-related cues from expected catastrophic consequences(28). Empirical evidence has shown that anxiety sensitivity is linked to PTSD symptoms in youth(29).

Previous studies on the effects of SARS-related quarantine suggest that isolated adults experienced a high level of psychological distress such as depression, irritability, and post-traumatic stress symptoms associated with lockdowns,(30, 31) with long-lasting psycho-behavioural implications for life in years after(32). Quite surprisingly, the present study found that neither children nor adolescents experienced any marked changes in their self-reported PTSS and anxiety three months after school resumption (i.e., lifting of home isolation). During the peak coronavirus disease epidemic periods in China, 2020, the youth's overarching concerns were disruption to their social interactions and schooling activities, whereas concerns for contracting coronavirus infection or getting ill from it were very low(33). Unlike conventional home-schooling styles applied in other countries, where parents, relatives, or other knowledgeable persons act as instructors for conducting primary education at home(34), the Chinese home-schooling style remained primarily organized by school teachers and combined the use of live/recorded broadcasts, WeChat/DingTalk (social network application) based group communication, and software-based homework submission and assessment. All school subjects were taught online, including the major subjects of Chinese language, sciences and mathematics, and the minor subjects of morality, music, art and gymnastics(35). The daily practice of learning routines was altered for most children and adolescents, as their socialisation with peers transitioned to electronics-based platforms(36). Although children and adolescents experienced a drastic routine disruption due to lockdowns, they may not be

completely isolated within a household or in an internet-accessible virtual community. Furthermore, an apparent reduction in academic pressure and increased time spent with family may help dissipate overall stress(37).

In this study, youth response to the coronavirus epidemic appeared qualitatively different from that of the adults. During prolonged periods of urban lockdowns, the impact of negative information in multimedia, excessive fears of being infected, and even the shame or guilt for coronavirus infection converged to shape the psychological well-being of many individuals across China. In particular, residents at the putative epicentre of initial epidemic in Wuhan city, China, subjective experiences of fear, loneliness, panic, anxiety and depression were widely reported amid the coronavirus outbreaks in early 2020(1, 38). However, this work shows that about three months after the recovery of social function in the local populace in central China, the youth in Wuhan city had similar psychological reactions with those in non-Wuhan areas. Prevalence of anxiety and PTSS in children and adolescents was also lower than expected. It is important to note that factors influencing PTSS outcomes are complex, often involving interaction with socioeconomic determinants. For example, primary caregivers in our samples were fairly well educated, with 54.65% of them having a bachelor's or higher degree. The majority of them were employed. As socioeconomic details such as household income levels and number of rooms in the house were not collected, our analysis could not be extended to include potential intervening factors. More a comprehensive design covering such socioeconomic details may be helpful in future investigation.

Overall, we did not find any significant differences in psychological health status between children and adolescents. Periods of lockdown generally serve as a serendipitous occasion for parents to mingle with their children in physical proximity. According to previous findings, traditional Chinese parents, as compared with American parents, tend to use supportive behaviours rather than verbal expressions to deliver care and love to their children(39). It is possible that home isolation measures during lockdowns ironically incentivized parents to discuss life events more frequently with children and adolescents, which represents a good opportunity of solidifying or improving parent-child interactions, through mutual engagement in family activities conducive to building children's self-esteem and confidence. For the youth, the process of staying closely with their families suffering and struggling together to recover from traumatic experiences can remarkably afford transformative and positive effects on growth(40). In this case, the youth may not necessarily experience an overt feeling of loneliness(41). They might even perceive lockdowns as some positive, rather than negative, challenges, which helped yield less psychological distress.

Limitations

Some limitations of this study should be recognised. We collected data by distributing online questionnaires to children and adolescents. The results and conclusions thus drawn may be influenced by the respondents' degree of verbal understanding and compliance, especially in the case of younger children who needed help from their guardians. We assessed the general psychopathology based on responses to stylised answer forms of the questionnaires, which are convenient for statistical analysis,

but this same approach tends to restrict and depth and scope of the subject responses, and fail to qualify subjective experiences beyond pre-specified inventory items.

Our current evaluation was conducted in the three months when local coronavirus epidemics had subsided, which allowed lockdowns to be lifted for recovery of social functions. Unfortunately, the baseline data (prior to the initial outbreaks) were unavailable, which can be crucial to interpretations of the analyses as we cannot be certain if the perceived symptomatology had arisen during the lockdowns and was not present before. Thus, this cohort study covering a post-epidemic period may be able to reflect full impact of isolation imposed by lockdown measures. In addition, we were not able to determine how many people refused to participate, as recruitment to the study was advertised on different channels and only those parents and young individuals willing to join contacted us.

Therefore, for prospective studies, we plan to employ face-to-face surveys, qualitative interviews, structured/semi-structured follow-up reports, and comprehensive surveys on information from primary guardians to further improve design and rigor of the study. It would be interesting to continue to follow up on the affected individuals so as to gain a better understanding on how isolation-related psychological consequences evolve and influence later life.

Conclusion

Despite perceived detriments from home isolation under lockdown measures during epidemic periods in early 2020, school-aged children and adolescents in Wuhan city and the nearby areas in Hubei province, central China, did not report an alarming surge in mental health problems three months after lifting of home isolation. Ready access to internet-based home schooling and social network activities, along with increased opportunities of solidifying social bonding with parents and family members, seemed to partially ease the psychological distress of living under home isolation. The home-schooling style adopted during lockdowns was literally invented *ad hoc*, for which no previous experience can be referenced. As the global crisis of coronavirus disease continue to evolve, the future of our world rests on how strong and resilient we raise our next generations to be. Lockdown-related isolation is likely to impact the life quality and experiences of children and adolescents who had difficulty in stress coping. Successful resolution of psychological distress is contingent on many factors including individual resilience/vulnerability, local epidemic situations, availability of support resources, prevention policies and media orientation. Our present study examined the long-term effects of home isolation on children's and adolescents' self-perceived mental health status, in the contexts of increased intra-familial interactions and use of internet-based social support. These findings could inform investigators and policy decision-makers on how to create a more balanced and sustainable approach to supporting children and their families to cope with epidemic disease-related challenges.

Declarations

Ethics approval and consent to participate

The research ethics committee of the Wuhan Mental Health Centre, Tongji Medical College of Huazhong University of Science & Technology, Wuhan, China, has approved the study protocols and procedures for informed consent (KY20200108).

Consent for publication

All the young participants and their guardians were asked to give their informed consent with regard to the purpose and contents of the study.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported by a grant (82071542) from the National Natural Science Foundation of China and a grant (WX17B15) for key projects under the Wuhan Health and Family Planning Commission. The authors have declared that they have no competing or potential conflicts of interest.

Authors' contributions

Dr. X.-F. Zhang and Prof. N.-K. Wong had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Y. Li, X.-F. Zhang, N.-K. Wong.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: X.-F. Zhang, N.-K. Wong

Critical revision of the manuscript for important intellectual content: N.-K. Wong, X.-F. Zhang.

Statistical analysis: F. Chen, X.-F. Zhang

Obtained funding: Y. Li, F. Zhang

Administrative, technical, or material support: C. Zhou, W. Zhang, M.-X. Chen

Study supervision: X.-F. Zhang, N.-K. Wong

Acknowledgements

Not applicable

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