

RESEARCH ARTICLE

Psychological stress of medical staffs during outbreak of COVID-19 and adjustment strategy

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Funding information

National Social Science Fund emergency management system construction research special project and National natural science foundation Central China Think Tank special key projects: (2020HZZK031) Natural science foundation of Hubei province: (2019CFB425)

Abstract

COVID-19 has a significant impact on public health and poses a challenge to medical staffs, especially to front-line medical staffs who are exposed to and in direct contact with patients. To understand the psychological stress status of medical staffs during the outbreak of COVID-19, random sample questionnaire survey was conducted among 2110 medical staffs and 2158 college students in all provinces of China through a questionnaire, which was compiled and completed through the Questionnaire Star platform relying on Wechat, QQ, and other social software. The differences in psychological stress status of different groups were compared through the analysis of the questionnaire. Results revealed that in all provinces of China, medical staffs scored significantly higher on all items of psychological stress than college students ($P < .001$). In Wuhan, medical staffs scored significantly higher than college students in all items of psychological stress ($P < .001$). While among medical staffs, the group in Wuhan area scored significantly higher than the group outside Wuhan on the following items: "Thought of being in danger," "The possibility of self-illness," "Worrying about family infection" ($P < .05$), "Poor sleep quality," "Needing psychological guidance," and "Worrying about being infected" ($P < .01$) in the Psychological Stress Questionnaire, but on the item "Confidence in the victory of the epidemic," the group in Wuhan area scored significantly lower than the group outside Wuhan ($P < .05$). The emotion, cognition, physical, and mental response of front-line medical

staff showed obvious "exposure effect", which calls for a psychological crisis intervention strategy that can be helpful.

KEYWORDS

artificial intelligence technology, COVID-19, medical staffs, psychological stress, public health

1 | INTRODUCTION

In January 2020, provinces across the country declared 2019 novel coronavirus as the first-level public health emergency response;¹ while the World Health Organization (WHO) declared the new coronary pneumonia as Public Health Emergency of International Concern (PHEIC) on January 30, 2020.² On January 23, 2020, Wuhan was closed to prevent the spread of the new coronavirus pneumonia.³ During the outbreak period, tension, anxiety, and other negative emotions began to breed in the country, and quickly spread and iterate among the members of the whole society,⁴ letting the whole country into psychological crisis, making the medical staff in the first line bear a huge work pressure and psychological pressure, which may have a certain impact on their emotional state, and make the medical staff engender psychological stress.⁵

Stress, the body's response to harmful stimuli, is a common physical and psychological phenomenon. Jiang proposed that stress is a biological, psychological, social integration system and a multi-factor interaction, feedback regulation and control system.^{6,7} Stressor is a stimulus that causes stress, including physical, chemical, biological, social, psychological, cultural, and other types. All kinds of stressor are related to each other, and one kind of stressor can also combine with the nature of other kind of stress sources, forming a compound stressor.⁸ Public health events, due to their suddenness, uncertainty, and harmfulness, bring human insecurity and instability, and impact on public emotional behavior, breaking people's inner balance, which is an important source of stress, and thus can cause a series of psychological stress response.⁹

Medical staffs, being the backbone of the fight in the first line of epidemic prevention and control, endure heavy work tasks, high risk of infection, and work pressure.^{9,10} Especially, the medical staffs in hospitals caring for confirmed or suspected patients are more likely to be exposed to high risk of infection and negative psychological stress than the general population. Moreover, they are also concerned about being infected and spreading the virus to their families, friends, or colleagues.¹¹⁻¹³ A psychological survey in *The Lancet Psychiatry* suggested that the rates of depression, anxiety, insomnia, and stress symptoms among medical staffs involved in the epidemic prevention and control were as high as 50.7%, 44.7%, 36.1%, and 73.4%, respectively.¹⁴ Another survey of the front-line medical staffs in Wuhan showed that their anxiety and panic were extremely prominent due to intense psychological stress in such a short time.⁹ In addition, studies have shown that the psychological stress scores of medical staff in isolation wards are generally higher,¹⁵ and that nurses show more mental sub-health in clinical work, especially physical characteristics such as dizziness, headache, and breathing difficulties.^{16,17} Similarly, during the SARS outbreak, the mental health problems of heat outpatient medical staffs in military hospitals were widespread, and all

the four factors of somatic, depression, anxiety, and compulsion were increased, among which the increase of depression is the most significant.¹⁸ The scores of somatization, interpersonal relation, depression, anxiety, and fear factors in SCL-90 of the nursing staff who participated in the treatment of the epidemic outbreak were significantly higher than those in the control group.¹³ Previous studies have shown that depression, anxiety, and other various physical and mental symptoms were undesirable consequences after disaster, and that the most common mental disorders that occurred after a disaster were anxiety and depression.^{19,20}

The main objective of psychological crisis intervention is to reduce the risk of acute psychological crisis and trauma, stabilize and reduce the immediate and serious consequences of it, and to promote the recovery or rehabilitation of individuals from adverse conditions.²¹ Fan²² believed that psychological intervention in a crisis situation can help people get out of the crisis as soon as possible and restore psychological balance. Medical staffs who are long-term in the front line of the epidemic show stronger psychological stress for receiving more negative emotional distress. It is consistent with the general psychological characteristics of the population after the disasters. Thus, their mental health should be the special attention of social and hospital managers, and the targeted psychological crisis intervention.^{4,23,24}

The study selecting medical staffs and college students from all over the country under the outbreak of COVID-19, investigated and analyzed the emotional state and psychological stress status of the medical staffs in the hard-hit areas of Wuhan and other areas as well as medical staffs and college students during the outbreak of the epidemic through an online questionnaire, so that we can provide guidance for the psychological health care and intervention counseling for medical staffs in the high-exposure area of emergencies.

2 | METHOD

2.1 | Subjects

In the formal test, we recruited medical staffs and college students from all provinces of the country, February 10-21, 2020, using random sampling. A total of 2110 medical staffs finished the questionnaire, of which 877 (male 255, female 622) were from hospitals in Wuhan and 1233 (male 247, female 976) were from hospital in areas outside Wuhan. Nearly, 2158 students finished the questionnaire, of which 1099 (male 430, female 669) were students from universities in Wuhan and 1059 (male 396, female 663) were students from universities outside Wuhan.

TABLE 1 Analysis of the main components of the Psychological Stress Questionnaire

Factor	Item	Number	Loading	Eigenvalue	% of variance
Risk awareness	Thought of being in danger	Q7	0.85	3.15	34.95
	The possibility of self-illness	Q8	0.77		
	Worrying about family infection	Q10	0.49		
Physical and mental response	Poor sleep quality	Q14	0.72	1.40	15.53
	Needing psychological guidance	Q15	0.68		
	Worrying about being infected	Q9	0.57		
	Fear	Q11	0.51		
Optimistic hope	Confidence in the victory of the epidemic	Q6	0.79	0.94	10.41
	Thinking the current outbreak is serious	Q16	0.56		

2.2 | Procedures

The study was designed in accordance with the tenets of the Declaration of Helsinki. Approval from the ethical authority in our school was granted. Confidentiality and the statement confirming informed consent was managed by placing anonymous coding of one self-report questionnaires.

This survey used the questionnaire, which was compiled and completed through the Questionnaire Star platform (Wenjuanxing, <http://www.wjx.cn>) relying on Wechat, QQ, and other social software to investigate the emotional state and psychological stress status of the medical staffs and college students. Random sampling was adopted to select the subjects nationwide to fill in the online questionnaire; and we have eliminated the incomplete and unserious respondents, such as six questions in a row or answer time less than 3 minutes. First of all, an original Psychological Stress Questionnaire with nine items was compiled through video interviews to collect information, and an analysis of exploratory factors was carried out to determine the questionnaire items and factors, thereby constructing good reliability. Then a wide range of formal tests were conducted.

2.3 | Development of Psychological Stress Questionnaire

Data from 504 subjects were collected as preliminary test through a web questionnaire with 17 items, including 45 in Wuhan and 459 outside Wuhan, 201 boys and 303 girls, and ages 17 to 25 (19.75 ± 0.09).

Through the exploratory factor analysis, the adaptive test results showed that the Kaiser-Meyer-Olkin value was 0.766 and the Bartlett's test χ^2 value was 1055.09 ($df = 36, P < .001$), indicating that exploratory factor analysis could be made. The principal component analysis method was used to conduct exploratory factor analysis of the samples and the maximum variance method was used to rotate them. According to the factor load matrix after the rotation axis, the analysis process of the items was as follows. First, delete five items with insufficient load and which are difficult to name on each factor; next, compare the load of each item on each factor, and delete three items with small load and similar load on different factors; third, analyze each factor, and delete the items with poor division and which are difficult to explain. As per the above principles, all nine items were retained and three factors were confirmed as the result, and the total variance was 60.88%, which is shown in Table 1. The factors were named in turn as followed: (a) Risk awareness, which reflects the self-evaluation of the risk stoicism of the subject's environment; (b) Physical and mental response, which reveals the stress response to the subject's current environment; (c) Optimistic hope, which mirrors how much the subjects were confident in defeating the epidemic and the optimism of the current outbreak.

The internal consistency reliability (Cronbach's α coefficient), split-half reliability, and the correlation of score between factors and the total score of the Psychological Stress Questionnaire are calculated by SPSS version 20.0 (SPSS Inc, Chicago, IL), and the results showed that the internal consistency reliability of population is .78, which are listed in Table 2.

TABLE 2 Reliability and correlation of Psychological Stress Questionnaire

	Reliability		Correlation		
	α coefficient	Split-half reliability	Risk awareness	Physical and mental response	Optimistic hope
Risk awareness	.66	0.55	1		
Physical and mental response	.63	0.62	0.66**	1	
Optimistic hope	.25	0.25	0.27**	0.07**	1
Questionnaire	.78	0.61			

** $P < .01$ (two-sided test).

2.4 | Data analysis

The SPSS version 20.0 was used for conducting descriptive statistics and *t* tests.

3 | RESULTS

3.1 | Differences between occupational groups

The occupational differences of psychological stress status in the sample are significant between the medical staff group and the college student group. As is shown in Table 3, medical staffs scored significantly higher on all items of Psychological Stress Questionnaire than the college students. Meanwhile, the emotional distribution of medical staffs and college students in China during the outbreak were mapped using an artificial intelligence technology (see Figure 1).

3.2 | Occupational differences of groups in Wuhan

The occupational differences of psychological stress status in the sample in Wuhan are significant between the medical staff group and the college student group. As is shown in Table 4, the medical staffs scored significantly higher on all items of Psychological Stress Questionnaire than college students.

3.3 | Regional differences among the group of medical staffs

The regional differences of psychological stress status of medical staff groups in different regions are significant in some items.

The measurements are shown in Table 5: (a) Medical staff in Wuhan area scored significantly higher than the medical staff outside Wuhan on "Thought of being in danger," "The possibility of self-illness," "Worrying about family infection," "Poor sleep quality," "Needing psychological guidance," and "Worrying about being infected" items in the Psychological Stress Questionnaire, and in the item of "Confidence in the victory of the epidemic," the medical staff in Wuhan area scored significantly lower than the medical staff in the area outside Wuhan. (b) The scores of medical staffs in Wuhan and outside Wuhan is not significant in items "Fear" and "Thinking the current outbreak is serious" of the Psychological Stress Questionnaire.

4 | DISCUSSION

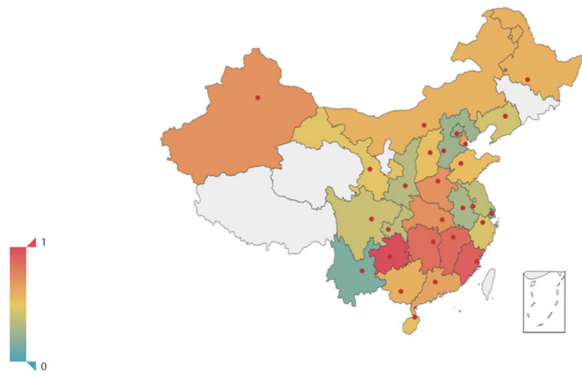
4.1 | The "exposure effect" of psychological stress among medical staffs

Compared with the medical staffs outside Wuhan and college students in Wuhan, medical staffs and medical staffs in Wuhan under great work pressure and psychological pressure, showing more negative cognition and emotions, due to long-term in the outbreak of the COVID-19 epidemic of the first line of prevention and control, which is the "exposure effect" in psychology. "Exposure effect" means that stimulating non-enhanced exposure to individuals can improve the emotional evaluation of stimulation by individuals.²⁵ The "exposure effect" was shown in the psychological stress situation. Medical staffs, especially in Wuhan area, located in the heart of the epidemic, facing the patient's aggravated, rescuing or even death condition every day, and being fearful of their own protection and the risk of infection, end up in stimulating the medical staff's instinctive stress response, including their unwillingness to talk about these issues, the brain repeatedly thinking of a person or scene that makes them uncomfortable and unforgettable, emotional

TABLE 3 Occupational differences in Psychological Stress Questionnaire scores

Factors	Items	Occupations	<i>M</i> ± <i>SD</i>	<i>t</i>	<i>P</i>
Risk cognitive	Thought of being in danger	Medical staffs	4.22 ± 0.70	53.73	<.001
		College students	2.87 ± 0.91		
	The possibility of self-illness	Medical staffs	3.55 ± 0.96	39.75	<.001
		College students	2.39 ± 0.94		
	Worrying about family infection	Medical staffs	4.64 ± 0.64	45.13	<.001
		College students	3.25 ± 1.26		
Physical and mental response	Poor sleep quality	Medical staffs	2.63 ± 0.98	31.76	<.001
		College students	1.69 ± 0.95		
	Needing psychological guidance	Medical staffs	2.19 ± 0.91	13.41	<.001
		College students	1.81 ± 0.94		
	Worrying about being infected	Medical staffs	4.17 ± 0.81	67.37	<.001
		College students	2.18 ± 1.09		
	Fear	Medical staffs	2.96 ± 0.78	35.76	<.001
		College students	2.03 ± 0.76		
Optimistic hope	Confidence in the victory of the epidemic	Medical staffs	4.52 ± 0.63	13.00	<.001
		College students	4.21 ± 0.89		
	Thinking the current outbreak is serious	Medical staffs	4.50 ± 0.61	30.86	<.001
		College students	3.80 ± 0.84		

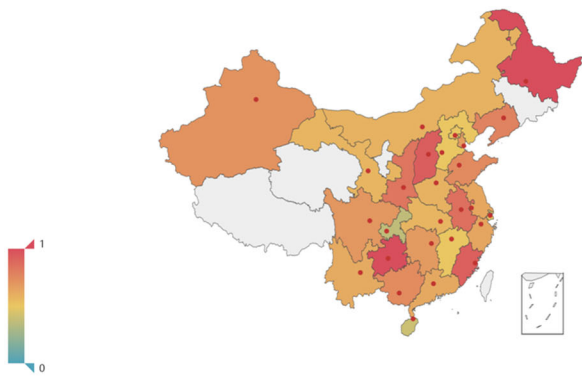
Fear Distribution of Medical Staffs



Fear Distribution of College Students



Confidence Distribution of Medical Staffs



Confidence Distribution of College Students

**FIGURE 1** Fear and confidence distribution of medical staffs and college students**TABLE 4** Occupational differences of samples in Wuhan in Psychological Stress Questionnaire scores

Factors	Items	Occupations	M ± SD	t	P
Risk cognitive	Thought of being in danger	Medical staffs	4.31 ± 0.68	44.18	<.001
		College students	2.86 ± 0.96		
	The possibility of self-illness	Medical staffs	3.66 ± 0.95	30.33	<.001
		College students	2.44 ± 0.97		
Worrying about family infection	Medical staffs	4.67 ± 0.60	34.70	<.001	
	College students	2.28 ± 1.22			
Physical and mental response	Poor sleep quality	Medical staffs	2.71 ± 1.02	23.29	<.001
		College students	1.76 ± 1.00		
	Needing psychological guidance	Medical staffs	2.27 ± 0.91	10.72	<.001
		College students	1.88 ± 0.95		
	Worrying about being infected	Medical staffs	4.23 ± 0.77	52.39	<.001
		College students	2.28 ± 1.12		
Fear	Medical staffs	2.96 ± 0.90	25.11	<.001	
	College students	2.07 ± 0.80			
Optimistic hope	Confidence in the victory of the epidemic	Medical staffs	4.48 ± 0.65	10.84	<.001
		College students	4.15 ± 0.92		
	Thinking the current outbreak is serious	Medical staffs	4.51 ± 0.63	23.83	<.001
		College students	3.80 ± 0.87		

TABLE 5 Regional differences of medical staffs in Psychological Stress Questionnaire scores

Factors	Items	Region	M ± SD	t	P
Risk cognitive	Thought of being in danger	Wuhan	4.31 ± 0.68	4.87	<.001
		Outside Wuhan	4.15 ± 0.72		
	The possibility of self-illness	Wuhan	3.66 ± 0.95	4.30	<.001
		Outside Wuhan	3.48 ± 0.96		
	Worrying about family infection	Wuhan	4.67 ± 0.60	2.01	.048
		Outside Wuhan	4.62 ± 0.66		
Physical and mental response	Poor sleep quality	Wuhan	2.71 ± 1.02	3.51	<.001
		Outside Wuhan	2.56 ± 0.94		
	Needing psychological guidance	Wuhan	2.27 ± 0.91	3.48	<.001
		Outside Wuhan	2.13 ± 0.90		
	Worrying about being infected	Wuhan	4.23 ± 0.77	2.94	.003
		Outside Wuhan	4.12 ± 0.84		
	Fear	Wuhan	2.96 ± 0.90	0.19	.851
		Outside Wuhan	2.95 ± 0.91		
Optimistic hope	Confidence in the victory of the epidemic	Wuhan	4.48 ± 0.65	2.31	.019
		Outside Wuhan	4.55 ± 0.61		
	Thinking the current outbreak is serious	Wuhan	4.51 ± 0.63	0.94	.349
		Outside Wuhan	4.49 ± 0.60		

instability, increased alertness, and so on. Studies have shown that the vicarious traumatization score of front-line nurses in the prevention and control of the COVID-19 outbreak is significantly lower than that of non-front-line nurses.²⁶ Compared with college students, front-line medical staffs are exposed to the risk of patients and outbreaks for a long time. Their perceived negative emotions are increasing and positive emotions are relatively low. Psychological stress response further affects the quality of sleep of health care workers, and they experience difficulty in sleep, light sleeping, more dreaming, waking up easily, and more night behavior such as turning over. Moreover, they often have multiple roles in addition to their own diagnosis, treatment, and nursing work, that is, appeasing patients, accompanying patients, dealing with administrative things and coordinating relationships, which can further lead to sleep problems. Hence, the decreased quality of sleep may affect the work efficiency of medical staffs, making them feel anxious, so they also need more urgent psychological intervention.

4.2 | Positive emotions and cognition among medical staffs

Our study also showed that the confidence feeling of Wuhan medical staffs were higher than those of college students. Although during COVID-19 outbreak, the medical staffs faced a more serious situation, with the strong national prevention and control measures, the support from the people throughout the country, slow improvement of patient symptoms and the declining number of confirmed, and having a relatively clear understanding of the COVID-19 outbreak through professional knowledge, they became more confident, which gave them more energy to sustain and work. A recent survey also showed that

clinical nurses had anxiety in responding to COVID-19 outbreak, but had lower levels of anxiety than the national average, and that most clinical nurses had a less severe response to the crisis stress of the COVID-19 outbreak, with mild cognitive, emotional, and behavioral impairments.²⁷ Positive and negative emotions have different dimensions, but they occur together in the process of individual's response to risk events. Furthermore, positive psychology emphasizes the stimulating of adaptive value of positive emotional experiences.²⁸ Fredrickson²⁹ proposed the Broaden-and-Build theory of positive emotions and emphasized that positive emotions help increase behavioral flexibility,³⁰ build personal resources,³¹ and eliminate the physiological effects of negative emotions.³² This also reveals that psychological workers help medical staffs to stimulate, maintain, and enhance positive emotions and get rid of negative emotions and negative psychological stress through psychological intervention.²³

4.3 | Clinical implications

At present, researchers pay more attention to the mental health problems of medical staffs. Especially, during the outbreak of the COVID-19, medical staffs bear higher work and psychological pressure; it is helpful for the prevention and control of the epidemic to understand how their psychological stress and emotional conditions are different from the ordinary people, and accordingly put forward corresponding adjustment strategies. Under this context, this study can be helpful in improving the scientific system of psychological stress and emotional adaptation of medical staff, and has a guiding significance for the prevention and treatment of infectious diseases

in the future. Furthermore, the present study provides the Psychological Stress Questionnaire, which is an effective measure that can be extended to evaluate the psychological stress of the medical staffs during the COVID-19 outbreak. As the COVID-19 enters its outbreak, more and more medical staffs are involved in the prevention and control. Medical staffs need to access to patients with new COVID-19 zero-distance, and to carry out various clinical treatment and care work wearing protective clothing and goggles. Being in this severe epidemic prevention and control environment for long-term, the medical staffs involved in the treatment continues to be in a high state of psychological stress. As a result, they will also face some psychological distress as follows:

- (1) Fatigue: When treating patients in the isolation room, they are often in a state of shaft rotation. And a long period of high-intensity work including rescuing, checking the room, accompanying the patient to send a test, and so on makes them physically and mentally fatigued.¹⁰
- (2) The sense of powerlessness of the COVID-19 epidemic: As a new infectious disease, the development trend of the epidemic, the current status quo, and duration and treatment methods are the difficult problems that the medical staffs and researchers are facing, which results in experiencing a sense of powerlessness.³³
- (3) Concern for themselves, their families and colleagues: Because of the high level of infectiousness of the virus and the current relatively inadequate supply of medical supplies, individual health medical staffs may not only worry about whether their own protection is in place or not, but also worry about the safety of their families and colleagues.

In view of the main mental health problems faced by medical workers at present, combining with the current requirements of epidemic prevention and control, psychological workers can provide psychological help and support to medical staffs through online psychological services.^{4,14,24}

4.3.1 | Build proper self-awareness

Cognitive systems are self-referential control systems that integrate information and reactions between external social systems and internal physiological systems.³⁴ Kjaer³⁵ found that a subjective assessment of the threat or risk for traumatic events in trauma sufferer was significantly associated with acute stress disorder. The cognitive-phenomenological-transactional theoretical model of stress also emphasizes the cognitive evaluation process of individual stress, and holds that thinking, experience, and the significance of the events experienced by individuals are the main intermediaries and direct motivations that determine stress response,³⁶ thus scientific and rational cognitive construction is particularly important. When treating patients, many medical staffs feel guilty that they cannot help them. But medicine is not everything, and this outbreak is the battle of all mankind, so the medical staffs do not need to attribute all the responsibility

of the medicine to their own. Medical staffs should build boundaries with work and patients, should not work longer hours alone without colleagues and understand the limits they can afford. When they reach the limitation, they need to think about how to better tell the story of what he or she is encountering, to tell the leader about the difficulties they have encountered at work, and hopefully have proper rest. Throughout the treatment process, medical staffs should affirm that their every medical activity and rescue is valuable, understand their limitations, and learn to forgive themselves.¹⁰ Keep sleep a priority, as much as possible, because lack of sleep and overwork can lead to a weakened immune system. According to the patient's severity, medical staffs should timely adjust their work rhythm hours to ensure that they have enough rest and relaxation time.

4.3.2 | Remind medical staffs to take care of themselves

First, keep sleeping and resting as much as possible. If medical staffs do feel bad about sleeping, they can do some relaxation and exercise activities. Second, although medical supplies are scarce, but under possible conditions we should ensure their basic diet. Moreover, at work, medical staffs can try every hour or two to look out of the window, find a corner and lean backwards on the wall for a while, or have deep breath for a few times. This will help avoid temporarily held empty bad feelings and ease work pressure.

4.3.3 | To assist the establishment of social support systems

In such a special period, in addition to professional psychological counselors, family support is very important. Medical staffs can connect with family, hope they understand their choices and share things beyond work. In addition to family members, colleagues who work side by side are another source of support. Medical staffs should encourage, cheer, and affirm each other, face the results of treatment objectively, do not blame each other, timely share and discuss feelings, experiences, and solutions to problems, and try to find out opportunities to share negative feelings that are bothersome.¹⁰ Furthermore, patient feedback is important. The recent increase in patient visits may also produce excessive emotions and behaviors. As a result, medical staffs should care for patients, especially confirmed patients, and remind themselves that patients or family members vent their emotions because they feel pressure and there is nothing personal about it.¹⁰

4.4 | Limitation of the study and future recommendations

With significant contributions to the study there are also some limitations, which should be noted. The first is the cross-sectional design

of this study; it is difficult to show the systematic changes of psychological stress in medical staffs during the epidemic. Additionally, data were obtained through self-report, which can be a source of bias. Therefore, findings should be interpreted with prudence. Future research could select samples of medical staffs in a range of sectors to assess generalizability of our study. Future research could also investigate medical staffs working in other countries, adopting same measurement to investigate results.

5 | CONCLUSION

During the outbreak period of the COVID-19, medical staffs, especially medical staffs in Wuhan area, had higher psychological stress level than college students, which showed obvious "exposure effect." Furthermore, although medical staffs in Wuhan area had higher feeling of impending crisis compared with other areas, they were more confident in defeating the outbreak of the COVID-19. In summary, the public should be concerned about the psychological stress status of medical staffs and take positive psychological crisis intervention strategy.

ACKNOWLEDGMENTS

We thank all participants for their time and interest as well as the editor and reviewers for their valuable feedback. This study was supported and granted by the "National Social Science Fund emergency management system construction research special project and National natural science foundation", "Central China Think Tank special key projects (2020HZZK031)", and "Natural science foundation of Hubei province (2019CFB425)" to YZ.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

AUTHOR CONTRIBUTIONS

Conceived and designed the questionnaire: YZ, LZ, and PW. Recruitment and payment of participants: YZ and GL. Analyses of the data: GW, QX, XC, YB, SX, FH, NL, JZ, and ML. Writing and revised the paper: WW, YZ, PW, and LZ. Partially written and revised: PW and LZ. All the authors have approved the manuscript and agreed with submission to the article.

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How to cite this article: Wu W, Zhang Y, Wang P, et al. Psychological stress of medical staffs during outbreak of COVID-19 and adjustment strategy. *J Med Virol.* 2020;92: 1962–1970. <https://doi.org/10.1002/jmv.25914>