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The Psychological Impact of COVID-19 Epidemic among Rural Primary and Middle School Students in Southern China: A Multicenter Study

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Abstract

Children and adolescents are greatly impacted by the tremendous changes during COVID-19 epidemic. Rural primary and middle school students, as a relatively less concerned population, owing to their inconvenience of accessing epidemic-associated information, might have more serious impact on mental health. From 11 May, 2020 to 20 May, 2020, a multicenter cross-sectional study was performed through a unified field questionnaire in 12 rural schools in Shantou, Hezhou and Nanchong. There were 20.02%, 8.56%, 5.26% of respondents suffering from mild, moderate, and severe anxiety during COVID-19 epidemic. The protective factors encompassed spraying bleach water for environmental disinfection (OR=0.604, 95% CI=0.425-0.858) and disinfecting unmanned environments with ultraviolet radiation (OR=0.351, 95% CI=0.193-0.639), while risk factors included female(moderate anxiety: OR=1.703, 95% CI=1.082-2.682; severe anxiety: OR=2.821, 95% CI=1.479-5.381), cognition about the rage of susceptible population (OR=1.554, 95% CI=1.028-2.34), going outside during the epidemic (OR=3.194, 95% CI=1.430-7.136), epidemic-related information acquisition *via* publicity of community and village committee (OR=2.142, 95% CI=1.187-3.866), and not wearing masks (OR=22.210, 95% CI=3.987-123.717). The anxiety disorder is more prevalent among rural primary and middle school students, female in particular, than the general population. Cognition regarding protective measures and effective precautionary measures are both helpful against anxiety. It is highly advised for policymakers to formulate psychological supports and interventions targeting this vulnerable group.

Keywords: COVID-19; anxiety; mental health; rural students

Abbreviations

Covid-19: Coronavirus Disease 2019; CSs: College Students; GP: General Population; HPs: Healthcare Professionals; GAD-7: Generalized Anxiety Disorder 7-Item

Introduction

Coronavirus Disease 2019 (COVID-19) initially broke out in Wuhan in late December 2019 and spread rapidly around the world, which has become a global health disaster [1]. The causative microorganism has been recognized as severe acute respiratory syndrome coronavirus 2, an RNA virus belonged to the β-family coronavirus [2]. Infected patients mainly manifest inflammatory respiratory symptoms such as fever, sore throat, cough, dyspnea, and even progress into respiratory distress syndrome and acute respiratory failure [3]. In comparison to the 2003 severe acute respiratory syndrome, COVID-19 may be less pathogenic but more contagious, which poses a big challenge to global health security [4,5].

Actually, the epidemic not only threatens infectious patients' lives but also leads to unbearable psychological impacts for those who are exposed to negative epidemic-related information. The objective and precise evaluation of public mental status is of paramount importance during the epidemic, which does benefit the principle formulation of mental intervention as well as the promotion of policy decisions. A series of studies have been conducted to investigate how the emergency of the COVID-19 outbreak influences the mental health of different populations such as College Students (CSs) [6], general population (GP) [7], and Healthcare Professionals (HPs) [8]. Noticeably, there was also a cross-sectional study that analyzed the prevalence of anxiety and depression among HPs, CSs and GP, and appealed for further mental interventions [9]. Nevertheless, less is known about how the ongoing COVID-19 affects the psychological status of rural students, who is a special population partly owing to their inconvenience of accessing epidemic-associated information and improperness of precautionary measures against the epidemic. Primary and middle school students in particular, as a younger group of adolescents, are much easier to develop mental illnesses than general population, such as depression, anxiety, eating disorders, substance use disorders, and psychosis [10]. They are more vulnerable to the psychological impact of COVID-19 and are weak in dealing with psychological problems [11]. Therefore, it is supposed to gain more mental support under the epidemic due to their immature mental status [11,12]. Fail to deal with the psychological problems in time may lead to poor education, health, and economic status in the future [13]. However, compared to urban students, rural primary and middle school students are often ignored during COVID-19 epidemic, exactly how COVID-19

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influences the psychological status of rural primary and middle school students is rarely investigated. To address this problem, this study tended to investigate the anxiety status of rural primary and middle school students and to further examine the relationship between their psychological impact and probable factors in terms of sociodemographic, knowledge, and precautionary measures under this sensitive period. An in-depth understanding of the impact will do benefit further mental monitoring and intervention.

Materials and Methods

Procedures and participants

A multicenter cross-sectional study was performed through a field questionnaire survey to investigate the psychological status of rural students during the ongoing epidemic of COVID-19. Strict multistage stratified cluster sampling was adopted to select participants in southern China. Firstly, three undeveloped cities in southern China (Shantou, Guangdong; Hezhou, Guangxi; Nanchong, Sichuan) were selected by multiple-stage cluster sampling. All of these three regions have a great number of villages both in central and non-central districts. Secondly, a primary school and a middle school were randomly selected respectively from central and non-central rural districts. Thirdly, approximately 100 students from two classes of each grade, including Grade 5-6 in primary school and Grade 7-8 in middle school, were invited to fill in the united questionnaires. The inclusion criteria of respondents are as followed: 1) were informed and voluntarily participated in the survey; 2) could read and understand the questionnaire; 3) lived in the investigated districts and studied in the investigated school during the outbreak of the epidemic; 4) have not been infected with COVID-19 by the end of the data collection; 5) have not been diagnosed with other mental disorders except mild, moderate and severe anxiety, or taking medications for mental diseases. Only if all conditions are met can they be included. All the participants were informed that their participation was voluntary and had signed the informed consent before they filled in the questionnaire. The whole study processed in 12 schools was restricted in 2 weeks (from 11 May, 2020 to 22 May, 2020). This study was approved by the ethics committee of Shantou University Medical College (Approval No.SUMC-2020-81).

Instrumentations

Data were collected by designed questionnaire, which was pre investigated, modified, analyzed and reviewed by experts. The designed questionnaire was mainly composed of 4 parts: a) sociodemographic information of respondents; b) cognition about COVID-19; c) precautionary measures against COVID-19; d) anxiety level exposed to the pandemic.

The sociodemographic data includes genders, ages, grades, academic achievements, parents' educational background, parents' occupations, whether lives with parents, and family income. Based on the new coronavirus prevention and control guidelines of Chinese Center for Disease Control and Prevention (5th Edition), we raised several questions about the knowledge and precautionary measures of COVID-19 to details understand the participants' cognition level and adopted protective measures against the epidemic. Specifically, knowledge about COVID-19 covered sources of infection, routes of transmission, susceptible population, symptoms, treatments, quarantine, and disinfection methods. Regarding precautionary measures, questions were included their eagerness for pandemic information, initiatives and approaches for getting epidemic-related information, frequency of going outside during the epidemic, wearing masks or not when going outside, frequency of changing masks, occasions of wearing masks, frequency of exercise since Wuhan was blockaded, nutrition supplement, covering mouth and nose when coughing or sneezing, frequency occasions of washing hands, and detergent on washing hands.

Generalized Anxiety Disorder 7-Item (GAD-7) Scale is currently one of the most commonly used instruments in detecting and assessing anxiety disorders owing to the satisfactory efficiency and reliability [9,14,15], which consists of 7 items: 1) Feeling nervous, anxious, or on edge; 2) Not being able to stop or control worrying; 3) Worrying too much about different things; 4) Trouble relaxing; 5) Being so restless that it's hard to sit still; 6) Becoming easily annoyed or irritable; 7) Feeling afraid as if something awful might happen. The total GAD-7 score was divided into Normal (0-4), Mild Anxiety (5-9), Moderate Anxiety (10-14) and Severe Anxiety (15-27). Considering the English reading level of the rural primary and middle school students, we adopted the translated version of the GAD-7 scale to assess the anxiety level of the respondents. The Cronbach's alpha was 0.90 and KMO was 0.88 [16].

Data analysis

Descriptive statistics were used to describe participants' demographic characteristics, knowledge regarding COVID-19, and precautionary measures against the pandemic. Quantitative data were reported as mean ± standard deviation. A chi-square test was used to assess the significance between anxiety and sociodemographic, knowledge, as well as precautionary measures. A multivariate logistic regression analysis was further used to analyze the significant factors associated with anxiety in the chi-square test. A two-sided P-value <0.05 indicated the statistical significance. Statistical analysis was performed using SPSS ver. 25.0.

Results

Sociodemographic characteristics of participants

Of 1204 collected questionnaires, 25 respondents did not complete the questionnaires, with the response rate of 97.9%. The baseline characteristics of the participants are presented in Table 1. There was a total of 559 males and 620 females, 31.84% from Shantou, Guangdong, 33.76% from Hezhou, Guangxi, and 34.86% from Nanchong, Sichuan. The average age of respondents was 12.83±1.27. More than half reported their fathers (57.17%) and mothers (58.61%) have a low level of education (under junior school). Additionally, the most common occupations of their parents are business and service practitioners (34.61% for fathers and 32.23% for mothers), while healthcare professionals accounted for 3.90% respectively. Most respondents (61.49%) live with their parents together, only a minority living with just mother or father. The difference in sociodemographic data by gender was also listed in Table 1.

The psychological impact by sociodemographic characteristics

Among 1179 respondents, 399 students experienced anxiety at different levels (mild anxiety: 20.02%, moderate anxiety: 8.56%, severe anxiety: 5.26%). Table 2 showed the association between

Table 1: Demographics of Respondents of Primary and Middle School Students in Southern China.

Variables, n (%)	Overall (n=1179)	Male 559 (47.41)	Female 620 (52.59)
Age (Years)	12.83±1.27	12.86±1.23	12.80±1.31
Region			
Shantou, Guangdong	370 (31.38)	167 (45.14)	203 (54.86)
Hezhou, Guangxi	398 (33.76)	174 (43.72)	224 (56.28)
Nanchong, Sichuan	411 (34.86)	218 (53.04)	193 (46.96)
Grade			
Grade 5	316 (26.80)	153 (48.42)	163 (51.58)
Grade 6	325 (27.57)	163 (50.15)	162 (49.85)
Grade 7	272 (23.07)	125 (45.96)	147 (54.04)
Grade 8	266 (22.56)	118 (44.36)	148 (55.64)
Academic achievement			
Excellent (Top 10%)	147 (12.47)	61 (41.50)	86 (58.50)
Fine (10~30 %)	387 (32.82)	168 (43.41)	219 (56.59)
Average (30-50 %)	400 (33.93)	201 (50.25)	199 (49.75)
Others (50-100 %)	96 (8.14)	50 (52.08)	46 (47.92)
Unknown	149 (12.64)	79 (53.02)	70 (46.98)
Father's education level			
Under junior high school	674 (57.17)	307 (45.55)	367 (54.45)
Senior school	172 (14.59)	93 (54.07)	79 (45.93)
Undergraduate	30 (2.54)	16 (53.33)	14 (46.67)
Master degree or above	303 (25.70)	143 (47.19)	160 (52.81)
Mother's education level			
Under junior high school	691 (58.61)	311 (45.01)	380 (54.99)
Senior school	132 (11.20)	75 (56.82)	57 (43.18)
Undergraduate	24 (2.03)	14 (58.33)	10 (41.67)
Master degree or above	332 (28.16)	159 (47.89)	173 (52.11)
Father's occupation			
Health worker	46 (3.90)	22 (47.83)	24 (52.17)
Civil servant or employee of non-medical institution	185 (15.69)	98 (52.97)	87 (47.03)
Business and service practitioner	408 (34.61)	184 (45.10)	224 (54.90)
Migrant worker	196 (16.62)	97 (49.49)	99 (50.51)
Farmer	344 (29.18)	158 (45.93)	186 (54.07)
Mother's occupation			
Health worker	46 (3.90)	26 (56.52)	20 (43.48)
Civil servant or employee of non-medical institution	181 (15.35)	99 (54.70)	82 (45.30)
Business and service practitioner	380 (32.23)	187 (49.21)	193 (50.79)
Migrant worker	262 (22.22)	109 (41.60)	153 (58.40)
Farmer	310 (26.30)	138 (44.52)	172 (55.48)
Whether lives with parents			
Father only	86 (7.30)	48 (55.81)	38 (44.19)
Mother only	127 (10.77)	70 (55.12)	57 (44.88)
Both parents	725 (61.49)	315 (43.45)	410 (56.55)
Neither	241 (20.44)	126 (52.28)	115 (47.72)
Low-income family			
Yes	146 (12.38)	80 (54.79)	66 (45.21)
No	551 (46.74)	256 (46.46)	295 (53.54)
Unknown	482 (40.88)	223 (46.27)	259 (53.73)

Table 2: Associations between Demographics and Anxiety Level of Primary and Middle School Students in Southern China.

Variables, n (%)	Total n=1179	Anxiety level				X^2	p
		Normal 780 (66.16)	Mild 236 (20.02)	Moderate 101 (8.56)	Severe 62 (5.26)		
Gender						18.888	<0.001
Male	559 (47.41)	377 (67.44)	127 (22.72)	39 (6.98)	16 (2.86)		
Female	620 (52.59)	403 (65.00)	109 (17.58)	62 (10.00)	46 (7.42)		
Region						13.079	0.042
Shantou, Guangdong	370 (31.38)	259 (70.00)	73 (19.73)	25 (6.76)	13 (3.51)		
Hezhou, Guangxi	398 (33.76)	251 (63.06)	86 (21.61)	31 (7.79)	30 (7.54)		
Nanchong, Sichuan	411 (34.86)	270 (65.69)	77 (18.74)	45 (10.95)	19 (4.62)		
Grade						6.403	0.699
Grade 5	316 (26.80)	219 (69.30)	57 (18.04)	28 (8.86)	12 (3.80)		
Grade 6	325 (27.57)	214 (65.85)	59 (18.15)	32 (9.85)	20 (6.15)		
Grade 7	272 (23.07)	175 (64.34)	61 (22.43)	21 (7.72)	15 (5.51)		
Grade 8	266 (22.56)	172 (64.66)	59 (22.18)	20 (7.52)	15 (5.64)		
Academic achievement						5.331	0.805
Excellent (Top 10%)	147 (14.27)	96 (65.31)	32 (21.77)	12 (8.16)	7 (4.76)		
Fine (10~30 %)	387 (37.57)	256 (66.15)	77 (19.90)	29 (7.49)	25 (6.46)		
Average (30-50 %)	400 (38.84)	267 (66.75)	80 (20.00)	37 (9.25)	16 (4.00)		
Others (50-100 %)	96 (9.32)	61 (63.54)	17 (17.71)	11 (11.46)	7 (7.29)		
Father's education level						14.091	0.119
Under junior high school	674 (57.17)	457 (67.81)	122 (18.10)	54 (8.01)	41 (6.08)		
Senior school	172 (14.59)	111 (64.54)	37 (21.51)	14 (8.14)	10 (5.81)		
Undergraduate	30 (2.54)	15 (50.00)	12 (40.00)	2 (6.67)	1 (3.33)		
Master degree or above	303 (25.70)	197 (65.02)	65 (21.45)	31 (10.23)	10 (3.30)		
Mother's education level						15.148	0.087
Under junior high school	691 (58.61)	466 (67.44)	129 (18.67)	55 (7.96)	41 (5.93)		
Senior school	132 (11.20)	88 (66.66)	30 (22.73)	9 (6.82)	5 (3.79)		
Undergraduate	24 (2.03)	11 (45.83)	7 (29.17)	2 (8.33)	4 (16.67)		
Master degree or above	332 (28.16)	215 (64.76)	70 (21.08)	35 (10.54)	12 (3.62)		
Father's occupation						7.727	0.806
Health workers	46 (3.90)	31 (67.39)	8 (17.39)	5 (10.87)	2 (4.35)		
Civil servants or employees of non-medical institutions	185 (15.69)	122 (65.95)	41 (22.16)	15 (8.11)	7 (3.78)		
Business and service practitioners	408 (34.61)	265 (64.95)	83 (20.34)	33 (8.09)	27 (6.62)		
Migrant workers	196 (16.62)	131 (66.84)	40 (20.41)	20 (10.20)	5 (2.55)		
Farmers	344 (29.18)	231 (67.15)	64 (18.61)	28 (8.14)	21 (6.10)		
Mother's occupation						10.766	0.549
Health workers	46 (3.90)	35 (76.09)	5 (10.87)	4 (8.69)	2 (4.35)		
Civil servants or employees of non-medical institutions	181 (15.35)	124 (68.51)	32 (17.68)	16 (8.84)	9 (4.97)		
Business and service practitioners	380 (32.23)	243 (63.95)	85 (22.37)	30 (7.89)	22 (5.79)		
Migrant workers	262 (22.22)	165 (62.98)	59 (22.52)	28 (10.69)	10 (3.81)		
Farmers	310 (26.30)	213 (68.71)	55 (17.74)	23 (7.42)	19 (6.13)		
Whether lives with parents						11.269	0.258
Father only	86 (7.30)	52 (60.46)	18 (20.93)	10 (11.63)	6 (6.98)		
Mother only	127 (10.77)	75 (59.06)	26 (20.47)	18 (14.17)	8 (6.30)		
Both parents	725 (61.49)	493 (68.00)	144 (19.86)	56 (7.73)	32 (4.41)		
None	241 (20.44)	160 (66.39)	48 (19.92)	17 (7.05)	16 (6.64)		
Low-income family						2.394	0.495
Yes	146 (20.95)	93 (63.70)	27 (18.49)	17 (11.64)	9 (6.17)		
No	551 (79.05)	363 (65.88)	114 (20.69)	43 (7.80)	31 (5.63)		

Table 3: Association between Knowledge of COVID-19 and Anxiety Level of Primary and Middle School Students in southern China.

Variables, n (%)	Total n=1179	Anxiety level				X^2	p
		Normal 780 (66.16)	Mild 236 (20.02)	Moderate 101 (8.56)	Severe 62 (5.26)		
Will the coronavirus spread from person-to-person?						6.911	0.075
Correct (Yes)	1122 (95.17)	748 (66.67)	225 (20.05)	91 (8.11)	58 (5.17)		
Error (No, unclear)	57 (4.83)	32 (56.14)	11 (19.30)	10 (17.54)	4 (7.02)		
Which of the following groups will spread COVID-19?							
With fever, dry cough and other symptoms						2.7	0.44
Correct (Will not spread)	173 (14.67)	119 (68.79)	36 (20.81)	13 (7.51)	5 (2.89)		
Error (Will spread, unclear)	1006 (85.33)	661 (65.70)	200 (19.88)	88 (8.75)	57 (5.67)		
Asymptomatic coronavirus infection						5.096	0.165
Correct (Will spread)	882 (74.81)	583 (66.10)	180 (20.41)	68 (7.71)	51 (5.78)		
Error (Will not spread, unclear)	297 (25.19)	197 (66.33)	56 (18.86)	33 (11.11)	11 (3.70)		
Symptomatic coronavirus infection						1.182	0.757
Correct (Will spread)	1048 (88.89)	691 (65.93)	212 (20.23)	88 (8.40)	57 (5.44)		
Error (Will not spread, unclear)	131 (11.11)	89 (67.94)	24 (18.32)	13 (9.92)	5 (3.82)		
Will the coronavirus spread through the following channels?							
Droplet transmission						2.451	0.484
Correct (Yes)	1092 (92.62)	724 (66.30)	215 (19.69)	93 (8.52)	60 (5.49)		
Error (No, unclear)	87 (7.38)	56 (64.37)	21 (24.14)	8 (9.19)	2 (2.30)		
Mosquito-borne transmission						3.389	0.335
Correct (Yes)	513 (43.51)	346 (67.45)	106 (20.66)	40 (7.80)	21 (4.09)		
Error (No, unclear)	666 (56.49)	434 (65.16)	130 (19.52)	61 (9.16)	41 (6.16)		
Contact transmission						1.893	0.595
Correct (Yes)	852 (72.26)	559 (65.61)	168 (19.72)	77 (9.04)	48 (5.63)		
Error (No, unclear)	327 (27.74)	221 (67.58)	68 (20.80)	24 (7.34)	14 (4.28)		
Who may be infected with the coronavirus?						9.872	0.02
Correct (Everyone)	1019 (86.43)	685 (67.22)	193 (18.94)	83 (8.15)	58 (5.69)		
Error (The elder, the young, children)	160 (13.57)	95 (59.38)	43 (26.88)	18 (11.25)	4 (2.50)		
How long does it take for a person infected with the coronavirus to develop symptoms?						1.686	0.64
Correct (1~14 days)	585 (49.62)	390 (66.67)	119 (20.34)	44 (7.52)	32 (5.47)		
Error (<12 hours, 12-24 hours, 14-28 days, unclear)	594 (50.38)	390 (65.66)	117 (19.70)	57 (9.59)	30 (5.05)		
How long is the quarantine of COVID-19?						2.323	0.508
Correct (14 days)	1051 (89.14)	694 (66.03)	212 (20.17)	87 (8.28)	58 (5.52)		
Error (No need of quarantine, 1 day, 7 day, unclear)	128 (10.86)	86 (67.19)	24 (18.75)	14 (10.94)	4 (3.12)		
Which of the following is the correct disinfection methods?							
Spraying alcohol to disinfect the air						3.423	0.331
Correct (Error)	199 (16.88)	136 (68.34)	43 (21.61)	14 (7.04)	6 (3.01)		
Error (Correct, unclear)	980 (83.12)	644 (65.71)	193 (19.69)	87 (8.88)	56 (5.72)		
Disinfecting surfaces with alcohol						2.255	0.521
Correct (Correct)	917 (77.78)	603 (65.76)	183 (19.96)	78 (8.50)	53 (5.78)		
Error (Error, unclear)	262 (22.22)	177 (67.56)	53 (20.23)	23 (8.78)	9 (3.43)		
Spraying bleach water for environmental disinfection						9.875	0.02
Correct (Correct)	270 (22.90)	162 (60.00)	72 (26.67)	23 (8.52)	13 (4.81)		
Error (Error, unclear)	909 (77.10)	618 (67.99)	164 (18.04)	78 (8.58)	49 (5.39)		
Disinfecting unmanned environments with ultraviolet radiation						15.732	0.001

Correct (Correct)	386 (32.74)	231 (59.84)	85 (22.02)	38 (9.85)	32 (8.29)		
Error (Error, unclear)	793 (67.26)	549 (69.23)	151 (19.04)	63 (7.95)	30 (3.78)		
Which of the following methods can effectively prevent coronavirus infection?							
No aggregation						8.367	0.039
Correct (Yes)	1106 (93.81)	732 (66.18)	224 (20.25)	89 (8.05)	61 (5.52)		
Error (No, unclear)	73 (6.19)	48 (65.75)	12 (16.44)	12 (16.44)	1 (1.37)		
Wearing mask						0.465	0.926
Correct (Yes)	1162 (98.56)	770 (66.26)	232 (19.97)	99 (8.52)	61 (5.25)		
Error (No, unclear)	17 (1.44)	10 (58.82)	4 (23.53)	2 (11.77)	1 (5.88)		
Frequent hand-washing						1.127	0.77
Correct (Yes)	1160 (98.39)	767 (66.12)	232 (20.00)	99 (8.53)	62 (5.35)		
Error (No, unclear)	19 (1.61)	13 (68.42)	4 (21.05)	2 (10.53)	0 (0.00)		
Frequent room ventilation						1.771	0.621
Correct (Yes)	1097 (93.04)	729 (66.45)	215 (19.60)	95 (8.66)	58 (5.29)		
Error (No, unclear)	82 (6.96)	51 (62.19)	21 (25.61)	6 (7.32)	4 (4.88)		
Can patients with COVID-19 be cured?						2.776	0.427
Correct (Yes)	953 (80.83)	639 (67.05)	187 (19.62)	81 (8.50)	46 (4.83)		
Error (No, unclear)	226 (19.17)	141 (62.39)	49 (21.68)	20 (8.85)	16 (7.08)		

Table 4: Association between Preventive Behavior for COVID-19 and Anxiety Level of Primary and Middle School Students in Southern China.

Variables, n (%)	Total n=1179	Anxiety level				X^2	*p*
		Normal 780 (66.16)	Mild 236 (20.02)	Moderate 101 (8.57)	Severe 62 (5.26)		
Do you take the initiative to obtain the epidemic situations?						6.41	0.093
Yes	858 (72.77)	557 (64.92)	171 (19.93)	77 (8.97)	53 (6.18)		
No	321 (27.23)	223 (69.47)	65 (20.25)	24 (7.48)	9 (2.80)		
How do you get information about the epidemic situation?							
Mobile phone, tablet or other electronic equipment						1.485	0.686
Yes	991 (84.05)	655 (66.09)	203 (20.48)	83 (8.38)	50 (5.05)		
No	188 (15.95)	125 (66.49)	33 (17.55)	18 (9.57)	12 (6.38)		
Television						1.201	0.753
Yes	913 (77.44)	598 (65.50)	185 (20.26)	82 (9.98)	48 (5.26		
No	266 (22.56)	182 (68.42)	51 (19.17)	19 (7.14)	14 (5.27)		
Newspapers, magazines or other traditional paper media						0.775	0.856
Yes	267 (22.65)	179 (67.04)	49 (18.35)	25 (9.36)	14 (5.25)		
No	912 (77.35)	601 (65.90)	187 (20.51)	76 (8.33)	48 (5.26)		
Information from parents						2.282	0.516
Yes	637 (54.03)	412 (64.68)	129 (20.25)	58 (9.10)	38 (5.97)		
No	542 (45.97)	368 (67.90)	107 (19.74)	43 (7.93)	24 (4.43)		
School education						3.495	0.321
Yes	629 (53.35)	404 (64.23)	130 (20.67)	56 (8.90)	39 (6.20)		
No	550 (46.65)	376 (68.37)	106 (19.27)	45 (8.18)	23 (4.18)		
Publicity of community and village committee						18.846	<0.001
Yes	420 (35.62)	266 (63.33)	82 (19.52)	34 (8.10)	38 (9.05)		
No	759 (64.38)	514 (67.72)	154 (20.29)	67 (8.83)	24 (3.16)		
Did you ask to go out during the outbreak?						10.656	0.014
Yes	65 (5.51)	32 (49.23)	17 (26.16)	11 (16.92)	5 (7.69)		

No	1114 (94.49)	748 (67.14)	219 (19.66)	90 (8.08)	57 (5.12		
How many times a week do you go out on average during the outbreak?						22.496	0.007
Every day	22 (1.87)	19 (86.36)	2 (9.09)	0 (0.00)	1 (4.55)		
Two to three times a week	87 (7.38)	49 (56.32)	25 (28.74)	11 (12.64)	2 (2.30)		
Once a week	300 (25.44)	178 (59.33)	73 (24.33)	29 (9.67)	20 (6.67)		
Never	770 (65.31)	534 (69.35)	136 (17.66)	61 (7.92)	39 (5.07)		
Since the blockade of Wuhan, do you wear a mask when you go out?						6.297	0.71
Never	36 (3.05)	26 (72.22)	8 (22.22)	1 (2.78)	1 (2.78)		
Mainly in the early period	166 (14.08)	109 (65.66)	35 (21.09)	12 (7.23)	10 (6.02)		
Mainly in the recent period	75 (6.36)	50 (66.67)	12 (16.00)	6 (8.00)	7 (9.33)		
Every time	902 (76.51)	595 (65.96)	181 (20.07)	82 (9.09)	44 (4.88)		
How often do you change the mask?						10.581	0.306
Don't wear a mask	7 (0.59)	5 (71.43)	2 (28.57)	0 (0.00)	0 (0.00)		
Use a mask more than three times	65 (5.51)	44 (67.69)	14 (21.54)	4 (6.15)	3 (4.62)		
Change after two to three times uses	359 (30.46)	246 (68.52)	78 (21.73)	22 (6.13)	13 (3.62)		
Change a mask every time	748 (63.44)	485 (64.84)	142 (18.98)	75 (10.03)	46 (6.15)		
When do you wear a mask?							
When playing sports						5.976	0.426
Wear	399 (33.84)	262 (65.66)	77 (19.30)	42 (10.53)	18 (4.51)		
Don't wear	598 (50.72)	396 (66.22)	120 (20.07)	50 (8.36)	32 (5.35)		
Not exercise	182 (15.44)	122 (67.03)	39 (21.43)	9 (4.95)	12 (6.59)		
When going to the hospital						5.604	0.469
Wear	887 (75.23)	580 (65.39)	175 (19.73)	82 (9.24)	50 (5.64)		
Don't wear	12 (1.02)	7 (58.33)	2 (16.67)	2 (16.67)	1 (8.33)		
Don't go to the hospital	280 (23.75)	193 (68.93)	59 (21.07)	17 (6.07	11 (3.93)		
When going to crowded places						17.403	0.008
Wear	906 (76.84)	599 (66.11)	180 (19.87)	83 (9.16)	44 (4.86)		
Don't wear	16 (1.36)	11 (68.75)	0 (0.00)	1 (6.25)	4 (25.00)		
Don't go to crowded places	257 (21.80)	170 (66.15)	56 (21.79)	17 (6.61)	14 (5.45)		
When going to an open place						4.548	0.603
Wear	406 (34.44)	269 (66.26)	78 (19.21)	36 (8.87)	23 (5.67)		
Don't wear	293 (24.85)	197 (67.24)	58 (19.80)	19 (6.48)	19 (6.48)		
Don't go to an open place	480 (40.71)	314 (65.42)	100 (20.83)	46 (9.58)	20 (4.17)		
How can you prevent the spread of droplets when you cough or sneeze in public?						11.129	0.084
Cover your mouth and nose with palms	119 (10.09)	79 (66.39)	20 (16.81)	16 (13.44)	4 (3.36)		
Cover your mouth and nose with a tissue or elbow	925 (78.46)	621 (67.14)	178 (19.24)	75 (8.11)	51 (5.51)		
Turn your head to the unmanned side	135 (11.4)	80 (59.26)	38 (28.15)	10 (7.40)	7 (5.19)		
How often do you wash your hands every day?						17.615	0.04
More than 15 times	208 (17.64)	126 (60.58)	38 (18.27)	26 (12.50)	18 (8.65)		
11-15 times	147 (12.47)	94 (63.95)	32 (21.77)	17 (11.56)	4 (2.72)		
6-10 times	493 (41.82)	330 (66.94)	99 (20.08)	37 (7.50)	27 (5.48)		
0-5 times	331 (28.07)	230 (69.49)	67 (20.24)	21 (6.34)	13 (3.93)		
Under what circumstances do you wash your hands?							
When go home						6.599	0.086
Yes	910 (77.18)	599 (65.83)	179 (19.67)	76 (8.35)	56 (6.15)		

No	269 (22.82)	181 (67.29)	57 (21.19)	25 (9.29)	6 (2.23)		
After coughing or sneezing						3.565	0.312
Yes	919 (77.95)	605 (65.83)	180 (19.59)	80 (8.70)	54 (5.88)		
No	260 (22.05)	175 (67.31)	56 (21.54)	21 (8.07)	8 (3.08)		
Before wearing mask and after taking off the mask						7.849	0.049
Yes	753 (63.87)	492 (65.34)	142 (18.86)	72 (9.56)	47 (6.24)		
No	426 (36.13)	288 (67.60)	94 (22.07)	29 (6.81)	15 (3.52)		
After exposure to public things						9.703	0.021
Yes	759 (64.38)	486 (64.03)	153 (20.16)	70 (9.22)	50 (6.59)		
No	420 (35.62)	294 (70.00)	83 (19.76)	31 (7.38)	12 (2.86)		
After touching animals						12.483	0.006
Yes	805 (68.28)	521 (64.72)	154 (19.13)	78 (9.69)	52 (6.46)		
No	374 (31.72)	259 (69.25)	82 (21.93)	23 (6.15)	10 (2.67)		
When you feel your hands dirty						8.512	0.037
Yes	853 (72.35)	552 (64.71)	176 (20.63)	71 (8.33)	54 (6.33)		
No	326 (27.65)	228 (69.94)	60 (18.41)	30 (9.20)	8 (2.45)		
What detergent do you use when washing your hands?						25.175	0.003
Disinfectant	374 (31.72)	228 (60.96)	74 (19.79)	41 (10.96)	31 (8.29)		
Liquid soap	510 (43.26)	351 (68.82)	107 (20.98)	29 (5.69)	23 (4.51)		
Soap	167 (14.16)	116 (69.46)	26 (15.57)	20 (11.98)	5 (2.99)		
Tap-water only	128 (10.86)	85 (66.41)	29 (22.66)	11 (8.59)	3 (2.34)		
How long have you exercised on average every week since Wuhan was blockaded?						22.745	0.007
More than seven hours a week	108 (9.16)	74 (68.52)	18 (16.67)	6 (5.55)	10 (9.26)		
Three to seven hours a week	178 (15.10)	96 (53.93)	44 (24.72)	22 (12.36)	16 (8.99)		
One to three hours a week	416 (35.28)	288 (69.23)	79 (18.99)	34 (8.17)	15 (3.61)		
Less than one hour a week	477 (40.46)	322 (67.50)	95 (19.92)	39 (8.18)	21 (4.40)		

Table 5: Multivariate Logistic Regression Analysis on Anxiety Level of Primary and Middle School Students in Southern China*.

Variables	n	SE	OR	*p*	OR (95% CI)
Mild					
Who may be infected with the coronavirus?					
Correct (Everyone)	43	0.211	1.554	0.036	(1.028, 2.348)
Error (The elder, the young, children)	193	-	-	-	-
Which of the following is the correct disinfection methods?					
Spraying bleach water for environmental disinfection					
Correct (Correct)	164	0.179	0.604	0.005	(0.425, 0.858)
Error (Error, unclear)	72	-	-	-	-
How many times a week do you go out on average during the outbreak?					
Every day	2	0.799	0.37	0.212	(0.077, 1.766)
Two to three times a week	25	0.277	1.897	0.021	(1.103, 3.263)
Once a week	73	0.175	1.599	0.007	(1.134, 2.255)
Never	136	-	-	-	-
How long have you exercised on average every week since Wuhan was blockaded?					
More than seven hours a week	31	0.311	0.772	0.406	(0.419, 1.422)
Three to seven hours a week	23	0.234	1.421	0.134	(0.898, 2.249)
One to three hours a week	5	0.184	0.952	0.79	(0.665, 1.365)

Less than one hour a week	3	-	-	-	-
Moderate					
Gender					
Female	62	0.232	1.703	0.022	(1.082, 2.682)
Male	39	-	-	-	-
Which of the following methods can effectively prevent coronavirus infection?					
No aggregation					
Correct (Yes)	12	0.391	2.262	0.037	(1.051, 4.870)
Error (No, unclear)	89	-	-	-	-
Did you ask to go out during the outbreak?					
Yes	11	0.41	3.194	0.005	(1.430, 7.136)
No	90	-	-	-	-
How often do you wash your hands every day?					
More than 15 times	26	0.349	2.122	0.031	(1.071, 4.204)
11-15 times	17	0.372	1.662	0.172	(0.802, 3.443)
6-10 times	37	0.299	1.154	0.632	(0.642, 2.073)
0-5 times	21	-	-	-	-
How long have you exercised on average every week since Wuhan was blockaded?					
More than seven hours a week	6	0.495	0.496	0.157	(0.188, 1.309)
Three to seven hours a week	22	0.319	1.533	0.181	(0.820, 2.867)
One to three hours a week	34	0.265	0.944	0.829	(0.562, 1.587)
Less than one hour a week	39	-	-	-	-
Severe					
Gender					
Female	16	0.329	2.821	0.002	(1.479, 5.381)
Male	46	-	-	-	-
Region					
Shantou, Guangdong	13	0.423	0.847	0.695	(0.370, 1.939)
Hezhou, Guangxi	30	0.361	2.098	0.04	(1.034, 4.255)
Nanchong, Sichuan	19	-	-	-	-
How do you get information about the epidemic situation?					
Publicity of community and village committee					
Yes	38	0.301	2.142	0.011	(1.187, 3.866)
No	24	-	-	-	-
Which of the following is the correct disinfection methods?					
Disinfecting unmanned environments with ultraviolet radiation					
Correct (Correct)	30	0.305	0.351	0.001	(0.193, 0.639)
Error (Error, unclear)	32	-	-	-	-
When do you wear a mask?					
When going to crowded places					
Wear	44	0.349	0.774	0.463	(0.391, 1.522)
Don't wear	4	0.876	22.21	<0.001	(3.987, 123.717)
Don't go to crowded places	14	-	-	-	-
What detergent do you use when washing your hands?					
Disinfectant	31	0.704	4.768	0.026	(1.200, 18.944)
Liquid soap	23	0.696	2.14	0.274	(0.547, 8.371)

Soap	5	0.816	1.585	0.572	(0.320, 7.847)
Tap-water only	3	-	-	-	-
How long have you exercised on average every week since Wuhan was blockaded?					
More than seven hours a week	10	0.477	2.185	0.101	(0.858, 5.563)
Three to seven hours a week	16	0.4	1.895	0.11	(0.864, 4.154)
One to three hours a week	15	0.379	0.689	0.326	(0.328, 1.449)
Less than one hour a week	21	-	-	-	-

*Previous significant variables calculated by chi-square test were further analyzed by multivariate logistic regression analysis, and only meaningful variables were shown here.

sociodemographic data and the anxiety level of rural students in southern China. The chi-square test showed that there was a significant difference in anxiety level between males and females (χ^2=18.888, p<0.001). Specifically, male students were comprised of 22.72% respondents with mild anxiety, 6.98% respondents with moderate anxiety, and 2.86% respondents with severe anxiety. In female students, the data were 17.58%, 10.00%, and 7.42% respectively. A significant difference in anxiety level between 3 cities could also be observed (χ^2=13.079, p<0.05). No significant effect was observed between students' anxiety level and other sociodemographic characteristics (p>0.05).

The psychological impact and cognition about COVID-19

With regards to cognition about COVID-19, Table 3 showed a vast majority of respondents (95.17%) thought that the coronavirus can spread from person to person, and the sources of infection were asymptomatic coronavirus infection (74.81%) and symptomatic coronavirus infection (88.89%). The most routine perceived approach of transmission was through droplet spread (92.62%) and contact transmission (72.26%). Additionally, the susceptible populations covered the elderly, the middle-aged, the young, and the kids (86.4%). Even for those apparent infections, there was a latent period of 1~14 days (49.62%). Therefore, a suspected infection should be under quarantine for 14 days (89.14%). Vital correct approaches towards sterilization included spraying alcohol to disinfect the air (16.88%), disinfecting surfaces with alcohol (77.78%), spraying bleach water for environmental disinfection (22.90%), and disinfecting unmanned environments with ultraviolet radiation (32.74%). Moreover, most respondents thought avoidance of gathering (93.81%), wearing masks (98.56%), frequent hand-washing (98.39%), and frequent room ventilation (93.04%) were effective precautionary measures against the transmission of COVID-19.

The chi-square test revealed a statistically significant difference in anxiety level among respondents knowing which kinds of population might be infected with coronavirus or not (χ^2=9.872, p<0.05). Furthermore, a significant difference in anxiety level could also be observed among respondents who thought it correct or not to spray bleach water for environmental disinfection, disinfect unmanned environment with ultraviolet radiation, and not aggregate against coronavirus transmission. Other variables in cognition were not significantly associated with anxiety level.

The psychological impact and precautionary measures against COVID-19

As was shown in Table 4, a vast majority of respondents would take initiative to obtain epidemic situations (72.77%). Among diverse information sources, the mobile phone, tablet or other electronic equipment (84.05%) and television (77.44%) were the most common accesses for the acquisition of relevant information. Only a few respondents would ask to go out during the outbreak (5.51%).

Significant differences in anxiety level were observed among individuals who accessed epidemic-related information from the publicity of community and village committee or not (χ^2=18.846, p<0.001), who asked to go out during the outbreak or not (χ^2=10.656, p<0.05), and wore a mask or not when going to crowded places (χ^2=17.403, p<0.05). Besides, the development of anxiety was significantly associated with the frequency of going outside (χ^2=22.496, p<0.05), the frequency of washing hands (χ^2=17.615, p<0.05), categories of detergent when washing hands (χ^2=25.175, p<0.05), the condition of washing hands, and the frequency of exercise (χ^2=22.745, p<0.05).

Multivariate logistic regression analysis

Table 5 indicated that individuals clear about who could be infected with coronavirus (OR=1.554, 95% CI: 1.028-2.348), who went out once a week (OR=1.599, 95% CI: 1.134-2.255) and 2-3 times a week (OR=1.897, 95% CI: 1.103-3.263) during the outbreak were more likely to develop mild anxiety. In contrast, those considering it correct to spray bleach water for environmental disinfection (OR=0.604, 95% CI: 0.425-0.858) were less likely to develop mild anxiety. Additionally, individuals who thought no aggregation could effectively prevent coronavirus infection (OR=2.262, 95% CI: 1.051-4.870), who asked to go outside during the outbreak (OR=3.194, 95% CI: 1.430-7.136) and who washed hands more than 15 times every day (OR=2.122, 95% CI: 1.071-4.204) were easier to experience moderate anxiety. Moreover, those who lived in Hezhou (OR=2.098, 95% CI: 1.034-4.255), who got epidemic-related information through publicity of community and village committee (OR=2.142, 95% CI: 1.187-3.866), who didn't wear masks in crowded places (OR=22.210, 95% CI: 3.987-123.717) and used disinfectant when washing hands (OR=4.768, 95% CI: 1.200-18.944) were more tended to experience severe anxiety. Individuals who thought it correct to disinfect unmanned environments with ultraviolet radiation were less likely to experience severe anxiety (OR=0.351, 95% CI: 0.193-0.639). Noticeably, gender might have a key impact on the development of anxiety. Female respondents were more likely to develop moderate anxiety (OR=1.703, 95% CI: 1.082-2.682) and severe anxiety (OR=2.821, 95% CI: 1.479-5.381) than male respondents.

Discussions

As the epidemic continues, mental health has emerged as another concern in addition to physical health. People continuously exposed

to the negative epidemic-related information may suffer from anxiety, depression, and stress disorders [17]. This study aims to evaluate the psychological impact and probable factors in terms of sociodemographic, knowledge, and precautionary measures among rural primary and middle school students during the ongoing period of COVID-19. In general, 33.84% of the study participants had a different level of anxiety. Among them, female students were more likely to develop anxiety than male students. Participants' cognition about COIVD-19 are average with an overall correct rate of 64.50%. In particular, cognition towards protective measures, such as correct disinfection methods were conducive to reduce anxiety.

It was reported that there were 5.8%, 2.1%, and 0.4% of the general population suffering from mild, moderate, and severe anxiety in China [18]. The prevalence was lower than our findings (mild anxiety: 20.02%, moderate anxiety: 8.56%, severe anxiety: 5.26%). The reasons for this phenomenon are multifold. Firstly, compared with general population, rural students might be more vulnerable and sensitive to the side psychological impact of the epidemic, which might be the reason why they are more likely to develop anxiety during this period. Secondly, the different study-conducting periods may subsequently lead to a change in prevalence. The afore-mentioned study was conducted on the initial outbreak of the epidemic, while ours was performed during the ongoing period. People during the ongoing epidemic period may worry more about when the epidemic could be terminated. Meanwhile, the epidemic also led to the abrupt withdrawal from school, which might be one of the reasons. Finally, it is worth noting that the self-evaluated tool in anxiety level (self-rating anxiety scale) is different from ours (GAD-7), although both of them possess evident reliability and validity. The results indicated that anxiety is more prevalent among the rural primary and middle school students than among the general population, and therefore, the government should implement more directed measures applicable to rural students when providing mental support for the general population.

Our findings indicated that female students show higher anxiety levels, which is fundamentally consistent with the previous studies [19,20]. Additionally, a systematic review also revealed that female was a significant risk factor associated with anxiety disorders [21]. It might attribute to that female students from low-income families had significantly more mental health problems over time compared to male students [22]. Priority may thereby be attached to females when providing mental support and intervention for the targeted population.

Not all knowledge about COVID-19 contribute to reduce anxiety. In contrast, knowledge concerning population susceptibility and severity of COVID-19 would result in mild and moderate anxiety, which was in good accordance with previous studies [23,24]. Indeed, on one hand, people having basic understandings of COVID-19, are well aware of self-protection, driving them far away from anxiety of getting an infection. On the other hand, they may also develop anxiety because knowledge associated with susceptibility and severity could result in fear of potential risks and negative assessment of infection [23], which might explain washing hands too frequently and using disinfectant instead of normal cleanser were risk factors. However, anxiety is not always deleterious. It has been reported that moderate anxiety was beneficial to knowledge learning and disease prevention [25]. In our study, we similarly found that individuals experiencing mild or moderate anxiety knew more about effective methods against the coronavirus infection. Therefore, more attention should be paid to those who had a severe anxiety. It is of great significance to early identify and assist them in coping with severe anxiety. Adopting anxiety assessment questionnaire in school is possibly an effective approach to early diagnose possible anxious students. Besides, promoting mental health application of mobile phone may also be a convenient and timely method for daily use.

Although it was not statistically significant in our study, most studies considered that regular physical activities regarding forms and intensities could relieve anxiety and depression. Some researchers even worried about the potential of cardiovascular disease increased globally due to a lack of sports during the epidemic [26,27]. However, as for rural students in China, outdoor exercise is more prevalent. Our results indicated that going out was a risk factor for mild and moderate anxiety groups. And going to crowded places without masks was even a strong risk factor in the severe group. Therefore, indoor exercises such as yoga and bodyweight training are recommended during the sensitive period [28-30].

To the best of our knowledge, this is the first study focusing on the psychological impact of COVID-19 epidemic among rural primary and middle school students during the pandemic of COVID-19. Our findings would serve as an evident reference for policy decisions in monitoring and supporting the mental health of rural students. The large sample size (1179 respondents) and the multicenter-sourced data (12 schools from Shantou, Hezhou, and Nanchong) raised the generalizability to public rural students in southern China. Additionally, we were concerned that some rural students didn't possess their Internet products or they may not answer the questionnaire according to the actual. Therefore, in contrast to most online surveys, we conducted a field paper questionnaire monitored by local well-trained investigators, which may consequently reduce selection bias and increase the reliability of answers.

However, there were several limitations in our study. Firstly, we were not allowed to perform a prospective study due to this sensitive period. This cross-sectional research not only inevitably brought some recall bias, such as the inaccurate answers to some questions about frequency, but also failed to establish causality between the cognition of COVID-19 and mental health. As consequences, we were unable to infer whether anxiety is the cause or the consequence of the variables. Secondly, we conducted the study among 12 schools at different time, which may have subtle changes in the psychological impact of rural students. To minimize the impact of time on psychological status, we have strictly restricted the whole study period to less than 2 weeks.

Despite several limitations mentioned above, our findings provided a key insight into how the ongoing epidemic affects the anxiety level among rural primary and middle school students, which would draw public attention towards them for mental health care. And future studies could be further performed to probe the comprehensive mental status integrating stress, anxiety, and depression disorder among this particularly vulnerable group.

Conclusion

Anxiety disorder is more prevalent among primary and middle

school students from rural areas than among the general population during the ongoing COVID-19 epidemic. In particular, female students, as a more sensitive population, should also arouse public attention on mental health care. Meanwhile, cognition concerning protective measures and effective precautionary measures are both helpful to prevent the development of anxiety. Future studies are needed to better understand the comprehensive mental status *via* integrating stress, anxiety, and depression disorder targeting this particularly vulnerable group. Policymakers such as the government and schools are strongly advised to formulate psychological support and intervention applicable to this group.

Author Contributions

Conceptualization, Liping Li and Wanbao Ye; Formal analysis, Yongxin Zhang and Haijie Xu; Investigation, Yongxin Zhang, Haijie Xu, Menglai Gan, Jianrui Ma, Jiarong Liu, Xiner Tan, Wenjing Hou and Wanbao Ye; Project administration, Yongxin Zhang; Supervision, Liping Li; Writing - original draft, Menglai Gan and Jianrui Ma; Writing – review & editing, Yongxin Zhang and Jianrui Ma.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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