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Perceived stress and its impact on the health behavior of Chinese residents during the COVID-19 epidemic: An Internet-based cross-sectional survey

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Abstract

Background and Aims: The novel coronavirus disease 2019 (COVID-19) causes severe respiratory illnesses, following exposure to air-borne droplets or direct contact, posing a great threat to human life. This study aimed to investigate perceived stress and its correlation with the health behaviors of Chinese residents during the COVID-19 epidemic.

Methods: An Internet survey was conducted among 2449 residents in 20 provinces of China on residents' perceived stress, perception of COVID-19, and health behaviors. SAS 9.4 was used to analyze the relationship between health behaviors and perceived stress, and logistic regression was used to explore the factors influencing health risk stress.

Results: The participants' perceived stress score was 22.25 ± 7.2 (total 56), and the incidence of health risk stress was 39.89% (977/2449). Females, students, and medical staff were at high risk. Health risk stress refers to a level of stress that is hazardous to health (score over 25). Perceived stress increased, while the frequency of health behaviors decreased. Age, perception of susceptibility to COVID-19, life-threatening level of COVID-19, perception of the importance of home isolation, and perception of the difference between a common cold and COVID-19 were positively related to the occurrence of health risk stress.

Conclusions: A negative correlation was found between health behaviors and perceived stress. Therefore, it is of great significance to provide psychological interventions for those who are experiencing health risk stress and to promote their health behaviors.

KEYWORDS
China, COVID-19, health behaviors, mental health, perceived stress

Lili Yao and Ying Xiong contributed equally to the work.

1 | INTRODUCTION

An outbreak of novel coronavirus disease 2019 (COVID-19) caused severe respiratory illnesses. On January 30, 2020, the World Health Organization (WHO) declared COVID-19 the sixth public health emergency of international concern.[1] At 24:00 on March 12, 2020, globally, there were 125,048 confirmed cases (6729 new), 4613 deaths (321 new), 80,981 cases (26 new), and 2984 deaths (38 new) in China. Outside of China, the disease has spread to 117 countries (4 new), where 44,067 patients (6703 new) have been diagnosed and 1440 (310 new) have died. The WHO assessed the risk of an epidemic in China, regionally and globally, and all had high risks.[2]

Since COVID-19 infection may come from airborne droplets or ordinary contact with acquaintances, colleagues, or strangers, outbreaks can trigger stress and influence the public perception of susceptibility, causing serious economic and social disruption. During the epidemic, to reduce the risk of infection, the government carried out city lockdowns, travel restrictions, traffic control, home isolation, and canceling of mass gathering activities. As time goes by, the stress response of residents was arise. Aslan et al. investigated the perceived stress of 358 undergraduates in Turkey during the pandemic. The subjects reported that they had high levels of perceived stress, mild generalized anxiety, and low satisfaction with life. Perceived stress harms mental health, and students' mental health is at high risk during the pandemic.[3] Babore et al. surveyed the perceived stress and coping strategies of 595 medical workers in Italy and found that women had higher perceived stress levels during the epidemic.[4] Stepowicz et al. surveyed 210 adult women aged 19 to 45 in Poland and found that women with a history of psychotherapy, women in the first trimester of pregnancy, and women who were single or in informal relationships tended to experience higher levels of perceived stress.[5]

Perceived stress during the epidemic has a negative impact on residents' lives and mental health, but the health behaviors implemented have played an important role in preventing infection. While the literature on the stress factors that influence mental health during COVID-19 is abundant, cross-border research on multiple health behaviors is lacking.[6] Wollast et al. conducted a comparative study during the solstice spring blockade and found that residents in Belgium and France had a more positive attitude, a higher social norm, a higher sense of control, and a higher intention of hand washing compliance and social contact with a higher limit, which is effective in preventing infection.[6] Parekh et al. pointed out that obesity was a risk factor for serious complications and death from COVID-19 in 2019. Public health efforts to contain the epidemic may change health behaviors associated with weight gain, inflammation, and poor cardiometabolic health, exacerbating the prevalence of obesity, poor immune health, and chronic diseases. The enduring impact of the epidemic on health behavior and the possibility of new outbreaks of COVID-19 highlight the need for creative and evolutionary, multilayered approaches to help individuals adapt their health behavior to prevent COVID-19 infection. The COVID-19 epidemic, together with the mandate to "stay home," may affect both positive health behaviors (sleep, physical activity) and negative health behaviors (alcohol, drug, and tobacco use) in adults.[7] In a survey of 2289 adults in China, Wang et al. showed that more than 50% of respondents said they spent less time engaging in daily physical activities and more time engaging in sedentary behaviors than they did before confinement. Only 20% of respondents reported participating in moderate to strenuous physical activity, 23% of adults reported changing their diet to be healthier, and 30% reported eating more vegetables, fruits, and dairy products than they did before they were quarantined at home. Participants paid more attention to the quality and patterns of their diet, which had a positive impact on their quality of life. So, people should be encouraged to perform exercise at home to maintain a healthy lifestyle during prolonged isolation and be healthy and physically fit to meet the challenges of the epidemic.[8]

At present, most studies focus on the relationship between perceived stress and mental health, while there are few studies on the relationship between perceived stress and health behavior. Therefore, this study aims to explore the current situation of perceived stress among Chinese residents during the epidemic and the relationship between perceived stress and health behavior.

2 | METHODS

2.1 | Aims

The aims of this study were (1) to assess the status of perceived stress and the health behaviors of Chinese residents during the epidemic; (2) to identify high-risk populations for perceived stress; and (3) to evaluate the relationship between perceived stress and the health behaviors of Chinese residents during the COVID-19 epidemic.

2.2 | Study design, setting, and participant

An Internet-based cross-sectional survey on perceived stress and health behaviors was conducted among 2449 Chinese residents from February 14 to February 22, 2020. Participants were enrolled voluntarily. The participant selection criteria included residents over the age of 18 and agreement to participate in this study. Accordingly, the exclusion criteria were residents who were unable to use computers, smartphones, and other electronic devices.

2.3 | Measures

2.3.1 | Demographic variables

Demographic variables including sex, age, marital status, educational level, and so forth, we intended to determine the current status of

perceived stress and the incidence of health risk stress among Chinese residents with different demographic characteristics.

2.4 | Chinese perceived stress scale (CPSS)

The PSS was developed by American psychologist Dr. Cohen[9] to assess the degree of stress caused by unpredictable, uncontrollable, or overwhelming life events. Currently, there are three versions (one with 14 items [PSS-14], one with 10 items [PSS-10], and one with 4 items [PSS-4]); the PSS-14 is considered a brief and easy version to administer and complete.[10] This study used the Chinese version of the perceived stress scale (CPSS) based on the PSS-14.[11] Each item had five options: never = 0, occasionally = 1, sometimes = 2, often = 3, always = 4. A score of 25 was taken as the critical value to evaluate stress, low-stress state (0–14 score), medium stress state (15–24 score), and health risk stress state (above 25 scores). Health risk stress means the level of perceived stress hazardous to health.[9] That is, the higher the score is, the greater the stress perceived by the residents during the epidemic. The reliability test showed that the Cronbach α coefficient of this survey was 0.829.

2.5 | COVID-19 perception and Health Behavior Questionnaire

Referring to the relevant literature on the prevention and control of infectious diseases, recommendations of the WHO and the National Health Committee of the People's Republic of China,[12–14] we developed the questionnaires of COVID-19 perception and health behavior, conducted a small-scale test online to assess the response time and the feelings of the respondents and finally deleted misleading or excessive items. Eventually, COVID-19 Perception and Health Behavior Questionnaire were determined (see Table 1). The COVID-19 perception questionnaire consists of 13 items, the first seven being knowledge items with possible answers of "Yes," "No," and "Do not know." Items 3, 4, 5, and 7 answer "No" correctly, and Items 1, 2, and 6 answer "Yes" correctly. If the answer is correct, 1 point will be obtained; if the answer is wrong, 0 points

TABLE 1 Confirmatory factor analysis of COVID-19 perceptions and health behaviors

Questionnaire	Range	β	IFI/GFI	RMSEA	Cronbach's α
COVID-19 perception			0.921/0.984	0.062	0.667
Knowledge score[a]	0–7	0.445			
Cognition of susceptibility to COVID-19	1–5	0.677			
Life-threaten level of the COVID-19	1–5	0.706			
The perceived severity of the COVID-19 epidemic	1–5	0.808			
The importance of home isolation during the COVID-19 epidemic	1–5	0.666			
The difference between COVID-19 and common cold	1–5	0.743			
Is there any confirmed or suspected COVID-19 patient within 1 km of yourself	1–5	0.655			
COVID-19 health behavior			0.981/0.986	0.042	0.827
Active attention to real-time information on COVID-19	1–5	0.405			
After the outbreak, take the initiative to advise family members to wash hands frequently, wear masks and other protective measures	1–5	0.680			
Wash hands frequently at home	1–5	0.767			
Pay attention to open windows and ventilate the home (at least twice a day)	1–5	0.726			
Keep a safe distance from strangers when going out (at least 1 m)	1–5	0.742			
Cover mouth and nose with a tissue or elbow when coughing or sneezing to avoid others	1–5	0.751			
Wear a mask when going out	1–5	0.650			
Consume a healthy diet to improve nutrition level	1–5	0.665			
Perform appropriate exercise at home	1–5	0.502			
Reduce group gatherings such as going out and gathering	1–5	0.412			

Abbreviations: GFI, goodness-of-fit index; IFI, incremental fit index; RMSEA, root mean square error of approximation.

[a]Includes seven knowledge items (K1: In general, is the longest incubation period for COVID-19 14 days? K2: Is the main transmission method of COVID-19 by droplet transmission and contact transmission? K3: Could antibiotics prevent COVID-19? K4:Could taking Shuanghuanglian oral liquid prevent COVID-19? K5:Could a room fumigated with vinegar kill SARS-CoV-2? K6: Could hot water at 56°C for 30 min kill SARS-CoV-2? K7: Could gauze masks or activated carbon masks prevent COVID-19?); β, standardized factor loading estimate.

will be obtained; the score range is 0–7 points. Cronbach's α was 0.607. Items 8–13 use the five-level Likert scoring method, and each is assigned a score of 1–5, with scores ranging from 6 to 30 points. Cronbach's α was 0.667. The COVID-19 Health Behavior Questionnaire included 10 items (Table 1). The answer also uses the five-level Likert scoring method, with scores of 1–5 points and a total score range of 6–30 points. Cronbach's α was 0.827.

2.6 | Statistical analysis

Data analyses were finished with SAS 9.4 (Copyright 2016 SAS Institute Inc.). The measurement data with a normal distribution are described as the mean ± standard deviation. Independent samples *t*-test and analysis of variance were used to calculate the differences among groups, and post hoc analysis was performed by the Student-Newman-Kenls-q (SNK-q) test. The categorical data were described with numbers and percentages, χ^2 analysis was used to test the difference between groups, and post hoc analysis was performed by the Bonferroni method. The relationship between health behaviors and perceived stress as examined by the γ coefficient. The variables with $p < 0.05$ in univariate analysis were included in multivariate logistic regression, and the risk factors for health risk stress were examined by a stepwise method (exclusion standard $p > 0.05$ and inclusion standard $p < 0.05$). Confirmatory factor analysis (CFA) was considered to have a good fit if the standardized factor loading estimate >0.4, root mean square error of approximation (RMSEA) < 0.08, goodness-of-fit index (GFI) > 0.90 and Tucker–Lewis index (TLI) > 0.90. CFA was conducted using Amos 24.0. *p* values less than 0.05 on both sides were considered statistically significant.

3 | RESULTS

3.1 | Demographic characteristics and perceived stress

This study collected 2533 Internet-based questionnaires, and 2449 were valid, with a response rate of 96.7%. The participants included 823 (33.61%) males and 1626 (66.39%) females. A total of 90.36% of the participants were 18–50 years old. There were 1783 (72.80%) urban residents, 394 (16.09%) township residents, and 272 (11.11%) rural residents. This study found that sex, age, province, marital status, education level, occupation, and monthly income had statistical significance in the score of perceived stress ($p < 0.05$). In addition, at least three groups of residents experienced extremely high stress. The score of the female residents' perceived stress (22.6 ± 6.99) was higher than that of the male residents (21.55 ± 7.57), but there was no significant difference in the incidence of health risk stress between the two groups. The residents aged 18–25 years old had higher perceived stress and health risk stress incidence (48.86%) than those aged over 30 years old. Students had the strongest perceived stress (23.87 ± 6.18), and 48.66% of students were in the state of health risk stress (see Table 2). Furthermore, residents who were in medical isolation or during the home isolation period experienced higher perceived stress (23.65 ± 6.59) than those who were not isolated (22.09 ± 7.25). Additionally, this study found that 45.19% of medical professionals were in a state of health risk stress.

3.2 | Health behaviors and perceived stress

The correlation between health behavior and perceived stress was negative, and the γ correlation coefficient ranged from −0.379 to −0.212. As perceived stress increased, the frequency of health behaviors decreased, and the data showed that residents who never or occasionally read real-time information about COVID-19 experienced the lowest incidence of health risk stress (0.1%) (see Table 3).

3.3 | Perception of COVID-19 and perceived stress

At present, the confirmed transmission routes of COVID-19 include exposure to droplets and direct contact. However, only 15.3% of the residents knew the transmission route, and 13.1% of the residents knew the masks that could prevent the virus from transmitting. Simultaneously, the study found that different perception levels of COVID-19 could affect the perceived stress score and the incidence of health risk stress (see Table 4).

3.4 | Multivariate analysis of health risk stress

The study found that 39.89% of the residents were experiencing health risk stress. Demographic characteristics and perception items were analyzed by univariate logistic regression with 13 variables (sex, marriage, occupation, monthly income, etc.). We found that age, perception of susceptibility to COVID-19, life-threatening levels of COVID-19, perception of the importance of home isolation, and perception of the difference between the common cold and COVID-19 were significantly related to the occurrence of health risk stress ($p < 0.05$) (see Table 5).

4 | DISCUSSION

An Internet-based cross-sectional survey was completed by 2449 Chinese residents to assess perceived stress and health behaviors during the COVID-19 outbreak. The 45th Statistical Report on Internet Development in China demonstrated that the number of Internet users was 904 million.[15] Some studies have confirmed that, compared to traditional paper questionnaire surveys, Internet surveys are time-saving and convenient.[16,17]

TABLE 2 Comparison of perceived stress and incidence of health risk stress among participants with different demographic characteristics

Variable	Label	N	Perceived stress score	t/F	p	Health risk stress	χ^2	p
Sex	Male	823	21.55 ± 7.57	−3.324	0.001	315 (38.27)	1.355	0.244
	Female	1626	22.60 ± 6.99			662 (40.71)		
Age (years)	18–25[a]	837	23.78 ± 6.24[c,d,e]	28.47	<0.001	409 (48.86)[c,d,e]	70.11	<0.001
	26–30[b]	463	23.33 ± 6.67[c,d,e]			209 (5.14)[c,d,e]		
	31–40[c]	427	21.31 ± 7.82[a,b,d]			140 (32.79)[a,b]		
	41–50[d]	486	20.10 ± 7.98[a,b,c]			150 (30.86)[a,b]		
	≥51[e]	236	20.77 ± 6.95[a,b]			69 (29.24)[a,b]		
Provinces	Chongqing[a]	1408	22.72 ± 7.03[b]	6.068	<0.001	603 (42.83)[b]	13.87	0.008
	Sichuan[b]	434	20.84 ± 7.69[a,c]			147 (33.87)[a]		
	Gansu[c]	151	22.69 ± 7.30[b]			59 (39.07)		
	Jiangxi[d]	114	21.72 ± 7.58			45 (39.47)		
	Others[e]	342	22.07 ± 6.89			123 (35.96)		
Marital status	Nonmarried[a]	1000	23.54 ± 6.42[b,c]	27.8	<0.001	471 (47.10)[b]	36.62	<0.001
	Married[b]	1353	21.35 ± 7.50[a]			473 (34.96)[a]		
	Divorced or widowed[c]	96	21.48 ± 8.58[a]			33 (34.38)		
Education level	Junior high school diploma or below[a]	374	20.77 ± 8.00[b,c]	9.318	<0.001	135 (36.10)	3.072	0.215
	Senior high school diploma or advanced diploma[b]	1038	22.47 ± 7.04[a]			414 (39.88)		
	Baccalaureate degree and above[c]	1037	22.55 ± 7.00[a]			428 (41.27)		
Occupation	Medical staff[a]	312	22.49 ± 6.05[b,c]	11.583	<0.001	141 (45.19)[c]	20.147	<0.001
	Student[b]	261	23.87 ± 6.18[a,c]			127 (48.66)[c]		
	Others[c]	1867	21.64 ± 7.61[a,b]			685 (36.51)[a,b]		
Monthly income (CNY)	≤3000[a]	845	22.64 ± 7.33[e]	2.762	0.026	362 (42.84)[e]	12.54	0.014
	3000–5000[b]	880	22.31 ± 7.30[e]			356 (40.45)		
	5000–7000[c]	365	22.09 ± 6.60[e]			140 (38.36)		
	7000–10,000[d]	215	21.8 ± 7.21[e]			78 (36.28)		
	>10,000[e]	144	20.6 ± 7.15[a,b,c,d]			41 (28.47)[a]		
Residence	Urban[a]	1783	22.29 ± 7.16	0.155	0.857	709 (39.76)	0.101	0.951
	Township[b]	394	22.19 ± 7.13			160 (40.61)		
	Rural[c]	272	22.04 ± 7.59			108 (39.71)		
Are there are medical staff in the family?	Yes	940	22.52 ± 6.91	1.529	0.126	391 (41.60)	1.843	0.175
	No	1509	22.07 ± 7.38			586 (38.83)		
Are you in the medical isolation observation period or the home isolation observation period?	Yes	246	23.65 ± 6.59	3.231	0.001	115 (46.75)	5.358	0.021
	No	2203	22.09 ± 7.25			862 (39.13)		
Have you experienced medical isolation observation period or home isolation observation period?	Yes	226	22.64 ± 6.96	0.867	0.386	100 (44.25)	1.968	0.161
	No	2223	22.21 ± 7.23			877 (39.45)		

Note: [a]compared with the first layer, $p < 0.05$; [b]compared with the second layer, $p < 0.05$; [c]compared with the third layer, $p < 0.05$; [d]compared with the fourth layer, $p < 0.05$; [e]compared with the fifth layer, $p < 0.05$; [f]compared with the sixth layer, $p < 0.05$.

Abbreviations: CNY, Chinese Yuan.

TABLE 3 Comparison of participants' health behaviors under different stress levels

Frequency	Total	Low stress	Medium stress	Health risk stress	γ coefficient	*p*
Active attention to real-time information on COVID-19						
Never or occasionally	2 (0.08)	0 (0.00)	1 (0.09)	1 (0.10)	−0.223	<0.001
Sometimes	52 (2.12)	6 (1.70)	17 (1.52)	29 (2.97)		
Often	501 (20.46)	40 (11.36)	225 (20.09)	236 (24.16)		
Always	1894 (77.34)	306 (86.93)	877 (78.30)	711 (72.77)		
After the outbreak, take the initiative to advise family members to wash hands frequently, wear masks and other protective measures						
Never or occasionally	83 (3.39)	5 (1.42)	22 (1.96)	56 (5.73)	−0.339	<0.001
Sometimes	119 (4.86)	4 (1.14)	41 (3.66)	74 (7.57)		
Often	774 (31.60)	64 (18.18)	354 (31.61)	356 (36.44)		
Always	1473 (60.15)	279 (79.26)	703 (62.77)	491 (50.26)		
Wash hands frequently at home						
Never or occasionally	64 (2.61)	4 (1.14)	11 (0.98)	49 (5.02)	−0.31	<0.001
Sometimes	137 (5.59)	9 (2.56)	45 (4.02)	83 (8.50)		
Often	1029 (42.02)	98 (27.84)	485 (43.30)	446 (45.65)		
Always	1219 (49.78)	241 (68.47)	579 (51.70)	399 (40.84)		
Pay attention to open windows and ventilate the home (at least twice a day)						
Never or occasionally	67 (2.74)	5 (1.42)	21 (1.88)	41 (4.20)	−0.3	<0.001
Sometimes	164 (6.70)	12 (3.41)	56 (5.00)	96 (9.83)		
Often	951 (38.83)	85 (24.15)	443 (39.55)	423 (43.30)		
Always	1267 (51.73)	250 (71.02)	600 (53.57)	417 (42.68)		
Keep a safe distance from strangers when going out (at least 1 m)						
Never or occasionally	96 (3.92)	9 (2.56)	25 (2.23)	62 (6.35)	−0.327	<0.001
Sometimes	236 (9.64)	14(3.98)	91(8.13)	131(13.41)		
Often	824 (33.64)	62 (17.61)	398 (35.54)	364 (37.26)		
Always	1293 (52.80)	267 (75.85)	606 (54.11)	420 (42.99)		
Cover mouth and nose with a tissue or elbow when coughing or sneezing to avoid others						
Never or occasionally	67 (2.74)	4 (1.14)	19 (1.70)	44 (4.50)	−0.379	<0.001
Sometimes	120 (4.90)	9 (2.56)	27 (2.41)	84 (8.60)		
Often	622 (25.40)	46 (13.07)	271 (24.20)	305 (31.22)		
Always	1640 (66.96)	293 (83.24)	803 (71.70)	544 (55.68)		
Wear a mask when going out						
Never or occasionally	44 (1.80)	2 (0.57)	16 (1.43)	26 (2.66)	−0.352	<0.001
Sometimes	83 (3.39)	9 (2.56)	24 (2.14)	50 (5.12)		
Often	313 (12.78)	24 (6.82)	115 (10.27)	174 (17.81)		
Always	2009 (82.03)	317 (90.06)	965 (86.16)	727 (74.41)		
Consume a healthy diet to improve nutrition level						
Never or occasionally	103 (4.21)	4 (1.14)	21 (1.88)	78 (7.98)	−0.371	<0.001
Sometimes	363 (14.82)	16 (4.55)	124 (11.07)	223 (22.82)		
Often	981 (40.06)	107 (30.40)	507 (45.27)	367 (37.56)		
Always	1002 (40.91)	225 (63.92)	468 (41.79)	309 (31.63)		

TABLE 3 (Continued)

Frequency	Total	Low stress	Medium stress	Health risk stress	γ coefficient	*p*
Perform appropriate exercise at home						
Never or occasionally	489 (19.97)	36 (10.23)	180 (16.07)	273 (27.94)	−0.31	<0.001
Sometimes	654 (26.70)	55 (15.63)	299 (26.70)	300 (30.71)		
Often	694 (28.34)	104 (29.55)	364 (32.50)	226 (23.13)		
Always	612 (24.99)	157 (44.60)	277 (24.73)	178 (18.22)		
Reduce group gathering activities such as going out and gathering						
Never or occasionally	448 (18.29)	60 (17.05)	185 (16.52)	203 (20.78)	−0.212	<0.001
Sometimes	89 (3.63)	4 (1.14)	24 (2.14)	61 (6.24)		
Often	317 (12.94)	16 (4.55)	152 (13.57)	149 (15.25)		
Always	1595 (65.14)	272 (77.27)	759 (67.77)	564 (57.73)		

4.1 | High-risk groups of health risk stress

Students had higher stress scores. The prevalence of perceived stress among students was high.[18] Because of COVID-19, universities delayed the spring semester, the Ministry of Education advocated the suspension of classes, and stress emerged from the unexpected events, while all of them had adverse effects on students. The outbreaks put tremendous psychological stress on students and caused unfavorable effects on learning due to the increased avoidance of learning activities and reduced concentration.[19] Commodari et al. found that students living in areas with strict government control reported higher levels of negative psychological feelings.[20] These results highlighted the necessity of establishing psychological support programs for students during the COVID-19 outbreak. In addition, the mental health of the isolated population deserves attention, as this group requires more social support and professional psychological crisis interventions.

Medical personnel should also be concerned. Initially, the health care workers were in the center of a stressful condition due to the uncertainty of the mode of transmission of the disease, the great fear, and the rigorous implementation of infection control protocols. This study showed that 45.19% of medical professionals were in the state of health risk stress, due to overloaded clinical treatment and public prevention efforts in hospitals and community settings. Such psychological distress may affect medical staff, who would be in high demand and insufficient in number during the outbreaks. Challenges and stress could trigger common mental disorders, including anxiety and depressive disorders and posttraumatic stress disorder, which in turn could result in hazards that exceed the consequences of the epidemic itself.[21,22] For on-the-job medical personnel, it is necessary to further stress the awareness of self-protection, the strict implementation of infectious disease protection, standardized practices, a peaceful mindset, and stress relief in a timely manner. The hospital should provide timely management and technical support, allocate and guarantee supplies, and provide online and offline psychological counseling services.

In addition, the score of the female residents' perceived stress was higher than that of the male residents. An online survey of 90 pregnant women in Spain by Biviá-Roig et al. showed that the epidemic had a significant adverse impact on physical activity and health-related quality of life.[23] Previous studies have also reported the psychological effects of COVID-19 on people who recovered from the disease and underwent different types of treatment. Patients recovering from COVID-19 suffered from severe depression and experienced significant symptoms of posttraumatic stress disorder.[24,25] In total, at least three groups of residents were experiencing extremely high stress. To improve efficiency and make good use of limited medical resources, it is important to decide the key target groups at the initial stage and set priorities accordingly. It was essential to involve stress or psychological therapists in the overall planning of COVID-19 prevention and control measures. To ensure the continuous provision of mental health services and reduce the risk of cross-infection, the government is developing and implementing a remote consultation network to conduct telephone or Internet-based consultations in a safe environment in China.[26]

4.2 | Negative relationship between health behavior and perceived stress

Data analysis of residents' health behaviors and different stress levels were statistically significant ($p < 0.05$). It is generally believed that stress is a process and the product of the interaction between humans and the environment, which mainly involves the mediating variables of stressors and the physical and mental response. Three types of responses can help the body respond to stressors, namely, direct stress responses, such as fight or escape through the adaptability of secondary signals of the body and brain and the assessment of stress responses in the cortical structures and

TABLE 4 The status quo of disease perception and its comparison with the incidence of perceived stress and health risk stress

Label	N	Perceived stress score	t/F	p	Health risk stress	χ^2	p
In general, is the longest incubation period for COVID-19 14 days?							
Wrong answer	198	23.74 ± 6.58	3.044	0.002	95 (47.98)	5.874	0.015
Correct answer	2251	22.11 ± 7.24			882 (39.18)		
Is the main transmission method of COVID-19 by droplet transmission and contact transmission?							
Wrong answer	2075	22.35 ± 7.23	1.653	0.098	238 (44.32)	5.62	0.018
Correct answer	374	21.68 ± 7.06			739 (38.65)		
Could antibiotics prevent COVID-19?							
Wrong answer	537	22.88 ± 7.31	2.321	0.02	209 (44.75)	5.684	0.017
Correct answer	1912	22.07 ± 7.16			768 (38.75)		
Could taking Shuanghuanglian oral liquid prevent COVID-19?							
Wrong answer	467	23.07 ± 6.84	2.761	0.006	212 (44.92)	6.148	0.013
Correct answer	1982	22.05 ± 7.27			765 (38.69)		
Could a room fumigated with vinegar kill SARS-CoV-2?							
Wrong answer	472	23.33 ± 6.92	3.664	<0.001	277 (43.97)	5.872	0.015
Correct answer	1977	21.99 ± 7.25			700 (38.48)		
Could hot water at 56°C for 30 min kill SARS-CoV-2?							
Wrong answer	630	22.92 ± 6.97	2.719	0.007	839 (40.43)	1.652	0.199
Correct answer	1819	22.01 ± 7.27			138 (36.90)		
Could gauze masks or activated carbon masks prevent COVID-19?							
Wrong answer	2128	22.31 ± 7.21	1.13	0.259	854 (40.13)	0.383	0.536
Correct answer	321	21.82 ± 7.17			123 (38.32)		
Cognition of susceptibility to COVID-19							
Weak or extremely weak[a]	36	23.58 ± 7.04	4.466	0.004	21 (58.33)	21.656	<0.001
General[b]	50	25.08 ± 5.39[d]			32 (64.00)[c,d]		
Strong[c]	813	22.58 ± 6.86			340 (41.82)[b]		
Very strong[d]	1550	21.95 ± 7.40[b]			584 (37.68)[b]		
Life-threat level of the COVID-19							
Not afraid or nothing afraid[a]	278	19.65 ± 8.26[b,c,d]	21.977	<0.001	91 (32.73)[c,d]	25.367	<0.001
Average[b]	768	21.62 ± 6.93[a,c,d]			267 (34.77)[c,d]		
Afraid[c]	964	22.89 ± 6.82[a,b]			419 (43.46)[a,b]		
Very afraid[d]	439	23.57 ± 7.26[a,b]			200 (45.56)[a,b]		
The perceived severity of the COVID-19 epidemic							
Not serious or nothing serious[a]	53	23.19 ± 6.75	0.446	0.721	25 (47.17)	3.074	0.38
Average[b]	131	21.9 ± 7.49			59 (45.04)		
Serious[c]	972	22.18 ± 6.97			389 (40.02)		
Strongly serious[d]	1293	22.29 ± 7.37			504 (38.98)		
The importance of home isolation during the COVID-19 epidemic							
Extremely unclear or relatively unclear[a]	26	23.77 ± 6.47[b]	20.432	<0.001	12 (46.15)[b]	49.558	<0.001
Uncertainty[b]	45	27.33 ± 3.52[a,c,d]			36 (80.00)[a,c,d]		

TABLE 4 (Continued)

Label	N	Perceived stress score	t/F	p	Health risk stress	χ^2	p
Quite clear[c]	420	24.04 ± 6.36[b]			203 (48.33)[b]		
Strongly clear[d]	1958	21.72 ± 7.34[b]			726 (37.08)[b]		
The difference between COVID-19 and the common cold							
Extremely unclear or relatively unclear[a]	73	26.04 ± 5.67[b,c,d]	30.254	<0.001	46 (63.01)[c,d]	48.152	<0.001
Uncertainty[b]	280	24.51 ± 6.53[a,c,d]			144 (51.43)[c,d]		
Quite clear[c]	1167	22.61 ± 6.77[a,b,d]			476 (40.79)[a,b,d]		
Strongly clear[d]	929	20.81 ± 7.69[a,b,c]			311 (33.48)[a,b,c]		
Is there any confirmed or suspected COVID-19 patient within 1 km of yourself							
Extremely unclear or relatively unclear[a]	114	23.58 ± 6.87[d]	25.292	<0.001	53 (46.49)[d]	30.664	<0.001
Uncertainty[b]	498	23.68 ± 6.60[d]			230 (46.18)[d]		
Quite clear[c]	792	23.03 ± 6.63[d]			342 (43.18)[d]		
Strongly clear[d]	1045	20.82 ± 7.67[a,b,c]			352 (33.68)[a,b,c]		

Note: a, compared with the first layer, $p < 0.05$; b, compared with the second layer, $p < 0.05$; c, compared with the third layer, $p < 0.05$; d, compared with the fourth layer, $p < 0.05$.

TABLE 5 Logistic regression model results of health risk stress incidence among participants

Variable	β	Std error	Wald χ^2	p	OR	95% CI
Age (years)						
18–25	0.94	0.165	32.444	<0.001	2.561	1.853, 3.539
26–30	0.817	0.177	21.372	<0.001	2.264	1.601, 3.201
31–40	0.268	0.182	2.18	0.14	1.308	0.916, 1.867
41–50	0.077	0.179	0.187	0.665	1.08	0.761, 1.534
≥51					1.0 (reference)	
Cognition of susceptibility to COVID-19						
Very strong	1.069	0.363	8.666	0.003	2.912	1.429, 5.934
Strong	0.994	0.325	9.361	0.002	2.703	1.43, 5.111
General	0.166	0.096	2.982	0.084	1.181	0.978, 1.425
Weak or extremely weak					1.0 (reference)	
Life-threat level of the COVID-19						
Not afraid or nothing afraid					1.0 (reference)	
Average	−0.078	0.159	0.239	0.625	0.925	0.678, 1.263
Afraid	0.426	0.153	7.763	0.005	1.531	1.135, 2.065
Very afraid	0.706	0.17	17.166	<0.001	2.026	1.451, 2.829
The importance of home isolation during the COVID-19 epidemic						
Extremely unclear or relatively unclear	0.027	0.437	0.004	0.95	1.028	0.437, 2.418
Uncertainty	1.452	0.398	13.315	<0.001	4.27	1.958, 9.313
Quite clear	0.293	0.119	6.116	0.013	1.341	1.063, 1.691
Strongly clear					1.0 (reference)	

(Continues)

TABLE 5 (Continued)

Variable	β	Std error	Wald χ^2	p	OR	95% CI
The difference between COVID-19 and the common cold						
Extremely unclear or relatively unclear	0.977	0.274	12.664	<0.001	2.656	1.551, 4.548
Uncertainty	0.624	0.151	17.182	<0.001	1.866	1.39, 2.507
Quite clear	0.214	0.099	4.699	0.03	1.239	1.021, 1.503
Strongly clear					1.0 (reference)	

pathways.[10] For the domestic material storage status, the study found that 71.37% of the residents had few or even no masks available when the epidemic broke out, while only 6.16% reserved sufficient disinfectant. The shortage of supplies and the sudden disruption of work and life were all the main sources of stress during the COVID-19 epidemic. We found that only 53.33% of residents often or always undertook appropriate exercises even when they were isolated at home. Chen et al.[27] reported that staying at home for a long time results in increased sedentary behaviors, reduced regular physical activity, and eventually increased health risks or a cycle of anxiety and depression. Therefore, it is suggested that residents' health behaviors should be improved, balanced diets and regular exercise should be maintained and immunity should be enhanced in a safe family environment.

4.3 | Residents' perception of disease is not optimistic under a stress state

Lai et al.[28] found that 73.71% of the residents were concerned about epidemic information, and public health authorities should keep close monitoring of the situation, providing accurate, clear, sufficient, timely, and trustworthy information. The more people learn about this novel virus and its associated outbreaks, the better they can respond. The media and governments should develop more channels and methods for information disclosure, strengthen propagation, and release epidemic information in real time. Residents should take rational views on COVID-19, abide by special regulations, improve their perception of prevention, obtain information through official channels, relieve stress, understand the importance of home isolation, and prevent virus transmission.

4.4 | Notable factors affecting health risk stress

This study found that 39.89% of the residents were in a state of health risk stress. Brewin et al.[29] reported a broader range of stress statuses, and predictor variables included gender, age, and perceived life threat. This study found that younger residents had higher disease susceptibility perception and higher life-threatening levels, were uncertain about the importance of home isolation or were extremely unclear about the difference between the common cold and COVID-19, which were significantly associated with health risk stress. It is necessary to take effective measures to deal with health risk stress, taking into consideration these factors.

This study had several advantages. First, to minimize personal contact during the outbreak, participants were surveyed via the Internet instead of face-to-face. The Internet survey is different from traditional investigation methods and is rapid and convenient. Second, this work revealed that some specific individuals need to be deeply concerned. Last, effective psychological interventions for residents maintaining mental health in the face of COVID-19 are needed, some psychological interventions should be implemented.

5 | CONCLUSION

This study provided timely and authentic data on perceived stress in relation to COVID-19. The Internet-based cross-sectional survey revealed that females, students, medical staff, and residents who were in medical isolation or home isolation had higher perceived stress levels. Furthermore, 39.89% of residents were experiencing health risk stress. Those younger residents with perceptions of higher disease susceptibility and higher life threat levels were uncertain about the importance of home isolation or were extremely unclear about the difference between the common cold and COVID-19, which are significantly associated with health risk stress. In addition, the frequency of health behaviors decreased as the perceived stress increased. The significant factors found in this study may contribute to identifying at-risk residents in a timely manner and providing necessary interventions.

6 | LIMITATIONS

We acknowledge that this study had a few limitations. One is the potential selection bias of the participants; although enrolled from 20 provinces, they do not represent the status of all Chinese individuals. Furthermore, we acknowledge the cross-sectional nature of the study, which limits conclusions concerning causality and peculiarities of sampling.

AUTHOR CONTRIBUTIONS

Lili Yao: Conceptualization; investigation; writing—original draft; writing—review and editing. **Ying Xiong:** Investigation; data curation; formal analysis. **Feng Yuan**: Conceptualization; investigation. **Yetao Luo**: Conceptualization; data curation; formal analysis. **Lupei Yan**: Investigation. **Yuerong Li**: Conceptualization; funding acquisition; writing—review and editing. All authors have read and approved the final version of the manuscript. The corresponding author had full access to all the data and took complete responsibility for the integrity of the data and the accuracy of the data analysis.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (NO.2020-250). Informed consent was obtained for all participants.

TRANSPARENCY STATEMENT

All authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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