Study on the Impact of Epidemic Severity on Psychological Health of the Medical Staff -Also Discuss the Mediating Effect of Risk Perception

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Abstract: COVID-19 has a long incubation period, rapid spread, the high demand for treatment and lack of previous treatment experience have brought great psychological pressure to medical staff involved in epidemic prevention and control, which has seriously affected their mental health. Based on interviews with some medical staff in designated hospitals for COVID-19, this paper measured the mental health status of medical staff for epidemic prevention by designing a scale, The structural equation model was used to explore the influence mechanism of epidemic severity and mental health of medical workers on the prevention and control of COVID-19. The results showed that not only the severity of hospitalization had a direct effect on the psychological stress of medical workers, but also the perceived risk had a mediating effect between the severity of the epidemic and the mental health of medical workers.

Keywords: COVID-19; SME; psychological health; mediating effect

1 Introduction

A public health emergency refers to a sudden outbreak of major infectious diseases, mass diseases of unknown cause, major in food and occupational poisoning, and other events that seriously affect public health, which may cause or cause serious damage to public health [1]. The Chinese government has quickly taken some strong measures to prevent the spread of the virus after Wuhan and other cities in Hubei province became high-risk areas for the disease. Medical teams were organized in many provinces and cities which across the country to assist Wuhan and 'one province for one city' to assist all parts of Hubei province. Medical staff are the core members of the fight against COVID-19. Due to the superposition of factors such as the limitation of understanding of the novel coronavirus, the uncertainty of treatment and the expectation of the society on the medical staff, medical staff are under the great psychological pressure. During the SARS outbreak in 2003, the greatest pressure for medical workers was their own vulnerability and the pressure of their working environment [2], so health care workers are at greater risk for anxiety and depression [3,4]. In the fight against COVID-19, while medical staff see it as their mission to be on the front line for a long time, they also fear for their own safety and that of their families [5]. In interviews with the medical staff in the designated hospitals in Wuhan to fight COVID-19, they were reported in serious stress, both physically and psychologically. Therefore, this study focuses on doctors and nurses involved in the novel

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coronavirus outbreak to explore the psychological health status of the medical staff in the fight against COVID-19, with a view to providing guidance for the psychological health of the medical staff in the fight against COVID-19.

2 Literature Review

2.1 Psychological Pressure

Psychological pressure often comes from life, including psychological, social, cultural and biological events, also known as the life events among people's life.

According to Selye. H, 1956, psychological pressure is an adaptive or coping response process which made by individuals when they face or perceive threats or challenges posed by environmental changes to the body [6]. The study of psychological stress can be divided into two schools: stress response theory and stress stimulation theory. Stress response theory states that when individuals, for example humans or animals, encounter a stressor for instance a threat, their bodies prepare to deal with the stressor and return to a stable state after the threat. According to the stress stimulation theory, external stimuli cause physical reactions in individuals, such as stress and fear. It was represented by Thomas Holmes and Richard Lage (1967). They believe that an individual's stress response comes from stimuli in the external environment, namely stressors. Stress stimulation theory emphasizes the influence of stress on people's psychology, thus affecting people's physical and mental health.

2.2 Psychological Stressors

A study in India showed the negative side of health care workers fighting the epidemic can increase the fear and concern of individuals, such as the risk of being a source of infection, being quarantined/isolated, putting family members and other staff at risk, improper use of personal protective equipment, family problems due to confinement and health insurance, etc. [7] To further understand the dilemma and psychological stress faced by medical workers in the fight against the epidemic, the study interviewed medical workers in four designated hospitals in Wuhan and found that their psychological stressors included:

(1) Inadequate early protection supplies, fear of becoming a source of infection and threatening life, household infection and family concerns about it. Due to the sufficient supply of protective equipment in the later stage, and people's protection awareness and understanding of themselves and the public, although there is still a certain amount of pressure, but the mental pressure is not as great as before the outbreak.

(2) Due to lack of understanding of the novel coronavirus, the professional capacity of medical staff cannot meet the needs of patients, resulting in a gap between expectations and reality. In the early stages of the outbreak, health workers were dismayed to find that the number of patients increased, their condition worsened, and they were not receiving effective treatment. Some health care workers say they get a brief lift after seeing a patient heal and recover. However, when they found that the patient's condition is deteriorating, there is no cure, more and more patients sent to the hospital, their mental endurance has reached the limit, is about to collapse.

(3) Stress caused by excessive work load. During the fight against the virus, not only medical personnel involved in the fight against the virus, including administrative staff and support staff also said that their bodies have been overworked.

(4) Pressure from other factors. Some medical workers who participated in the interview said that the stress caused by conflicts between colleagues and them was relatively small compared to the first three types of stress, due to the distribution of medical protective materials, daily affairs outside of professional work (filling out forms, etc.) and the incomprehension of patients' families.

From the interview, we learned that the severity of the epidemic has a great impact on the mental and physical health of medical workers. This paper focuses on the discussion of the former.

Recent research results show that personal risk perception affects social distancing between people during the COVID-19 pandemic, and a safe atmosphere helps reduce risk awareness and shorten social distancing [8]. Epidemiological data have an impact on individual mental health [9]. Thus, in emergency situations, the impact of the epidemic and protective measures are important factors affecting an individual's level of risk perception, which will affect an individual's mental health. After the outbreak of COVID-19, not only the patients' lives are in danger, but also the medical staff are under psychological pressure such as tension, anxiety, sadness and fear. This is despite many studies exploring the psychological impact of COVID-19 on medical workers [10,11], How severe and to what extent the outbreak is affecting the mental health of health care workers is still to be determined. The purpose of this paper is to explore the mechanism of the epidemic on the mental health status of medical workers.

3 Research Design

This study adopted a mixed research approach of collecting empirical and survey data to confirm the hypothesis. The first step is to design an interview outline for pre-research. For example, asking whether health care workers involved in the fight against the pneumonia epidemic were under any psychological stress. How did these psychological stresses affect their physical and mental health, and how did they manifest themselves? How will they cope with psychological stress when it arises? The second step is to build on the literature review and the first step to design a set of questionnaires targeting the psychological well-being of health care workers participating in the fight against pneumonia. The questionnaire is composed of two parts. One part is the basic information of the survey respondents, reflecting the basic characteristics of the survey respondents. The other part is a scale to measure mental health. A set of subjective questions was used to measure the impact dimensions of the physical and mental health of anti-epidemic health care workers and the extent of their impact. Mental health is the dependent variable of the questionnaire, and the independent variable is a set of 5-point Likert scales with "1" = "strongly disagree" and "5" = "strongly agree". The questionnaire was filled out by medical staff who had participated in COVID-19 combat.

3.1 Participants

The questionnaire was conducted online among doctors, nurses, hospital administrative staff, students and interns from all over the country who supported Hubei's anti-epidemic efforts.

Basic demographic information includes gender, age, education level, occupation type, the severity of the epidemic in the place where they live, the epidemic situation in the hospital where they work, and their own medical condition (whether or not they have underlying diseases). A total of 354 questionnaires were collected in this survey. After logical screening and elimination of those suspected to be untrue answers and those that took too short time to answer questions. The number of valid questionnaires was 332, their effective rate was 93.78% and their average response time was 237.47 seconds.

In this survey, more than half of participants were female, whose quantity was 211. Female accounted for 63.553%, male accounted for 36.45%. Most of them are aged between 31 and 45, with 166 samples, accounting for 50%. Doctors and nurses accounted for 77.41% of the total number of medical staff, and there were more doctors than nurses, accounting for 62.05% and 15.36% respectively. The hospitals which were considered to have the most severe epidemic were accounted for 20.48%, 25.90% severe, 21.38% moderate, 11.45% milder and 20.78% mild.

3.2 Measures

According to the theoretical basis analysis and interview results above, it is preliminarily believed that the epidemic will affect the mental health of anti-epidemic healthcare workers and the epidemic has an impact on the psychological well-being of anti-epidemic healthcare workers through self-perception of risk. Therefore, the severity in hospital (SH), risk of perception (RP) and psychological health (PH) are three variables that need to be measured.

The severity of the hospital outbreak is divided into 5 levels according to the severity of the outbreak: the most severe area, the more severe area, the intermediate area, the less severe area and the mild area, with 5 questions.

Risk of perception was measured from four dimensions, including the possibility, severity, influence and persistence of being infected. There were four questions in total.

Psychological health designs questions from sleep, mood, fatigue, physical fitness and reaction 5 dimensions, a total of 5 questions.

3.3 Data analysis procedure

Data analysis after questionnaire collection is carried out in two steps. Step 1 is descriptive statistical analysis. Descriptive statistical analysis will be carried out on the data collected, which includes mean, standard deviation and correlation analysis of the variables. Step 2 is EFA Analysis (Exploratory Factor Analysis). EFA was used to establish the construct validity of the scale and questionnaire. Step 3 is SEM analysis to verify the theoretical model. The first 2 steps of data analysis were carried out using SPSS 21.0, and the third step was carried out using AMOS.

4 Result

4.1 EFA Analysis

According to the survey data sources, the pre-scale divided the psychological health scale of anti-epidemic medical staff into 3 factors and 14 questions.

EFA was used to evaluate the construction validity of the scale. SPSS21.0 software was used for statistical analysis of the data collected from the questionnaire. KMO=0.803, greater than the threshold value of 0.5, and the chi-square value of Bartlett spherical test was 2619.258 (P<0.001), which was suitable for factor analysis. Factors were extracted using principal component analysis and factor rotation was performed by maximum variance rotation. The cumulative contribution rate of the factor matrix of 14 items was 60.847%, and the factor load was >0.7. The principles of item deletion are as follows:(1) Delete one item at a time, and then conduct a new factor analysis until the optimal factor composition appears. (2) The common factor problem items of unstable structures were deleted in the order of factor loading from large to small. (3) Delete the items with small factor load, and delete the items with factor load <0.5. (4) Delete problem items with two or more common factors greater than 0.5 at the same time. (5) Delete the question items with unclear meaning.

After exploratory factor analysis, the three problem items were finally deleted, and the severity in hospital (SH), risk of perception (RP)and psychological health (PH) 3 factors of 11 items questionnaire scale were finally formed.

4.2 Reliability and Validity Analysis

We used Cronbach's Alpha coefficient for reliability analysis to check the stability and reliability of the questionnaire. Validity analysis is used to measure the accuracy of the questionnaire to reflect the factors under investigation. Bartlett spherical test is generally used. According to Cronbach's Alpha coefficient, the Cronbach coefficient of the severity in hospital, risk of perception and psychological health are all greater than 0.8, and the combined Cronbach coefficient is 0.841, indicating that the questionnaire has a high consistency. Exploratory factor analysis was carried out for 11 question items with 3 factors. The maximum variance method was used for rotation, and the principal component analysis of correlation matrix was used to obtain the KMO value of 0.859. Bartlett spherical test also passed the significance test, indicating that the validity of the questionnaire was good. The reliability and validity test results of each variable are shown in Table 1.

Table 1 Sample Reliability and Validity Statistical Results

Factors	Code	Number of Observation variables	Cronbach's Alpha	Overall Cronbach's Alpha
Severity in hospital	SH	3	0.869	0.859
Risk of perception	RP	3	0.871	
Psychological health	PH	5	0.877	
Bartlett Spherical Inspection	KMO		0.805	
	Degree of Freedom		55	
	Sig		0.000	

4.3 Common Factor Extraction

In this study, the principal component analysis was used to extract common factors. According to the total variance interpretation table, the eigenvalues of the three extracted common factors were all greater than 1. The lowest contribution rate of common factors was 14.315%, the highest contribution rate was 42.289%, and the cumulative contribution rate of common factors was 74.835%. Maximum variance method is used to rotate, gravel figure shows a comparison between the third and the fourth is obvious turning point, and three public factor accumulation explain variance accounted for 74.835% of total variance contribution rate, is more ideal effect. So it is reasonable for this study to extract before three public factor namely the severity in hospital, risk of perception and psychological health.

4.4 SEM Analysis

1) Conceptual model. Risk perception is the process of moving from external risk to the internal psychological perception of a person. When SARS broke out in 2003, the severity of the epidemic influenced the perceptions and behaviours of the population, and the level of anxiety was mainly related to the uncertainty and inevitability of the consequences of SARS, among other things. Data show that the extent of SARS disturbance among people in epidemic areas is significantly higher than that in non-epidemic areas [12]. The SARS epidemic information has an impact on the individual's coping behavior and psychological health through risk perception. Individuals are more likely to perceive a high level of risk from information that is close to them, including the presence or absence of diagnosed patients in their area and the presence or absence of diagnosed patients among their acquaintances. Information about the cure and preventive measures in place can reduce the level of risk perception. This is consistent with the interview results of the medical staff involved in the fight against COVID-19. Some of the interviewees reported that they felt very uncomfortable and psychologically distressed when the number of patients increased and the cure was not effective. Based on this, this study puts forward three hypotheses:

Hypothesis H1: There was a significant positive effect between the severity in hospital and risk of perception.

Hypothesis H2: The severity in hospital negatively affects psychological health through risk of perception.

Hypothesis H3: there is a significant negative effect between severity in hospital and psychological health.

2) *Model validation.* In this study, AMOS24.0 was used to establish a structural equation model of the relationship between the severity in hospital and the psychological health of the anti-epidemic medical staff. By the severity in hospital, risk of perception and psychological health of three potential variables and their 11 observation of data import is configured to run the model with AMOS, we get model adaptation index. It is easy to know all kinds of fitting indexes reach the judgment standard according to the corresponding evaluation criterion, which shows that the fitting degree of the model is higher. Model Adaptation indexes and corresponding evaluation criteria of the model are shown in Table 2. If the score of psychological health is higher, means psychological health is worse. In this study, the data from the psychological health questionnaire were analyzed without reverse processing, but the statistical results were

interpreted in reverse.

Table 2 Model fitness statistics table

Adaptation Index	Decision Reference Value	Model Result Value	Affect of Adaptation
$\chi 2/df$	< 3.00	2.832	well
GFI	> 0.90 >0.80 (reasonable)	0.894	reasonable
AGFI	> 0.90 (well) >0.80 (reasonable)	0.863	reasonable
RMR	< 0.05 (well) <0.1 (reasonable)	0.076	reasonable
RMSEA	≤ 0.05 (well) <0.08 (reasonable)	0.049	well
CFI	> 0.90	0.915	well
NFI	> 0.90	0.92	well
TLI	> 0.90	0.924	well
PNFI	> 0.50	0.78	well
PGFI	> 0.50	0.703	well

The path coefficient of AMOS running simulation model is shown in Figure. The standardized path coefficient between risk of perception and the severity in hospital and the standardized path coefficient between risk of perception and psychological health among the medical staff is not zero and positive, combined with questionnaires that measure of psychological health scores and psychological health value is a pair of reciprocal index, which explains that the severity in hospital and risk of perception has a significant positive effect. There was a significant negative effect between the severity in hospital and psychological health. So let's say that H1 and H3 are true.

Bootstrap method was used to test the mediating utility in the mediating model. In this study, 5,000 samples were used to evaluate the mediating utility of the severity of the epidemic on psychological health. The results are shown in Table 3.

Under the confidence level of 0.05, the bias correction confidence interval (BC) and percentile position confidence interval (PC) of mediating utility were not 0, and the significance test indicated that the mediating utility of medical staff's risk of perception was obvious in the epidemic resistance. At the same time, since the direct utility of the severity in hospital on the psychological health of the medical staff does not include 0, it indicates that the influence of risk of perception on the psychological health of the medical staff is a partial mediating utility. Hypothesis H2 is verified. At the same time, the severity in hospital of psychological health of medical staff’s direct utility is 0.166, risk of perception of mediating effect is 0.148, two numerical differences are only 0.018, suggesting that the severity in hospital for the direct effects of psychological health of the medical staff and through risk of perception of indirect influence on the psychological health of the medical staff.

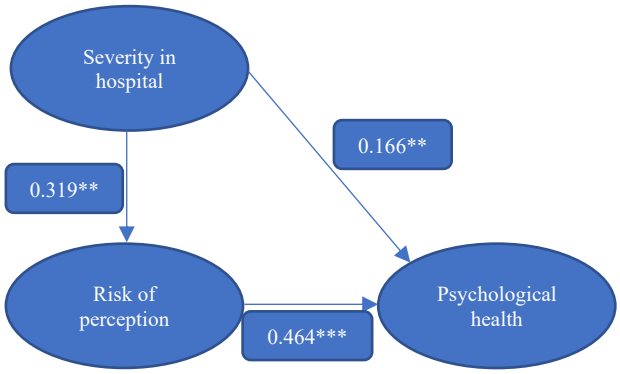

Figure 1 SEM Model of This Research Framework

Table 3 Mediating Utility of Self-risk Perception

Route	Utility	Point Estimate	Bootstrapping Deviation-corrected Confidence Interval 95%		Percentage Position Interval 95%	
			Lower Limit Value	Upper Limit Value	Lower Limit Value	Upper Limit Value
SH ↓ PH	Total effects	0.314	0.213	0.421	0.213	0.42
	Direct effects	0.166	0.065	0.26	0.066	0.268
	Indirect effects	0.148	0.099	0.212	0.096	0.209

5 Implications

The severity in hospital is an important factor affecting the front-line medical staff, and the role of it has a certain mediating effect, which means that risk of perception in the fight against COVID-19 medical staff should be considered flexibly. Therefore, in addition to paying attention to the development of the epidemic, the competent authorities should also take measures to relieve the psychological pressure on the front-line medical staff fighting the epidemic.

6 Conclusion

To study the factors affecting the psychological health of COVID-19 epidemic resistant medical staff, the aim is to provide evidence for the formulation of necessary policies on the psychological health of epidemic resistant medical staff. This study investigated 332 front-line medical staff who participated in COVID-19 epidemic prevention in Hubei province, and found that the severity in hospital not only directly affected the psychological health of the medical staff, but also affected the psychological health of the medical staff through the medium of risk

of perception.

6.1 There are some differences in the severity in hospitals, and there is little difference in the impact on the psychological health of the medical staff.

The analysis results showed that although anti-epidemic medical staff believed that different hospitals in Hubei province presented different epidemic severity, on the whole, there was no significant difference in the psychological impact of anti-epidemic medical staff. Besides the 11.45% of the hospitals which the medical staff worked had mild epidemics, the severity in hospital in the other four grades was around 20%. Further data statistics showed that the impact on the psychological health of the medical staff was roughly the same from the five hospitals with different levels of severity in hospital. The average score of psychological health problems was about 3, with the minimum value of 2.98 and the maximum value of 3.26.

The main reason for this result is that the severity of the epidemic varies in different hospitals in Hubei province. However, Hubei is a high-risk area in China, where's epidemic is already quite serious and the psychological pressure of the front-line medical staff of fighting the epidemic is already very high, so there is no qualitative difference in the impact on psychological health.

6.2 Mediating effect of risk of perception

The severity in hospital has put a lot of pressure on COVID-19 medical staff. Medical staff believe that the risk of COVID-19 infection increases if the outbreak is severe, which is 3.64 on a five-point scale. The average value of the latent variable of risk perception reached 3.91 points, indicating that once they are infected, they will have a great impact on their life. The score of this question option reached 3.98 points out of 5 points.

The severity in hospital by risk of perception indirectly affects the resistance to disease medical staff's psychological health, this is mainly due to their high risk of perception, which because of their high density if the COVID-19 virus and large probability of exposure to novel coronavirus, which plays an important role in the mediation between the psychological health and the severity in hospital. The severity of in-hospital outbreaks not only directly affects the psychological well-being of frontline health care workers fighting the epidemic, but also indirectly affects their psychological well-being by increasing the level of self-risk among health care workers, a finding that is similar to previous studies. There is a new finding in this study that the mediating effect of risk of perception is equivalent to the direct effect of the severity of the epidemic on psychological health. The results of this study suggest that, in addition to controlling the severity of the epidemic, the issue of reducing the level of risk perception among frontline health care workers should not be overlooked, which provides some direction when it comes to relieving psychological stress among health care workers and the focus and content of media coverage of the epidemic.

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