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Public Behavior Change, Perceptions, Depression, and Anxiety in Relation to the COVID-19 Outbreak

Jing Huang,[1,2,3,4,5,a] Fangkun Liu,[6,a] Ziwei Teng,[1,2,3,4,5] Jindong Chen,[1,2,3,4,5] Jingping Zhao,[1,2,3,4,5] Xiaoping Wang,[1,2,3,4,5] Ying Wu,[7] Jingmei Xiao,[1,2,3,4,5] Ying Wang,[1,2,3,4,5] and Renrong Wu[1,2,3,4,5,8]

[1]Mental Health Institute of the Second Xiangya Hospital, Central South University, Changsha, China, [2]China National Clinical Research Center on Mental Disorders, Changsha, China, [3]China National Technology Institute on Mental Disorders, Changsha, China, [4]Hunan Medical Center For Mental Health, Changsha, China, [5]Hunan Key Laboratory of Psychiatry and Mental Health, Changsha, China, [6]Department of Neurosurgery, Xiangya Hospital, Central South University (CSU), Changsha, China, [7]Intensive Care Unit, The Second Xiangya Hospital, Central South University (CSU), Changsha, China, and [8]Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences, Shanghai, China

Background. COVID-19 has spread rapidly and internationally, which has elicited public panic and psychological problems. Public protective behaviors and perception play crucial roles in controlling the spread of illness and psychological status.

Methods. We conducted a cross-sectional online survey in the hardest-hit Hubei province and other areas in China affected by the COVID-19 outbreak. Questions about their basic information, the perception of the COVID-19 outbreak, recent preventive or avoidance behaviors, and self-reported mental health scales including the Patient Health Questionnaire and Self-Rating Anxiety Scale were included. Binary logistic regressions were used to investigate the association between personal variables/perceptions and psychological distress.

Results. A total of 6261 people were included in the analysis, with 3613 (57.7%) in Hubei province (1743 in Wuhan). The majority of people have adopted preventive and avoidance behaviors. People from Hubei, with contact history, and people who were infected or whose family members were infected had a much higher prevalence of depression and anxiety. Providing truthful and sufficient information, informing the public about the severity of the disease, and perceptions that the outbreak can be controlled by protective behaviors were associated with lower prevalence of depression and anxiety.

Conclusions. Assessing the public response, perception, and psychological burden during the outbreak may help improve public health recommendations and deliver timely psychological intervention. Further research may focus on the psychological status of a specialized group to identify methods of delivery of better support based on public response and psychological demand.

Keywords. anxiety; COVID-19; depression; perceptions; public behavior change.

In December 2019, a new virus caused by pneumonia emerged in Wuhan, Hubei province. It has rapidly and widely spread in China and other countries, which caused an exponential increase in patients with infection [1, 2]. Within weeks, the numbers of confirmed cases, suspected cases, and deaths rose substantially. On January 29, 2020, Xizang raised its public health emergency response to level 1, which required all of the 31 provincial-level regions in mainland China to set up the highest level of emergency public health alerts and responses. On January 30, the World Health Organization (WHO) declared the outbreak a public health emergency of international concern (PHEIC). As of February 10, 2020, the number of confirmed cases rose to 37 626 in mainland China, with 7333 in critical condition and 1016 deaths. The virus was then named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee for Taxonomy of Virus (ICTV) on Febuary 11. Later, the WHO named SARS-CoV-2-caused pneumonia the 2019 novel coronavirus disease (COVID-19). With the national fight to combat the COVID-19 outbreak, the speed of new confirmed cases per day in other provinces has slowed down, while the most affected province, Hubei, is still engulfed by the outbreak. And the incidence is still rising, with no observation of a downward turning point for new cases of infection.

During the outbreak, the government closed the schools, canceled public activities, and ordered everyone to stay at home and avoid outside activities as much as possible. The transmission of COVID-19 from human to human, a large number of confirmed cases and suspected cases, and the increasing number of deaths elicited public fear of infection [3]. Meanwhile, people were flooded with varying and uncertain information from numerous sources, which may have increased public panic and potential psychological problems [4]. The uncertainty of the new virus outbreak, the extensive information or rumors, and the shortage of necessities may have increasd worry in the population. During the start of our survey on February 10, the outbreak seemed to reach a

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[a]Equal contribution

Correspondence: Renrong Wu, MD, PhD, Mental Health Institute of the Second Xiangya Hospital, 139 Renmin Road, Changsha, Hunan, China 431008 (wurenrong@csu.edu.cn).

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peak. In response to this, the National Health Commission of China has launched several policies and notices regarding how to cope with the psychological burden caused by the COVID-19 pandemic [5, 6]. Previous studies have suggested the importance of early assessment of anxiety and behavioral responses to the spread of infectious disease [7–10]. However, no study has been performed to assess public response, protective behavior changes, and the relationship between perception and psychological burden during the COVID-19 outbreak. Therefore, a timely and accurate measurement of public responses and psychological distress is extremely important [11, 12].

We conducted a large survey in the hardest-hit Hubei province and other areas affected by the COVID-19 outbreak, with 3613 in Hubei province and 2648 outside Hubei province. Due to the extensive Internet coverage and >1.3 billion mobile Internet users in China, according to a recent report by the Ministry of Industry and Information Technology [13], the survey was conducted through the Internet to avoid exposure and increase response speed and participation [13]. This survey provided a snapshot of public adoption of preventive behaviors or avoidance behaviors, perception, and psychological status during the peak period of the outbreak.

METHODS

Study Design and Population

The cross-sectional online survey was designed for performance in Hubei province for about 3000 participants, and outside Hubei province for 3000 participants. The sample size was chosen to allow for sufficient power to analyze likely differences between subgroups, such as confirmed cases, people with a history of recent contact with COVID-19 patients, medical staff, etc. The survey was sent and collected between February 10 at 22:00 and February 15 at 22:00 by the Mental Health Institute of the Second Xiangya Hospital, Central South University. The Internet-based survey was conducted via the Star Questionnaire survey Web site, which is the biggest questionnaire platform in China, consisting of people from the Chinese general public who volunteer to participate in online questionnaire surveys. The URL for the survey is https://www.wjx.cn/hj/0sqxejkhzeec508qvsrhwq.aspx. Confirmed cases and suspected cases increased quickly after Wuhan was sealed off on January 23, 2020. By February 15, the date we finished data collection, 68 500 people in China were confirmed, 56 249 of whom came from Hubei province (39 462 cases in Wuhan).

Participants had to be ≥18 years old and had to understand Chinese and have heard of COVID-19. They needed to answer questions about their basic information, their perception of the COVID-19 outbreak, recent preventive or avoidance behaviors, and self-reported mental health scales. After a complete description of the survey to the subjects, electronic informed consent was obtained. The basic information of the participants included gender, age, job, marriage status, education level, and address. The survey also asked people 7 questions about preventive behaviors (public mask-wearing, increases in handwashing and frequency of handwashing, surface sterilization) and avoidance behaviors (such as avoiding crowded places or public transport or people with contact history, wearing personal protective gear, adopting social distancing behavior, urging their family members or friends to adopt these behaviors). As a supplementary question, people were asked about frequency of checking the news about the progression of the outbreak online. The news on new COVID-19 cases and new deaths was updated daily on the website of the National Health Commission of the People's Republic of China (http://www.nhc.gov.cn/xcs/xxgzbd/gzbd_index.shtml).

The perception of the COVID-19 outbreak includes the severity of the disease, attitudes toward the disease, information, support, worry about becoming infected, and worry for family members. Each question had 5 response options: strongly agree (scored as 5), tend to agree, neither agree nor disagree, tend to disagree, or strongly disagree (scored as 1). One question was related to the level of concern about the outbreak to see whether participants had paid much attention to the COVID-19 epidemic news. Eight questions were about their understanding of the disease, timely and true information, basic supplies, and external support. One of the items assessed whether participants believed that recommended behaviors reduced their risk of being infected. Six questions evaluated participants' worries and attitudes toward the outbreak, including worry about becoming infected, worry for family for friends, worry about contact with an infected but symptomless individual, worry about having COVID-19-related symptoms, and attitudes toward the disease. It should be noted that 2 questions related to worry about themselves or their loved ones becoming infected had 6 response options; 5 options were about worry levels, and the last option was confirmed infection, which means the participant/1 of their family members has a confirmed infection.

The 9-item depression module from the Patient Health Questionnaire (PHQ-9) was employed in the survey to evaluate depression. Each of the 9 questions in the module corresponds to 1 of the DSM-IV criteria, scored from 0 (not at all) to 3 (nearly every day). People with a PHQ-9 score ≥10 had high sensitivity and specificity for major depression [14]. People who scored 10 or higher were defined as having depression related to COVID-19. Anxiety was assessed using the Self-Rating Anxiety Scale (SAS), which is well validated and widely used for anxiety screening and severity measurement. Participants were asked about their feelings over the past week concerning the COVID-19 outbreak. Previous studies have shown that the upper limit for the Chinese general population is an index score of 50. In this study, people who scored ≥50 were defined as having

anxiety related to COVID-19, and those with scores ≥60 were defined as having moderate to severe anxiety [15, 16].

Statistical Analysis

SPSS 25.0 software was used for the analyses. We used binary logistic regression to investigate the univariate association between personal variables and psychological distress (prevalence of depression or anxiety) and the association between public perceptions and psychological distress. Another set of binary logistic regression was applied to assess the multivariate associations between personal variables and psychological distress after adjusting for significant personal variables. Odds ratios were used to assess these associations. Data were weighted to gender, age, marriage, and working status based on the data from the National Statistics Institute of China. The prevalence of public behaviors, perceptions, depression, and anxiety changed <1% or marginally 1% after the weighting procedure; therefore, the unweighted data were used for analysis in this study.

RESULTS

Overall, 6523 completed the survey in 5 days at the peak of the COVID-19 outbreak. Among them, 170 (2.61%) reported confirmation of COVID-19 infection, 220 (3.37%) reported that their families or friends had confirmed COVID-19 infection, and 634 (9.72%) had a contact history. After verification of the original data, 260 were excluded from analyses (including 246 under the age of 18 years and 16 with incomplete information), leaving 6261 for further analysis, including 3585 (57.3%) female and 2676 (42.7%) male participants; 3613 (57.7%) were in Hubei province, and 2648 (42.3%) came from outside Hubei province, from the other 30 provincial-level regions in mainland China.

Protective Behaviors and Public Perceptions

Table 1 lists public behavior changes in response to the COVID-19 outbreak. The most commonly (96.3%) adopted preventive behavior was to wear a mask when going outside, and the most commonly (95.0%) adopted avoidance behavior was reducing the frequency of going out, dining together, and visiting others. A majority of people (99.5%) had adopted at least 1 of these behaviors.

Table 2 shows perceptions in response to the COVID-19 outbreak. Eighty-three percent of people firmly believed that taking protective efforts would reduce their risk of catching

Table 1. Behavior Response to COVID-19

Behavior Response to COVID-19	Percentage of Positive Responses (n = 6261)
Preventive behavior	
Sterilize the surface of the floor, desktop, mobile phone, and other objects more often than usual	81%
Cover your mouth and nose with bent elbows when coughing or sneezing	81%
Washed my hands with soap and water more often than usual	91%
In the past 3 days, you certainly wore a mask when you went out	96%
Avoidance behavior	
Keep away from potentially infected people	86%
Try to keep at least 1 meter away from others, especially when going out	85%
Reduce the frequency of going out, dining together, and visiting others	95%
Avoid crowded places	93%
Reduce the frequency of taking public transport	86%
Have you advised your family and friends in the following areas during the epidemic?	
Avoid crowded places	92%
Wash hands with soap and water more often than usual	87%
Wear masks when going out	97%
Reduce the frequency of taking public transport	84%
Reduce the frequency of going out, dining together, and visiting others	94%
In the past 24 hours, how many times have you washed your hands with soap?	
0–4	36%
5–9	40%
10–14	15%
15–19	4%
≥20	5%
In the past week, how often did you check the changes of confirmed infected cases on average?	
More than once a day	53%
Once a day	39%
Once every other day	4%
1 or 2 times a day	3%
Seldom	1%

COVID-19; 78.3% strongly agreed that SARS-CoV-2 was a virus with a strong infection ability; 69.2% firmly believed that infection with COVID-19 led to severe consequences; ~70% of participants were worried about that they or their family members or friends would be infected or that they would get symptoms similar to those of COVID-19 infection; ~70% of participants tended to agree or strongly agreed that they were getting truthful, adequate, and timely epidemic information, basic supplies, and support from others.

Depression and Anxiety Status in All Subjects

In total, 17.2% (1077/6261) people scored over the cutoff point on the PHQ-9, indicating the prevalence of depression, with a standard score of 4.57 ± 5.75. Of these, 8.0% (502/6261) scored ≥15, suggesting high depression. People aged 18–24, people from Hubei province, single people (including unmarried, divorced, and widowed), people with contact history, and people who had been infected or whose family members had been confirmed to have COVID-19 infection were more likely to have symptoms of depression. Medical staff were less likely to have depression compared with other professions. The largest effects were for people with confirmed infection, who were significantly more likely than people without confirmed COVID-19 infection to have depression (odds ratio [OR], 3.6; 95% CI, 2.6–5.0). People whose family members had confirmed infection had the second-highest prevalence of depression (OR, 3.1; 95% CI, 2.3–4.2), followed by people who had contact history (OR, 2.0; 95% CI, 1.7–2.4) (Table 3). People from Hubei province were more likely to be depressed than people from outside Hubei province (20.1% vs 13.2%; OR, 1.7; 95% CI, 1.4–1.9). Further analyses suggested that these variables remained significant predictors for psychological distress even after adjusting for other significant personal variables.

The SAS was used to assess the public anxiety level; 13.5% (841/6261) of participants with a standardized score of ≥50 (38.92 ± 10.17) were considered to have anxiety about the COVID-19 outbreak, with 4.9% (309/6261) reporting moderate or severe anxiety. Similar anxiety prevalence distributions were found in different groups, and more people from Hubei province, with contact history, who had confirmed infection, and with family members with confirmed infection were more likely to have anxiety. Medical staff and people aged 35–54 were less likely to have anxiety. People from Hubei province were more likely to be anxious than people from outside Hubei province (16.5% vs 9.5%; OR, 1.9; 95% CI, 1.6–2.2). The largest effects were also for people who with confirmed COVID-19 infection (OR, 4.6; 95% CI, 3.3–6.5), people whose family members had confirmed infection (OR, 4.1; 95% CI, 3.1–5.5), and people who had contact history (OR, 2.3; 95% CI, 1.9–2.8) (Table 3), even after adjusting for other significant personal variables.

Association Between Perceptions and Psychological Status

Next, we examine the association between perceptions and psychological status. Binary logistic regressions showed a significant association between public perceptions about the COVID-19 outbreak and depression. Perceptions that taking protective efforts will reduce the risk of being infected (OR, 0.7; 95% CI, 0.7–0.8), that SARS-CoV-2 is a virus with a strong infection ability (OR, 0.8; 95% CI, 0.7–0.9), that they had acquired truthful, adequate, and timely epidemic information (OR, 0.8; 95% CI, 0.7–0.8), and that they had enough food, daily necessities, and water supplies (OR, 0.7; 95% CI, 0.7–0.8) were associated with reduced depression levels. People who felt worried about becoming infected (OR, 1.6; 95% CI, 1.5–1.7), felt worried about family members becoming infected (OR, 1.5;

Table 2. Public Perceptions in Response to the COVID-19 Outbreak; Values Are Numbers (%) of Responses

	Strongly Disagree	Tend to Disagree	Neither Agree nor Disagree	Tend to Agree	Strongly Agree
I believe that taking protecting efforts will reduce my risk of catching COVID-19	100/6261 (1.6)	22/6261 (0.4)	136/6261 (2.2)	808/6261 (12.9)	5159/6261 (83.0)
SARS-CoV-2 is a virus with a strong infection ability	98/6261 (1.6)	22/6261 (0.4)	174/6261 (2.8)	1063/6261 (17.0)	4904/6261 (78.3)
Infection with SARS-CoV-2 leads to severe consequence	96/6261 (1.5)	77/6261 (1.2)	401/6261 (6.4)	1354/6261 (21.6)	4333/6261 (69.2)
You have acquired truthful, adequate, and timely epidemic information	176/6261 (2.8)	168/6261 (2.7)	1037/6261 (16.6)	2145/6261 (34.3)	2735/6261 (43.7)
Recently you have had enough food, daily necessities, and water	175/6261 (2.8)	432/6261 (6.9)	1620/6261 (25.9)	2757/6261 (44.0)	1282/6261 (20.5)
Recently you have received help and support from others (family members, friends, or collegues) when in need	236/6261 (3.8)	300/6261 (4.8)	1808/6261 (28.9)	2388/6261 (38.1)	1529/6261 (24.4)
I pay lots of attention to the COVID-19 epidemic news	39/6261 (0.6)	53/6261 (0.9)	149/6261 (2.4)	1445/6261 (23.1)	4575/6261 (73.1)
I am worried that I will be infected	268/6106 (4.4)	501/6106 (8.2)	1301/6106 (21.3)	2209/6106 (36.2)	1827/6106 (29.9)
I am worried that my family members or friends will be infected	140/6056 (2.3)	275/6056 (4.5)	648/6056 (10.7)	2128/6261 (35.1)	2865/6056 (47.3)
I am worried that I will get symptoms similar to COVID-19 infection	273/6261 (4.4)	458/6261 (7.3)	1240/6261 (19.8)	1996/6261 (31.9)	2294/6261 (36.6)
I am worried that people I've been in contact with carried the virus even if they are without any symptoms	120/6261 (1.9)	271/6261 (4.3)	965/6261 (15.4)	2453/6261 (39.2)	2452/6261 (39.2)
I feel scared when I hear the COVID-19 epidemic news	313/6261 (5.0)	589/6261 (9.4)	2504/6261 (40.0)	2250/6261 (35.9)	605/6261 (9.7)

Table 3. Association Between Personal Variables and Depression or Anxiety During the COVID-19 Outbreak

Variable and Variable Levels	No. (%) of Participants	No. (%) With Depression	Odds Ratio (95% CI)	No. (%) With Anxiety	Odds Ratio (95% CI)
Sex					
Women	3585 (57.3)	607 (16.9)	1.0 (0.8–1.1)	466 (13.0)	0.9 (0.8–1.0)
Men	2676 (42.7)	470 (17.6)	Reference	381 (14.2)	Reference
Age group					
18–24 y	1284 (20.5)	274 (21.3)	1.5 (1.0–2.1)	227 (17.7)	1.3 (0.9–1.9)
25–34 y	2374 (37.9)	466 (19.6)	1.1 (0.8–1.6)	370 (15.6)	1.1 (0.8–1.6)
35–54 y	2272 (36.3)	281 (12.4)	0.8 (0.5–1.1)	201 (8.8)	0.6 (0.4–0.9)
55–64 y	280 (4.5)	44 (15.7)	Reference	39 (13.9)	Reference
≥65 y	51 (0.8)	12 (23.5)	1.7 (0.8–3.4)	10 (19.6)	1.5 (0.7–3.3)
Location					
Hubei province	3613 (57.7)	728 (20.1)	1.7 (1.4–1.9)	595 (16.5)	1.9 (1.6–2.2)
Other	2648 (42.3)	349 (13.2)	Reference	252 (9.5)	Reference
Marriage status					
Single	2580 (41.2)	518 (20.1)	1.4 (1.2–1.6)	420 (16.3)	1.5 (1.3–1.7)
Married	3681 (58.8)	559 (15.2)	Reference	427 (11.6)	Reference
Working status					
Medical staff	600 (9.6)	68 (11.3)	0.6 (0.5–0.8)	56 (9.3)	0.6 (0.5–0.9)
Service industry	592 (9.5)	119 (20.1)	1.2 (1.0–1.5)	97 (16.4)	1.2 (1.0–1.6)
Other	5069 (81.0)	890 (17.6)	Reference	694 (13.7)	Reference
Educational attainment					
University degree or above	3294 (52.6)	602 (18.3)	1.2 (1.0–1.3)	474 (14.4)	1.2 (1.0–1.4)
Less than university degree	2967 (47.4)	475 (16.0)	Reference	373 (12.6)	Reference
Contact history					
Yes	603 (9.6)	168 (27.9)	2.0 (1.7–2.4)	147 (24.4)	2.3 (1.9–2.8)
No	5658 (90.4)	909 (16.1)	Reference	700 (12.4)	Reference
Confirmed					
Yes	155 (2.5)	65 (41.9)	3.6 (2.6–5.0)	63 (40.6)	4.6 (3.3–6.5)
No	6106 (97.5)	1012 (16.6)	Reference	784 (12.8)	Reference
With family members confirmed					
Yes	205 (3.3)	78 (38.0)	3.1 (2.3–4.2)	77 (37.6)	4.1 (3.1–5.5)
No	6056 (96.7)	999 (16.5)	Reference	770 (12.7)	Reference

95% CI, 1.4–1.7), felt worried about getting COVID-19-related symptoms (OR, 1.5; 95% CI, 1.4–1.6), felt worried that people they had had contact with were infected but symptomless (OR, 1.4; 95% CI, 1.3–1.5), or felt scared about the disease (OR, 1.9; 95% CI, 1.8–2.1) were more likely to be depressed. The associations were still significant after adjusting for significant personal variables (Table 4).

A significant association was also found between public perceptions about the COVID-19 outbreak and anxiety. Getting reliable and timely information (OR, 0.7; 95% CI, 0.7–0.8), believing in the severity of the disease (OR, 0.6; 95% CI, 0.6–0.7), having enough basic supplies (OR, 0.7; 95% CI, 0.6–0.7), receiving enough support from others (OR, 0.9; 95% CI, 0.8–0.9), and paying lots of attention to the COVID-19 epidemic news (OR, 0.8; 95% CI, 0.7–0.9) were associated with a reduced prevalence of anxiety. Worry about becoming infected (OR, 1.7; 95% CI, 1.6–1.9), worry about family members becoming infected (OR, 1.4; 95% CI, 1.3–1.5), worry about getting COVID-19-related symptoms (OR, 1.4; 95% CI, 1.3–1.5), worry that people they had had contact with were infected but symptomless (OR, 1.3; 95% CI, 1.2–1.4), or fear about the disease (OR, 1.9; 95% CI, 1.8–2.1) increased the likelihood of suffering from anxiety. After adjusting for all significant personal variables including age, location, marriage, working status, contact history, and confirmed cases, all of these variables remained significant (Table 4).

DISCUSSION

Our results suggest that the Chinese general public had obvious responses and behavior changes about 2 weeks after 31 provincial-level regions in mainland China activated level 1 public health emergency responses. People showed high adoption rates of various protective behaviors, such as mask-wearing, disinfection, and social distancing. The most affected province, Hubei, is still engulfed by the outbreak. Most restaurants, hotels, malls, cinemas, and other entertainment-related public places have been closed. Several methods of restriction on access have been adopted by communities and villages, including locking all unused doors or blocking roads to limit access, restricting all unauthorized individuals, and distributing cards for temporary access. Community members are required to have their temperature taken and are only be allowed in

Table 4. Association Between Perception Variables and Depression or Anxiety During the COVID-19 Outbreak

Factors	Association With Depression			Association With Anxiety	
	Mean (SD) Score,[a] No. of Participants	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)[b]	Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)[b]
I believe that making protective efforts will reduce my risk of catching COVID-19	4.8 (0.7), 6261	0.7 (0.7–0.8)	0.8 (0.7–0.8)	0.6 (0.6–0.7)	0.6 (0.6–0.7)
SARS-CoV-2 is a virus with a strong infection ability	4.7 (0.7), 6261	0.8 (0.7–0.9)	0.8 (0.8–0.9)	0.6 (0.6–0.7)	0.7 (0.6–0.7)
Infection with SARS-CoV-2 leads to severe consequence	4.6 (0.8), 6261	0.9 (0.8–1.0)	0.9 (0.8–1.0)	0.8 (0.7–0.9)	0.8 (0.7–0.9)
You have acquired truthful, adequate, and timely epidemic information	4.1 (1.0), 6261	0.8 (0.7–0.8)	0.8 (0.7–0.9)	0.7 (0.7–0.8)	0.8 (0.7–0.8)
Recently you have had enough food, daily necessities, and water	3.7 (1.0), 6261	0.7 (0.7–0.8)	0.8 (0.7–0.8)	0.7 (0.6–0.7)	0.7 (0.7–0.8)
Recently you have received help and support from others (family members, friends, or colleagues) when in need	3.7 (1.0), 6261	0.9 (0.9–1.0)	0.9 (0.9–1.0)	0.9 (0.8–0.9)	0.9 (0.8–0.9)
I pay lots of attention to the COVID-19 epidemic news	4.7 (0.6), 6261	0.9 (0.8–1.0)	0.9 (0.9–1.1)	0.8 (0.7–0.9)	0.8 (0.7–0.9)
I am worried that I will be infected	3.8 (1.1), 6106	1.6 (1.5–1.7)	1.6 (1.4–1.7)	1.7 (1.6–1.9)	1.7 (1.5–1.8)
I am worried that my family members or friends will be infected	4.2 (1.0), 6056	1.5 (1.4–1.7)	1.5 (1.4–1.6)	1.4 (1.3–1.5)	1.4 (1.2–1.5)
I am worried that I will get COVID-19-related symptoms	3.9 (1.1), 6261	1.5 (1.4–1.6)	1.5 (1.4–1.6)	1.4 (1.3–1.5)	1.4 (1.3–1.5)
I am worried that people I've been in contact with were infected but symptomless	4.1 (0.9), 6261	1.4 (1.3–1.5)	1.4 (1.3–1.5)	1.3 (1.2–1.4)	1.3 (1.2–1.4)
I feel scared when I hear the COVID-19 epidemic news	3.4 (1.0), 6261	1.9 (1.8–2.1)	1.9 (1.8–2.1)	1.9 (1.8–2.1)	2.0 (1.6–2.4)

[a]Scores from 1 to 5. Each question had 5 response options: strongly agree (scored as 5), tend to agree, neither agree nor disagree, tend to disagree, or strongly disagree (scored as 1). High scores indicate greater agreement with the statements.

[b]Adjusted for gender, age, marriage, and working status.

with a normal temperature. Newspapers, television, broadcast, Internet, magazines, and other media make efforts to strengthen public awareness of protective behaviors and personal health to control virus infection. The high rate of adoption of protective behavior proves the notable effects of these measures.

The prevalence of psychological distress was associated with several personal variables. People from Hubei province, who were single, who had contact history, who had confirmed infection, and who had a family member with confirmed infection were significantly more likely to suffer from depression and anxiety. People who had confirmed COVID-19 infection and who had a family member with confirmed infection had the highest prevalence, suggesting that psychological counseling and support to deal with psychological problems for these groups are urgently needed. Medical staff was less likely to have depression (OR, 0.6; 95% CI, 0.5–0.8) and anxiety (OR, 0.6; 95% CI, 0.5–0.9) compared with other professionals in the total sample. The relatively lower risk of psychological problems can be partly explained by the effect of education; knowledge about the disease reduces depression/anxiety prevalence. The government has emphasized the importance of timely mental health care for medical staff and timely offered telephone counseling, online counseling, and cam-consulting services, which can also partly explain the results. The medical staff in Hubei province showed a much higher risk of depression (17.5%, 29/166; OR, 2.1; range, 1.3–3.6) than those outside Hubei province (9.0%, 39/434). Medical staff in Hubei province also had higher anxiety (16.9%, 28/166; OR, 2.9; range, 1.7–5.1) compared with medical staff outside Hubei province (6.5%, 28/434). Statistical data have shown that the outbreak has caused 1716 confirmed cases of medical staff infection, with 1502 (87.5%) in Hubei province, through February 11. Frontline medical professionals work under great working and psychological stress, which may cause higher prevalence of depression and anxiety [4, 17]. A large sample survey on the psychological status of frontline medical staff and patients fighting in Hubei province should be performed.

The associations between public perceptions and psychological distress can provide some insight into factors that could be targeted to reduce mental health problems. Perceptions relating to trust, severity, information, and supply showed significantly varied associations, with lower depression prevalence after adjusting for all significant personal variables. As we expected, believing that taking protecting efforts will reduce the risk of catching COVID-19, having access to truthful, adequate, and timely epidemic information, and receiving enough basic supplies were associated with lower prevalence of depression and anxiety. Previous studies and historical experience bear proof that threats, especially of the outbreak of a new infectious disease, can cause negative behavioral responses and fears and undermine public confidence [18, 19]. Being flooded with varying and uncertain information increases the risk of having psychological problems [20]. Timely and clear information could help the public response quickly, cut off the spread of rumors and misinformation, and increase the rates of protective behavior changes [8, 19].

Perception of severity, such as perceiving that SARS-CoV-2 is a virus with strong infection ability and that infection with SARS-CoV-2 leads to severe consequences, was a predictor of fewer mental problems. This may be partly explained by the idea that a certain understanding of the disease can reduce the

prevalence of depression and anxiety. These results support the findings in previous outbreaks that providing enough information, informing the public about the severity of the disease and about protective behaviors, will not increase public panic [8, 21]. By contrast, Rubin et al. [8], who assessed perceptions and behaviors related to the swine flu outbreak, found that taking the disease lightly was associated with fewer behavior changes. Lack of attention and protective behaviors ultimately increase individuals' risk of infection. Informing the public about the severity of the outbreak helps intensify public preparedness and response efforts. Public perceptions relating to worry about becoming infected or worry about family members becoming infected, worry about getting COVID-19-related symptoms, the possibility of people with whom one has been in contact being infected with SARS-CoV-2 virus without clinical symptoms, and being scared about COVID-19 epidemic news were also associated with higher levels of depression and anxiety.

Limitations

There are several limitations of this study. First, due to the pandemic and severity of COVID-19, the cross-sectional survey was carried out through the Internet. Although statistics have shown that there are >1300 million mobile Internet users in China, our survey does not include and cannot represent people without access to the Internet. For improving the representativeness of the online survey design, weighting procedures were applied by comparing with national census data. The outcomes changed ≤1% after weighting the data by gender, age, marriage, and working status. This suggested some evidence of the representativeness of online surveys. Besides, the selection of the questions and scales in the survey did not include a stress scale or a social support scale. Two easily comprehensible, widely used self-reported scales were used in this study. With <30 questions in total, the scales were well accepted by the participants and received good responses. Third, the survey was designed for the public; some questions for specific population groups were not included. For example, basic information related to the infection, symptoms, and treatment details were not included for people who have been confirmed. Questions about knowledge of COVID-19 have yet to be used as well. The main focus of the survey was behavior changes, perceptions, and their association with the prevalence of depression and anxiety. The survey has been revised several times to make sure it can be completed in a relatively short period to reduce fatigue of the participants. Another limitation is that questions about whether the participants lost a relative or friend due to COVID-19 and/or lost their job were not included. People who lost their lovers, family members, or friends may suffer a severe psychological burden and require immediate help. Further studies should be performed to explore the psychological status of people in a specialized group to understand their different demands and provide better psychological support.

CONCLUSIONS

With more than 40 000 confirmed cases reported in China on February 10, the COVID-19 outbreak has developed into a serious public health problem. A majority of people have adopted various preventive and avoidance behaviors. People from Hubei, with contact history, and people who had confirmed infection or whose family members were infected had much higher prevalence of depression or anxiety, which requires urgent psychological intervention. Providing clear and sufficient information, informing the public about the severity of the disease, and perceptions that the outbreak will be controlled by protective behaviors were associated with lower prevalence of depression and anxiety. Further research could focus on the psychological status of a specialized group to offer effective psychological counseling and support.

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Availability of data. The data are not publicly available.

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