



Research Article

Effects of Isolation on Mental Health Status of Adolescents during The COVID-19 Pandemic

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Abstract

Objective: To investigate the long-term effects of COVID-19 isolation on adolescent mental health.

Methods: In this study, 12490 adolescents in Jingzhou city were investigated by general demographic survey, the 12-item general health questionnaire (GHQ-12), the 9-item of Patient health questionnaire depression module (PHQ-9), the 7-item of generalized anxiety disorder (GAD-7), and post-traumatic The posttraumatic stress disorder checklist-5(PCL-5) during the normal epidemic prevention and control period.

Results: The study found that 44.5% of adolescents in the isolated group had at least one of these mental health disorders, which is higher than that in the non-isolated group, while it is only 36.9% in the non-isolated group. The proportion of psychological damage in the isolated group was higher than that in the non-isolated group, such as 23.5% in the GHQ-12 isolated group and 18.6% in the non-isolated group ($P < 0.001$). Among the mental health effects of isolation on adolescents, concentrated isolation had significant effects on adolescent depression ($P < 0.001$). After controlling for confounding factors such as general population conditions, Isolation was found to be an independent risk factor for long-term GHQ-12 ($OR=1.255, CI=1.043-1.311$), PHQ-9 ($OR=1.218, CI=1.036-1.432$) and GAD-7 ($OR=1.350, CI=1.195-1.712$) trauma in adolescents ($P < 0.05$). **Discussion:** Studies have found that adolescents undergoing quarantine can cause long-term psychological trauma to general mental health, anxiety and depression, while adolescents without isolation have relatively little impact on their mental health. Therefore, In addition to mental health counseling and social support given to adolescents, more attention should be paid to the impact of isolation on adolescents' mental health during the pandemic.

Key words: COVID-19; Isolation; Mental Health; Teenagers; Questionnaire Survey.

In early December 2019, the COVID-19 caused by Severe acute respiratory syndrome Coronavirus 2 (SARS-Cov-2) spread globally. By July 03, 2022, more than 546 million confirmed cases and 6.3 million deaths had been reported globally(1-3). More and more studies have shown that in the early stage of the pandemic, epideia-related measures such as local lockdown, closure of schools and companies, and social isolation have seriously damaged the mental health of the general population and medical workers(4-10). However, in the middle and later stages of the pandemic, people have paid less attention to the mental health of adolescents(11, 12). Although adolescents are less likely to be infected with COVID-19 than adults(13), they may be damaged to their mental health through pressure spillovers from other family members, changes in environmental policies, and changes in daily living habits(11, 14), thus leading to potential psychological and family "scars" for adolescents. That is, long-term and interwoven personal psychological problems and family relationship problems(15). Therefore, the motivation of this study is to solve the problem of the relative lack of research on adolescent mental health after the impact of the pandemic on adolescent mental health, under the situation of regular epidemic prevention and control in local areas.

Among the numerous studies on the impact of COVID-19 on adolescent mental health, existing studies tend to collect data during the epidemic period and conduct cross-sectional studies to study the impact of COVID-19 on adolescent mental health from the aspects of isolation, social support, positive and negative emotions towards COVID-19 during the pandemic(6, 14, 16-18). There are some obvious limitations to these studies. Firstiy, due to the limited access to face-to-face contact during the pandemic, most of the existing studies are based on samples of online surveys of adolescents, which are limited in their representation of adolescents with

universal Internet access and their data. Studies have shown that adolescents who frequently use the Internet are positively correlated with poor mental health(19). Secondly, existing studies mainly focus on the mental health of adolescents during the COVID-19 pandemic, while there is a lack of tracking of adolescents' mental health after the epidemic is controlled.

Through the data collection after the epidemic control in Jingzhou City, the study is studied the impact of the epidemic on adolescent mental health in the later period and addressed the gaps mentioned above. To this end, we adopted a combination of online and offline data collection method, and published questionnaires on the platform of Wenjuanxing (<https://www.wjx.cn/>). The class teacher guides the students to fill in the blanks after training. This study focuses on the relationship between adolescents' mental health and their age, gender, family income (self-rated), parents' education, parents' occupation, the situation of the epidemic itself and the situation of their families. And the long-term effects of isolation on adolescent mental health.

1. Methods and objects

1.1 Objects

The study was approved by the Ethics Committee of the Jingzhou Mental Health Center, where written informed consent was received online before respondents took the survey and were promised absolute confidentiality of their personal information.

In this study, a cross-sectional study was conducted in May 2021 and November 2021 in Jingzhou City. The research object was junior high school students and above. 16,025 questionnaires were sent out, and 12,490 effective questionnaires were collected, with an effective rate of 77.9%. During this period, the epidemic in Jingzhou City was well controlled and entered the stage of regular prevention and control.

1.2 Methods

1.2.1 Demographic Characteristics

This study collected the grade, gender, family income (self-rated), parents' education, parents' occupation, etc.

1.2.2 Living Status Information during COVID-19

This study collected information about the respondents themselves and their family members during COVID-19 (such as confirmed COVID-19 infection, suspected COVID-19 infection, close contact with COVID-19 infected persons, Participated in epidemic-related rescue services and none of the above), whether they were quarantined during the epidemic (defined here as medical requirements and community quarantine for epidemic prevention and control), the method of quarantine, and the duration of quarantine.

1.2.3 GHQ-12

This questionnaire consisted of 12 items, with Cronbach α of 0.85. The score was divided into four levels, ranging from "able", "normal", "unable" and "not at all", 0-0-1-1. The score ranges from 0 to 12, with a higher score indicating a lower level of mental health and a cut-off value of 3. This questionnaire aims at the mental health status of the subjects in the recent 2-3 weeks(20).

1.2.4 PHQ-9

This questionnaire consisted of 9 items, with Cronbach α of 0.83-0.84, divided into 4 grades, ranging from 0 for "not at all" to 3 for "almost every day". The score ranged from 0 to 27, and the total score was ≥ 10 cut-off value, among which 0 to 4 was no depression. 5~9 May have mild depressive symptoms, 10~14 May have moderate depression, ≥ 15 score of severe depression, this questionnaire aims at the mental health status of the subjects in the recent 2 weeks. The reliability and validity of PHQ-9 in the general population and patients with mental disorders have been demonstrated, and it has been widely used to assess depressive symptoms in adolescents(21).

1.2.5 GAD-7

This questionnaire includes 7 items, with Cronbach α of 0.83 and a 4-point scale ranging from 0 for "not at all" to 3 for "almost every day". The score ranges from 0 to 21 for evaluating the severity of anxiety symptoms: Total score ≥ 10 cut-off value, 0~4 score without anxiety; 5~9 were classified as mild; 10 to 14 were classified as moderate; ≥ 15 was classified as severe. This questionnaire was aimed at the mental health status of the subjects in the recent 2 weeks. This scale has been used in many studies to assess anxiety symptoms in adolescents(22).

1.2.6 PCL-5

The questionnaire was used to measure the severity of PTSD symptoms, which consisted of 20 items, Cronbach α was 0.90, corresponding to four groups of PTSD symptoms: Items 1 to 5 are intrusion symptoms, items 6 to 7 are avoidance symptoms, items 8 to 14 are negative cognitive and emotional changes, and items 15 to 20 are arousal and translational changes on a five-point scale ranging from 0 for "not at all" to 4 for "extreme" on a scale of 0 to 80. In this study, 33 points were used as the cut-off value. If the score is greater than or equal to 33 points, it indicates obvious post-traumatic stress symptoms and may meet the clinical diagnostic criteria of PTSD(23).

1.2.7 Propensity Score Matching method (PSM)

This study used propensity score matching method to analyze the baseline data such as grade, gender, family income (self-rated), parents' education, parents' occupation, physical and family conditions during the epidemic period, and standardized mean difference (SMD) values to assess the balance between the isolated group and the unisolated group. SMD < 0.1 usually indicates good balance, and the differences between quarantined and unquarantined groups can be considered small.

1.3 Statistical Processing

All data were analyzed using SPSS. 26 version and R language 4.21 version. Confounding factors except isolation were excluded by using R language "matching" and "tableone" package, and the

balance between the two groups was measured by SMD (standardized mean difference). SPSS Chi-square test and nonparametric test were used to analyze the differences in mental health scores between the two groups and the influences of isolation time and isolation measures on the isolation group. The mental health scores with non-normal distribution were expressed by median and interquart spacing. Multivariate logistic regression was used to calculate the risk factor and 95% confidence interval for mental health problems after excluding potential factors.

2. Results

2.1 Demographic characteristics

A total of 12,490 participants completed the survey in this cross-sectional study, and 7,171 of the enrolled participants (57.4%) were female; Most of them are college students, including 4,875 junior college students (39.1%) and 2,362 undergraduate students (18.9%). 1,336 people (9.1%) experienced home or centralized isolation during the COVID-19 outbreak; 9580 (76.7%) self-identified as having an average family income, most adolescent fathers and mothers were educated (7111, 56.9% vs 7993, 64%) in junior high school or below, and 25 (0.2%) of their own and 30 (0.2%) of their family members had confirmed or suspected COVID-19 infection during the COVID-19 outbreak (Table 1).

Table 1. Demographic characteristics of adolescents.

Characteristics	Overall number(%)	Isolation situation, number/percentage (%)	
		Isolation	Non-isolation
Total number of peoples	12490(100)	1136(9.1)	11154(90.9)
Sex			
Female	7174(57.4)	808(60.5)	6366(57.1)
Male	5316(42.6)	528(39.5)	4788(2.9)
Grade			
Junior high school	2837(22.7)	181(13.5)	2656(23.8)
Senior high school	2416(19.3)	309(23.1)	2107(18.9)
Junior college	4875(39.1)	457(34.2)	4418(39.6)
Undergraduate	2362(18.9)	389(29.2)	1973(17.7)
Only child			
Yes	4738(37.9)	500(37.4)	4238(38.0)
No	7752(62.1)	863(62.8)	3916(62.0)
Homehold income(self-rated)			
Well	940(7.5)	85(6.3)	855(7.7)
General	9580(76.7)	1019(76.3)	8561(76.8)
Bad	1970(15.8)	232(17.4)	1738(15.5)
Father's education			
Junior high school and blow	7111(56.9)	795(59.5)	6316(56.6)
High or technical school	3059(24.5)	323(24.2)	2736(24.6)
College degree or above	2320(18.6)	218(16.3)	2102(18.8)
Mather's education			
Junior high school and blow	7993(64)	873(65.3)	7120(63.8)
High or technical school	2621(21)	283(21.2)	2338(21)
College degree or above	1876(15)	180(13.5)	1696(15.2)
Father'occupation			

Grassroots employees	7631(61.1)	805(60.3)	6826(61.2)
Civil servant	1905(15.3)	193(14.4)	1712(15.3)
Enterprise managers	2954(23.6)	338(25.3)	2616(23.5)
Mather'occupation			
Grassroots employees	7404(59.3)	766(57.3)	6638(59.5)
Civil servant	2757(22.1)	267(20)	2490(22.3)
Enterprise managers	2329(18.6)	303(22.7)	2026(18.2)
Oneself status of COVID-19			
Confirmed with COVID-19	25(0.2)	4(0.3)	21(0.2)
COVID-19 close connectors	20(0.2)	6(0.4)	14(0.1)
Participate in rescue worker	530(4.2)	80(6)	450(4)
None of the above	11915(95.4)	1246(93.3)	10669(95.7)
Family status of COVID-19			
Confirmed with COVID-19	30(0.2)	6(0.4)	24(0.2)
COVID-19 close connectors	16(0.1)	2(0.1)	14(0.1)
Participate in rescue worker	1284(10.3)	164(12.4)	1120(10.1)
None of the above	11160(89.4)	1164(87.1)	9996(89.6)

Table 2. Distribution of psychological status in isolated and unisolated groups.

Characteristics	Isolation situation, number/percentage (%)			χ^2	P
	Overall(%)	Isolation	Non-isolation		
GHQ-12					
NO	10098(80.8)	1022(76.5)	9076(81.4)	18.2	<0.001
Yes	2392(19.2)	314(23.5)	2078(18.6)		
PHQ-9					
No	8812(70.6)	865(64.7)	7947(71.2)	25.9	<0.001
Mild	2423(19.4)	300(22.5)	2123(19)		
Moderate	756(6.1)	100(7.5)	656(5.9)		
Severe	499(4)	71(5.3)	428(3.9)		
GAD-7					
No	9412(75.4)	924(69.2)	8488(76.0)	32.9	<0.001
Mild	2227(17.8)	288(21.6)	1939(17.4)		
Moderate	623(5)	93(7)	530(4.8)		
Severe	228(1.8)	31(2.2)	197(1.8)		
PCL-5					
No	11460(91.8)	1216(91)	10244(91.8)	12.3	<0.001
Yes	1030(8.2)	120(9)	910(8.2)		

2.2 Influence of quarantine on adolescents' mental health

According to the statistics and analysis, during the normal epidemic prevention and control period, the people who were quarantined during the outbreak were more likely to be isolated than those

who were not. The positive rate of psychological abnormality was higher, among which, GHQ-12 (314[23.5%]vs2078[18.6%], $P < 0.001$), the PHQ - 9 moderately severe (175 [12.8%] vs1084 [9.7%], $P < 0.001$), GAD - 7 moderately severe (124 [9.5%] vs727 [6.6%], $P < 0.001$), PCL-5 (120 [9%] vs910

[8.2%], $P < 0.001$) Regarding general mental health status (593[44.5%]vs4112[36.9%], $P < 0.001$) (Table 2)

2.3 The median and interquartile range of GHQ-12, PHQ-9, GAD-7 and PCL-5

Median scores and interquartile range of GHQ-12, PHQ-9, GAD-7 and PCL-5 of all participants were 1.0(0.0-2.0), 1.0(0.0-6.0), 0.0(0.0-4.0) and 2.0 (0.0-11.0), respectively. During the normal epidemic prevention and control period,

the median and interquartile range psychological symptoms of those who were quarantined during the outbreak were higher than those who were not quarantined. Among them, the IQR of GHQ-12 was 1.0 (0.0-3.0) vs. 1.0 (0.0-2.0), and the IQR of PHQ-9 was: 2.0 (0.0 7.0) vs 1.0 (0.0 5.0), GAD IQR are much less - 7:1.0 (0.0 6.0) vs 0.0 (0.0 4.0), the IQR are much less PCL-5:4.0 (0.0 15.0) vs 1.0 (0.0 10.0) (table 3).

Table 3 Median and quartile of psychological scores in isolated and unisolated groups

Psychological symptoms	Median/quartile	Isolation situation/Median/quartile		P
		Isolation	Non-isolation	
GHQ-12	1.0(0.0-2.0)	1.0 (0.0-3.0)	1.0(0.0-2.0)	<0.01
PHQ-9	1.0 (0.0-6.0)	2.0 (0.0-7.0)	1.0(0.0-5.0)	<0.01
GAD-7	0.0(0.0-4.0)	1.0(0.0-6.0)	1.0(0.0-4.0)	<0.01
PCL-5	2.0(0.0-11.0)	4.0(0.0-15.0)	1.0(0.0-10.0)	<0.01

2.4 The effect of isolation duration and mode on mental health

In terms of isolation time, 224 participants (13.8%) spent less than 14 days in isolation, 1112 participants (83.2%) spent more than 14 days in isolation, 1196 participants (89.5%) spent at home, 140 (10.55%) spent in centralized isolation, and the

isolation time had no effect on psychological symptoms ($P < 0.05$). Centralized isolation was associated with more depressive symptoms than home isolation ($P = 0.013$) (Table 4).

Table 4 Effects of isolation time and isolation mode on mental health

Quarantine measures	Total Number of People/Percent Age (%)	Mental Health Disparities (P)			
		GHQ-12	PHQ-9	GAD-7	PCL-5
Quarantine time					
Less than 14 days	224 (16.8)	0.825	0.718	0.708	0.772
More than 14 days	1112 (83.2)				
Quarantine method					
Isolation at home	1196 (89.5)	0.23	0.013	0.178	0.401
Centralized isolation	140 (10.5)				

2.5 The impact of isolation on mental health

Before the matching of propensity score, the SMD of grade, mother's occupation and the situation of epidemic itself between the two groups was greater than 0.1, showing poor balance; after the matching of propensity score, the SMD of all

characteristics between the two groups was less than 0.1, showing good balance between the two groups (see supplementary material). After adjusting for potential confounding factors, there was a relative increase in overall psychological risk in the isolated population compared with the

non-isolated population. Among them, suffering from The risk rate (OR) for general mental health symptoms was 1.255, confidence interval (CI) was 1.043-1.311 ($P=0.016$), The OR with depressive symptoms was 1.218, with a confidence interval of 1.036-1.432 ($P=0.017$), and the OR with anxiety

symptoms was 1.350, with a confidence interval of 1.195-1.712 ($P=0.001$), which showed significant differences. The OR with traumatic stress disorder symptoms was 1.255. The confidence interval was 0.918-1.715 ($P=0.154$), with no statistical difference (Table 5).

Table 5 Impact of isolation on mental health

Psychological symptoms	Isolation,OR(95%CI) ^a	P
GHQ-12		
unadjusted	1.342(1.72-1.536)	<0.001
adjusted	1.255(1.043-1.511)	0.016
PHQ-9		
unadjusted	1.349(1.197-1.421)	<0.001
adjusted	1.218(1.036-1.432)	0.017
GAD-7		
unadjusted	1.420(1.254-1.607)	<0.001
adjusted	1.350(1.118-1.600)	0.001
PCL-5		
unadjusted	1.499(1.195-1.881)	<0.001
adjusted	1.255(0.918-1.715)	0.154

^aThe adjustment factors are general demographic data such as gender, grade, whether he is an only child, family economic income (self-assessment), father's education and occupation, mother's education and occupation, and self and family situation during the epidemic.

Discussion

This study investigated the potential impact of COVID-19 isolation on the mental health of adolescents in Jingzhou City. During the period of normal epidemic prevention and control, data related to COVID-19 isolation, demographic characteristics and mental health symptoms were collected among adolescents. It has found that 44.5% of the participants who undergoing COVID-19 isolation suffered from at least one mental health symptom during the period of normal epidemic prevention and control. Among them, general mental health abnormalities, depression, anxiety and traumatic stress disorder are higher than those who are not isolated (36.9%). Meanwhile, analysis on the difference of mental health between the isolated and the unisolated groups have showed that the isolated group are more likely to suffer from

psychological symptoms than the unisolated group. These suggest that the coronavirus quarantine has a long-term impact on adolescent mental health damage, and that centralized isolation is associated with isolation at home is more likely to cause depressive symptoms in adolescents. Through the propensity score matching method, disturbing factors such as grade, gender, family income (self-assessment), parents' educational background, parents' occupation, and the situation of their families during the epidemic were excluded, and isolation was related to the risk of mental health abnormalities. Therefore, the relevant medical staff, teachers and parents should pay attention to the long-term damage of the new crown isolation to the mental health of adolescents, and while providing sufficient and transparent information on the epidemic situation, they should strengthen psychological counseling for adolescents and enhance mental health education.

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To the best of my knowledge, this study is the first to systematically examine the long-term impact of COVID-19 isolation on adolescent mental health during the period of routine epidemic control. In terms of studying the long-term psychological impact of the epidemic on people, more studies mainly focus on patients recovering from acute infection suffering from persistent long-term mental illness(24), and few studies focus on the long-term impact of epidemic prevention and control isolation on the formation of psychological trauma in adolescents. It is estimated that one in seven (14%) people aged 10-19 globally suffer from a mental disorder [20]. Adolescent development is a sensitive period for the onset of several specific forms of mental disorders, characterized by increased emotional and social sensitivity(25), and adolescents are more likely to suffer from psychological trauma and form long-term psychological effects during the epidemic. Many previous studies have shown that isolation is associated with the risk of negative psychology(26, 27). Meanwhile, an editorial based on the three mechanisms of brain plasticity, developmental response, social status and economic factors in neuroscience has shown that epidemic isolation may affect the long-term psychological trauma of young people(28). Therefore, as a vulnerable group in society, adolescents are also in a critical period of physical and psychological growth, and their mental health during isolation and later psychological trauma are equally worthy of attention(29). During the epidemic prevention and control phase, in addition to the psychological trauma caused by the outbreak isolation, closed school management also affects the mental health problems of adolescents(30).

To sum up, the epidemic isolation has a long-term impact on adolescents' mental health, which is a further supplement to previous studies. Meanwhile, the grade, family income, gender, parents' education and occupation, as well as the situation between the epidemic may affect the rehabilitation of adolescents' psychological trauma.

Psychological rehabilitation is a long-term process. Medical staff may want to give more lectures on mental health knowledge, improve the popularization of psychological knowledge, schoolteachers also need to conduct regular psychological evaluation of students, students with poor psychological talk, parents need to care about and love their children, reduce the pressure brought by the epidemic to children. At the same time, the mental toughness of teenagers also needs to be improved.

This study comprehensively demonstrates the relationship between isolation and long-term effects on adolescent mental health, but there are also some shortcomings. First, it is mainly conducted online, and offline, and psychological abnormalities are defined according to the symptom scale, instead of clinical diagnosis. Second, the psychological evaluation is conducted collectively, and there may be interference factors in the measurement process.

Declarations

1) Consent to publication

We declare that all authors agreed to publish the manuscript at this journal based on the signed Copyright Transfer Agreement and followed publication ethics.

2) Ethical approval and consent to participants

This case has ethical approval and patient consent.

3) Disclosure of conflict of interests

We declare that no conflict of interest exists.

4) Funding

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5) Availability of data and material

We declare that the data supporting the results reports in the article are available in the published article.

6) Acknowledgement

None.

7) Authors 'contribution

Authors contributed to this paper with the case management (BL, SCN, ZYT), writing (ZYT),

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revision (BL and SCN), editing (BL and SCN) and final approval (BL).

8) Authors' biography

None

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