Perceived Stress and Its Impact on Health Behavior of Chinese Residents during the Epidemic of COVID-19: An Internet Survey

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Abstract

Background: The outbreak of 2019 novel coronavirus disease(COVID-19) caused severe respiratory illnesses, which might be resulted from air-borne droplets or direct contact, posing a great threat to human life. Meanwhile, the epidemic might trigger excessive stresses and produce terrible impacts on mental health even health behaviors, especially of the vulnerable individuals. So this study paved the way for psychological interventions focused on vulnerable groups during the COVID-19 epidemic.

Methods: An internet survey was conducted among 2,449 residents in 20 Provinces of China, collecting the data about the perceived stress, the cognition of COVID-19 and the health behaviors. SAS9.4 was used to analyze the relationship between health behaviors and perceived stress, and logistic regression was used to explore the influencing factors of health risk stress.

Results: The perceived stress score was 22.25±7.2(total56), and the incidence of health risk stress was 39.89% (977/2449). Perceived stress increased, while the frequency of health behaviors decreased, such as washing hands and wearing masks. Age, cognition of susceptibility to COVID-19, life-threatening level, cognition of the importance of home isolation, and cognition of the difference between 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 improve residents' knowledge of the COVID-19, to provide good social support and psychological interventions for those how are experiencing health risk stress and to promote their health behaviors.

1. Background

Emerging infectious diseases pose potential risks to the public health across the world. Outbreaks of Ebola in Africa, West Nile encephalitis in North America, severe acute respiratory syndrome (SARS) in Asia and Canada, and avian flu in Southeast Asia and China suggested that both developed and developing countries were constantly under the threat of infectious epidemics [1]. An outbreak of 2019 novel coronavirus disease(COVID-19)cropped up in Wuhan, China, on December 8, 2019, caused severe respiratory illnesses. On January 30, 2020, the World Health Organization(WHO) declared COVID-19 as the sixth public health emergency of international concern [2]. At 24:00 on March 12, 2020, globally, there had been 125048 confirmed cases (6729 newly), 4613 deaths (321 newly), 80981cases(26 newly)and 2984 deaths (38 newly)in China. Outside of China, the disease has spread to 117 countries(4 newly), where 44067 patients(6703 newly) have been diagnosed and 1440 (310newly) died. WHO assessed risk of epidemic, China, regional and global,were all very high [3].Since COVID-19 infection could be caused by air-borne droplets or direct contact with strangers, colleagues, and even acquaintances, outbreaks would trigger stress and influence the public perception of susceptibility, leading to serious economic and social disruption. During the epidemic, in order to reduce the risk of infection,the government introduced many measures such as city blockade, travel restriction, traffic control, home isolation, and canceling mass gathering activities. As time goes by, stress response of residents would undoubtedly arise.The ability to identify stress is be beneficial to the individual to develop self-coping mechanisms. Stress would bring about worse psychological well-being and health [4]. Studies found that people would change behaviors due to obvious stress response. During the epidemic of Severe Acute Respiratory Syndrome (SARS), stress state changed people's living habits and behaviors to some extent, because people adopted negative coping styles when facing public health emergencies [5]. It was also reported that public health emergencies caused nervousness and increased perceived stress, which were key factors leading to changes of individual's behavior. The overreaction behavior would increase along the increase of stress, and health behaviors would decrease. Therefore, the psychological reaction of tension and loss of control would lead to the adverse overreaction to control events, which was not conducive to the formation of health behaviors [6]. Increased perceived stress and decreased health behaviors were hurtful to the prevention and control of the epidemic. The study analyzed the current situation of Chinese residents' perceived stress and health behaviors, as well as the influencing factors of the incidence rate of health risk stress, providing reference for psychological interventions during the epidemic.

2. Methods

2.1 Aims

The aims of this study were: (1) to identify high-risk populations of perceived stress and to propose psychological interventions; (2) to assess the prevalence of health risk stress and its impact on mental health; (3) to evaluate the relationship between perceived stress and health behaviors of Chinese residents during the COVID-19 epidemic.

2.2 Study design and Participant

An internet-based survey on perceived stress and health behaviors were conducted among 2449 Chinese residents, from February 14 to February 22, 2020. Participants were enrolled voluntarily, but not selected randomly. Nevertheless, we strived to avoid any systematic selection bias, and they should represent Chinese as much as possible. The participants selection criteria included: urban and rural residents over the age of 18; medical personnel, teachers, company employees, students, farmers, service industry employees and other occupational groups were also eligible. Accordingly, exclusion criteria were residents who were unable to use computers, smart phones and other electronic devices. In addition, individuals with anxiety, depression, schizophrenia and other mental diseases were also excluded.

2.3 Measures

Demographic Variables.

Including gender, age, marital status, educational level, et al. See Table 1. We intended to know the current status of perceived stress and the incidence of health risk stress among Chinese residents with different demographic characteristics.

Table 1
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	χ2	P
gender		Male	823	21.55 ± 7.57	-3.324	0.001	315(38.27)	1.355	0.244
		Female	1626	22.6 ± 6.99			662(40.71)		
age(years)	a	18–25	837	23.78 ± 6.24cde	28.47	< 0.001	409(48.86)cde	70.11	< 0.001
	b	26–30	463	23.33 ± 6.67cde			209(45.14)cde		
	c	31–40	427	21.31 ± 7.82abd			140(32.79)ab		
	d	41–50	486	20.1 ± 7.98abc			150(30.86)ab		
	e	≧ 51	236	20.77 ± 6.95ab			69(29.24)ab		
Provinces	a	Chongqing	1408	22.72 ± 7.03b	6.068	< 0.001	603(42.83)b	13.87	0.008
	b	Sichuan	434	20.84 ± 7.69ac			147(33.87)a		
	c	Gansu	151	22.69 ± 7.3b			59(39.07)		
	d	Jiangxi	114	21.72 ± 7.58			45(39.47)		
	e	Others	342	22.07 ± 6.89			123(35.96)		
Marital status	a	Non-married	1000	23.54 ± 6.42bc	27.8	< 0.001	471(47.10)b	36.62	< 0.001
	b	Married	1353	21.35 ± 7.5a			473(34.96)a		
	c	Divorced or widowed	96	21.48 ± 8.58a			33(34.38)		
Education level	a	Junior high school diploma or below	374	20.77 ± 8bc	9.318	< 0.001	135(36.10)	3.072	0.215
	b	Senior high school diploma or Advanced diploma	1038	22.47 ± 7.04a			414(39.88)		
	c	Baccalaureate degree and above	1037	22.55 ± 7a			428(41.27)		
Occupation	a	Medical staff	312	22.49 ± 6.05bc	11.583	< 0.001	141(45.19)c	20.147	< 0.001
	b	Student	261	23.87 ± 6.18ac			127(48.66)c		
	c	Others	1867	21.64 ± 7.61ab			685(36.51)ab		
Monthly income(RMB)	a	≦ 3000	845	22.64 ± 7.33e	2.762	0.026	362(42.84)e	12.54	0.014
	b	3000–5000	880	22.31 ± 7.3e			356(40.45)		
	c	5000–7000	365	22.09 ± 6.6e			140(38.36)		
	d	7000–10000	215	21.8 ± 7.21e			78(36.28)		

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, $P < 0.05$.

Variable	Label		N	perceived stress score	t/F	P	Health risk stress	χ2	P
	e	10000	144	20.6 ± 7.15abcd			41(28.47)a		
Residence	a	Urban	1783	22.29 ± 7.16	0.155	0.857	709(39.76)	0.101	0.951
	b	Township	394	22.19 ± 7.13			160(40.61)		
	c	Rural	272	22.04 ± 7.59			108(39.71)		
Whether 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)		
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, $P < 0.05$.									

Chinese perceived stress scale (CPSS)

The perceived stress scale (PSS) was developed by American psychologist Dr. Cohen s [7], assessing the degree of stress caused by unpredictable, uncontrollable or overloaded life. Currently, there are 3 versions of 14 items(PSS-14), 10 items (PSS-10) and 4 items(PSS-4), while PSS-14 is considered as a brief and easy one to administer and complete [8]. According to the national conditions and the local settings, this study revised the Chinese version of perceived stress scale (CPSS). The scale(PSS-14) was first translated by two domestic scholars, then translated back by two Chinese-American scholars, and lastly revised by one Chinese-American and one domestic scholar. The overall structure and items were examined and modified to be in accordance with China's cultural background, forming the preliminary scale, which had good reliability and validity in investigation [9], Therefore, CPSS(14 items)was used to investigate the perceived stress of residents during the epidemic of COVID-19. Each item had 5 options: never = 0, almost = 1, sometimes = 2, often = 3, always = 4. Positive responses assessed the ability to deal with perceived stress, while negative assessed the lack of control, bad emotions, and reactions. The 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 score). Health risk stress represented the level of perceived stress that was found to impact health in previous study [9]. That is, the higher the score, the greater stress perceived by the residents during the epidemic.The reliability test showed the Cronbach coefficient of this survey was 0.829, a high internal consistency.

COVID-19 Cognition and Health Behavior Questionnaires

Referring to the relevant literature on the prevention and treatment of infectious diseases, the prevention of COVID-19 of the WHO and the National Health Committee of the People's Republic of China [10–13], the research team discussed the rationality and scientificity of questionnaire online, then, conducted a small-scale test online to assess the response time and the feelings of the respondents and finally deleted misleading or excessive items, enhancing the feasibility of the survey.Eventually, 13 cognitive items and 10 health behavior items about the COVID-19 were determined. The Cronbach coefficient of the two questionnaires were 0.667 and 0.827.

2.4 Statistical analysis

The measurement data of normal distribution were described with the mean plus or minus standard deviation. Groups were compared with independent samples *T* test and variance analysis, and the afterwards by SNK. The data were explained with the rate of adoption, and the *chi-square* analysis and Bonferroni method were employed in the comparison between groups. The relationship between health behaviors and perceived stress as examined by the linear trend test and the Gamma coefficient described the correlation between them. Variables with $P < 0.05$ in univariate logistic regression were included in multivariate logistic regression, and the independent risk factors of health risk stress were examined by stepwise regression (exclusion standard 0.05). $P < 0.05$ was considered statistically significant. All analyses were finished with SAS9.4(Copyright 2016 SAS Institute Inc. Cary, NC, USA) $P < 0.05$ was considered statistically significant.

2.5 Research quality control

A series of measures were adopted to control quality strictly:(1) Each question must be answered, otherwise the questionnaire could not be submitted; (2)To avoid repeated submission and filling, each IP address could only submit once; (3)Invalid questionnaires were deleted. (logical errors, finished within 1 minute or more than 30 minutes).

3. Results

This study collected 2,533 internet-based questionnaires and 2,449 were valid and been put into the database for analysis, with an effective rate of 96.7%. It revealed a negative correlation between health behaviors and perceived stress, 39.89% residents were trapped in health risk stress.

3.1 Demographic characteristics & perceived stress

Participants, 823 (33.60%) male and 1626 (66.39%) female, 90.4% aged 18–50, 1,783 urban residents(72.8%)and 666 township and rural residents(27.2%). 374 (15.3%) received junior high school education or below, and 2,075 (84.7%)received senior high school education or above. The data of gender, age, marital status, education level, and the analysis of perceived stress were statistically significant.($P < 0.05$). This research found 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, but no statistical difference in the incidence of health risk stress between the two groups. The residents aged 18–25 had higher perceived stress (23.78 ± 6.24) 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 1. Besides, residents who were in medical isolation or home isolation observation experienced higher perceived stress(23.65 ± 6.59)than those who were not isolated. Further, this study found that 45.19% of medical professionals were in the state of health risk stress.

3.2 health behaviors and perceived stress

The correlation between health behavior and perceived stress was negative, and the Gamma correlation coefficient ranged from − 0.212 to -0.379. As the perceived stress increased, the frequency of health behaviors decreased, such as washing hands and wearing masks. The data showed that the residents who never or occasionally read the real-time information of COVID-19 experienced the lowest incidence of health risk stress (0.1%), while the residents who always wore masks when going out had the highest incidence of health risk stress (74.41%). See Table 2.

Table 2
Comparison of participants' health behaviors under different stress states

	Frequency	total	Low stress	Medium stress	Health risk stress	χ2	P	χ2*	P	Gamms coefficient	P
Active Attention to Real-time Information of COVID-19	Never or Occasionally	2(0.08)	0(0.00)	1(0.09)	1(0.10)	33.647	< 0.001	28.902	< 0.001	-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)	120.569	< 0.001	107.782	< 0.001	-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)	122.946	< 0.001	105.023	< 0.001	-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 at home (at least twice a day)	Never or Occasionally	67(2.74)	5(1.42)	21(1.88)	41(4.20)	103.891	< 0.001	88.838	< 0.001	-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(51.74)	250(71.02)	600(53.57)	417(42.68)						
Keep a safe distance from strangers when going out (at least 1 meter)	Never or Occasionally	96(3.92)	9(2.56)	25(2.23)	62(6.35)	138.724	< 0.001	110.082	< 0.001	-0.327	< 0.001
	Sometimes	236(9.64)	14(3.98)	91(8.13)	131(13.41)						
	Often	824(33.65)	62(17.61)	398(35.54)	364(37.26)						
	Always	1293(52.80)	267(75.85)	606(54.11)	420(42.99)						

* Linear Trend Test

	Frequency	total	Low stress	Medium stress	Health risk stress	χ2	P	χ2*	P	Gamms coefficient	P
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)	135.224	< 0.001	111.793	< 0.001	-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(66.97)	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)	68.996	< 0.001	51.648	< 0.001	-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)						
Have health Diets to improve nutrition level	Never or Occasionally	103(4.21)	4(1.14)	21(1.88)	78(7.98)	217.075	< 0.001	179.163	< 0.001	-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)						
Take appropriate exercise at home	Never or Occasionally	489(19.97)	36(10.23)	180(16.07)	273(27.94)	166.904	< 0.001	143.359	< 0.001	-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)	77.653	< 0.001	26.898	< 0.001	-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(65.13)	272(77.27)	759(67.77)	564(57.73)						
* Linear Trend Test											

3.3 Cognition of COVID-19 & perceived stress

At present, the confirmed transmission routes of the COVID-19 include droplet and contact. However, 74.27%-80.93% of residents were sure whether taking antibiotics / Shuanghuanglian oral solution could prevent the transmission, whether vinegar could kill the virus, and whether hot water over 56 degrees Celsius could kill the virus for 30 minutes. It can be concluded that residents had a certain ability to identify rumors. But only 15.3% of the residents knew the transmission route, and 13.1% knew the masks that could prevent the virus from transmitting, and the overall disease awareness rate was 62.04%. Simultaneously, the study found that different cognitive levels of COVID-19 could affect perceived stress score and the incidence of health risk stress. See Table 3.

Table 3
The status quo of disease cognition and its comparison with the incidence of perceived stress and health risk stress

	Label		N	Perceived stress score	t/F	P	Health risk stress	χ2	P
In general, is the longest incubation period for COVID-19 14 days?		No or Unclear	198	23.74 ± 6.58	3.044	0.002	95(47.98)	5.874	0.015
		Yes	2251	22.11 ± 7.24			882(39.18)		
Is COVID-19 the main transmission method by droplet transmission and contact transmission?		No or Unclear	2075	22.35 ± 7.23	1.653	0.098	238(44.32)	5.62	0.018
		Yes	374	21.68 ± 7.06			739(38.65)		
Could antibiotics prevent COVID-19?		No or Unclear	537	22.88 ± 7.31	2.321	0.02	209(44.75)	5.684	0.017
		Yes	1912	22.07 ± 7.16			768(38.75)		
taking shuanghuanglian oral liquid could prevent COVID-19?		No or Unclear	467	23.07 ± 6.84	2.761	0.006	212(44.92)	6.148	0.013
		Yes	1982	22.05 ± 7.27			765(38.69)		
Could room fumigated vinegar kill SARS-CoV-2?		No or Unclear	472	23.33 ± 6.92	3.664	< 0.001	277(43.97)	5.872	0.015
		Yes	1977	21.99 ± 7.25			700(38.48)		
Could hot water at 56 degrees celsius kill SARS-CoV-2 for 30 minutes?		No or Unclear	630	22.92 ± 6.97	2.719	0.007	839(40.43)	1.652	0.199
		Yes	1819	22.01 ± 7.27			138(36.90)		
Mask types that can prevent viral infections		No or Unclear	2128	22.31 ± 7.21	1.13	0.259	854(40.13)	0.383	0.536
		Yes	321	21.82 ± 7.17			123(38.32)		
cognition of susceptibility to COVID-19	a	Weak or extremely weak	36	23.58 ± 7.04	4.466	0.004	21(58.33)	21.656	< 0.001
	b	General	50	25.08 ± 5.39d			32(64.00)cd		
	c	Strong	813	22.58 ± 6.86			340(41.82)b		
	d	very strong	1550	21.95 ± 7.4b			584(37.68)b		
life-threaten level	a	Not afraid or nothing afraid	278	19.65 ± 8.26bcd	21.977	< 0.001	91(32.73)cd	25.367	< 0.001
	b	average	768	21.62 ± 6.93acd			267(34.77)cd		
	c	afraid	964	22.89 ± 6.82ab			419(43.46)ab		
	d	very afraid	439	23.57 ± 7.26ab			200(45.56)ab		
The perceived severity of the COVID-19	a	Not serious or nothing serious	53	23.19 ± 6.75	0.446	0.721	25(47.17)	3.074	0.38
	b	average	131	21.9 ± 7.49			59(45.04)		
	c	Serious	972	22.18 ± 6.97			389(40.02)		

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, $P < 0.05$.

	Label		N	Perceived stress score	t/F	P	Health risk stress	χ2	P
	d	strongly serious	1293	22.29 ± 7.37			504(38.98)		
The importance of home isolation during the COVID-19	a	extremely unclear or relatively unclear	26	23.77 ± 6.47b	20.432	< 0.001	12(46.15)b	49.558	< 0.001
	b	uncertainty	45	27.33 ± 3.52acd			36(80.00)acd		
	c	quite clear	420	24.04 ± 6.36b			203(48.33)b		
	d	strongly clear	1958	21.72 ± 7.34b			726(37.08)b		
The Difference between COVID-19 and Common Cold	a	extremely unclear or relatively unclear	73	26.04 ± 5.67bcd	30.254	< 0.001	46(63.01)cd	48.152	< 0.001
	b	uncertainty	280	24.51 ± 6.53acd			144(51.43)cd		
	c	quite clear	1167	22.61 ± 6.77abd			476(40.79)abd		
	d	strongly clear	929	20.81 ± 7.69abc			311(33.48)abc		
Is there any confirmed or suspected COVID-19 patient within 1 km of yourself	a	extremely unclear or relatively unclear	114	23.58 ± 6.87d	25.292	< 0.001	53(46.49)d	30.664	< 0.001
	b	uncertainty	498	23.68 ± 6.6d			230(46.18)d		
	c	quite clear	792	23.03 ± 6.63d			342(43.18)d		
	d	strongly clear	1045	20.82 ± 7.67abc			352(33.68)abc		

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, $P < 0.05$.

3.4 Multivariate Analysis of Health Risk Stress

The study found that 39.89% of the residents were trapped in health risk stress. Demographic characteristics and cognitive items were analyzed by the univariate logistic regression with 13 variables (gender, marriage, occupation, monthly income, etc.). The data detected that age, cognition of susceptibility to COVID-19, life-threatening levels, cognition of the importance of home isolation, and cognition of the difference between common cold and COVID-19 were significantly related to the occurrence of health risk stress, $P < 0.05$. See Table 4.

Table 4
Logistic Regression Model Results of Health Risk Stress Incidence among participants

Variable		β	Stderr	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-threaten level							
	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)	
The Difference between COVID-19 and 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)	

4. Discussion

An internet-based survey was finished by 2449 Chinese residents to assess the perceived stress and health behaviors during the COVID-19 outbreak. The 44th Statistical Report on Internet Development in China demonstrated that the number of internet users was 854 million [14]. Some studies had confirmed that,compared to the traditional paper questionnaire survey, online-based surveys were time-saving and convenient [15, 16].

High risk groups of health risk stress

Students had higher stress scores. The prevalence of perceived stress among students was high [17]. Because of theCOVID-19, universities delayed the spring semester, and 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 significant psychological stress on students and caused unfavorable effects on learning [18], for the increased avoidance of learning activities and the reduced concentration. Those results highlighted the necessity to establish psychological support

programs for students during the COVID-19 outbreak. Besides, the mental health of the isolated population deserved attention, requiring more social support and professional psychological crisis interventions.

Further, medical personnel also attracted attention. 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 tremendous fear, and the rigorous implementation of infection control protocols. It was reported that 30% of the confirmed cases occurred on health care workers (HCWs)during Middle East Respiratory Syndrome-Corona Virus outbreaks, the SARS epidemic in 2003 and the influenza A/Hemagglutinin1 Neuraminidase1(H1N1) pandemic in 2009. Researchers evaluated psychological stress on HCWs with different modalities, and stress was constantly high [18]. This study showed that 45.19% of medical professionals were in the state of health risk stress, over-loaded clinical treatment and public prevention efforts in hospitals and community settings. Such psychological distress may affect HCWs, who would be in a high demand and shortage during the outbreaks. Challenges and stress could trigger common mental disorders, including anxiety and depressive disorders, and post-traumatic stress disorder, which in turn could result in hazards that exceed the consequences of the epidemic itself [19, 20]. For on-the-job medical personnel, it is necessary to further stress the awareness of self-protection, the strict implementation of infectious disease protection, the standardized practices, the peaceful mindset, and the 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.

Totally, at least three groups of residents were experiencing extremely high stress. In order 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. The guidelines divided the population affected by COVID-19 into four groups, the medical staff, especially those in the clinic, the suspected persons, the susceptible groups and the general public [21]. It was essential to involve stress or psychological therapists in the overall planing of COVID-19 prevention and control. Their main responsibility was to minimize psychological harm and provide timely assistance, that is, to provide mental health support for high risk stress individuals. The work of psychological intervention was initiated by the Chinese Society of Psychiatry, a team of experts to organize intervention efforts and provide technical guidance [22]. In the current epidemic, face-to-face psychological counseling requires high standards of on-site isolation to minimize risks. This service is only available to the clinic medical staff who are not infected, and it is not available to ordinary residents who are actually in a need of psychological intervention. In order to ensure the continuous provision of mental health services and reduce the risk of cross-infection, the government is developing and implementing remote consultation network to conduct telephone or internet-based consultations in a safe environment [21].

Negative Relationship between health Behavior and perceived Stress

Individual's perceived stress exerted significant effects on behaviors and experience [23]. Data analysis of residents' health behaviors and different stress states were statistically significant ($p < 0.05$), which was consistent with the results of the impact of perceived stress on health behaviors investigated during the SARS epidemic [5]. It is generally believed that stress is a process and the product of the interaction between human and environment, which mainly involves the mediating variables of stressor 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, the assessment of stress responses in the cortical structures and pathways [8]. 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 all were the main sources of stress during the epidemic of COVID-19. Residents with monthly income more than 10,000RMB encountered lower rates of perceived stress and health risk stress, so it suggested that the economic situation was also an important factor in the face withCOVID-19.

The relation between perceived cognitive deficits and depressive symptoms partially reflected in the quality of sleep and perceptions of stress [24] and anxiety. Anxiety levels closely mirrored the daily number of new cases and were strongly associated with the intensity of the outbreak [25]. Psychobehavioral responses during the SARS or H1N1 influenza outbreaks indicated a positive association between anxiety level and protective behaviors [25–27]. However, if anxiety got beyond some level, it would show adverse effects, and previous studies obtained the same results [28]. Logistic regression models were also used to examine the prevalence of high levels of perceived stress and poor sleep quality and found them increased in proportion to the smart-phone use and insufficient physical activity [29]. This work got the result that only 53.33% of residents often or always took appropriate exercises even when they were isolated at home. Study [30] reported that a long time staying at home would result in increased sedentary behaviors, reducing regular physical activity,and eventually leading to increased health risks or a cycle of anxiety and depression. Therefore, it is suggested to improve residents' health behaviors, keep balanced diets, maintain regular exercises and enhance immunity in a safe family environment.

Residents' cognition of disease is not optimistic under stress state

For knowledge of SARS, approximately 63% answered two or more questions correctly [28]. Nowadays, the overall awareness rate of COVID-19 was 62.04%. This disease hasn't been fully understood, there is no drugs or vaccines specific for the virus and the official authorities are also in a high need of related information and health behaviors. This survey showed that 73.71% of the residents were very concerned with the epidemic information, which was accurate, clear, sufficient, timely, and trustworthy. Public health authorities should keep close monitor on the situation. Because the more people learn about this novel virus and its associated outbreaks, the better people can respond [31]. The media and governments should develop more channels and methods for information disclosure, strengthening the disease education, and release epidemic information in real time. Residents should take rational views on COVID-19, abide by the special regulations, improve awareness of prevention, obtain information through official channels, relieve stress, understand the importance of home isolation, and prevent virus transmission.

Notable factors affecting health risk stress

The onset of a sudden and immediate life-threatening illness could cause high stress status [32]. This study found that 39.89% of the residents were in the state of health risk stress. A number of important factors triggered residents' health risk stress. Perceived life threat emerged as the most significant predictor for the Impact of Event Scale—Revised(IES-R)and Hospital and Anxiety Scale(HADS)scores that reflected stress-related symptoms [32], Literature reported a broader range of stress status, other predictor variables such as gender, age, and perceived life threat [33]. This study found younger residents with higher disease susceptibility perception and higher life threatening level were uncertain about home isolation importance or extremely unclear about the difference between common cold and COVID-19, significantly associated with health risk stress. It is necessary to take effective measures to deal with health risk stress, taking in consideration of these factors.

- This study had several highlights. Firstly, to minimize personal contact during the outbreak, participants were surveyed by internet instead of face-to-face, internet survey is different from traditional investigation methods, it is rapid and convenient. Secondly, this work revealed some specific individuals need to be deeply concerned. Lastly, effective psychological interventions for residents keep mental health against COVID-19 are needed, we put forward some suggestions for psychological interventions. However, We have to acknowledge that this study had a few vital limitations. One is the potential selection bias of the participants, although enrolled from 20 provinces, not represent the status of all Chinese. Yet, due to the rather big number, it still made sense, and indicated the overall trend. Furthermore, we had to acknowledge the limitation of uncontrollable.

5. Conclusion

This study provided a timely and authentic data on perceived stress in relation withCOVID-19. The internet-based survey revealed that the female, students, medical staff and residents who were in medical or home isolation observation, scored higher in stress evaluation. Furthermore, 39.89% of residents were under health risk stress. Those younger resident with perception of higher disease susceptibility and higher life threaten level, were uncertain of the importance of home isolation or extremely unclear about the difference between common cold and COVID-19, 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 work may help to identify the at-risk residents for timely and necessary interventions.

Abbreviations

COVID-19: 2019 novel coronavirus disease; CPSS: Chinese perceived stress scale; HADS: Hospital and Anxiety Scale; HCWs: health care workers; H1N1: Hemagglutinin1 Neuraminidase 1; IES-R:Impact of Event Scale—Revised; PSS: The perceived stress scale; SARS: severe acute respiratory syndrome; WHO: World Health Organization.

Declarations

7.1 Ethics approval and consent to participate

The consent we obtained from study participants was written. 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.

7.2 Consent for publication

Not applicable

7.3 Availability of data and materials

All data and materials used in this work were publicly available.

7.4 Competing interests

The authors declare no competing interests.

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7.6 Authors contributions

All authors have made substantial contributions to the work are as follows. Lili Yao, BSN, Master Candidate, RN, contributed to study design and article drafting. Yetao Luo, MAS, contributed to study design, data analysis, and data interpretation. Feng Yuan, BSN, RN, contributed to study design and data collection. Lupei Yan, BSN, Master Candidate, RN, contributed to data collection. Yuerong Li, MSN, RN, Associate professor, contributed to thoroughly revised the manuscript. All authors read and approved the final manuscript.

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