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Retrospective Cohort Study

COVID-19 impact on high school student's education and mental health: A cohort survey in China

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Abstract**BACKGROUND**

The ongoing coronavirus disease 2019 (COVID-19) pandemic and the universal implementation of control measures are fundamentally affecting every aspect of our society and daily lives.

AIM

To evaluate the prevalence of post-traumatic stress disorder symptoms and their associated factors as well as the effects and attitudes towards online education in Chinese high school students.

METHODS

A total of 883 students were included. The first, second and third-year students of a high school in Lanzhou, Gansu province of China were invited to participate in this study. They were requested to involve their parents to complete the survey together. A detailed questionnaire of 65 questions was designed and divided into five sections. The survey was anonymously conducted *via* WeChat, a Chinese multipurpose messaging, social media and mobile payment app.

RESULTS

Overall, 32.94% of students experienced post-traumatic stress disorder due to the COVID-19 epidemic. The majority of students (60.82%) felt that online education was not (10.76%) or less effective (50.06%) in terms of gaining knowledge and improving practical and communications skills. Correlation analysis revealed that the class level, residential background and whether living with parents were

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significantly linked with the effectiveness and satisfaction of the online education system. Of the final year students, 74.2% said that the COVID-19 outbreak has negatively affected their preparation for the college entrance exam, and 68% of students felt that this outbreak increased psychological pressure for their college entrance examination preparation. In case of having COVID-19 symptoms during the exam, 50.7%, 13.3%, and 10.2% would notify the proctor, teacher and parents, respectively.

CONCLUSION

We found a high prevalence rate of post-traumatic stress disorder symptoms in high school students. Thus, our results call for urgent attention from both government and schools to implement effective interventions to cope with the psychological effects and the disturbance of education by COVID-19 on children.

Key Words: COVID-19; Post-traumatic stress disorder; Students; College entrance examination; China; Education

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Core Tip: This study evaluated the prevalence of post-traumatic stress disorder (PTSD) symptoms and their associated factors as well as the effects and attitudes towards online education in Chinese high school students. We found a high prevalence rate of post-traumatic stress disorder symptoms in high school students. Thus, our results call for urgent attention from both government and schools to implement effective interventions to cope with the psychological effects and the disturbance of education by coronavirus disease 2019 on children.

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INTRODUCTION

The ongoing coronavirus disease 2019 (COVID-19) pandemic and the universal implementation of control measures are fundamentally affecting every aspect of our society and daily lives. School closure is one of the most important measures widely implemented worldwide. According to UNESCO's estimates, more than 190 countries have adopted nationwide school closures, resulting in roughly 90% of the global student population out of school and confined at home[1]. The classroom syllabus has been swiftly changed into an online education system. However, the education sector was not well-prepared to launch such large-scale online education programs. Thus, the effectiveness of this new education format and the effects on students remain largely uncertain.

According to epidemiological research after a traumatic event, about 5%-12% of individuals may develop post-traumatic stress disorder (PTSD) [2]. School closure, living in confinement and risk of the infection are creating anxiety and are affecting education, psychological health and well-being of students [1]. According to Chinese government estimates approximately 220 million teenagers were not allowed to go out during the COVID-19 epidemic in China. However, the consequences and the degrees of impact could vary among different levels of students.

In China, the schooling system includes primary school (6 years), junior middle school/secondary school (3 years) and senior middle school/ high school (3 years). Afterwards, students have the opportunity to continue to higher education by passing the college entrance examination, a nine-hour national higher education entrance exam. It is offered once a year and taken by around 10 million students annually. It is the sole determinant for admission to virtually all Chinese colleges and universities. Because of a limited amount of university spots available, it is an ultra-competitive

exam and imposes tremendous pressure on the third-year high school students.

The COVID-19 epidemic was first reported in China. The teenagers were restricted at home for a long time and were the first to switch to online education. Although the rises of psychosomatic issues caused by COVID-19, especially in teenagers, have been widely reported [3-5], innovative investigation into this issue remains scarce. In this study, we conducted a large cohort survey in a high school at the end of the COVID-19 epidemic in China. We evaluated the prevalence of PTSD symptoms and their associated factors as well as the effects and attitudes towards online education. We further investigated the impact on the final year high school students relating to the college entrance examination.

MATERIALS AND METHODS

Study population

The first, second and third-year students of a high school in Lanzhou, Gansu province of China were invited to participate in this study. They were requested to complete the survey with their parents. The study was conducted from April 20 to April 30, 2020.

Survey instrument

A detailed questionnaire comprising of 65 questions was designed and divided into five sections. The first four sections were designed for all the students, comprising of 11 demographic, 11 COVID-19, 9 online educations and 22 PTSD related questions. The final section consisted of 11 college entrance examination related questions specific for the final year students. The survey was anonymously conducted *via* WeChat, a Chinese multipurpose messaging, social media and mobile payment app.

The 9 online education related questions were designed to assess effectiveness (3 questions), efficiency (3 questions) and satisfaction (3 questions). Each question was comprised of five options including no, low, average, good and excellent.

In this study, we used Impact of Events Scale-Revised (IES-R) self-questioner to examine the psychological impact[6,7]. Further detail has been documented previously [5]. IES-R questioner was translated into Chinese language. IES-R questioner validity and reliability has been extensively reported[8-10].

Statistical analysis

Descriptive statistical analysis was done to demonstrate the demographic characteristics of the participants. First, a univariate analysis was done to screen statistically significant variables, which were subsequently subjected to multivariate logistic regression analyses. The estimations of the strengths of associations were revealed by the odds ratio with a 95% confidence interval. Descriptive and inferential statistics were calculated using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, United States). All statistical tests were two-sided, and a *P* value < 0.05 was considered statistically significant.

RESULTS

In total, 893 students participated in the survey. Ten students declined to continue. Therefore, 883 students were included. Participant demographic characteristics were given in Table 1. There were 33.4% first-year, 23.6% second-year and 43.0% final year students. Most students were from the Han ethnic background (98.1%), and 53.2% were girls and 46.8% were boys. The majority of the students were living with parents (96.3%) in urban areas (85.4%) (Table 1).

The majority of students (683 of 866) reported that their families are fully aware of COVID-19. Overall, students reported that they were affected economically (41.6%), psychologically (22.1%), emotionally (6.8%), socially (6.8%) and physically (6.8%) by the COVID-19 epidemic. In contrast, 14.9% of students reported that they were unaffected. A large percentage (93.0%) reported that they have gone back to their normal routine (Table 2). The outbreak negatively affected 68.3% of student's studies. Although 96.5% of the respondents were willing to returning back to schools, 63.0% of students have concerns regarding the risk of getting COVID-19 once back to school. Knowledge about the signs and symptoms of COVID-19 such as fever, difficulty/shortness of breath, cough, flu-like symptoms, diarrhea, fatigue, sore throat and chills were found to be known by 65.2%, 12.9%, 7.6%, 4.4%, 1.6%, 1.0%, 0.9% and

Table 1 Demographic characteristics

Characteristic	Total	%
Sex		
Male	413	46.8
Female	470	53.2
Class		
Class 1	295	33.4
Class 2	208	23.6
Class 3	380	43.0
Ethnic		
Han	866	98.1
Others	17	1.9
Residence		
Urban	754	85.4
Rural	129	14.6
Children		
Single	441	49.9
Double	388	43.9
Multiple	54	6.1
Father education		
Primary or less	82	9.3
Middle	331	37.5
College	299	33.9
University	157	17.8
Not filled	14	1.6
Mother education		
Primary or less	69	7.8
Middle	310	35.1
College	294	33.3
University	191	21.6
Not filled	19	2.2
Father profession		
Farmer	118	13.4
Teacher, doctor and civil	60	6.8
Private company employees	137	15.5
Self-business	47	5.3
Others	506	57.3
Not filled	15	1.7
Mother profession		
Farmer	108	12.2
Teacher, doctor and civil	69	7.8
Private company employees	149	16.9
Self-business	79	8.9

Others	457	51.8
Not filled	21	2.4
Monthly income in RMB		
< 3000	196	22.2
3001-5000	388	43.9
5001-10000	242	27.4
10000	57	6.5
Live with who		
Parents	850	96.3
Grand parents	23	2.6
Caregivers	10	1.1

0.1% of participants, respectively. When students suspect infection, 51.0% of the participants prefer to inform their teachers, whereas 29.7% would go into self-isolation (Table 2).

In this study, a total of 33.0% students had an IES-R score above 20 (Table 3). PTSD symptoms were significantly higher in rural ($P = 0.001$) compared to urban students. PTSD symptoms were also significantly more prevalent in students whose parents have lower education and profession levels (Table 3).

Students felt that online education was not (10.8%) or less effective (50.1%) for acquisition of knowledge, enlightening practical as well as communication skills. Students reported that it was not (17.9%) or less (43.9%) effective that students were not able to complete their homework, communicate with teachers and take advantages of the multimedia setup. Over half (64.8%) of the students reported that they were not or less satisfied and had difficulties adapting to the online education system (Supplementary Table 1). Correlation analysis revealed that the class level, residential background and whether they lived with parents were significantly associated with satisfaction and effectiveness of the virtual tutoring system (Supplementary Table 2).

This study showed that IES-R scores were substantially associated with residential background, the education level and profession of parents and family monthly income (Supplementary Table 2). According to univariate analysis, residential background, family monthly income and the professions of mother and father were significantly linked with PTSD symptoms. For multiple logistic regression analysis, only residential background remained as a significant factor relating to PTSD symptoms in children (Supplementary Table 3).

In this study, 380 participants were final year students and thus were eligible to fill in the college entrance examination section of the questionnaire. Twenty-seven participants did not complete all questions and were excluded, resulting in 353 students for final analysis. Among them, 74.2% said that the COVID-19 outbreak negatively affected their preparation for the college entrance exam. The outbreak increased psychological pressure for the college entrance examination preparation in 68.0% of students. Although 54.7% students regarded the online learning system as helpful to their preparation, 97.7% said that school opening would be beneficial for preparing for the college entrance examination. The postponement of the college entrance examination was favored by 90.4% of students. There were concerns regarding the risk of getting COVID-19 during the exam from 61.8% of students. To minimize the risk, 41.6% participants said that they would follow strict personal hygiene during the college entrance examination. A face mask would be worn during the exam by 19.5%, and 17.8% would use the mask on the way to the exam and to home. If a student had COVID-19 symptoms during the exam, then 50.7%, 13.3% and 10.2% would notify the proctor, teacher and parents, respectively (Supplementary Table 4).

DISCUSSION

To minimize the spread of COVID-19, China has implemented strict quarantine measures including school closures, travel bans, lockdowns and within-population quarantine. These measures have majorly impacted the mental health of young

Table 2 Prevalence of post-traumatic stress disorder symptoms among high school students

Features	Total	Positive	%	P value
Prevalence	883	291	33.0	
Class				0.61
Class 1	295	98	33.2	
Class 2	208	63	30.3	
Class 3	380	130	34.2	
Residence				0.001
Urban	754	230	30.5	
Rural	129	61	47.3	
Father education				0.05
Primary or less	82	26	31.7	
Middle	331	129	39.0	
College	299	85	28.4	
University	157	48	30.6	
Not filled	14	3	21.4	
Mother education				0.024
Primary or less	69	35	50.7	
Middle	310	103	33.2	
College	294	89	30.3	
University	191	57	29.8	
Not filled	19	7	36.8	
Father profession				0.009
Farmer	118	55	46.6	
Teach, doctor and civil servant	60	17	28.3	
Private company employees	137	46	33.6	
Self-business	47	18	38.3	
Others	506	153	30.2	
Not filled	15	2	13.3	
Mother profession				0.019
Farmer	108	51	47.2	
Teach, doctor and civil servant	69	18	26.1	
Private company employees	149	53	35.6	
Self-business	79	26	32.9	
Others	457	137	30.0	
Not filled	21	6	28.6	

children and adolescents[3,4]. Here, we first measured the COVID-19 epidemic effects on the mental health of high school students. Further, we identified the potential risk factors linked with PTSD symptom development in this youth cohort. Our results showed that 33.0% of students experienced PTSD signs and symptoms due to the COVID-19 epidemic. The high PTSD symptom incidence rate is likely attributed to several factors, including confinement at home, worrying about their academic progress and future plans as well as fearing the risk of infection [3,4,11-15]. We found that PTSD symptoms were significantly higher in rural students and students whose parents have lower levels of education and professions. This is in line with the fact that COVID-19 has had a substantial effect on the global economy, including an increase in

Table 3 Response related to the effects, knowledge and preparedness for coronavirus disease 2019

Inquiry item	n	%
Do you and your family understand the COVID-19 outbreak?	866	98.1
COVID-19 affected you physically	60	6.8
COVID-19 affected you economically	367	41.6
COVID-19 affected you psychologically	195	22.1
COVID-19 affected you emotionally	69	7.8
COVID-19 affected you socially	60	6.8
COVID-19 did not affect you	132	14.9
Did you back to your normal routine after COVID-19 epidemic under control in China?	821	93.0
The COVID-19 outbreak has negatively affected your study?	603	68.3
Do you think the COVID-19 outbreak will have a long-term negative impact on your future studies?	221	25.0
Do you think students should gradually return to school?	848	96.0
Are you fully prepared for returning to school?	852	96.5
Do you think there is a risk of getting COVID-19 back to school?	556	63.0
How will you reduce the risk of getting COVID-19 after school opening?		
Strict personal hygiene	294	33.3
Wear a mask on the way to school and home	129	14.6
Wear a mask at school	268	30.4
Avoid eating in the cafeteria	9	1.0
Reduce exchanges and activities between classmates	47	5.3
Avoid or reduce the use of public transportation	38	4.3
Avoid or reduce access to public places	92	10.4
Do not know	5	0.6
No action required	1	0.1
Symptoms of new corona virus infections?		
Fever	576	65.2
Cough	67	7.6
Chills	1	0.1
Difficulty breathing/shortness of breath	114	12.9
Flu-like symptoms	39	4.4
Diarrhea	14	1.6
Fatigue	9	1.0
Sore throat	8	0.9
None of the above	48	5.4
Do not know	7	0.8
What do you do if you feel the symptoms of COVID-19 at school?		
Confidential	2	0.2
Continue school normally	2	0.2
Self-isolation	262	29.7
Take medicine by self-	1	0.1
Visit doctor by self	71	8.0
Notify the teacher	450	51.0

Notify parents	86	9.7
Tell class fellow	1	0.1
Do not know	1	0.1
Others	7	0.8

COVID-19: Coronavirus disease 2019.

the unemployment rate[16]. Families with low social economic status having such economic loss will likely experience immediate effects on their daily livelihood. This will subsequently increase psychological and economic pressure on their children[17].

To minimize education losses, the authorities have swiftly launched online portals and web-based applications and switched the education system to a virtual education system. However, virtual education systems need an efficient and well-organized learning environment and implementation. However, the sudden outbreak of COVID-19 in China caused a substantial variance in virtual systems among schools of different provinces. In this study, the majority of students were not satisfied with online education. The class level of the students, residential background and living with parents were significantly linked with the online education system effectiveness. There are two possible reasons. First, students from higher classes are skilled enough to adapt the virtual education system. Provinces or families with an advanced socioeconomic background are more equipped with the latest technologies. Second, the majority of the participants were not happy with the virtual teaching system. The education department officials should take this issue seriously to improve the virtual education system effectiveness and ensure all students have access to the digital devices and its use.

The final year high school students are facing with mounting pressure of the national college entrance exam. The results of this exam often have a lifelong effect on most Chinese citizens[18]. The college entrance examination usually takes place from June 7 to June 8 every year. The Chinese Ministry of Education postponed the exam by 1 mo due to the COVID-19 epidemic. In our survey, over half of the final year students felt that the COVID-19 outbreak negatively affected their preparation for the exam and increased their psychological pressure. Although half of the students thought the online learning system helped their preparation, almost all the students preferred school opening for better preparation of the college entrance examination. Over 90.0% of students favored the postponement of the college entrance examination. Over half have concerns of the potential risk of getting COVID-19 during the exam, but they are prepared to take precaution measures.

A limitation in this study is that this survey was conducted in a single school in China in a region with a low number of confirmed COVID-19 cases. Therefore, the findings in this study may not represent other schools and regions in China. Finally, we did not study the content of online education in detail in our cohort as it cannot represent the format of other regions because it varies markedly among different schools and regions in China.

CONCLUSION

In this study, we found that 33.0% of high school students have experienced PTSD symptoms due to the COVID-19 epidemic. These symptoms are significantly more common in students living in rural areas and whose parents have a low education level and low grade jobs. The epidemic has affected the preparation of the national college entrance exam for the final year students, but they appreciate the postponement of the exam by 1 mo. Notably, a large proportion of respondents were not satisfied with online education. Therefore, it is suggested that the authorities optimize the online education program and ensure equal opportunities for the students to get access to the digital learning. Our results call for urgent attention from both government and schools to implement effective interventions to manage the psychological effects and the disturbance of education by COVID-19 on children.

ARTICLE HIGHLIGHTS

Research background

Coronavirus disease 2019 (COVID-19) pandemic control measures are disturbing every aspect of our daily lives. School closures have been widely implemented according to COVID-19 cases in the world. Therefore, approximately 90% of the global student population is confined at home.

Research motivation

School education was suddenly replaced with a virtual education system but the education sector was not ready to adopt it. Therefore, the effects of this new education system on student learning remain ambiguous. Additionally, the risks of infection and confinement at home are affecting student education and psychological health.

Research objectives

The current study was designed to explore the prevalence of post-traumatic stress disorder (PTSD) symptoms and their associated factors in high school students and their assessment of the online education system.

Research methods

The first, second and third-year students of a high school at Lanzhou were invited to participate *via* WeChat, a local social media app in this study. Descriptive and inferential statistics were calculated using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, United States). All statistical tests were two-sided, and a *P* value < 0.05 was considered statistically significant.

Research results

In total, 883 students were included in this study. Among them, 33.4% were first year, 23.6% were second year, and 43.0% were third year students. The majority (98.1%) of students' families were well-aware of COVID-19. Overall, 41.6% of students were affected economically, and 22.1% were affected psychologically due to the COVID-19 epidemic. Interestingly, 14.9% of students said that they were not affected by the COVID-19 epidemic. In this study, the prevalence of PTSD symptoms was 33.0%, and its prevalence was significantly higher in rural students (*P* = 0.001) than in urban students. The high prevalence of PTSD symptoms significantly correlated with the education level, residential background, parent's profession and family monthly income.

Research conclusions

In summary, our results showed that the prevalence of PTSD symptoms was 33.0% among high school students due to the COVID-19 epidemic, and a significantly high prevalence occurred in students who live in rural areas and whose parents had low-grade jobs and education level. Our results further highlighted that the COVID-19 epidemic has also affected the final year student's national college entrance exam preparation. Most notably, the majority of respondents were not pleased with the virtual education system.

Research perspectives

Education department officials should take measures to optimize the online education system and guarantee equal access to the digital learning devices. Further, we suggest that effective measures should also be implemented to minimize the risk of psychological issues caused by COVID-19 on students.

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