The impacts of COVID-19 outbreak on mental health in general population in different areas in China

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Abstract

Background. This study aimed to explore the impacts of COVID-19 outbreak on mental health status in general population in different affected areas in China.

Methods. This was a comparative study including two groups of participants: (1) general population in an online survey in Ya'an and Jingzhou cities during the COVID-19 outbreak from 10–20 February 2020; and (2) matching general population selected from the mental health survey in Ya'an in 2019 (from January to May 2019). General Health Questionnaire (GHQ-12), Self-rating Anxiety Scale (SAS), and Self-rating Depression Scale (SDS) were used.

Results. There were 1775 participants (Ya'an in 2019 and 2020: 537 respectively; Jingzhou in 2020: 701). Participants in Ya'an had a significantly higher rate of general health problems (GHQ scores $\geqslant$3) in 2020 (14.7%) than in 2019 (5.2%) ($p < 0.001$). Compared with Ya'an (8.0%), participants in Jingzhou in 2020 had a significantly higher rate of anxiety (SAS scores $\geqslant$50, 24.1%) ($p < 0.001$). Participants in Ya'an in 2020 had a significantly higher rate of depression (SDS scores $\geqslant$53, 55.3%) than in Jingzhou (16.3%) ($p < 0.001$). The risk factors of anxiety symptoms included female, number of family members ($\geqslant$6 persons), and frequent outdoor activities. The risk factors of depression symptoms included participants in Ya'an and uptake self-protective measures.

Conclusions. The prevalence of psychological symptoms has increased sharply in general population during the COVID-19 outbreak. People in COVID-19 severely affected areas may have higher scores of GHQ and anxiety symptoms. Culture-specific and individual-based psychosocial interventions should be developed for those in need during the COVID-19 outbreak.

Introduction

The coronavirus disease 2019 (COVID-19) was detected and reached an outbreak in Wuhan, China in January 2020 (Qiu et al., 2020). By now, the COVID-19 has reached the level of a pandemic, causing a lot of people infected and died across the world (Huang et al., 2020; Kooraki, Hosseiny, Myers, & Gholamrezanezhad, 2020; Qi et al., 2020). Compared with severe acute respiratory syndrome (SARS, 2003), COVID-19 outbreak may be associated with more psychological distress and symptoms of mental illness (Leung, 2003; Mak et al., 2009; Qiu et al., 2020; Shi et al., 2020; Wang et al., 2020a).

A study showed that 53.8% general population rated the psychological impact of the outbreak as moderate or severe, 16.5% reported moderate to severe depressive symptoms, and 28.8% reported moderate to severe anxiety symptoms (Wang et al., 2020b). Female gender, being a student, having symptoms of COVID-19, and poor perceived health were associated with higher rates of anxiety and depression (Shi et al., 2020; Wang et al., 2020b). Evidence shows that people in different affected areas of COVID-19 may face various psychological stressors and suffer from different mental health problems (e.g. anxiety, depression, insomnia) (Huang, 2017; Li, Liu, & Li, 2001; Liu et al., 2020; Yang et al., 2020). People in severely affected areas may be more likely to have psychological problems (e.g. anxiety, depression) than those in less affected areas.

Although evidence shows that the rates of anxiety and depression in infected patients are significantly higher than that in general population (Wang et al., 2020a), few studies have been conducted to explore the differences of psychological problems (e.g. anxiety, depression) in

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general population in different affected areas of COVID-19 out-break. Moreover, there is no study to compare the psychological problems in general population pre and post of COVID-19 out-break. Further studies should be conducted in these important areas.

Jingzhou city locates in the central and southern of Hubei province, China, and Ya'an city in the western Sichuan province, China. Jingzhou (about 200 kilometers away from Wuhan) is closer to Wuhan, the epicenter of COVID-19 outbreak in China, than Ya'an (about 1300 kilometers away from Wuhan). Ya'an and Jingzhou have the same administrative setup. According to the statistical yearbook at the end of 2019, the population of Jingzhou (5.5701 million) is about 3.6 times more than that of Ya'an (1.5339 million), the ratio of urban population to rural population of the two cities is similar (Jingzhou: 1:2.1; Ya'an: 1:2.6), and the per capita gross national product of the two cities is also similar (Jingzhou: CNY44 000; Ya'an: CNY47 000) (He et al., 2019; Yao et al., 2019). However, by 24:00 on 9 February 2020, there were two new COVID-19 cases in Jingzhou, with a total of 15 confirmed cases (confirmed rate: 0.27 per 100 000 population) and a fatality rate of 1.4% (Jingmen Municipal People's Government, 2020). The confirmed cases continually increased sharply. At the same time, there were only four confirmed cases (confirmed rate: 0.26 per 100 000 population) in Ya'an, and all of them were treated in hospital without death (The Standing Committee of the People's Congress of Ya'an city, 2020). The confirmed cases did not increase sharply. There were significant differences in the severity of the COVID-19 out-break in these two cities.

The present study aimed to (1) explore the psychological problems (e.g. anxiety, depression) in general population pre and post the COVID-19 outbreak (to use the research data in Ya'an city in 2019 and 2020), and (2) identify the differences in psychological problems in general population in two areas with different outbreak severity (to use the research data in Ya'an and Jingzhou in 2020).

Methods

Setting and participants

This was a comparative study including two groups of participants. The first group included general population in Ya'an and Jingzhou cities who participated in a self-designed online mental health survey using Wenjuan Star during the period of national quarantine from 10–20 February 2020 in China. The survey link was posted on the website and sent to possible participants (general people) in Ya'an and Jingzhou cities. Moreover, all the participants were also asked to send the survey link to other possible participants (general population, aged ⩾16 years) in Ya'an and Jingzhou. The registered participants clicked the link on the platform and responded to the survey voluntarily until the convenience sample reached the sample size. This was an anonymous survey, and confidentiality of data was ensured. Given 25% of possible mental health problems (e.g. anxiety or depression), with the type I error probability <0.05, and 1% of the allowable error, the minimum sample size was calculated as 1120 for this study. A total of 1244 participants (538 individuals in Ya'an, and 706 individuals in Jingzhou) finished the online survey. Six questionnaires (1 from Ya'an, and 5 from Jingzhou) that did not provide valid age or gender information were excluded from the analysis. A total of 1238 eligible participants [537 individuals (99.8%) in

Ya'an, and 701 individuals (99.3%) in Jingzhou] were included in the final analysis.

The second group was selected from the data of Ya'an mental health survey in general population in 2019 (from January to May 2019). The samples (total: 8876 individuals) in the Ya'an mental health survey in 2019 were representative participants randomly selected from all population in Ya'an city. Detailed sampling methods and procedures of the Ya'an mental health survey in 2019 have been elaborated elsewhere (Gao et al., 2020a). In order to increase the comparability of Ya'an samples in 2019 and 2020, the matching principle [criteria: individuals in the mental health survey in 2019 match with individuals in 2020 online mental health survey ($n = 537$), with the same gender and age ±2 years old] was used to select individuals ($n = 537$) from the mental health survey in 2019. Inclusion criteria of participants in this study: (1) age ⩾16 years old, (2) local residents (e.g. Jingzhou or Ya'an), (3) living in the area (Jingzhou or Ya'an) more than 6 months, (4) non-COVID-19 infected patients, and (5) non-COVID-19 suspects. Exclusion criteria: (1) age <16 years old, and (2) non-local residents.

The study was approved by the medical ethics committees at the Ya'an Fourth People's Hospital and the Jingzhou Mental Health Center. Written informed consent was received: (1) online questionnaire for the first group, and (2) in person before the investigation for the second group.

Measures

The measurement of this study mainly included demographic information, COVID-19 epidemic knowledge, response methods, attitudes toward the outbreak, and mental health status. The 12-Item General Health Questionnaire (GHQ-12), Self-rating Anxiety Scale (SAS), and Self-rating Depression Scale (SDS) were used to assess mental health status, and the Impact of Events Scale-Revised (IES-R) was used to assess the affected degree of psychological conditions.

General information

The general information tool was used to collect the general demographic information, the knowledge of COVID-19 epidemic, the response methods [e.g. psychological response to the pandemic (mild, moderate, or severe)], and attitudes (e.g. use or not use self-preventive measures, such as washing hands and wearing masks) toward the outbreak and other relevant information. The three education levels included junior middle school and below, senior middle school, and college and above. We defined the household size in three groups, living alone, living with 2–5 people, and 6 or above people.

Mental health status

(1) 12-Item General Health Questionnaire (GHQ-12): Mainly to survey the general population's mental health status in the past month, Chinese version of GHQ-12 was used to assess the general mental health problems. It was developed by Goldberg (Goldberg et al., 1997), and revised by Zheng for the Chinese population. It has been widely used in epidemiological studies of mental disorders in the community (Ge et al., 2018; Tak, Van Hespen, Verhaak, Eekhof, & Hopman-Rock, 2016). GHQ-12 consists of 12 items and each item scores 0 or 1. The total score is 12. There are three levels defined by the total score, 0–1 for low risk, 2–3 for medium risk, and ⩾4 for high risk (Cano et al., 2001). According to the structural analysis of GHQ-12 scale,

evidence showed that the validity of the three-factor model was better than that of the two dimensions and the one dimension, including the three dimensions of low social function, depression/anxiety and self-confidence (Campbell, Walker, & Farrel, 2003). The internal consistency is $\alpha = 0.840$.

(2) *The Self-rating Anxiety Scale* (*SAS*): Mainly to survey the general population's anxiety status in the past month, SAS was developed by Zung (1971). It was used to measure the anxiety symptoms among the general population during the COVID-19 outbreak. The questionnaire has 20 self-report questions and is scored on a four-point Likert scale, according to the frequency of symptoms in the past 7 days, ranging from 1 to 4. The standard cutoff scores were used to define: ⩽50 as no anxiety; 50–59 as minimal to mild anxiety; 60–69 as moderate to marked anxiety; and ⩾70 scores as severe anxiety (Cheng, Liu, Fan, Bai, & Liu, 2018). The questionnaire (Chinese version) has been widely used and demonstrated adequate reliability and validity (Gao et al., 2012; Shi, Liu, Wang, & Wang, 2015). The internal consistency is $\alpha = 0.840$.

(3) *The Self-rating Depression Scale* (*SDS*): Mainly to survey the general population's depression status in the past month, SDS (Chinese version) was administered in the study. Used to evaluate mood symptoms in the past 7 days, it has a 20-item scale. Each item is scored on a Likert scale ranging from 1 to 4. The standard cutoff scores were used to define: <50 as no depression; 50–59 as minimal to mild depression; 60–69 as moderate to marked depression; and ⩾70 as severe depression (Cheng et al., 2018; Liao et al., 2010). The reliability and validity of the Chinese version of SDS have been confirmed in previous studies (Chen et al., 2015; Leung, Lue, Lee, & Tang, 1998). The internal consistency is $\alpha = 0.869$.

(4) *The Impact of Events Scale-Revised* (*IES-R*): The IES-R is mainly used to survey the impact of events on the general population in the past month. The Chinese version has better reliability and validity in Chinese population (Huang, Zhang, & Xiang, 2006; Li et al., 2001; Zhou, Zhou, Xiao, & Yan, 2009). It was used to evaluate the psychological response associated with trauma in China. The IES-R has a 22-item scale, with each item scored on a Likert scale ranging from 0 to 5, total score is 0–110 scores, and demarcation is 35 scores (Sun et al., 2011). The internal consistency is $\alpha = 0.962$.

Statistical analysis

All statistical analyses were conducted using SPSS statistical software (IBM SPSS Statistics for Windows, Version 25.0). Cross-tabulation was performed to compare the demographic and COVID-19-related variables, and χ^2 test was used for categorical variables (e.g. GHQ, SAS, and SDS total score levels) in Ya'an and Jingzhou from 2019 to 2020. Mann–Whitney U test was used to examine the differences of GHQ, SAS, SDS, and IES total scores in Ya'an between 2019 and 2020, and between Ya'an and Jingzhou in 2020 because of the non-parametric nature of the data. After identifying the associated variables using correlation analysis, a logistic regression model was used to analyze the factors associated with GHQ total score levels in Ya'an from 2019 to 2020, and the factors associated with GHQ, SAS, and SDS total score levels in Ya'an and Jingzhou in 2020. A linear regression model was used to analyze the factors associated with IES total scores in Ya'an and Jingzhou. All statistical tests were two-tailed with a significance level of 0.05.

Results

Data from a total of 1775 eligible participants (Ya'an: 537 participants in 2019 and 537 participants in 2020; Jingzhou: 701 participants in 2020) were included in the final analysis.

Demographic and COVID-19-related characteristics of the participants in Ya'an and Jingzhou in 2019 and 2020

Table 1 shows the demographic and COVID-19-related characteristics of the participants in Ya'an and Jingzhou in 2019 and 2020. There were no significant differences in the median ages of the participants in Ya'an and Jingzhou in 2019 and 2020 ($p > 0.05$).

Comparisons between 2019 and 2020 in Ya'an
There were no significant differences in most demographics (e.g. gender, age, marital status, employment) in Ya'an groups between 2019 and 2020. However, there were more participants of Han ethnicity (97.6%), living in the urban area (87.3%), with an education level of senior middle school (77.5%), and with family income per person year more than CNY50 000 (41.7%) in 2020 compared to 2019 (92.7, 34.3, 20.3, and 8.1%, respectively) ($p < 0.001$).

Comparisons between Ya'an and Jingzhou in 2020
There were more males (51.9%), participants aged 30 years or below (45.2%), minority ethnicity (7.4%), living in the rural area (34.0%), being single (52.1%), being students (22.6%), education level of senior middle school (86.3%), and good financial status (higher than average) (17.0%) in Jingzhou than in Ya'an (27.9, 35.9, 2.4, 12.7, 16.2, 5.1, 77.5, and 7.4%, respectively) ($p < 0.001$). However, there were significantly less participants living alone (4.3%), and with family income per person year over CNY50 000 (34.2%) in Jingzhou than in Ya'an (7.3% and 41.7%, respectively) ($p < 0.05$).

There were significant differences in most COVID-19-related variables between Ya'an and Jingzhou in 2020. In Jingzhou, there were significantly more participants reported back from Wuhan (5.8%), with the knowledge of COVID-19 (75.5%), mild psychological response to the pandemic (31.5%), contact with confirmed cases (17.5%), and infection of relatives or friends (11.3%) compared to Ya'an (0.2, 32.8, 6.5, 0.7, and 0.2%, respectively) ($p < 0.001$). However, there were significantly less participants who reported self-preventive measures such as washing hands and wearing masks in Jingzhou (77.7%) than in Ya'an (96.6%) ($p < 0.001$).

General health, depression, anxiety, and impact of event

Comparisons between 2019 and 2020 in Ya'an
Table 2 shows the frequency of general health, depression, anxiety, and impact of event in Ya'an in 2019 and 2020. In Ya'an, there were significantly more participants who reported positive symptoms (scores ⩾3) of GHQ in 2020 (14.7%) than that in 2019 (5.2%) (about 2.8 times higher in 2020 than 2019) ($p < 0.001$). The sub-scores of GHQ (scores ⩾1), including social functioning and depression/anxiety, increased significantly in 2020 (20.5% and 19.7%, respectively) than 2019 (6.5% and 8.0%, respectively) ($p < 0.001$). The IES total score was significantly higher in 2020 (median = 10) than 2019 (median = 0) in Ya'an ($p < 0.001$), indicating that the COVID-19 outbreak had a more severe impact on psychological health in the population.

Comparisons between Ya'an and Jingzhou in 2020
The GHQ total scores (scores ⩾3) were significantly higher in Jingzhou (31.7%) than in Ya'an (14.7%) ($p < 0.001$), indicating

Table 1. Demographic and COVID-19-related characteristics of participants in Ya'an and Jingzhou in 2019 and 2020

	Ya'an 2019 (N = 537) N (%)	Ya'an 2020 (N = 537) N (%)	Jingzhou 2020 (N = 701) N (%)
Gender[a]			
Male	150 (27.9)	150 (27.9)	364 (51.9)[###]
Female	387 (72.1)	387 (72.1)	337 (48.1)
Age (years) median (range)[b]	34.0 (72)	33.0 (76)	34.0 (48)
Age groups[a]			
≤30 years	193 (35.9)	193 (35.9)	317 (45.2)[###]
31–59 years	327 (60.9)	327 (60.9)	326 (46.5)
≥60 years	17 (3.2)	17 (3.2)	58 (8.3)
Ethnicity[a]			
Han	498 (92.7)	524 (97.6)***	649 (92.6)[###]
Minority	39 (7.3)	13 (2.4)	52 (7.4)
Living area[a]			
Urban	184 (34.3)	469 (87.3)***	463 (66.0)[###]
Rural	353 (65.7)	68 (12.7)	238 (34.0)
Household size[a]			
Alone	–	39 (7.3)	30 (4.3)[#]
2–5 persons	–	437 (81.4)	571 (81.5)
≥6 persons	–	61 (11.4)	100 (14.3)
Marital status[a]			
Single	92 (17.1)	87 (16.2)	365 (52.1)[###]
Married	425 (79.1)	419 (78.0)	314 (44.8)
Divorced/widow	20 (3.7)	31 (5.8)	22 (3.1)
Employment[a]			
Employed	317 (58.8)	490 (91.2)	514 (73.3)[###]
Unemployed	24 (4.7)	20 (3.7)	22 (4.1)
Students	196 (36.5)	27 (5.1)	165 (22.6)
Level of education[a]			
Junior middle school and below	361 (67.2)	121 (22.5)***	96 (13.7) [###]
Senior middle school	109 (20.3)	416 (77.5)	605 (86.3)
College and above	67 (12.5)	0	0
Family income per person year (CNY)[a]			
≤30k	302 (66.2)	185 (34.5)***	278 (39.7)[#]
30–50k	117 (25.7)	128 (23.8)	183 (26.1)
≥50k	37 (8.1)	224 (41.7)	240 (34.2)
Family financial status[a]			
Poor (lower than average)	–	78 (14.5)	102 (14.6)[###]
Average	–	419 (78.0)	480 (68.5)
Good (higher than average)	–	40 (7.4)	119 (17.0)
Working out of the living area[a]			
Yes	–	38 (7.1)	53 (7.6)
No	–	499 (92.9)	648 (92.4)
Back from Wuhan[a]			
Yes	–	1 (0.2)	41 (5.8)[###]

(Continued)

Table 1. (Continued.)

	Ya'an 2019 (N = 537) N (%)	Ya'an 2020 (N = 537) N (%)	Jingzhou 2020 (N = 701) N (%)
No	–	536 (99.8)	660 (94.2)
Information sources[a]			
Public media	–	439 (81.8)	584 (83.3)[##]
Others	–	23 (4.3)	51 (7.3)
Both	–	75 (14.0)	66 (9.4)
Knowledge of COVID-19[a]			
With	–	176 (32.8)	529 (75.5)[###]
Without	–	361 (67.2)	172 (24.5)
Outdoor activities[a]			
None	–	320 (59.6)	444 (63.3)
Often	–	217 (40.4)	257 (36.7)
Self-preventive measures (washing hands and wearing masks)[a]			
Yes	–	519 (96.6)	545 (77.7)[###]
No	–	18 (3.4)	156 (22.3)
Psychological response to the pandemic[a]			
Mild	–	35 (6.5)	221 (31.5)[###]
Moderate	–	329 (61.3)	411 (58.6)
Severe	–	173 (32.2)	69 (9.8)
Contact with confirmed case[a]			
Yes	–	4 (0.7)	123 (17.5)[###]
No	–	533 (99.3)	578 (82.5)
Infection of relatives or friends[a]			
Yes	–	1 (0.2)	79 (11.3)[###]
No	–	536 (99.8)	622 (88.7)

[a]χ^2 tests.
[b]Mann–Whitney U test.
Comparisons of the demographics in Ya'an between 2019 and 2020: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Comparisons of the demographics in Ya'an and Jingzhou in 2020: #$p < 0.05$, ##$p < 0.01$, ###$p < 0.001$.

participants in Jingzhou had worse general health than those in Ya'an (Table 2). All three sub-scores of GHQ (scores ⩾1), social functioning, depression/anxiety, and self-confidence were significantly higher in Jingzhou than in Ya'an ($p < 0.001$).

There was no significant difference in SAS total scores between Ya'an and Jingzhou ($p > 0.05$). When using 50 as the cutting-off score of SAS, there were significantly more participants that scored ⩾50 in Jingzhou (24.1%) than in Ya'an (8.0%) ($p < 0.001$). However, participants in Ya'an [median (range): 55.0 (75)] showed significantly higher SDS total scores than those in Jingzhou [37.5 (53)] ($p < 0.001$). There were significantly more participants that scored ⩾53 of SDS in Ya'an (55.3%) than in Jingzhou (16.3%) ($p < 0.001$). The IES total scores were not significantly different between the two groups ($p > 0.05$).

Risk factors for general health, symptoms of anxiety, depression, and impact of event

Ya'an from 2019 to 2020
Table 3 shows the results of the binary logistic regression analysis of factors associated with the general health in Ya'an in 2019 and

2020. The bivariate analysis indicated that participants in 2020 and with higher IES total scores had a significantly higher risk of increased scores of GHQ ($p < 0.01$ and $p < 0.001$).

Ya'an and Jingzhou in 2020
Table 4 shows the results of binary logistic regression analysis in Ya'an and Jingzhou in 2020. The bivariate analysis indicated that participants in Jingzhou, with more outdoor activities, and mild psychological response to the COVID-19 outbreak were significantly associated with higher scores of GHQ ($p < 0.05$ or $p < 0.001$). Participants in Jingzhou were found to have a significantly higher risk of symptoms of anxiety than those in Ya'an ($p < 0.001$). Being males, living with 2–5 family members, and with occasional outdoor activities were the protective factors of symptoms of anxiety ($p < 0.01$ or $p < 0.001$). Participants in Ya'an and who uptake self-preventive measures were significantly more susceptible to symptoms of depression ($p < 0.05$ or $p < 0.001$). Using univariate analysis, we found a significant interaction effect of area × family income levels between Ya'an and Jingzhou ($p = 0.014$), without significant between-group differences in area and family income levels. In Jingzhou, the IES total score was

Table 2. General health, depression, anxiety, and impact of event in Ya'an and Jingzhou in 2019 and 2020

	Ya'an 2019 $N = 537$	Ya'an 2020 $N = 537$	Jingzhou 2020 $N = 701$
GHQ levels N (%)[a]			
GHQ total score <3	509 (94.8)	458 (85.3)***	479 (68.3)###
GHQ total score ≥3	28 (5.2)	79 (14.7)***	222 (31.7)###
GHQ sub-score N (%)[a]			
Social functioning <1	502 (93.5)	427 (79.5)***	457 (65.2)###
≥1	35 (6.5)	110 (20.5)***	244 (34.8)###
Depression/anxiety <1	494 (92.0)	431 (80.3)***	445 (63.5)###
≥1	43 (8.0)	106 (19.7)***	256 (36.5)###
Self-confidence <1	520 (96.8)	526 (98.0)	643 (91.7)###
≥1	17 (3.2)	11 (2.0)	58 (8.3)###
Anxiety levels N (%)[a]			
SAS total score <50	–	494 (92.0)	532 (75.9)###
SAS total score ≥50	–	43 (8.0)	169 (24.1)###
Anxiety total score: median (range)[b]	–	40.0 (75)	36.3 (54)
Depression levels N (%)[a]			
SDS total score <53	–	240 (44.7)	587 (83.7)###
SDS total score ≥53	–	297 (55.3)	114 (16.3)###
Depression total score: median (range)[b]	–	55.0 (75)	37.5 (53)###
Impact of event total score: median (range)[b]	0 (67)	10.0 (110)***	10.0 (71)

[a]χ^2 tests.
[b]Mann–Whitney U test.
Comparisons of the demographics in Ya'an between 2019 and 2020 *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Comparisons of the demographics in Ya'an and Jingzhou in 2020 #$p < 0.05$, ##$p < 0.01$, ###$p < 0.001$.

Table 3. Binary logistic regression analysis of the factors associated with the general health in Ya'an from 2019 to 2020

	General health (GHQ)	
Variables	β (s.e)	OR (95% CI)
Time		
2019 (2020 = 1)	−1.09 (0.38)	0.34 (0.16–0.71)**
Gender		
Male (female = 1)	0.07 (0.26)	1.07 (0.65–1.76)
Age groups		
≤30 years (≥60 years = 1)	0.87 (0.96)	2.40 (0.37–15.76)
31–59 years (≥60 years = 1)	0 (0.78)	1.00 (0.22–4.64)
Ethnicity		
Han (minority = 1)	0.14 (0.65)	1.15 (0.32–4.14)
Living area		
Urban (rural = 1)	−0.47 (0.30)	0.63 (0.35–1.13)
Marital status		
Single (divorced/widow = 1)	0 (0.62)	1.00 (0.30–3.38)
Married (divorced/widow = 1)	0.05 (0.53)	1.05 (0.38–2.95)
Level of education		
Junior middle school and below (college and above = 1)	0.06 (0.78)	1.07 (0.23–4.91)
Senior middle school (college and above = 1)	−0.04 (0.81)	0.96 (0.20–4.66)
IES total score	0.05 (0.01)	1.05 (1.03–1.06)***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

positively correlated with the income levels, with higher IES scores in a family with higher income. In Ya'an, a family with low (≤CNY30 k) and high (≥CNY50 k) incomes showed a higher IES total score than a family with middle-level income (CNY30–50 k). Both in Ya'an and Jingzhou, participants who were working out of the living areas showed a significant increase in IES total score than those who were not working out of the living areas ($p = 0.005$).

Discussion

To the best of our knowledge, this is the first study to compare the prevalence of psychological symptoms (e.g. anxiety, depression) in the general population before and after the COVID-19 outbreak in Ya'an, China. The present study has also explored the different psychological impacts of the COVID-19 in general population in various affected areas (e.g. mildly affected area: Ya'an and moderately affected area: Jingzhou). The findings of this study may provide more comprehensive evidence for understanding the psychological impact of COVID-19 outbreak and high-risk population of psychological problems, improving the health policy making, and development of population-specific psychosocial interventions.

The results of this study showed that there were 14.7% of the participants who reported the impaired psychological wellbeing (GHQ scores ≥3) in Ya'an after the outbreak of COVID-19 in 2020, including decreased social functioning and increased depression/anxiety symptoms. Compared with participants in 2019 before the outbreak of COVID-19 (5.2%), the results of this study show that participants have about 2.8 times increase of general health problems (scores of GHQ ≥3) after the COVID-19 outbreak. The results of this study are consistent with previous studies which demonstrated the severe psychological effects of COVID-19 outbreak (Gao et al., 2020a, 2020b; Qiu et al., 2020; Shi et al., 2020; Wang et al., 2020b). Moreover, there was an earthquake of magnitude 7.0 in Lushan county, Ya'an city in 2013, resulting in 196 deaths, more than 250 000 houses damaged or collapsed, and over 10 000 people injured (Hong Kong Red Cross, 2018). Compared with the total scores of participants' IES in 2019 in Ya'an, 5 years after the Lushan earthquake (2013), this study shows 4.7 times increase of the total scores of IES in participants after the COVID-19 outbreak in 2020. The increased scores of GHQ and IES may reflect the severity of negative impacts of the COVID-19 outbreak on mental health status in general population.

Compared with participants in Jingzhou (24.1%, 16.3%), participants in Ya'an in 2020 had a significantly lower level of anxiety symptoms (8.0%), but a higher level of depression symptoms (55.3%). The GHQ total scores (scores of GHQ ≥3) were significantly higher in Jingzhou than in Ya'an, including sub-scores of

Table 4. Binary logistic regression analysis of the factors associated with the general health, depression, and anxiety in Ya'an and Jingzhou in 2020

Variables	General health (GHQ)		Anxiety (SAS)		Depression (SDS)	
	B (s.e.)	OR (95% CI)	B (s.e.)	OR (95% CI)	B (s.e.)	OR (95% CI)
City						
Ya'an (Jingzhou = 1)	−1.17 (0.22)	0.31 (0.71–1.64)[###]	−1.04 (0.27)	0.36 (0.21–0.61)[###]	1.71 (0.21)	5.54 (3.69–8.31)[###]
Gender						
Male (female = 1)	−0.15 (0.15)	0.86 (0.65–1.15)	−0.57 (0.18)	0.57 (0.40–0.80)[##]	−0.16 (0.15)	0.86 (0.64–1.14)
Age groups						
⩽30 years (⩾60 years = 1)	0.35 (0.34)	1.41 (0.73–2.74)	0.04 (0.41)	1.04 (0.47–2.30)	−0.22 (0.34)	0.81 (0.42–1.56)
31–59 years (⩾60 years = 1)	−0.05 (0.30)	0.95 (0.53–1.71)	−0.06 (0.35)	0.94 (0.48–1.85)	0.16 (0.31)	1.17 (0.64–2.14)
Living area						
Urban (rural = 1)	0.06 (0.18)	1.06 (0.74–1.52)	0.09 (0.22)	1.09 (0.71–1.66)	0.06 (0.19)	1.07 (0.73–1.56)
Family size						
Alone (⩾6 persons = 1)	−0.09 (0.37)	0.92 (0.45–1.89)	0.62 (0.38)	1.86 (0.89–3.92)	0.31 (0.35)	1.36 (0.68–2.73)
2–5 persons	−0.22 (0.21)	0.80 (0.54–1.20)	−1.02 (0.22)	0.36 (0.23–0.56)[###]	0.01 (0.21)	1.01 (0.66–1.53)
Marital status						
Single (divorced/widow = 1)	−0.69 (0.38)	0.50 (0.24–1.06)	−0.80 (0.46)	0.45 (0.18–1.11)	0.04 (0.37)	1.04 (0.50–2.14)
Married (divorced/widow = 1)	−0.62 (0.34)	0.54 (0.28–1.05)	−0.61 (0.41)	0.54 (0.25–1.20)	0.13 (0.32)	1.13 (0.60–2.14)
Family income per person year						
⩽30k (>50k = 1)	−0.32 (0.18)	0.73 (0.51–1.04)	0.29 (0.23)	1.33 (0.85–2.07)	−1.09 (0.17)	0.83 (0.59–1.16)
30–50k (>50k = 1)	−0.32 (0.19)	0.73 (0.50–1.45)	0.08 (0.24)	1.08 (0.68–1.72)	−0.21 (0.18)	0.81 (0.57–1.16)
Subjective financial status						
Poor (higher than average = 1)	0.43 (0.27)	1.53 (0.91–2.58)	0.42 (0.31)	1.53 (0.83–2.81)	0.26 (0.29)	1.29 (0.74–2.26)
Average (higher than average = 1)	0.08 (0.21)	1.08 (0.72–1.62)	−0.11 (0.25)	0.90 (0.55–1.46)	0.24 (0.22)	1.27 (0.82–1.97)
Working out of the living area						
Yes (no = 1)	−0.29 (0.15)	0.75 (0.56–1.00)	0.37 (0.30)	1.44 (0.81–2.58)	−0.16 (0.27)	0.85 (0.51–1.43)
Knowledge of COVID-19						
Yes (no = 1)	−0.05 (0.17)	0.95 (0.68–1.34)	−0.06 (0.21)	0.94 (0.63–1.42)	0.10 (0.16)	1.11 (0.81–1.51)
Outdoor activities						
Occasionally (often = 1)	−0.29 (0.15)	0.75 (0.56–1.00)[#]	−0.54 (0.17)	0.59 (0.42–0.82)[##]	0.04 (0.14)	1.04 (0.79–1.37)
Self-preventive measures (washing hands and wearing masks)						
Yes (no = 1)	0.33 (0.21)	1.40 (0.93–2.09)	0.01 (0.23)	1.01 (0.64–1.59)	0.49 (0.25)	1.64 (1.00–2.69)[#]
Psychological response to the outbreak						
Mild (severe = 1)	0.58 (0.25)	1.78 (1.09–2.88)[#]	0.27 (0.28)	1.30 (0.75–2.28)	−0.10 (0.24)	0.91 (0.57–1.45)
Moderate (severe = 1)	0.32 (0.21)	1.38 (0.91–2.10)	−0.05 (0.25)	0.96 (0.59–1.56)	0.15 (0.17)	1.16 (0.83–1.62)
Contact with confirmed case						
Yes (no = 1)	−0.59 (0.24)	0.55 (0.34–0.89)	1.32 (0.23)	3.76 (2.39–5.92)	0.29 (0.26)	1.33 (0.81–2.19)
Infection of relatives or friends						
Yes (no = 1)	−0.05 (0.28)	0.95 (0.55–1.63)	0.71 (0.30)	2.04 (1.14–3.65)	0.23 (0.31)	1.26 (0.69–2.30)

[#]$p < 0.05$, [##]$p < 0.01$, [###]$p < 0.001$.

social functioning, depression/anxiety, and self-confidence. Compared with the previous study in Wuhan, which reported the prevalence of depression (48.3%) and anxiety (22.6%) during the early period of the pandemic (Gao et al., 2020a, 2020b), this study found the consistent prevalence of anxiety in Jingzhou (24.1%) and depression in Ya'an (55.3%), and much lower prevalence of depression in Jingzhou (16.3%) and anxiety in Ya'an (8.0%). It is reasonable that people in Jingzhou, a moderately affected area of COVID-19 near Wuhan, have a higher level of anxiety symptoms and poorer general psychological outcomes,

which may be associated with a higher level of stress and fear responding to the higher incidence and mortality rate of the COVID-19, more strict quarantine and prolonged lockdown of the social activity. However, participants in Ya'an, a mildly affected area of COVID-19, reported significantly higher depression symptoms than Jingzhou, which may be associated with previous earthquake disasters (e.g. Lushan earthquake in 2013) in Ya'an (Gao et al., 2020a). It has been well established empirically that depression and anxiety are highly comorbid. However, evidence also shows that immediate response to stress usually induces anxiety, while long-term chronic factors contribute to depression (Hammen, 2018). Thus, higher anxiety in Jingzhou might be related to the immediate psychological responses to the COVID-19 outbreak, and higher depression in Ya'an might be explained partly by the simultaneous effects of Lushan earthquake in 2013 and the COVID-19 outbreak. Further studies are needed in this area.

The results of this study showed that females were more likely to have anxiety than males, which is consistent with a few previous studies (Angst & Dobler-Mikola, 1985; Bruce et al., 2005; Regier, Narrow, & Rae, 1990; Wang et al., 2020b). Interestingly, participants living with 2–5 family members during the COVID-19 outbreak had a significantly lower risk for anxiety than those living alone and with more than six family members. Evidence shows that living alone, divorced, or widowed status is a significant risk factor for the high prevalence of anxiety disorders (Ansseau et al., 2008; Hunt, Issakidis, & Andrews, 2002). Burch and Walker (1978) investigated the effect of population density on anxiety in university students and found a significant relationship between population density and perceived anxiety for both genders. The findings of this study may suggest that more than six people in a family may be considered to have high living density and risk of infection of COVID-19, which may cause more stress and anxious symptoms. Living with 2–5 family members, but not alone, may be helpful for communication and mutual support in a family, which may reduce stress level and anxious symptoms. In this study, outdoor activities were found to be related to a higher prevalence of anxiety and general psychological symptoms. This indicates that more outdoor activities may increase exposure to the virus, resulting in more anxiety and psychological symptoms.

The results of this study showed that higher uptake of self-preventive measures (washing hands and wearing masks) was significantly associated with anxiety symptoms. Evidence also indicated that moderate levels of anxiety were associated with higher uptake of preventive measures during the 2003 SARS-CoV in Hong Kong (Leung, 2003). However, contrary to our findings, Wang et al. (2020b) reported that the precautionary measures adopted to prevent the spread of COVID-19 had protective psychological effects during the early stage of the epidemic. The discrepancy may be explained by the different study period. Our study was conducted 2 months after the initial stage of the outbreak, and the persistent spread of COVID-19 throughout the world contributed to the increased uptake of self-preventive measures and the increase of the level of anxiety and depression.

Working out of the living area and having contacts with confirmed cases were found to be significantly associated with higher impacts on psychological health in this study. The possible reasons may be related to that people working out of the living area and having contacts with confirmed cases may experience extensive fear of infection and frustration, and thus cause more psychological symptoms.

Our findings have several important and immediate implications for emergency public health response for COVID-19 outbreak. First, emergency public health response and policy for reducing the impacts of COVID-19 should be developed as the COVID-19 outbreak may sharply increase the negative psychological impacts on general population. Second, different immediate psychological needs of the general population should be identified in different affected areas of COVID-19 outbreak. The results of this study indicate that the general population may present different levels of anxiety and depression in different affected areas. Thus, different psychosocial interventions should be developed according to the characteristics of different psychological problems in various affected areas. Third, high-risk groups of psychological problems (e.g. anxiety, depression) should be identified for early psychosocial interventions. This study shows that being females, living alone or with more than six family members, working out of the living area, and having contacts with confirmed cases may suffer greater psychological impacts of the COVID-19 outbreak. Fourth, there have been many concerns of self-preventive measures as either a facilitator or barrier for improving mental health in general population. The results of this study showed that greater uptake of self-preventive measures was associated with higher levels of depression. However, it may be explained by the increased exposure to the pandemic. Providing accurate health information and education to general population in the community should be helpful to reduce anxiety and depression induced by the COVID-19 pandemic through the appropriate use of self-preventive measures.

Gradient Impact Model (GIM) for impact of disaster events: Our findings show that the population may present different levels of psychological problems (e.g. anxiety, depression, etc.) in different affected areas. Based on this preliminary evidence, authors of this study propose GIM firstly as the model to illustrate how different severities of disaster events (e.g. infectious disease outbreak, earthquake, etc.) may cause various levels of physical and psychological impacts on people in the various affected areas. The GIM suggests the gradient reduced the impact trend for people from severely to mildly affected areas of disaster events, and specific interventions should be developed in different affected areas. Further studies need to be conducted to test the model.

This study has several limitations. Given the limited resources available and time-sensitivity of the outbreak, we adopted the online convenient sampling strategy for the online mental health survey in 2020, which was not based on a random selection and sampling bias might exist. Although we have adjusted the statistical methodology to minimize the possible bias induced by sampling, the conclusion was less generalizable to the entire population, particularly the older people who may not commonly use the online survey. Only self-reported levels of psychological health, anxiety, depression, and impact of the event are another limitation. The status of mental health problems is based on the respondents' self-reports instead of clinical diagnosis. It may not always be aligned with assessment by mental health professionals. This is a cross-sectional study, the association between psychological problems and risk factors is not a causal relationship. Still, the results of the study should be interpreted with caution due to the significant differences in demographic information of the participants between the two different areas.

In conclusion, the frequency of general psychological symptoms was higher during the COVID-19 outbreak in 2020 compared to 2019 in Ya'an. When comparing the prevalence in two

cities, there was a significantly higher prevalence of anxiety in Jingzhou, and a significantly higher prevalence of depression in Ya'an. Several risk factors associated with higher anxiety and depression were identified, including females, living alone, or with more than six family members, higher uptake of self-preventive measures, and more outdoor activities. People working out of the living area and contacts with confirmed cases had more adverse impacts on their psychological health. Geographical area and population-specific psychosocial interventions including online intervention should be developed to reduce psychological symptoms in general population in various affected areas.

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