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Title Page

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The physical and mental health problems of Chinese frontline healthcare workers before, during and after COVID-19 rescue mission: a qualitative study

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Keywords: COVID-19, frontline healthcare workers, physical health, mental health, qualitative study

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The physical and mental health problems of Chinese frontline healthcare workers before, during and after COVID-19 rescue mission: a qualitative study

Abstract

Aim: To explore the physical and mental health problems of frontline healthcare workers fighting the COVID-19 across the three stages of epidemic rescue mission (before, during, and after) in China.

Design: A descriptive phenomenological design reported based on COREQ checklist.

Method: Purposive sampling method was used to recruit participants. Thirty-one frontline healthcare workers were interviewed from October to November 2020. They were from other sixteen provinces of China to fight COVID-19 in Hubei Province. Phenomenological research methods and Colaizzi's seven-step analysis method were used for data analysis.

Results: Physical and mental health problems existed before, during and after the epidemic rescue mission. Meanwhile, eleven themes emerged in three stages. Two themes appeared before rescue mission: basic diseases, anxiety before rescue mission; five themes appeared during rescue mission: basic physical function disorder, physical exhaustion, negative cognition, negative emotions, negative behavior; four themes appeared after rescue mission: physical dysfunction, negative emotions, stigmatization, hypochondriasis.

Conclusion: Both physical and mental health problems occurred throughout the three stages. The study results pointed that a comprehensive prevention and control system is needed that covers both physical and mental health problems of frontline healthcare workers throughout three stages of epidemic rescue mission (before, during, and after), which also need themselves, their families, hospitals, the government, social organizations to involve in.

Keywords: COVID-19, frontline healthcare workers, physical health, mental health, qualitative study

Strengths

1. This study explores the physical and mental health problems of frontline healthcare workers related to the epidemic rescue mission through a unified perspective of mental and physics and through a qualitative study.

2. This study focuses on the health of frontline healthcare workers throughout the three stages of epidemic rescue mission (before, during and after).

3. The types of physical and mental health problems faced by frontline healthcare workers in the three stages before, during and after epidemic rescue mission are different.

1 Introduction

In the past 30 years, there have been more than 40 new types of major epidemic around the world, including severe acute respiratory syndrome (SARS), Middle East Respiratory Syndrome (MERS) influenza (H1N1) and so on [1-2]. According to WHO data, major epidemics were once the second highest cause of death [3]. For example, the COVID-19 outbreak has been associated with significant morbidity and medical complications around the world; it has infected over 267,244,380 people and resulted in 5,280,678 deaths globally as of December 8, 2021[4]. Major epidemics are characterized by high infectivity, pathogenicity, and mortality [5], which not only directly threaten the survival and development of human beings but also have a considerable impact on the world economy.

Frontline healthcare workers (HCWs) are important resource in every country. They play a vital role in controlling the development of epidemic, reducing casualties, ensuring economic development and social stability [6]. Moreover, the Chinese National Health Commission sent HCWs from other provinces to support the COVID-19 outbreak area in early 2020 and most of them never involved in epidemic rescue mission before. However, these HCWs suffered various health problems due to epidemic rescue mission related stressors. Previous studies found that HCWs faced a variety of stressors related to epidemic rescue mission, including the high intensity of the work, high risk of viral infection, and ethical issues [7]. Moreover, they also experienced environment-related stressors such as harsh working environments, long-time wearing personal protective equipment (PPE), cultural differences, and lack of protective supplies [8-9]. These stressors resulted in HCWs easily suffering both physical and mental health problems (such as viral infection, depression, anxious and so on) during epidemic medical rescue mission[10]. HCWs with health problems not only reduce the quality of providing continue patient care, but also hinder the flexible response to the control of epidemic[11].

Extant studies found that HCWS were prone to suffer viral infections and mental health problems[10-12]. But these studies mainly focus on the mental health problems of HCWS in two stages (during and after the epidemic rescue mission) through quantitative studies with scales[3,13]. Only one research found HCWs also experienced mental health problems before arriving at the epidemic rescue mission scene, including tension, hopelessness, and fear[14]. What's more, according to the stress response theory, individuals will have dual physical and mental responses when facing various stressors. This meaning that when HCWs face epidemic rescue mission which is huge stress source, they may have physical and mental health problems. Finally, the current studies also neglect the physical health problems among HCWs in three stages of epidemic rescue mission. If the physical and mental health of HCWs is ignored, the health of HCWs cannot be effectively protected. This will ultimately seriously reduce the ability of medical aid to deal with major epidemics in the future. Thus, it is necessary to pay attention to the physical and mental health of HCWs and explore the physical and mental health problems in different stages of epidemic medical rescue mission (before, during and after).

Qualitative research is typically used to acquire an in-depth understanding of people's experience under specific circumstances[15]. Its primary advantage is that researchers can be involved in the process of data collection and analysis. Therefore, we conducted a qualitative study to explore both physical and mental health problems of HCWs fighting COVID-19 in Hubei Province, China, in the three phases of epidemic rescue mission (before, during and after). This study provides references for preventing or solving these health problems and ultimately contributing to better protecting the health of HCWs fighting COVID-19 and other major epidemics in the future.

2 THE STUDY

2.1 Aim

This study aimed to explore physical and mental health problems of HCWs in different stages of COVID-19 epidemic rescue mission (before, during and after).

2.2 Design

This study was reported based on the guidelines for Consolidated Criteria for Reporting Qualitative Studies (COREQ checklist, see Supplementary File 1). Phenomenological studies, a kind of qualitative methodology, investigate individuals' experiences of being immersed in a situation, which aids researchers in understanding the essence of a phenomenon [16].

2.3 Participants

Purpose sampling was used to enroll HCWs who participated in the epidemic rescue mission in Hubei province, China, during the COVID-19 outbreak in 2020. Meanwhile, inclusion criteria for the participants were that they had to have traveled to Hubei Province to fight COVID-19 for at least a month. Participants were excluded if they were auxiliary or logistic HCWs.

2.4 Data collection

The study was conducted between October and November 2020, when the rescue work in Hubei had been over for about six months. The principal investigator participating in the national medical aid mission team fighting COVID-19 in 2020 issued telephone invitations post via mobile phone to several directors of these hospital and head nurses. HCWs who agreed to participate in study contact researcher by mobile phone. We contacted ten hospitals involving in fighting COVID-19. HCWs with varied demographic backgrounds were selected to ensure sample representativeness. Data collection occurred concurrently with the data analysis, which may have facilitated the identification of thematic saturation. The sample size was not certain until theoretical saturation was achieved, which means that data analysis was identifying no new information [17].

Face-to-face and semi-structured interviews were conducted by five experienced researchers, including one professor, three postgraduate students and one clinical nursing who had been trained in qualitative interviewing methods and ethics. Before interviewing, an interview guide based on an extensive literature survey of HCWs' health problems was developed. Then, two HCWs who were fighting COVID-19 in Hubei were pre-interviewed to familiarize the interviewing researchers with the study's progress and to modify the interview guide (for the final interview guide see Table 1).

Before interview, participants decided the quiet interview places (such as, meeting room) by mobile phone. At the beginning of each interview, they were asked to complete the demographic information via a questionnaire. Then, with the participants' permission, all interviews were audio-recorded using a small recording device; the duration of the interviews were between 20 and 60 min. The interview followed an interview guide, and open and flexible discussions on the topics were also allowed [18]. The researchers encouraged the interviewees to be expressive. During the interview, interviewers wrote notes about the participants' body language and their own reflections so that the participants' perspectives would be correctly stated and understood. Additionally, appropriate pauses in or changes of the topic were applied whenever participants seemed to feel uncomfortable during the interviews. Subsequent telephone interviews were conducted if there was any doubt about the content of the interview. The HCWs were compensated 100 RMB for taking part in the interview.

2.5 Data analysis

Data collection and analysis occurred simultaneously and were managed by Nvivo 11.0 software. Within 24 hours from the end of the interview, the recording was transcribed word-for-word. Haase's (1987)[19] adaption of Colaizzi's (1978)[20] method was used to analyze the transcripts. First, the researchers read every transcript several times to gain an understanding of the meanings conveyed. Second, significant statements and phrases were identified from each transcript. Third, the researchers described and analyzed the aspects of the data that were not obvious on the surface of the explicit statements in each transcript. The researchers then integrated all of the results into an exhaustive narrative description and they also created and validated formulated meanings through research team discussions to reach consensus. Fourth, these formulated meanings were sorted into clusters of themes and categories. Fifth, the researchers identified the fundamental structure of the experience and developed a full and clear description of each of the six themes. Finally, to validate the study, the researchers asked the participants if the findings captured the essence of their experiences. To enhance confirmability, three researchers independently analyzed the transcripts. Thereafter, findings from the researchers were compared and discussed at team meetings until consensus was achieved.

All participants gave verbal consent at the beginning of the individual interview. Anonymity and confidentiality were maintained by using numbers to replace names (e.g., I1) and by removing identifying information from the transcripts. All transcripts were saved on a password-protected computer. Additionally, we followed the standards for Reporting Qualitative Research guidelines.

2.6 Ethics approal

This research was approved by the Ethics Committee of university (No. 2020-R-39).

2.7 Rigor

The Linclon and Guba's (1985)[21] four criteria to ensure trustworthiness including credibility, transferability, dependability and confirmability were used to enhance the rigor. The research team included five experienced researchers, including one professor, three postgraduate students and one clinical nursing. Interviews were performed by three experienced researchers who had been trained in qualitative interviewing methods and had qualitative experiences. Data were analyzed by each researcher independently, to ensure the reliability and validity. The findings from each researcher were compared. And the different findings were input for further discussed until consensus was achieved. The thick description and verbatim quotes ensure the transferability of findings. The researchers included experts from healthcare workers' statements to verify the concordance of findings with raw data. This way was used to enhance the confirmability and indicate the data was not based on preconceived notions. All the decisions about data collection and analysis were recorded and maintain audit trail of our study established the dependability and confirmability.

2.8 Patient and public involvement

As this study focused on the health problems of HCWs fighting COVID-19, patients or the public were not involved.

3 Results

The HCWs who participated in this study included 15 females and 16 males; 18 nurses and 13 doctors; aged 24 –50 years. The characteristics of HCWs are summarized in Table 2. Eleven main themes were identified from the HCWs' dataset (Figure1).

3.1 Before the epidemic rescue mission

Some HCWs had underlying diseases (systemic lupus erythematosus, asthma, and allergic constitutions) when they received epidemic rescue mission notice. Undoubtedly, they were at high-risk of being infected or even dying during the epidemic rescue mission. *"I had an allergic constitution. I didn't mention that. The leaders didn't know I was allergic. At first, I really wanted to join in the rescue work. I was afraid that others would prevent me from participating in this work because of this disease."*（*I16*）

The most common mental health problem the HCWs experienced at this time was anxiety, especially for those who had never participated in an emergency rescue operation against a major pandemic before. They said there were two reasons leading to the anxiety. First, they were fear of being infected by COVID-19. *"I was really worried when I first went there on February 7. At that time, it was said that the number of cases there were increasing every day. It was the first time that I had been involved in the epidemic rescue mission, and I was very worried."*（*I4*） Second, HCWs said that they were very anxious because they were unable to handle family affairs or protect the health and safety of their family members. *"My older parents and my father-in-law were still in the hospital and I have two children. I was worried that if something happened suddenly, there would be nobody helping my family."*（*I23*）

3.2 During the epidemic rescue mission

3.2.1 Basic psychological function disorder during rescue mission

Some HCWs said they suffered arrhythmias, chest tightness, breathing difficulties, and even fainting because of such factors as high-intensity work, circadian clock disorders, and hypoxia resulting from wearing PPEs. *"Most of the time, I did not have arrhythmias. But when I was lying in bed, I had premature heartbeats and arrhythmia. Anyway, I felt uncomfortable at that time."*（*I14*）

Because of the airtightness of the protective equipment and the irritation from disinfectants, HCWs experienced symptoms of hypoxia and carbon dioxide retention, which eventually led to a decline in lung function. *"When our medical team was relaxing in the hotel at night, I frequently heard my colleagues coughing. It was a common problem for everyone because wearing an N95 mask affected one's own lung function. It was also stated in the literature that wearing an N95 mask in such an enclosed environment for a long time affects people's lung function."*（I5）

The HCWs suffered from gastrointestinal problems, including nausea, vomiting, diarrhea, and stomachache because of poor diet, physical hypoxia, and mental stress. *"Not long after I entered the ward, I suddenly felt uncomfortable. I immediately vomited in the protective suit and the N95 mask I was wearing."*（ I26）

The HCWs had endocrine symptoms such as hypoglycemia and menstrual disorder. HCWs often went to work without having breakfast in order to avoid vomiting and wasting equipment, which was the high risk of hypoglycemia. For female rescue workers, the high intensity of rescue work and menstrual problems led to menstrual disorder. *"During the rescue period, the menstrual period moved forward by half a month, that is, 3 times in 2 months."*（I14:） *"You had to eat at the end of the day, which means that you had to spend about 7 or 8 hours in the ward before you ate. So, there were many people who had hypoglycemia at that time."*（ I28:）

3.2.2 Physical exhaustion during rescue mission

During the epidemic rescue mission, the HCWs' physical capabilities deteriorated significantly as a result of wearing PPEs, frequent shifts, insufficient personal rest time, and high-intensity work. *"In the early days, because there was not enough protective equipment, we had to wear diapers and left after being in the ward for more than 10 hours. This working model was adopted so as not to waste any equipment. So, we did not leave the ward until we could not hold on. Our physical exhaustion was the most serious in the early stages of the rescue."*（ I7）

The HCWs reported that they had symptoms of device-related skin injuries, dermatitis, rashes, nasal mucosal injuries, and oral ulcers because of the prolonged wearing of sealed PPEs, frequent use of harsh disinfectants, and a rather simple, non-nutritious diet. *I21: "One person in our rescue team who worked for 2 days straight after coming to the ward had rashes on his scalp. At that time, he couldn't go to work because he was afraid of being infected because of those rashes." "In the early stages of the rescue, there were no vegetables available."（I7）*

The HCWs were at high risk of being infected with COVID-19 because of their close contact with patients and the strain of the work. *"What impressed me the most was that six people in the original department of the hospital where we worked as rescuers had already been infected."(I15)* Likewise, there was also a risk of death. Some HCWs had cardiac arrest and died suddenly because of long-term fatigue. "*There was a nurse who fainted due to hypokalemia, and then she had a heart attack.*"*(I9)*

3.2.3 Negative cognition during rescue mission

The HCWs had strong sense of being protected when they first arrived at the ward to work. However, in the later stages, when they had become familiar with the protection procedures, their sense of self-protection diminished as they realized they were at an increased risk of infection. *"One month later, the team members, including myself, had a weak sense that we could prevent infection because we had worked for a month without infection.*"（*I21*）

The HCWs suspected that they were infected, without clear medical evidence. This phenomenon is hypochondriasis. "*I was very nervous after I had been coughing for 2 or 3 hours. I was very sensitive because the symptoms of COVID-19 include asymptomatic dry cough.*"（*I15*）

The HCWs sometimes thought that they were unable to save the patient's life, which diminished feelings of efficacy. *"Treatment was a worrying thing because there was no standard treatment strategy for COVID-19. The treatment guide was updated seven times a month. I did not know how to treat it effectively."(I12)*

3.2.4 Negative emotions during rescue mission

The main emotional problem that the HCWs dealt with was their fear of being infected by the virus. This fear derived from the people around them who suspected they were experiencing symptoms of infection and because of ineffectiveness of the protective equipment. "*In fact, I was mainly worried about infectious diseases, including being infected myself, and the risk of transmitting the virus to others."(I4)*

When HCWs entered the ward, the challenging tasks their work entailed made them anxious. *"At that time, minimizing the mortality rate was required. Therefore, we were under enormous pressure to treat critically ill patients who were often at a higher risk of death." (I6)*. Personal inner conflict was also a cause of anxiety. *"I had a conflict because I needed an assistant, a nurse, a doctor … and at least five people around me when performing the intubation surgery. The virus formed aerosols that might infect anyone. At that time, I wondered whether it was worth saving a patient with low hopes of survival when it put so many medical staff in danger."(I7)*

The HCWs were prone to feeling helpless because of their inability to socialize, the shortage of protective and medical equipment, the ineffective treatment of patients, and their inability to handle housework. *"The next day after I arrived in the ward, I didn't get any supplies except the bare minimum. I did not think we could protect ourselves without any protective supplies. It was a really desperate situation."(I7)*

The HCWs were required to isolate themselves, which resulted in them being away from family and colleagues, and in loneliness. *"We were working in the separate rescue ward alone. Thus, at that time, we had no contact with anyone else for 2 months and we were isolated."(I15)*

3.2.5 Negative behavior during rescue mission

Some HCWs relaxed by overeating. *"I tended to relax by eating lots of food. Finally, I had gained 10 kg after rescue."* Many HCWs also suffered from insomnia because of the high stress. *(I3)* "To be honest, I hardly slept for a week."*(I24)*

The HCWs engaged in compulsive behaviors, including excessive hand-washing and other excessive protective behaviors because they worried about being infected by COVID-19. *"The phenomenon of overly protective behavior also existed because of inner tension. In fact, we pressed hard [on the nose clips of our masks] out of fear of infection, which resulted in breaking the skin."(I8)*

The HCWs exhibited social avoidance, work avoidance, and avoidance of epidemic-related information. *"I did not want to call my families. I'm sure that I deliberately avoided talking about the rescue work with my family."(I15)*

3.3 After the epidemic rescue mission

3.3.1 Physical disfunction after rescue mission

Some HCWs over-ate to relieve stress, causing them to gain weight. However, most people suffered a loss of appetite, causing rapid weight loss. *"Everyone said that they were thinner as they weighed around 6–7 kg less than before."(I14)*

Because of the high intensity of work, some HCWs exhibited cardio-cerebrovascular symptoms, including myocardial ischemia, angina pectoris, palpitation, chest tightness, lacunar cerebral infarction, and elevated blood pressure. *"After we came back, we had a physical examination and there was lacunar infarction in our team members. But they had no lacunar infarction before."(*I9*)*

The HCWs reported respiratory symptoms, including throat discomfort, pulmonary nodules, ground-glass changes in the lungs, and respiratory infection. *"I was diagnosed with a lung problem after physical examination." (I7)*

Some HCWs experienced endocrine symptoms, including elevated blood sugar levels, and some female rescuers also had symptoms of menstrual disorders. *"The physical examination showed that my blood sugar was a little higher than before. There were also many girls who found that their menstrual periods had changed."(I7)*

Low back or cervical pain was also a symptom reported by some HCWs. *"I had to bend over to administer medication, which led to cervical spine pain and back pain. I didn't feel the pain before, but now it's very painful."(*I29*)*

Many HCWs found that their immunity had declined and they had more frequent colds and rhinitis. *"I often had colds; they were more frequent than before." (*I21*)*

3.3.2 Negative emotions after rescue mission

The HCWs had to avoid contact with others during quarantine, which made many lonely. I16: "I thought isolation made me more uncomfortable than working. I could not go out and see anyone during quarantine." They also found themselves tending to hide their own physical and mental health problems. *"Chinese people were relatively unwilling to talk about their psychological conditions. I thought it was a normal phenomenon. There were many psychological problems among our team members but it was difficult for them to take the initiative to speak out."(I6)*

The HCWs experienced nightmares, increased alertness, and avoidance behavior as the main symptoms of posttraumatic stress disorder. *"During our isolation and recuperation, I had a nightmare every day.(* I12 *) "When I returned to work, I saw the patients in the ward. I felt so nervous because I was afraid that the patients needed oxygen. And then I immediately prepared oxygen for them."(I29) "Sometimes I am reluctant to remember the rescue experience."(I8)*

When the rescuers heard the news of the accidental death of their colleagues, they were fearful and worried that they might die suddenly. *"After her [the colleague] death, we were really under a lot of pressure. It was possible that I might die suddenly. I didn't dare to go to sleep because I was afraid that I would die suddenly in my sleep."(* I1 *)*

Some HCWs have experienced depression since returning home. *"There was a mental health examination provided by the hospital, which showed that many were abnormal. One of them had suicidal tendencies." (I1)*

3.3.3 Stigmatization after rescue mission

Many HCWs faced stigmatization. During the quarantine period, hotel staff treated them differently for fear they might spread the virus. And after returning home, the HCWs' neighbors also worried about catching the virus from them and stay away from them. *"My mother told me that the people near our house didn't want to allow me come home because I had been to Wuhan." (I29)*

3.3.4 Hypochondriasis after epidemic rescue mission

Even after the epidemic rescue mission was over, some HCWs continued to have symptoms of hypochondria. They suspected themselves of being infected or mentally ill. *"I had a sore throat in the quarantined hotel and I thought I was sick. But my blood revealed no problems in the nucleic acid test at that time." The problem of insomnia also persisted after the HCWs finished the rescue work. (I5)* "*I think the biggest problem is insomnia. When I was in quarantine and even when I went back to work, I had symptoms of insomnia*." (*I13)*

4 Discussion

The novelty of this study lies in a deep exploration of the physical and mental health problems of HCWs fighting COVID-19 based on first-hand interviews. The results reveal that HCWs had quite serious physical and mental health problems throughout the epidemic rescue mission (before, during, and after). This study compensates for the shortcomings of previous studies of the health problems of HCWs, which, to some extent, have ignored the health problems that existed before rescue. The need for measures to protect the health of these HCWs throughout the three phases of epidemic rescue mission is urgent.

This study found the worrying phenomenon that some HCWs hid their underlying diseases before participating in rescue work. This behavior may be associated with the HCWs' strongly held beliefs about professionalism and their sense of responsibility to heal infected people[22]. Because an extended period of stressful rescue work may cause diseases of various organs [23], the underlying diseases of rescuers undoubtedly increase their risk of sudden death during and after rescue mission [24]. Therefore, hospital administrators must conduct physical and mental examinations of HCWs in order to identify high-risk individuals.

A similar phenomenon was also found after the rescue work. Some emergency health workers hid their physical and mental discomfort out of shame, which may be related to face culture in China [25]. This behavior not only constitutes a high-risk factor for the development of more serious physical and mental illness but also becomes an obstacle to their returning to their daily routine after the rescue [26]. Therefore, their colleagues and family members should be sensitive to the HCWs' abnormal physical and mental reactions through observation and communication [27]. Furthermore, hospital managers should establish early screening programs to monitor the early signs of physical or mental health problems among HCWs[28].

5 Implications for future practice

First, because HCWs face many stressors during the epidemic medical rescue mission, the protection of their health must not be the sole responsibility of the healthcare worker themselves[29]. Support from others not only provides material support but also spiritual support, both of which can decrease the risk of HCWs suffering health problems and improve the efficiency of patient care [30]. Thus, hospital administrations should cooperate with others to establish a comprehensive prevention and support system [28]. Second, though the epidemic rescue mission may be over, its long-term impact on the health of the HCWs continues, as this study confirmed. Therefore, it is necessary for hospital managers to establish long-term health profiles of HCWs to track and solve their health problems after the epidemic rescue mission.

6 Limitation

A limitation of this study was that all participants were interviewed nearly 6 months after epidemic rescue mission, which resulted in recall bias. However, because this was the first time that most HCWs had ever experienced working during major epidemic, their recollection of the experience was relatively clear, as was confirmed during the interviews. Further research should collect information about healthcare workers' health problems during each phase of epidemic rescue mission (before, during, and after) to reduce recall bias.

7 Conclusion

HCWs fighting COVID-19 experienced physical and mental health problems across the three phases of epidemic rescue mission. To protect their health, a comprehensive prevention and control system is needed that covers both physical and mental health problems and involves the HCWs themselves, their families, hospitals, the government, and social organizations throughout the epidemic rescue mission (before, during, and after).

Statements

Contributorship statement:

DF conceived of the study, participated in its design and coordination, and helped to draft the manuscript, XS participated in data analysis and interpretation of the data and drafted the manuscript; ZW helped to draft the manuscript; HL participated in data collection; MR helped to draft the manuscript.

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Tables

Table1

Semi-structured interview guide

Questions
1. What worries did you have when you were informed going to work in hospitals in Hubei province?
2. What did you feel uncomfortable physically or mentally when you arrived at the Hubei province?
3. What did you feel uncomfortable physically or mentally when you worked in the insolation ward?
4. How has your physical and mental health changed after the rescue work compared to before the rescue work?

Table2

Sociodemographic data of interviewers

Serial number	Profession and department	Gender	Age	Education degree	Place of dispatch	COVID-19 ward start date
I1	Oncology nurse	Female	38	Master's degree	Shandong Province	February 2020
I2	Operating nurse	Male	34	Undergraduate	Shandong Province	February 2020
I3	Respiratory physician	Male	35	PhD	Shandong Province	February 2020
I4	Liver physician	Male	33	PhD	Shandong Province	February 2020
I5	Nurse in coronary heart disease	Male	29	Undergraduate	Shandong Province	February 2020
I6	Doctor in the intensive care unit	Male	36	PhD	Shandong Province	February 2020
I7	Anesthesiologist	Male	40	PhD	Shandong Province	February 2020
I8	Urological nurse	Female	42	Undergraduate	Shandong Province	February 2020
I9	Gynecology nurse	Female	38	Undergraduate	Shandong Province	February 2020
I10	Respiratory physician	Female	38	PhD	Shandong Province	February 2020
I11	Respiratory physician	Female	41	PhD	Shandong Province	February 2020
I12	Cardiologist	Male	50	PhD	Shandong Province	February 2020
I13	Respiratory physician	Male	36	Master's degree	Shandong Province	February 2020
I14	Respiratory nurses	Female	41	Junior college	Shandong Province	January 2020
I15	Lymphoid nurse	Female	35	Undergraduate	Shandong Province	January 2020
I16	Gastroenterology nurse	Female	40	Undergraduate	Hebei Province	February 2020
I17	Doctor in the intensive care unit	Male	44	master's degree	Hebei Province	January 2020
I18	Neurology nurse	Female	36	Undergraduate	Shandong Province	February 2020
I19	Nurse in the intensive care unit	Male	37	Undergraduate	Hefei province	January 2020
I20	Emergency department nurse	Female	42	Undergraduate	Hefei province	February 2020
I21	General practice nurse	Female	37	Undergraduate	Hefei province	February 2020
I22	Hematologist	Male	42	master's degree	Hefei province	February 2020
I23	General practice nurse	Male	37	Undergraduate	Hefei province	January 2020
I24	Nurse in the intensive care unit	Female	47	Undergraduate	Guangdong province	February 2020
I25	Doctor in the intensive care unit	Male	41	PhD	Guangdong province	February 2020
I26	Neurologist	Male	41	PhD	Guangdong province	February 2020
I27	Respiratory physician	Male	48	Master's degree	Guangdong province	February 2020
I28	Respiratory nurse	Female	34	Undergraduate	Guangdong province	January 2020
I29	Respiratory nurse	Female	24	Undergraduate	Guangdong province	January 2020
I30	Nurse in the intensive care unit	Male	32	Undergraduate	Shandong Province	January 2020
I31	Emergency department nurse	Female	30	Undergraduate	Shandong Province	January 2020

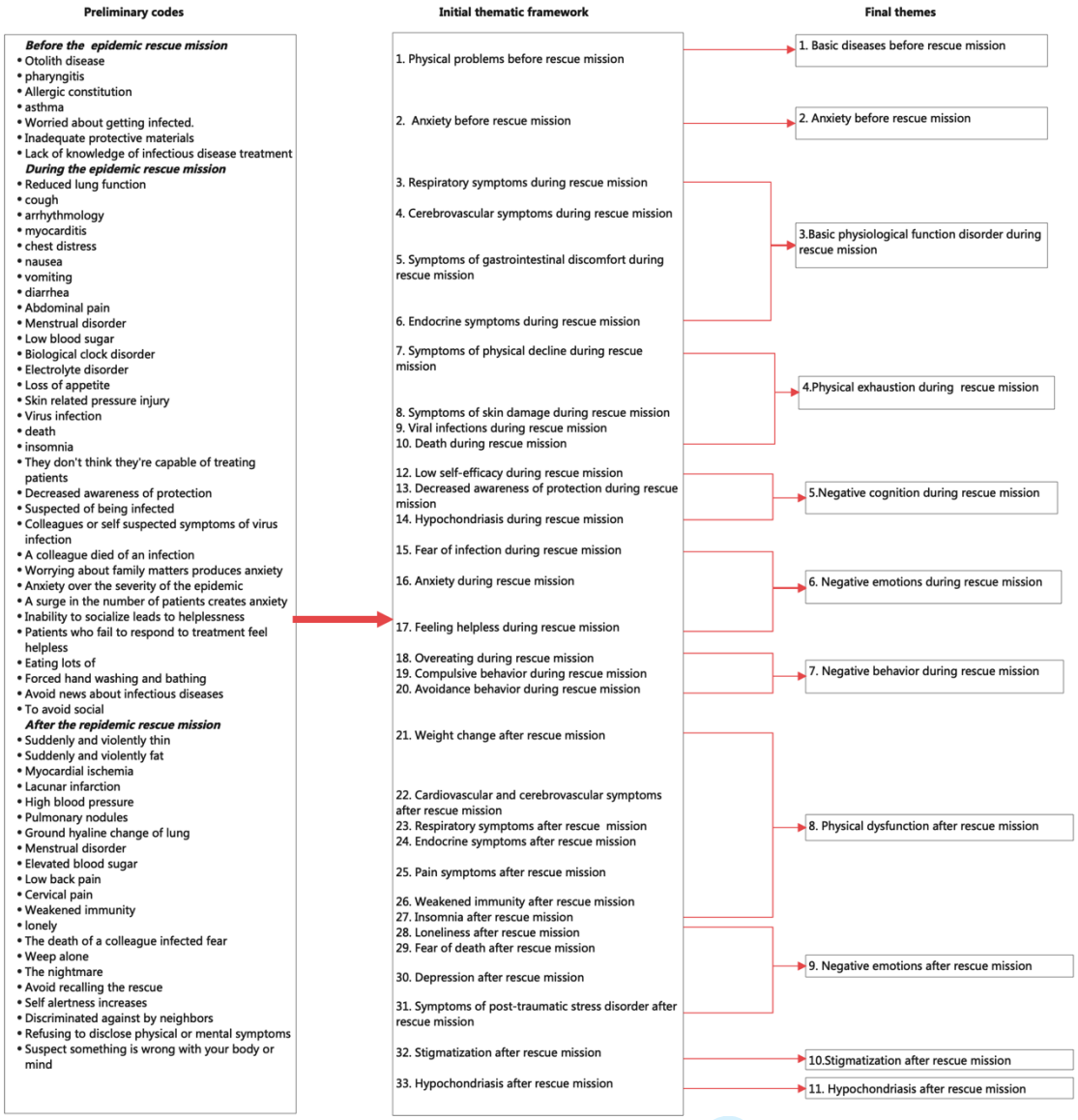

Figure1: Preliminary codes, initial thematic framework and final themes.

Table S1 Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No Item Guide questions/description	Page/Answers
Domain 1: Research team and reflexivity Personal Characteristics	
1. Interviewer/facilitator-Which author/s conducted the interview or focus group?	Page 4. All authors.
2. Credentials-What were the researcher's credentials? E.g. PhD, MD	PhD and MD
3. Occupation-What was their occupation at the time of the study?	Page 4. HCWs in COVID-19 mission.
4. Gender-Was the researcher male or female?	Both male and female.
5. Experience and training-What experience or training did the researcher have?	The researchers have participated in qualitative studies before.
Relationship with participants	
6. Relationship established-Was a relationship established prior to study commencement?	Page 4. No previous relationship.
7. Participant knowledge of the Interviewer-What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Page 4. Information was provided in recruiting.
8. Interviewer characteristics-What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Page 4-5. We explained several strategies of ensuring dependability, credibility, confirmability and transferability.
Domain 2: study design	
Theoretical framework	
9. Methodological orientation and Theory-What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, content analysis	Page 5. Phenomenological analysis.

Participant selection	
10. Sampling-How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 3. Purposive.
11. Method of approach-How were participants approached? e.g. face-to-face, telephone, mail, email	Page 4. face-to-face.
12. Sample size-How many participants were in the study?	Page 6. 31
13. Non-participation-How many people refused to participate or dropped out? Reasons?	Page 4. HCWs who agreed to participate in study contact researcher by mobile phone. We ended interviewing when date saturation. When date saturation and 31 HCWs were supposed to be reached and there was nobody dropping out.
Settings	
14. Setting of data collection Where was the data collected? e.g. home, clinic, workplace	Page4. Before interview, participants decided the peaceful interview places include workplace, meeting room and cafeteria by mobile phone.
15. Presence of non-participants Was anyone else present besides the participants and researchers?	Page 5. They were interviewed individually.
16. Description of sample-What are the important characteristics of the sample? e.g. demographic data, date	Page 6 and Table 2.
Data collection	
17. Interview guide-Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 4. A semi-structured format with open-ended questions was used.
18. Repeat interviews-Were repeat interviews carried out? If yes, how many?	Page 4-5. No repeat interview.

19. Audio/visual recording-Did the research use audio or visual recording to collect the data?	Page 4. Audio record.
20. Field note- Were field notes made during and/or after the interview or focus group?	Page 5. Field notes
21. Duration What was the duration of the interviews or focus group?	Page 4. 20–60 minutes.
22. Data saturation-Was data saturation discussed?	Page 4.
23. Transcripts returned-Were transcripts returned to participants for comment and/or correction?	Page 5. Yes.
Domain 3: analysis and findings	
Data analysis	
24. Number of data coders-How many data coders coded the data?	Page 6. Six
25. Description of the coding tree-Did authors provide a description of the coding tree?	Page 21. Table 3.
26. Derivation of themes-Were themes identified in advance or derived from the data?	Page 6. Yes
27. Software What software, if applicable, was used to manage the data?	Page 5. Nvivo 11.0
28. Participant checkin- Did participants provide feedback on the findings?	No additional feedback.
Reporting	
29. Quotations presented-Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number	Page 7-12. Yes
30. Data and findings consistent-Was there consistency between the data presented and the findings?	Page 7-12. Yes

31. Clarity of major themes Were major themes clearly presented in the findings?	Page 7-12. Yes
32. Clarity of minor themes Is there a description of diverse cases or discussion of minor themes?	Page 7-12. Yes

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The physical and mental health problems of Chinese frontline healthcare workers before, during and after COVID-19 rescue mission: a qualitative study

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Title Page

Title

The physical and mental health problems of Chinese frontline healthcare workers before, during and after COVID-19 rescue mission: a qualitative study

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Keywords: COVID-19, frontline healthcare workers, physical health, mental health, qualitative study

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The physical and mental health problems of Chinese frontline healthcare workers before, during and after COVID-19 rescue mission: a qualitative study

Abstract

Objective: To explore the physical and mental health problems of frontline healthcare workers fighting the COVID-19 across the three stages of epidemic rescue mission (before, during, and after) in China.

Design: A qualitative study was adopted using face to face, in-depth semi-structured interviews. Phenomenological research methods and Colaizzi's seven-step analysis method were used for data analysis.

Setting: The offices of healthcare workers in twelve tertiary hospitals.

Participants: Thirty-one frontline healthcare workers were interviewed from October to November 2020. They were from other sixteen provinces of China to fight COVID-19 in Hubei Province.

Results: Physical and mental health problems existed before, during and after the epidemic rescue mission. Meanwhile, eleven themes emerged in three stages. Two themes appeared before rescue mission: basic diseases, anxiety before rescue mission; five themes appeared during rescue mission: basic physical function disorder, physical exhaustion, negative cognition, negative emotions, negative behavior; four themes appeared after rescue mission: physical dysfunction, negative emotions, stigmatization, hypochondriasis.

Conclusion: Both physical and mental health problems occurred throughout the three stages. The study results pointed that a comprehensive prevention and control system is needed that covers both physical and mental health problems of frontline healthcare workers throughout three stages of epidemic rescue mission (before, during, and after), which also need themselves, their families, hospitals, the government, social organizations to involve in.

Keywords: COVID-19, frontline healthcare workers, physical health, mental health, qualitative study

Strengths

1. This study explores the physical and mental health problems of frontline healthcare workers related to the epidemic rescue mission through a unified perspective of mental and physics and through a qualitative study.
2. This study focuses on the health of frontline healthcare workers throughout the three stages of epidemic rescue mission (before, during and after).
3. The types of physical and mental health problems faced by frontline healthcare workers in the three stages before, during and after epidemic rescue mission are different.

1 Introduction

In the past 30 years, there have been more than 40 new types of major epidemic around the world, including severe acute respiratory syndrome (SARS), Middle East Respiratory Syndrome (MERS) influenza (H1N1) and so on [1-2]. According to WHO data, major epidemics were once the second highest cause of death [3]. For example, the COVID-19 outbreak has been associated with significant morbidity and medical complications around the world; it has infected over 267,244,380 people and resulted in 5,280,678 deaths globally as of December 8, 2021 [4]. Major epidemics are characterized by high infectivity, pathogenicity, and mortality [5], which not only directly threaten the survival and development of human beings but also have a considerable impact on the world economy.

Frontline healthcare workers (HCWs) are important resource in every country. They play a vital role in controlling the development of epidemic, reducing casualties, ensuring economic development and social stability [6]. Moreover, the Chinese National Health Commission sent HCWs from other provinces to support the COVID-19 outbreak area in early 2020 and most of them never involved in epidemic

rescue mission before. However, these HCWs suffered various health problems due to epidemic rescue mission related stressors. Previous studies found that HCWs faced a variety of stressors related to epidemic rescue mission, including the high intensity of the work, high risk of viral infection, and ethical issues [7]. Moreover, they also experienced environment-related stressors such as harsh working environments, long-time wearing personal protective equipment (PPE), cultural differences, and lack of protective supplies [8-9]. These stressors resulted in HCWs easily suffering both physical and mental health problems (such as viral infection, depression, anxious and so on) during epidemic medical rescue mission [10]. HCWs with health problems not only reduce the quality of providing continue patient care, but also hinder the flexible response to the control of epidemic [11].

Extant studies found that HCWS were prone to suffer viral infections and mental health problems [10-12]. But these studies mainly focus on the mental health problems of HCWS in two stages (during and after epidemic rescue mission) through quantitative studies with scales [3,13]. Only one research found HCWs also experienced mental health problems before arriving at the epidemic rescue mission scene, including tension, hopelessness, and fear [14]. What's more, according to the stress response theory, individuals will have dual physical and mental responses when facing various stressors. This meaning that when HCWs face epidemic rescue mission which is huge stress source, they may have physical and mental health problems. Finally, the current studies also neglect the physical health problems among HCWs in three stages of epidemic rescue mission. If the physical and mental health of HCWs is ignored, the health of HCWs cannot be effectively protected. This will ultimately seriously reduce the ability of medical aid to deal with major epidemics in the future. Thus, it is necessary to focus on the physical and mental health of HCWs and explore their physical and mental health problems in different stages of the epidemic medical rescue mission (before, during, and after).

This study adopted a qualitative research design to explore both physical and mental health problems of HCWs fighting COVID-19 in Hubei Province, China, in the three phases of epidemic rescue mission (before, during and after). It provides

references for preventing or solving these health problems and ultimately contributing to better protecting the health of HCWs fighting COVID-19 and other major epidemics in the future.

2 THE STUDY

2.1 Aim

This study aimed to explore physical and mental health problems of HCWs in different stages of COVID-19 epidemic rescue mission (before, during and after).

2.2 Design

Qualitative research is typically used to acquire an in-depth understanding of individuals' experiences under specific circumstances [15]. Phenomenological study, a kind of qualitative methodology, investigate individuals' experiences of being immersed in a situation, which aids researchers in understanding the essence of a phenomenon [16]. COVID-19 is a new infectious disease. The epidemic rescue mission that HCWs are involved in is a new experience and completely different from their daily work. A phenomenological study is a research method used for exploring new experiences. This study followed the guidelines for Consolidated Criteria for Reporting Qualitative Studies (COREQ checklist, see table s1).

2.3 Participants

Purpose sampling was used to enroll HCWs who participated in the epidemic rescue mission in Hubei province, China, during the COVID-19 outbreak in 2020. Meanwhile, inclusion criteria for the participants were that they had to have traveled to Hubei Province to fight COVID-19 for at least a month. Participants were excluded if they were auxiliary or logistic HCWs.

2.4 Data collection

The study was conducted between October and November 2020, when the rescue work in Hubei had been over for about six months. First, the HCWs' group manager forwarded participant recruitment information to WeChat workgroups. This included the study's aim and methods (interviews); inclusion criteria; voluntary participation and withdrawal at any given time even after agreeing to participate in the interview and contact information (i.e., mobile phone number) to confirm participation. In the

interview, participants were required to respond to four open-ended questions related to the epidemic rescue mission. If they had any negative emotions, unreasonable thoughts or other unpleasant experiences, some psychological services could be provided. Second, HCWs who were interested and agreed to participate in this study contacted the researcher by mobile phone. Subsequently, the interview was scheduled in a quiet, relaxed, and independent room for face-to-face interviews without any disturbances.

HCWs with varied demographic backgrounds were selected to ensure sample representativeness. Data collection occurred concurrently with the data analysis, which may have facilitated the identification of thematic saturation. The sample size was not certain until theoretical saturation was achieved, which means that data analysis was identifying no new information [17].

Face-to-face and semi-structured interviews were conducted by five experienced researchers, including one professor, three postgraduate students and one clinical nursing who had been trained in qualitative interviewing methods and ethics. Before interviewing, an interview guide based on an extensive literature survey of HCWs' health problems was developed. Then, two HCWs who were fighting COVID-19 in Hubei were pre-interviewed to familiarize the interviewing researchers with the study's progress and to modify the interview guide (for the final interview guide see Table 1).

Before interview, participants decided the quiet interview places (such as, meeting room) by mobile phone. At the beginning of each interview, they were asked to complete the demographic information via a questionnaire. Then, with the participants' permission, all interviews were audio-recorded using a small recording device; the duration of the interviews were between 20 and 60 min. The interview followed an interview guide, and open and flexible discussions on the topics were also allowed [18]. The researchers encouraged the interviewees to be expressive. During the interview, interviewers wrote notes about the participants' body language and their own reflections so that the participants' perspectives would be correctly stated and understood. Additionally, appropriate pauses in or changes of the topic were applied

whenever participants seemed to feel uncomfortable during the interviews. Subsequent telephone interviews were conducted if there was any doubt about the content of the interview. The HCWs were compensated 100 RMB for taking part in the interview.

2.5 Data analysis

Data collection and analysis occurred simultaneously and were managed by Nvivo 11.0 software. Within 24 hours from the end of the interview, the recording was transcribed word-for-word. Haase's (1987) [19] adaption of Colaizzi's (1978) [20] method was used to analyze the transcripts. First, the researchers read every transcript several times to gain an understanding of the meanings conveyed. Second, significant statements and phrases were identified from each transcript. Third, the researchers described and analyzed the aspects of the data that were not obvious on the surface of the explicit statements in each transcript. The researchers then integrated all of the results into an exhaustive narrative description, and they also created and validated formulated meanings through research team discussions to reach consensus. Fourth, these formulated meanings were sorted into clusters of themes and categories. Fifth, the researchers identified the fundamental structure of the experience and developed a full and clear description of each of the six themes. Finally, to validate the study, the researchers asked the participants if the findings captured the essence of their experiences. To enhance confirmability, three researchers independently analyzed the transcripts. Thereafter, findings from the researchers were compared and discussed at team meetings until consensus was achieved.

All participants gave verbal consent at the beginning of the individual interview. Anonymity and confidentiality were maintained by using numbers to replace names (e.g., I1) and by removing identifying information from the transcripts. All transcripts were saved on a password-protected computer. Additionally, we followed the standards for Reporting Qualitative Research guidelines.

2.6 Ethics approval

The Ethics Committee of School of Nursing and Rehabilitation, Shandong University approved this research (No. 2020-R-39).

2.7 Rigor

The Linclon and Guba's (1985) [21] four criteria to ensure trustworthiness including credibility, transferability, dependability and confirmability were used to enhance the rigor. The research team included five experienced researchers, including one professor, three postgraduate students and one clinical nursing. Interviews were performed by three experienced researchers who had been trained in qualitative interviewing methods and had qualitative experiences. Data were analyzed by each researcher independently, to ensure the reliability and validity. The findings from each researcher were compared. And the different findings were input for further discussed until consensus was achieved. The thick description and verbatim quotes ensure the transferability of findings. The researchers included experts from healthcare workers' statements to verify the concordance of findings with raw data. This way was used to enhance the confirmability and indicate the data was not based on preconceived notions. All the decisions about data collection and analysis were recorded and maintain audit trail of our study established the dependability and confirmability.

2.8 Patient and public involvement

As this study focused on the health problems of HCWs fighting COVID-19, patients or the public were not involved.

3 Results

The HCWs who participated in this study included 15 females and 16 males; 18 nurses and 13 doctors; aged 24 – 50 years. The characteristics of HCWs are summarized in Table 2. Eleven main themes were identified from the HCWs' dataset (Figure1).

3.1 Before the epidemic rescue mission

3.1.1 Physical health problems before rescue mission

Some participants had underlying diseases (systemic lupus erythematosus, asthma, and allergic constitutions) when they received epidemic rescue mission notice. Undoubtedly, they were at high-risk of being infected or even dying during the epidemic rescue mission. *"I had an allergic constitution. I didn't mention that. The*

leaders didn't know I was allergic. At first, I really wanted to join in the rescue work. I was afraid that others would prevent me from participating in this work because of this disease." (I16)

3.1.2 Mental health problems before rescue mission

The most common mental health problem the participants experienced at this time was anxiety, especially for those who had never participated in an emergency rescue operation against a major pandemic before. They said there were two reasons leading to the anxiety. First, they were fear of being infected by COVID-19. *"I was really worried when I first went there on February 7. At that time, it was said that the number of cases there were increasing every day. It was the first time that I had been involved in the epidemic rescue mission, and I was very worried."* (I4) Second, the participants said that they were very anxious because they were unable to handle family affairs or protect the health and safety of their family members. *"My older parents and my father-in-law were still in the hospital and I have two children. I was worried that if something happened suddenly, there would be nobody helping my family."* (I23)

3.2 During the epidemic rescue mission

3.2.1 Basic physiological function disorder during rescue mission

Some participants said they suffered arrhythmias, chest tightness, breathing difficulties, and even fainting because of such factors as high-intensity work, circadian clock disorders, and hypoxia resulting from wearing PPEs. *"Most of the time, I did not have arrhythmias. But when I was lying in bed, I had premature heartbeats and arrhythmia. Anyway, I felt uncomfortable at that time."* (I14)

Because of the airtightness of the protective equipment and the irritation from disinfectants, participants experienced symptoms of hypoxia and carbon dioxide retention, which eventually led to a decline in lung function. *"When our medical team was relaxing in the hotel at night, I frequently heard my colleagues coughing. It was a common problem for everyone because wearing an N95 mask affected one's own lung function. It was also stated in the literature that wearing an N95 mask in such an enclosed environment for a long time affects people's lung function."* (I5)

The participants suffered from gastrointestinal problems, including nausea, vomiting, diarrhea, and stomachache because of poor diet, physical hypoxia, and mental stress. *"Not long after I entered the ward, I suddenly felt uncomfortable. I immediately vomited in the protective suit and the N95 mask I was wearing."* (I26)

The participants had endocrine symptoms such as hypoglycemia and menstrual disorder. Participants often went to work without having breakfast in order to avoid vomiting and wasting equipment, which was the high risk of hypoglycemia. For female rescue workers, the high intensity of rescue work and menstrual problems led to menstrual disorder. *"During the rescue period, the menstrual period moved forward by half a month, that is, 3 times in 2 months."* (I14) *"You had to eat at the end of the day, which means that you had to spend about 7 or 8 hours in the ward before you ate. So, there were many people who had hypoglycemia at that time."* (I28)

3.2.2 Physical exhaustion during rescue mission

During rescue mission, the participants' physical capabilities deteriorated significantly as a result of wearing PPEs, frequent shifts, insufficient personal rest time, and high-intensity work. *"In the early days, because there was not enough protective equipment, we had to wear diapers and left after being in the ward for more than 10 hours. This working model was adopted so as not to waste any equipment. So, we did not leave the ward until we could not hold on. Our physical exhaustion was the most serious in the early stages of the rescue."* (I7)

The participants reported that they had symptoms of device-related skin injuries, dermatitis, rashes, nasal mucosal injuries, and oral ulcers because of the prolonged wearing of sealed PPEs, frequent use of harsh disinfectants, and a rather simple, non-nutritious diet. *"One person in our rescue team who worked for 2 days straight after coming to the ward had rashes on his scalp. At that time, he couldn't go to work because he was afraid of being infected because of those rashes."* (I21) *"In the early stages of the rescue, there were no vegetables available."* (I7)

The participants were at high risk of being infected with COVID-19 because of their close contact with patients and the strain of the work. *"What impressed me the*

most was that six people in the original department of the hospital where we worked as rescuers had already been infected." (I15) Likewise, there was also a risk of death. Some participants had cardiac arrest and died suddenly because of long-term fatigue. "*There was a nurse who fainted due to hypokalemia, and then she had a heart attack*." (I9)

3.2.3 Negative cognition during rescue mission

The participants had strong sense of being protected when they first arrived at the ward to work. However, in the later stages, when they had become familiar with the protection procedures, their sense of self-protection diminished as they realized they were at an increased risk of infection. *"One month later, the team members, including myself, had a weak sense that we could prevent infection because we had worked for a month without infection.*" (I21)

The participants suspected that they were infected, without clear medical evidence. This phenomenon is hypochondriasis. "*I was very nervous after I had been coughing for 2 or 3 hours. I was very sensitive because the symptoms of COVID-19 include asymptomatic dry cough.*" (I15)

The participants sometimes thought that they were unable to save the patient's life, which diminished feelings of efficacy. *"Treatment was a worrying thing because there was no standard treatment strategy for COVID-19. The treatment guide was updated seven times a month. I did not know how to treat it effectively*." (I12)

3.2.4 Negative emotions during rescue mission

The main emotional problem that the participants dealt with was their fear of being infected by the virus. This fear derived from the people around them who suspected they were experiencing symptoms of infection and because of ineffectiveness of the protective equipment. "*In fact, I was mainly worried about infectious diseases, including being infected myself, and the risk of transmitting the virus to others."* (I4)

When participants entered the ward, the challenging tasks their work entailed made them anxious. *"At that time, minimizing the mortality rate was required. Therefore, we were under enormous pressure to treat critically ill patients who were*

often at a higher risk of death." (I6). Personal inner conflict was also a cause of anxiety. *"I had a conflict because I needed an assistant, a nurse, a doctor … and at least five people around me when performing the intubation surgery. The virus formed aerosols that might infect anyone. At that time, I wondered whether it was worth saving a patient with low hopes of survival when it put so many medical staff in danger."* (I7)

The participants were prone to feeling helpless because of their inability to socialize, the shortage of protective and medical equipment, the ineffective treatment of patients, and their inability to handle housework. *"The next day after I arrived in the ward, I didn't get any supplies except the bare minimum. I did not think we could protect ourselves without any protective supplies. It was a really desperate situation."* (I7)

The participants were required to isolate themselves, which resulted in them being away from family and colleagues, and in loneliness. *"We were working in the separate rescue ward alone. Thus, at that time, we had no contact with anyone else for 2 months and we were isolated."* (I15)

3.2.5 Negative behavior during rescue mission

Due to the high intensity, long duration and high-risk rescue mission, some participants exhibited negative behavior problems, such as overeating, compulsive behavior, avoidance behavior, and other behavioral problems.

Some participants relaxed by overeating. *"I tended to relax by eating lots of food. Finally, I had gained 10 kg after rescue." Many* HCWs *also suffered from insomnia because of the high stress.* (I3) "*To be honest, I hardly slept for a week."* (I24)

The participants engaged in compulsive behaviors, including excessive hand-washing and other excessive protective behaviors because they worried about being infected by COVID-19. *"The phenomenon of overly protective behavior also existed because of inner tension. In fact, we pressed hard [on the nose clips of our masks] out of fear of infection, which resulted in breaking the skin."* (I8)

The participants exhibited social avoidance, work avoidance, and avoidance of epidemic-related information. *"I did not want to call my families. I'm sure that I deliberately avoided talking about the rescue work with my family."* (I15)

3.3 After the epidemic rescue mission

3.3.1 Physical disfunction after rescue mission

Some participants over-ate to relieve stress, causing them to gain weight. However, most people suffered a loss of appetite, causing rapid weight loss. *"Everyone said that they were thinner as they weighed around 6–7 kg less than before."* (I14)

Because of the high intensity of work, some participants exhibited cardio-cerebrovascular symptoms, including myocardial ischemia, angina pectoris, palpitation, chest tightness, lacunar cerebral infarction, and elevated blood pressure. *"After we came back, we had a physical examination and there was lacunar infarction in our team members. But they had no lacunar infarction before."* (I9)

The participants reported respiratory symptoms, including throat discomfort, pulmonary nodules, ground-glass changes in the lungs, and respiratory infection. *"I was diagnosed with a lung problem after physical examination."* (I7)

Some participants experienced endocrine symptoms, including elevated blood sugar levels, and some female rescuers also had symptoms of menstrual disorders. *"The physical examination showed that my blood sugar was a little higher than before. There were also many girls who found that their menstrual periods had changed."* (I7)

Low back or cervical pain was also a symptom reported by some participants. *"I had to bend over to administer medication, which led to cervical spine pain and back pain. I didn't feel the pain before, but now it's very painful."* (I29)

Many participants found that their immunity had declined and they had more frequent colds and rhinitis. *"I often had colds; they were more frequent than before."* (I21)

3.3.2 Negative emotions after rescue mission

The participants had to avoid contact with others during quarantine, which made many lonely. "*I thought isolation made me more uncomfortable than working. I could not go out and see anyone during quarantine*." (I16) They also found themselves tending to hide their own physical and mental health problems. *"Chinese people were relatively unwilling to talk about their psychological conditions. I thought it was a normal phenomenon. There were many psychological problems among our team members but it was difficult for them to take the initiative to speak out."* (I6)

The participants experienced nightmares, increased alertness, and avoidance behavior as the main symptoms of posttraumatic stress disorder. *"During our isolation and recuperation, I had a nightmare every day."* (I12) *"When I returned to work, I saw the patients in the ward. I felt so nervous because I was afraid that the patients needed oxygen. And then I immediately prepared oxygen for them."* (I29) *"Sometimes I am reluctant to remember the rescue experience."* (I8)

When the rescuers heard the news of the accidental death of their colleagues, they were fearful and worried that they might die suddenly. *"After her [the colleague] death, we were really under a lot of pressure. It was possible that I might die suddenly. I didn't dare to go to sleep because I was afraid that I would die suddenly in my sleep."* (I1)

Some participants have experienced depression since returning home. *"There was a mental health examination provided by the hospital, which showed that many were abnormal. One of them had suicidal tendencies."* (I1)

3.3.3 Stigmatization after rescue mission

Many participants faced stigmatization. During the quarantine period, hotel staff treated them differently for fear they might spread the virus. And after returning home, the participants' neighbors also worried about catching the virus from them and stay away from them. *"My mother told me that the people near our house didn't want to allow me come home because I had been to Wuhan."* (I29)

3.3.4 Hypochondriasis after epidemic rescue mission

Even after the epidemic rescue mission was over, some participants continued to have symptoms of hypochondria. They suspected themselves of being infected or

mentally ill. *"I had a sore throat in the quarantined hotel and I thought I was sick. But my blood revealed no problems in the nucleic acid test at that time." The problem of insomnia also persisted after the* participants *finished the rescue work.* (I5) "*I think the biggest problem is insomnia. When I was in quarantine and even when I went back to work, I had symptoms of insomnia*." (I13)

4 Discussion

The novelty of this study lies in a deep exploration of the physical and mental health problems of HCWs fighting COVID-19 based on first-hand interviews. The results reveal that HCWs had quite serious physical and mental health problems throughout the epidemic rescue mission (before, during, and after). This study compensates for the shortcomings of previous studies of the health problems of HCWs, which, to some extent, have ignored the health problems that existed before rescue. The need for measures to protect the health of these HCWs throughout the three phases of epidemic rescue mission is urgent.

This study found the worrying phenomenon that some participants hid their underlying diseases before the rescue work. This behavior may be associated with the participants' strongly held beliefs about professionalism to heal infected people [22]. Because an extended period of stressful rescue work may cause diseases of various organs [23], the underlying diseases of rescuers undoubtedly increase their risk of sudden death during and after rescue mission [24]. Therefore, hospital administrators must conduct physical and mental examinations of HCWs in order to identify high-risk individuals.

The participants' narrative showed that they experienced physical problems in their respiratory, cardio-cerebrovascular, gastrointestinal, and endocrine systems during the rescue mission. These symptoms were related to the high physical and mental stress and prolonged wearing of PPEs. Unlike most previous studies which focused on HCWs' fatigue status and overlooked the causes of the fatigue [25], the present study found that the overburden on the respiratory, cardio-cerebrovascular, gastrointestinal, and endocrine system may be the reason for HCWs' fatigue. Therefore, the hospital administrators should regularly monitor the health status of

HCWs and provide prompt treatment in case of problems. Additionally, this study revealed that the physiological function disorder experienced during their rescue mission continued for a long period after the mission had ended. This finding was similar to prior studies. For example, a cohort study showed that Chinese frontline nurses continued to show somatic symptoms after returning from the rescue mission [26]. Therefore, hospital administrators should persistently follow up on their health status even after the completion of rescue work.

The participants, apart from physical problems, also reported more emotional problems throughout the rescue mission. Among these negative emotions, anxiety was the most prevalent before and during the rescue work. Zakeri et al. [27] also found that 18.8% and 34.7% of Iranian nurses had severe anxiety before and during pandemic, respectively. According to participants' narratives, the main stressors causing anxiety of HCWs before the rescue mission emanated from worrying about getting infected or infecting their family members. Therefore, it is important for hospital administrators to reduce HCWs' anxiety by eliminating these stressors. We found that helplessness was another common emotion experienced during the rescue mission which was supported by a previous qualitative study [28]. They found that high helplessness experienced by HCWs was mainly caused by the ineffective treatment of patients, whereas our results showed that the inability to socialize or manage housework, and the shortage of medical equipment constituted other causes of their helplessness. HCWs' helplessness not only contributed to more mental problems, but also increased their job burnout and turnover intention [29]. Thus, it is valuable for hospital administrators to reduce HCWs' helplessness through psychological interventions. Additionally, during and after the rescue mission, loneliness was another emotional problem experienced. This finding concurred with a previous study, where Italian HCWs stated that living in an isolated environment to avoid cross-infection increased their loneliness during the pandemic [30]. Therefore, loneliness needed to be addressed by increasing HCWs' online social activities.

Another concern was the negative behavior of participants during the rescue mission. Eating problems were very troublesome. The participants with overeating

behavior were more likely to vomit during work. Those who abstained from food or consumed less to avoid vomiting were prone to develop symptoms of hypoglycemia. Therefore, hospital administrators should pay more attention to the eating habits of HCWs. Additionally, we also found a new phenomenon of social avoidance. The participants avoided communicating with their family members although they had sufficient opportunities to make contact during the rescue mission. The probable explanation was that in Chinese family-oriented culture, participants chose not to communicate with their family members to avoid exposing their poor physical and mental status, and thereby relieve family members' concerns about their health status [31]. The social avoidance problem may lead to the lack of social support for HCWs, which is detrimental for them to resist pandemic stress and lead to more physical diseases [32]. Thus, it is important for hospital administrators to intervene by urging HCWs to develop a plan to regularly communicate with their family members.

The present study also found negative cognition in participants, which was consistent with Simonetti et al' study [33]. This study found that 50.65% of Italian nurses had low self-efficacy during the pandemic. A previous study showed that frontline nurses' low efficacy reduced their use of a positive coping strategy and increased incidence of PTSD [34]. Therefore, it is necessary for hospital administrators to resolve this issue. Moreover, the present study found a new phenomenon, where HCWs' sense of self-protection gradually reduced as the rescue process progressed, which made them more susceptible to infection. Therefore, hospital administrators should constantly remind HCWs to strengthen their self-protection awareness and behavior.

Some participants reported stigmatization, when they returned home after the rescue mission, because the individuals around them were afraid of being infected. These findings concurred with a previous study [35]. Jain et al. [36] found that HCWs generally perceived more stigma from the public and internalized this discrimination. This resulted in them regarding themselves as infection sources which reduced their interpersonal interaction ability. Therefore, hospital administrators should provide HCWs with cognitive interventions to eliminate these unreasonable cognitive biases.

Moreover, some participants showed hypochondriasis after the rescue mission. For example, when the participants coughed, they suspected that they were infected. Thus, the hospital administrators should conduct preventive physical and mental health examinations on HCWs to differentiate between actual and perceived disease. HCWs who are diagnosed with an illness need to be promptly treated. Those with hypochondriasis should be provided with mental health education and stress management training to help promote their health recovery.

A similar phenomenon was also found after the rescue work. Some emergency health workers hid their physical and mental discomfort out of shame, which may be related to face culture in China [37]. This behavior not only constitutes a high-risk factor for the development of more serious physical and mental illness but also becomes an obstacle to their returning to their daily routine after the rescue [38]. Therefore, their colleagues and family members should be sensitive to the HCWs' abnormal physical and mental reactions through observation and communication [39]. Furthermore, hospital managers should establish early screening programs to monitor the early signs of physical or mental health problems among HCWs [40].

5 Implications for future practice

First, because HCWs face many stressors during the epidemic medical rescue mission, the protection of their health must not be the sole responsibility of the healthcare worker themselves [41]. Support from others not only provides material support but also spiritual support, both of which can decrease the risk of HCWs suffering health problems and improve the efficiency of patient care [42]. Thus, hospital administrations should cooperate with others to establish a comprehensive prevention and support system [40]. Second, though the epidemic rescue mission may be over, its long-term impact on the health of the HCWs continues, as this study confirmed. Therefore, it is necessary for hospital managers to establish long-term health profiles of HCWs to track and solve their health problems after the epidemic rescue mission.

6 Limitation

A limitation of this study was that all participants were interviewed nearly 6 months after epidemic rescue mission, which resulted in recall bias. However, because this was the first time that most HCWs had ever experienced working during major epidemic, their recollection of the experience was relatively clear, as was confirmed during the interviews. Further research should collect information about healthcare workers' health problems during each phase of epidemic rescue mission (before, during, and after) to reduce recall bias.

7 Conclusion

HCWs fighting COVID-19 experienced physical and mental health problems across the three phases of epidemic rescue mission. To protect their health, a comprehensive prevention and control system is needed that covers both physical and mental health problems and involves the HCWs themselves, their families, hospitals, the government, and social organizations throughout the epidemic rescue mission (before, during, and after).

Statements

Contributorship statement:

DF conceived of the study, participated in its design and coordination, and helped to draft the manuscript, XS participated in data analysis and interpretation of the data and drafted the manuscript; ZW helped to draft the manuscript; HL participated in data collection; MR helped to draft the manuscript.

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Tables

Table1

Semi-structured interview guide

Questions
1. What worries did you have when you were informed going to work in hospitals in Hubei province?
2. What did you feel uncomfortable physically or mentally when you arrived at the Hubei province?
3. What did you feel uncomfortable physically or mentally when you worked in the insolation ward?
4. How has your physical and mental health changed after the rescue work compared to before the rescue work?

Table2

Sociodemographic data of interviewers

Gender	Female	16 (51.6%)
	Male	15 (48.4%)
Age	21-30	3 (9.7%)
	31-40	17 (54.8%)
	41-50	11 (35.5%)
Education degree	Junior college	1 (3.2%)
	Undergraduate	16 (51.6%)
	Master's degree	5 (16.1%)
	PhD	9 (29%)
Profession	Doctor	13 (41.9%)
	Nurse	18 (58.1%)
Place of dispatch	Shandong province	18 (58%)
	Hebei province	2 (6.4%)
	Anhui province	5 (8.3%)
	Guangdong province	6 (19.4%)
COVID-19 ward start date	January 2020	9 (29.0%)
	February 2020	22 (71.0%)

Figure1: Preliminary codes, initial thematic framework, and final themes

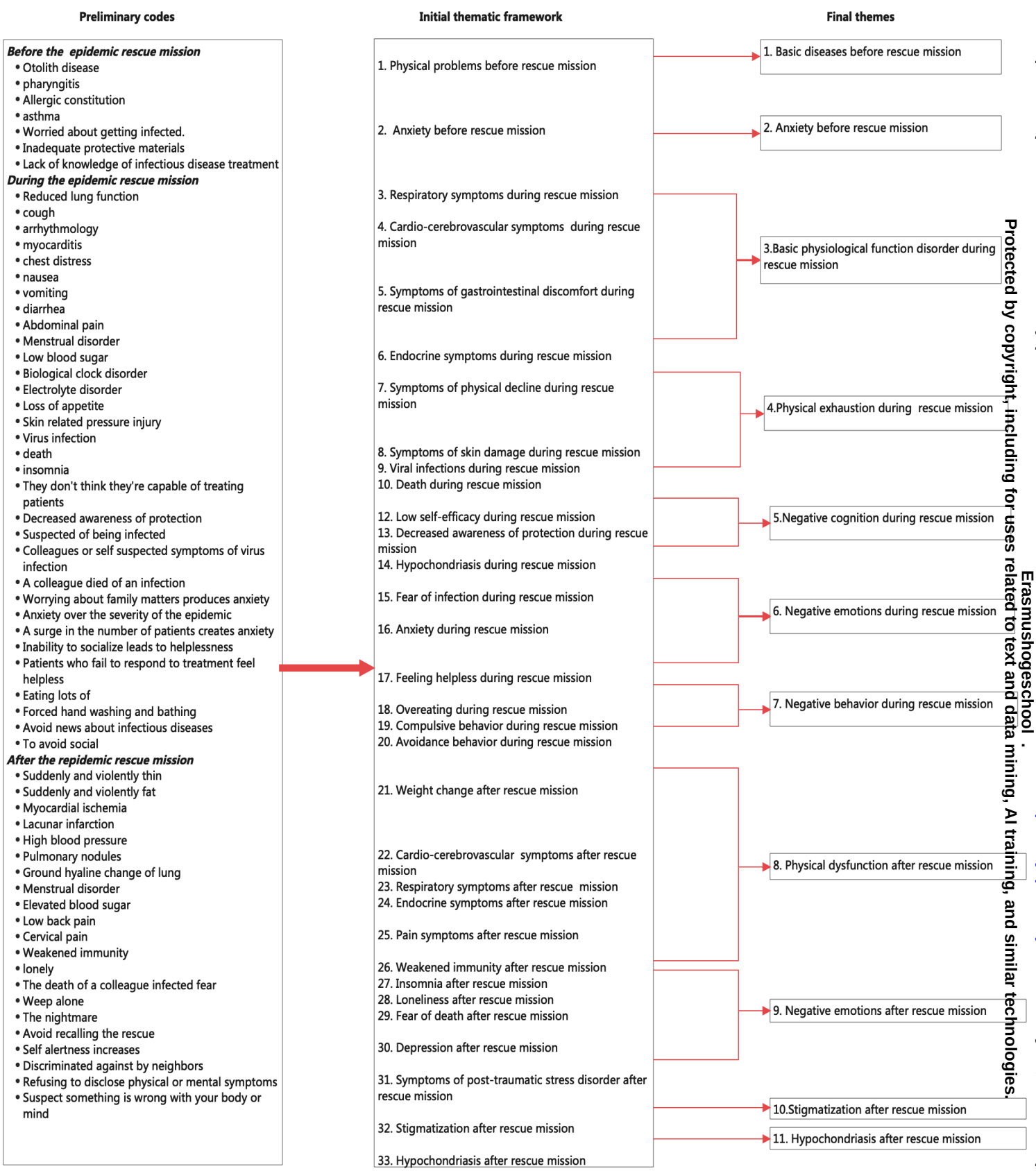

Figure1: Preliminary codes, initial thematic framework and final themes.

Table S1 Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No Item Guide questions/description	Page/Answers
Domain 1: Research team and reflexivity Personal Characteristics	
1. Interviewer/facilitator-Which author/s conducted the interview or focus group?	Page 4. All authors.
2. Credentials-What were the researcher's credentials? E.g. PhD, MD	PhD and MD
3. Occupation-What was their occupation at the time of the study?	Page 4. HCWs in COVID-19 mission.
4. Gender-Was the researcher male or female?	Both male and female.
5. Experience and training-What experience or training did the researcher have?	The researchers have participated in qualitative studies before.
Relationship with participants	
6. Relationship established-Was a relationship established prior to study commencement?	Page 4. No previous relationship.
7. Participant knowledge of the Interviewer-What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Page 4. Information was provided in recruiting.
8. Interviewer characteristics-What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Page 4-5. We explained several strategies of ensuring dependability, credibility, confirmability and transferability.
Domain 2: study design	
Theoretical framework	
9. Methodological orientation and Theory-What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, content analysis	Page 5. Phenomenological analysis.

Participant selection	
10. Sampling-How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 3. Purposive.
11. Method of approach-How were participants approached? e.g. face-to-face, telephone, mail, email	Page 4. face-to-face.
12. Sample size-How many participants were in the study?	Page 6. 31
13. Non-participation-How many people refused to participate or dropped out? Reasons?	Page 4. HCWs who agreed to participate in study contact researcher by mobile phone. We ended interviewing when date saturation. When date saturation and 31 HCWs were supposed to be reached and there was nobody dropping out.
Settings	
14. Setting of data collection Where was the data collected? e.g. home, clinic, workplace	Page4. Before interview, participants decided the peaceful interview places include workplace, meeting room and cafeteria by mobile phone.
15. Presence of non-participants Was anyone else present besides the participants and researchers?	Page 5. They were interviewed individually.
16. Description of sample-What are the important characteristics of the sample? e.g. demographic data, date	Page 6 and Table 2.
Data collection	
17. Interview guide-Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 4. A semi-structured format with open-ended questions was used.
18. Repeat interviews-Were repeat interviews carried out? If yes, how many?	Page 4-5. No repeat interview.

19. Audio/visual recording-Did the research use audio or visual recording to collect the data?	Page 4. Audio record.
20. Field note- Were field notes made during and/or after the interview or focus group?	Page 5. Field notes
21. Duration What was the duration of the interviews or focus group?	Page 4. 20–60 minutes.
22. Data saturation-Was data saturation discussed?	Page 4.
23. Transcripts returned-Were transcripts returned to participants for comment and/or correction?	Page 5. Yes.
Domain 3: analysis and findings	
Data analysis	
24. Number of data coders-How many data coders coded the data?	Page 6. Six
25. Description of the coding tree-Did authors provide a description of the coding tree?	Page 21. Table 3.
26. Derivation of themes-Were themes identified in advance or derived from the data?	Page 6. Yes
27. Software What software, if applicable, was used to manage the data?	Page 5. Nvivo 11.0
28. Participant checkin- Did participants provide feedback on the findings?	No additional feedback.
Reporting	
29. Quotations presented-Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number	Page 7-12. Yes
30. Data and findings consistent-Was there consistency between the data presented and the findings?	Page 7-12. Yes

31. Clarity of major themes Were major themes clearly presented in the findings?	Page 7-12. Yes
32. Clarity of minor themes Is there a description of diverse cases or discussion of minor themes?	Page 7-12. Yes

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Physical and mental health problems of Chinese frontline healthcare workers before, during, and after the COVID-19 rescue mission: a qualitative study

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Title Page

Title

Physical and mental health problems of Chinese frontline healthcare workers before, during, and after the COVID-19 rescue mission: a qualitative study

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Keywords: COVID-19, frontline healthcare workers, physical health, mental health, qualitative study

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Physical and mental health problems of Chinese frontline healthcare workers before, during, and after the COVID-19 rescue mission: a qualitative study

Abstract

Objective: To explore the physical and mental health problems of frontline healthcare workers fighting coronavirus disease (COVID-19) across the three phases of the epidemic rescue mission (before, during, and after) in China.

Design: A qualitative study was adopted using face to face, in-depth semi-structured interviews. Phenomenological research methods and Colaizzi's seven-step analysis method were used in the study.

Setting: The setting of the study was the offices of healthcare workers in 12 tertiary hospitals.

Participants: Thirty-one frontline healthcare workers from 16 provinces in China, who carried out rescue missions in Hubei Province, were interviewed from October to November 2020.

Results: Physical and mental health problems existed before, during and after the COVID-19 rescue mission. Eleven themes emerged during the three phases. Two themes appeared before rescue mission: basic diseases, anxiety before rescue mission. Five themes appeared during rescue mission: basic physical function disorder, physical exhaustion, negative cognition, negative emotions, and negative behavior. Four themes appeared after rescue mission: physical dysfunction, negative emotions, stigmatization, and hypochondriasis.

Conclusion: Both physical and mental health problems occurred throughout the three phases. The study results pointed that a comprehensive prevention and control system that addresses both physical and mental health problems of frontline healthcare workers throughout the three phases of epidemic rescue mission (before, during, and

after), and that involves themselves, their families, hospitals, the government, and social organizations is needed.

Keywords: COVID-19, frontline healthcare workers, physical health, mental health, qualitative study

Strengths and Limitations

1. This study explored the physical and mental health problems of frontline healthcare workers who carry out epidemic rescue mission, through a unified perspective of mental and physical health and through a qualitative study.
2. The sample size of this qualitative study was comparatively large, and the study sample was diverse.
3. Due to the uniqueness of the sample, the results of the study should be generalized with caution to HCWs fighting against other infectious disease outbreaks, especially those in other countries.

1 Introduction

In the past 30 years, there have been more than 40 new types of major epidemic around the world, including severe acute respiratory syndrome, Middle East respiratory syndrome, pandemic influenza 2009 and so on [1-2]. According to World Health Organization (WHO) data, major epidemics were once the second highest cause of death [3]. For example, coronavirus disease (COVID-19) outbreak has been associated with significant morbidity and medical complications around the world; by December 8, 2021, 267,244,380 people had been infected with COVID-19 and there had been 5,280,678 deaths globally as of December 8, 2021 [4]. Major epidemics are characterized by high infectivity, pathogenicity, and mortality [5], which not only directly threaten the survival and development of human beings but also have considerable impact on the world economy.

Frontline healthcare workers (HCWs) are an important resource in every country. They play a vital role in controlling the spread of an epidemic, reducing casualties, and ensuring economic development and social stability [6]. In early 2020, the Chinese

National Health Commission sent HCWs from other provinces to support COVID-19 outbreak areas, and most had no prior experience carrying out epidemic rescue mission. These HCWs suffered various health problems due to epidemic rescue mission-related stressors, which, as previous studies found, included high intensity of work, high risk of viral infection, and ethical issues [7]. Moreover, HCWs also experienced environment-related stressors such as harsh working environments, long periods of wearing personal protective equipment (PPE), cultural differences, and lack of protective supplies [8-9]. These stressors made HCWs easily susceptible to both physical and mental health problems (such as viral infection, depression, and anxiety) during the rescue mission [10]. HCWs with health problems not only reduce the quality of the provision of continued patient care, but also hinder a flexible response to the control of an epidemic [11].

Extant studies have found that HCWS are prone to suffer viral infections and mental health problems [10-12]. However, these studies mainly focused on the mental health problems of HCWS in two phases (during and after the rescue mission) through quantitative studies with scales [3,13]. Only one study found that HCWs also experienced mental health problems (tension, hopelessness, and fear) before arriving at the epidemic rescue mission scene[14]. What's more, according to the stress response theory, individuals exhibit dual physical and mental responses when facing various stressors. This means that when HCWs carry out epidemic rescue mission, which is an experience that induces considerable stress, they may have physical and mental health problems. Finally, the current studies also neglect the physical health problems among HCWs in three stages of epidemic rescue mission. If the physical and mental health of HCWs is ignored, the health of HCWs cannot be effectively protected. This will ultimately seriously reduce the ability to manage major epidemics in the future. Thus, it is necessary to focus on the physical and mental health of HCWs and explore their physical and mental health problems in different phases of epidemic medical rescue mission (before, during, and after).

This study adopted a qualitative research design to explore both physical and mental health problems in the three phases of epidemic rescue mission (before, during

and after) of HCWs fighting COVID-19 in Hubei Province, China. It serves as a reference for preventing or solving these health problems and ultimately contributing to better protection of the health of HCWs fighting COVID-19 and other major epidemics in the future.

2 The study

2.1 Aim

This study aimed to explore physical and mental health problems of HCWs in different phases of COVID-19 epidemic rescue mission (before, during and after).

2.2 Design

Qualitative research is typically used to acquire an in-depth understanding of individuals' experiences under specific circumstances [15]. Phenomenological study is a qualitative research method that analyzes the inner and outer components of a particular phenomenon, extracts the important elements of the phenomenon, and explores the relationships among the elements in the surrounding context. Phenomenological study requires the researcher to bracketing prior concepts and preconceptions, and to focus on life experiences, and returning to the phenomenon itself, thus contributing to the understanding of people, behaviors, and the meaning behind the phenomenon[16]. COVID-19 is a new infectious disease. The epidemic rescue mission that HCWs are involved in is a new experience and completely different from their daily work. Therefore, it is appropriate to explore the health problems of HCWs during COVID-19 epidemic rescue mission using a phenomenological approach to aid the deeper understanding of the various important elements and their relationships behind the phenomena. This study followed the guidelines for Consolidated Criteria for Reporting Qualitative Studies (COREQ checklist, see table s1).

2.3 Participants

Purposive sampling was used to enroll HCWs who participated in the epidemic rescue missions in Hubei Province, China, during the COVID-19 outbreak in 2020.

The inclusion criteria for the participants were that they had to have traveled to Hubei Province to fight COVID-19 for at least 1 month. Participants were excluded if they were auxiliary or logistic HCWs.

2.4 Data collection

The study was conducted in October and November 2020, 6 months after the completion of the rescue work in Hubei. First, the HCWs' group manager forwarded participant recruitment information to WeChat workgroups. This included the study's aim and methods (interviews), inclusion criteria, information on the voluntary nature of the study and the ability to withdrawal at any given time even after agreeing to participate in the interview, and researcher contact information (i.e., mobile phone number) to confirm participation. The interview required participants to respond to four open-ended questions related to their experiences during their epidemic rescue mission. If they had any negative emotions, unreasonable thoughts or other unpleasant experiences, some psychological services could be provided (e.g., professional psychological assessment and counseling, stress management and emotional regulation training). Second, HCWs who were interested and agreed to participate in the study contacted the researcher by mobile phone. The interview was scheduled in a quiet, relaxed, and private room for face-to-face interviews without any disturbances.

HCWs with varied demographic backgrounds were selected to ensure sample representativeness. Data collection occurred concurrently with the data analysis, which may have facilitated the identification of thematic saturation. The sample size was not certain until theoretical saturation was achieved, when no new information was identified in the analysis [17].

Face-to-face and semi-structured interviews were conducted by five experienced researchers, including one professor, three postgraduate students and one clinical nurse who had been trained in qualitative interviewing methods and ethics. An interview guide based on an extensive literature survey of HCWs' health problems was developed for the interviews. Then, two HCWs who battled COVID-19 in Hubei were pre-interviewed to familiarize the interviewing researchers with the study's progress and to modify the interview guide (for the final interview guide see Table 1).

Before the interview, the participants decided on a quiet interview space (such as, meeting room) by mobile phone. At the beginning of each interview, they were asked to provide their demographic information via a questionnaire. Then, with the participants' permission, all interviews were audio-recorded using a small recording device. The interviews lasted between 20 and 60 min. An interview guide was followed, and the discussions on the topics were open and flexible [18]. The researchers encouraged the interviewees to be expressive. During the interview, interviewers wrote down their observations about the participants' body language and their own reflections so that the participants' perspectives would be correctly understood and described. Additionally, appropriate pauses or changes in a topic were applied whenever the participants seemed to feel uncomfortable during the interviews. Subsequent telephone interviews were conducted if there was any doubt about the content of the interview. The HCWs were compensated 100 RMB for taking part in the interview.

2.5 Data analysis

Data collection and analysis occurred simultaneously and were managed using Nvivo 11.0 software (QSR International, Doncaster, Australia). Within 24 hours from the end of the interview, the recording was transcribed word-for-word. Haase's (1987) [19] adaption of Colaizzi's (1978) [20] method was used to analyze the transcripts. First, the researchers read every transcript several times to gain a thorough understanding of the meanings conveyed. Second, significant statements and phrases were identified from each transcript. Third, the researchers described and analyzed the aspects of the data that were not obvious, explicit statements in each transcript. The researchers then integrated all of the results into an exhaustive narrative description, and they also created and validated formulated meanings through research team discussions to reach consensus. Fourth, these formulated meanings were sorted into clusters of themes and categories. Fifth, the researchers identified the fundamental structure of the experience and developed a full and clear description of each of the six themes. Finally, to validate the study, the researchers asked the participants if the findings captured the essence of their experiences. To enhance confirmability, three

researchers independently analyzed the transcripts. Thereafter, findings from the researchers were compared and discussed at team meetings until consensus was achieved.

All participants provided verbal consent at the beginning of the individual interview. Anonymity and confidentiality were maintained by replacing names with numbers (e.g., I1) and by removing identifying information from the transcripts. All transcripts were saved on a password-protected computer. Additionally, we followed the standards for reporting qualitative research guidelines.

2.6 Ethics approval

This study was approved by the Ethics Committee of the School of Nursing and Rehabilitation of Shandong University (No. 2020-R-39).

2.7 Rigor

Linclon and Guba's (1985) [21] four criteria for evaluating trustworthiness (credibility, transferability, dependability, and confirmability) were used to enhance the rigor of the study. The research team consisted of five experienced researchers, including one professor, three postgraduate students, and one clinical nurse. The interviews were performed by three experienced researchers who had been trained in qualitative interviewing methods and had prior experience performing qualitative research. The data were analyzed by each researcher independently, to ensure reliability and validity. The findings from each researcher were compared. Differences in findings were resolved through discussion and consensus. Thick description and verbatim quotes were used to ensure the transferability of the findings. The researchers included experts from healthcare workers' statements to verify the concordance of findings with raw data. This method was used to enhance the confirmability of the data and to illustrate that data were not based on preconceived notions. All decisions regarding data collection and analysis were recorded and an audit trail was maintained to establish the dependability and confirmability of the study.

2.8 Patient and public involvement

As this study focused on the health problems of HCWs fighting COVID-19, the patients and the public were not involved.

3 Results

The participants in this study were 15 women and 16 men, aged between 24 and 50 years. Eighteen were nurses and 13 were doctors. The characteristics of the participants are summarized in Table 2. Eleven main themes were identified from the HCWs' dataset (Figure1).

3.1 Before the epidemic rescue mission

3.1.1 Physical health problems before rescue mission

Some participants had underlying diseases (systemic lupus erythematosus, asthma, and allergic constitutions) when they received their epidemic rescue mission notice. Undoubtedly, they were at high risk of being infected or even dying during the rescue mission. *"I had an allergic constitution. I didn't mention that. The leaders didn't know. At first, I really wanted to join in the rescue work. I was afraid that others would prevent me from participating in this work because of this disease."* (I16)

3.1.2 Mental health problems before rescue mission

The most common mental health problem the participants experienced before rescue mission was anxiety, especially for those who had never participated in such an operation before. They cited two main reasons for their anxiety. The first reason was that they feared of being infected by COVID-19. *"I was really worried when I first went there on February 7. At that time, it was said that the number of cases there were increasing every day. It was the first time that I had been involved in the epidemic rescue mission, and I was very worried."* (I4) The second reason was that they were very anxious because they were unable to handle family affairs or protect the health and safety of their family members. *"My old parents and my father-in-law were still in the hospital, and I have two children. I was worried that if something happened suddenly, there would be nobody helping my family."* (I23)

3.2 During the epidemic rescue mission

3.2.1 Basic physiological function disorder during rescue mission

Some participants said they suffered arrhythmias, chest tightness, breathing difficulties, and even fainting because of such factors as high-intensity work, circadian clock disorders, and hypoxia resulting from wearing PPE. *"Most of the time, I did not have arrhythmias. But when I was lying in bed, I had premature heartbeats and arrhythmia. Anyway, I felt uncomfortable at that time."* (I14)

Because of the airtightness of the PPE and the irritation from disinfectants, participants experienced symptoms of hypoxia and carbon dioxide retention, which eventually led to a decline in lung function. *"When our medical team was relaxing in the hotel at night, I frequently heard my colleagues coughing. It was a common problem for everyone because wearing an N95 mask affected one's own lung function. It was also stated in the literature that wearing an N95 mask in such an enclosed environment for a long time affects people's lung function."* (I5)

The participants suffered from gastrointestinal problems, including nausea, vomiting, diarrhea, and stomachache because of poor diet, physical hypoxia, and mental stress. *"Not long after I entered the ward, I suddenly felt uncomfortable. I immediately vomited in the protective suit and the N95 mask I was wearing."* (I26)

Some participants had endocrine symptoms such as hypoglycemia and menstrual disorder. Participants often went to work without having breakfast in order to avoid vomiting and wasting equipment, which placed them at high risk for hypoglycemia. For female rescue workers, the high intensity of rescue work and led to menstrual disorder. *"During the rescue period, the menstrual period moved forward by half a month, that is, 3 times in 2 months."* (I14) *"You had to eat at the end of the day, which means that you had to spend about 7 or 8 hours in the ward before you ate. So, there were many people who had hypoglycemia at that time."* (I28)

3.2.2 Physical exhaustion during rescue mission

During rescue mission, the participants' physical capabilities deteriorated significantly as a result of wearing PPE, frequent shifts, insufficient personal rest time, and high-intensity work. *"In the early days, because there was not enough protective equipment, we had to wear diapers and left after being in the ward for more than 10 hours. This working model was adopted so as not to waste any equipment. So, we did*

not leave the ward until we could not hold on. Our physical exhaustion was the most serious in the early stages of the rescue." (I7)

The participants reported that they had symptoms of device-related skin injuries, dermatitis, rashes, nasal mucosal injuries, and oral ulcers because of the prolonged use of sealed PPEs, frequent use of harsh disinfectants, and a rather simple, non-nutritious diet. *"One person in our rescue team who worked for 2 days straight after coming to the ward had rashes on his scalp. At that time, he couldn't go to work because he was afraid of being infected because of those rashes."* (I21) *"In the early stages of the rescue, there were no vegetables available."* (I7)

The participants were at high risk of being infected with COVID-19 because of their close contact with patients and the strain of the work. *"What affected me the most was that six people in the original department of the hospital where we worked as rescuers had already been infected."* (I15) Likewise, there was also a risk of death. Some participants had cardiac arrest and died suddenly because of long-term fatigue. "*There was a nurse who fainted due to hypokalemia, and then she had a heart attack*." (I9)

3.2.3 Negative cognition during rescue mission

The participants had a strong sense of being protected when they first arrived at the ward to work. However, in the later stages, when they had become familiar with the protection procedures, their sense of self-protection diminished as they realized they were at an increased risk of infection. *"One month later, the team members, including myself, had a weak sense that we could prevent infection because we had worked for a month without infection.*" (I21)

The participants suspected that they were infected, without clear medical evidence. This phenomenon is referred to as hypochondriasis. "*I was very nervous after I had been coughing for 2 or 3 hours. I was very sensitive because the symptoms of COVID-19 include asymptomatic dry cough.*" (I15)

The participants sometimes thought that they were unable to save the patient's life, which lowered their sense of efficacy. *"Treatment was a worrying thing because there was no standard treatment strategy for COVID-19. The treatment guide was*

updated seven times a month. I did not know how to treat the disease effectively." (I12)

3.2.4 Negative emotions during rescue mission

The main emotional problem that the participants dealt with during rescue mission was the fear of being infected by the virus. This fear stemmed from the suspicions of those around them that they were experiencing symptoms of infection and because of the ineffectiveness of the PPE. "*In fact, I was mainly worried about infectious diseases, including being infected myself, and the risk of transmitting the virus to others."* (I4)

When participants entered the ward, the challenging tasks their work entailed made them anxious. *"At that time, the need to minimize the mortality rate was urgent. Therefore, we were under enormous pressure to treat critically ill patients who were often at a higher risk of death.*" (I6). Personal inner conflict was also a cause of anxiety. *"I had a conflict because I needed an assistant, a nurse, a doctor … and at least five people around me when performing the intubation surgery. The virus formed aerosols that could infect anyone. At that time, I wondered whether it was worth saving a patient with low hopes of survival when it put so many medical staff in danger."* (I7)

The participants were prone to feelings of helplessness because of their inability to socialize, the shortage of protective and medical equipment, the ineffectiveness of the treatment of patients, and their inability to handle family matters. *"The next day after I arrived in the ward, I didn't get any supplies except the bare minimum. I did not think we could protect ourselves without any protective supplies. It was a really desperate situation."* (I7)

The participants were required to isolate themselves, which resulted in their being away from family and colleagues, and experiencing a sense of loneliness. *"We were working in the separate rescue ward alone. Thus, at that time, we had no contact with anyone else for 2 months and we were isolated."* (I15)

3.2.5 Negative behavior during rescue mission

Due to the high intensity, long durations, and high risk of the work performed during rescue mission, some participants exhibited negative behavior problems, such as overeating, compulsive behavior, and avoidance behavior.

Some participants relaxed by overeating. *"I tended to relax by eating lots of food. Finally, I had gained 10 kg after the rescue mission." Many* HCWs *also suffered from insomnia because of the high stress.* (I3) "*To be honest, I hardly slept for a week."* (I24)

The participants engaged in compulsive behaviors, including excessive hand-washing and other excessive protective behaviors because they worried about being infected by COVID-19. *"The phenomenon of overly protective behavior also existed because of inner tension. In fact, we pressed hard [on the nose clips of our masks] out of fear of infection, which resulted in breaking the skin."* (I8)

The participants exhibited social avoidance, work avoidance, and avoidance of epidemic-related information. *"I did not want to call my family members. I'm sure that I deliberately avoided talking about the rescue work with my family."* (I15)

3.3 After the epidemic rescue mission

3.3.1 Physical disfunction after rescue mission

Some participants overate to relieve stress, causing them to gain weight. However, most people suffered a loss of appetite, causing rapid weight loss. *"Everyone said that they were thinner as they weighed around 6–7 kg less than before."* (I14)

Because of the high intensity of work, some participants exhibited cardio-cerebrovascular symptoms, including myocardial ischemia, angina pectoris, palpitation, chest tightness, lacunar cerebral infarction, and elevated blood pressure. *"After we came back, we had a physical examination and there was lacunar infarction in our team members. But they had no lacunar infarction before."* (I9)

The participants reported respiratory symptoms, including throat discomfort, pulmonary nodules, ground-glass changes in the lungs, and respiratory infection. *"I was diagnosed with a lung problem after physical examination."* (I7)

Some participants experienced endocrine symptoms, including elevated blood sugar levels, and some female rescuers also had symptoms of menstrual disorders. *"The physical examination showed that my blood sugar was a little higher than before. There were also many women who found that their menstrual periods had changed."* (I7)

Low back or cervical pain was also a symptom reported by some participants. *"I had to bend over to administer medication, which led to cervical spine pain and back pain. I didn't feel the pain before, but now it's very painful."* (I29)

Many participants found that their immunity had declined and they had more frequent colds and rhinitis. *"I often had colds; they were more frequent than before."* (I21)

3.3.2 Negative emotions after rescue mission

The participants had to avoid contact with others during quarantine, which caused many to experience loneliness. "*I thought isolation made me more uncomfortable than working. I could not go out and see anyone during quarantine*." (I16) They also found themselves tending to hide their own physical and mental health problems. *"Chinese people are relatively unwilling to talk about their psychological conditions. I thought it was a normal phenomenon. There were many psychological problems among our team members but it was difficult for them to take the initiative to speak out."* (I6)

The participants experienced nightmares, increased alertness, and avoidance behavior as the main symptoms of posttraumatic stress disorder. *"During our isolation and recuperation, I had a nightmare every day."* (I12) *"When I returned to work, I saw the patients in the ward. I felt so nervous because I was afraid that the patients needed oxygen. And then I immediately prepared oxygen for them."* (I29) *"Sometimes I am reluctant to remember the rescue experience."* (I8)

When the rescuers heard the news of the accidental deaths of their colleagues, they would be fearful and worried that they too might die suddenly. *"After her [the colleague] death, we were really under a lot of pressure. It was possible that I might*

die suddenly. I didn't dare to go to sleep because I was afraid that I would die suddenly in my sleep." (I1)

Some participants experienced depression after returning home. *"There was a mental health examination provided by the hospital, for which many had abnormal results. One of them had suicidal tendencies."* (I1)

3.3.3 Stigmatization after rescue mission

Many participants faced stigmatization. During the quarantine period, hotel staff treated them differently for fear they might spread the virus. After returning home, the participants' neighbors also worried about catching the virus from them and avoided contact with them. *"My mother told me that the people near our house didn't want to allow me come home because I had been to Wuhan."* (I29)

3.3.4 Hypochondriasis after rescue mission

Even after the epidemic rescue mission was over, some participants continued to have symptoms of hypochondria. They believed that they were either infected or mentally ill. *"I had a sore throat in the quarantine hotel and I thought I was sick. But my blood revealed no problems in the nucleic acid test at that time."* (I5) *The problem of insomnia also persisted after the* participants *finished the rescue work.* "*I think the biggest problem is insomnia. When I was in quarantine and even when I went back to work, I had symptoms of insomnia*." (I13)

4 Discussion

The novelty of this study lies in its use of first-hand interviews to deeply explore of the physical and mental health problems of HCWs fighting COVID-19. The results revealed that HCWs had quite serious physical and mental health problems before, during, and after their participation in epidemic rescue mission. This study compensates for the shortcomings of previous studies on the health problems of these HCWs, which, to some extent, have ignored the health problems that existed before the rescue mission. There is an urgent need for measures that protect the health of these HCWs throughout the three phases of epidemic rescue mission is urgent.

This study observed a worrying phenomenon of participants hiding their underlying diseases before the rescue work. This behavior may be associated with

strongly held beliefs regarding professionalism in the healing of infected people [22]. Because an extended period of stressful rescue work may cause diseases of various organs [23], the underlying diseases of rescuers undoubtedly increase their risk of sudden death during and after rescue mission [24]. Therefore, hospital administrators should conduct physical and mental health examinations of these HCWs in order to identify high-risk individuals.

During rescue mission, the participants reported experiencing respiratory, cardio-cerebrovascular, gastrointestinal, and endocrinal problems. These symptoms were related to the high physical and mental stress and prolonged wearing of PPE. Unlike most previous studies that focused on fatigue but overlooked the causes of the fatigue among these HCWs [25], the present study found that the burden on the respiratory, cardio-cerebrovascular, gastrointestinal, and endocrine systems may be the reason for the fatigue experienced. Therefore, the hospital administrators should regularly monitor the health status of HCWs who carry out epidemic rescue missions and provide prompt treatment of problems. Additionally, this study revealed that the physiological function disorder experienced during rescue mission continued for a long period of time after the mission had ended. This finding was in line with those of prior studies. For example, a cohort study showed that Chinese frontline nurses continued to show somatic symptoms after returning from the rescue missions [26]. Therefore, hospital administrators should persistently follow up on the health status of HCWs even after the completion of the rescue work.

The participants reported experiencing emotional problems as well as physical problems throughout the rescue mission. Among the negative emotions experienced, anxiety was the most prevalent before and during the rescue work. Similarly, Zakeri et al. [27] found that 18.8% and 34.7% of Iranian nurses had severe anxiety before and during the epidemic, respectively. The results of the interviews suggested that the main stressors causing anxiety among HCWs before the rescue mission were due to fear of infection and of infecting family members. Therefore, it is important for hospital administrators to reduce HCWs' anxiety by eliminating these stressors. We found that helplessness was another common emotion experienced during rescue

mission, and this finding was in line with those of a previous qualitative study [28]. The previous study found that the high sense of helplessness was primarily caused by the ineffectiveness of the treatment given to patients. Our results showed that the inability to socialize or manage housework, and the shortage of medical equipment were other factors that increased the sense of helplessness. Helplessness not only contributed to more mental problems, but also increased job burnout and turnover intention [29]. Thus, it is valuable for hospital administrators to reduce helplessness through psychological interventions. Additionally, during and after rescue mission, loneliness was another emotional problem experienced. This finding concurred with that of a previous study in which Italian HCWs reported that living in an isolated environment to avoid cross-infection increased their loneliness during the pandemic [30]. Therefore, the problem of loneliness needed to be addressed by increasing HCWs' online social activities.

Another concern was the negative behavior of participants during the rescue mission. Eating problems were very troublesome. The participants with overeating behavior were more likely to vomit during work. Those who abstained from food or consumed less to avoid vomiting were prone to develop symptoms of hypoglycemia. Therefore, hospital administrators should pay more attention to the eating habits of HCWs. Additionally, we also found a new phenomenon of social avoidance. The participants avoided communicating with their family members although they had sufficient opportunities to make contact during rescue mission. A probable explanation for this finding was that due to the influence of Chinese family-oriented culture, participants chose not to communicate with their family members to avoid exposing their poor physical and mental status, and thereby relieve family members' concerns about their health status [31]. Social avoidance could have led to a lack of social support, which made these HCWs more susceptible to epidemic-related stress and more physical diseases [32]. Thus, it is important for hospital administrators to intervene by urging HCWs to develop a plan to regularly communicate with their family members.

The present study also found negative cognition in participants, which was consistent with the findings of Simonetti et al. [33]. Simonetti et al. found that 50.65% of Italian nurses had low self-efficacy during the pandemic. Another previous study showed that frontline nurses' low efficacy reduced their use of a positive coping strategy and increased the incidence of post-traumatic stress disorder (PTSD)[34]. Therefore, it is necessary for hospital administrators to resolve this issue. Moreover, the present study witnessed a new phenomenon, where HCWs' sense of self-protection gradually reduced as the rescue process progressed, which made them more susceptible to infection. Therefore, hospital administrators should constantly remind HCWs to strengthen their self-protection awareness and behavior.

Some participants reported experiencing stigmatization when they returned home, because the individuals around them were afraid of being infected. These findings concurred with those of a previous study [35]. Jain et al. [36] found that the HCWs generally perceived more stigmatization from the public and internalized this discrimination. This resulted in them regarding themselves as infection sources which reduced their ability to interpersonally interact with others. Therefore, hospital administrators should provide these HCWs with cognitive interventions that eliminate these unreasonable cognitive biases. Moreover, some participants showed hypochondriasis after the rescue mission. For example, when the participants coughed, they suspected that they were infected. Thus, the hospital administrators should conduct preventive physical and mental health examinations on HCWs to differentiate between actual and perceived diseases. HCWs who are diagnosed with an illness should be promptly treated. Those with hypochondriasis should be provided with mental health education and stress management training to help promote their mental health recovery.

A similar phenomenon was also found for the phase after the rescue mission. Some emergency health workers hid their physical and mental discomfort out of shame, which may be related to face culture in China [37]. This behavior is not only a high-risk factor for the development of more serious physical and mental illness but also an obstacle to resuming a daily routine after the rescue mission[38]. Therefore,

colleagues and family members should be sensitive to the HCWs' abnormal physical and mental reactions through observation and communication [39]. Furthermore, hospital managers should establish early screening programs to monitor the early signs of physical and mental health problems among these HCWs [40].

5 Implications for future practice

This study had two major implications for future practice. First, because HCWs face many stressors during epidemic rescue mission, the protection of their health must not be the sole responsibility of HCWs themselves [41]. They should be provided with both material and moral support, both of which can decrease the risk of their suffering health problems and improve the efficiency of patient care [42]. Thus, hospital administrations should cooperate with others to establish a comprehensive prevention and support system [40]. Second, epidemic rescue mission has long-term impacts on the health of HCWs, as this study confirmed. Therefore, it is necessary for hospital managers to establish long-term health profiles of HCWs to track and solve their health problems after epidemic rescue mission.

6 Limitations

A limitation of this study was that all participants were interviewed nearly 6 months after their epidemic rescue mission, which might have caused recall bias. However, because this was the first time that most HCWs had ever experienced working during major epidemic, their recollection of the experience was relatively clear, as was confirmed during the interviews. Further studies should collect information about HCWs health problems during each phase of the epidemic rescue mission (before, during, and after) to reduce recall bias. Furthermore, the participants in this study were HCWs involved in the epidemic rescue mission of COVID-19 rescue mission in Wuhan, China, and therefore, the results of this study are not generalizable to HCWs fighting against other infectious disease outbreaks especially those in other countries. Finally, as a qualitative study, this study could not estimate the frequency and severity of these health problems reported, and thus, future quantitative studies are needed to make up for this deficiency.

7 Conclusion

HCWs fighting COVID-19 experience physical and mental health problems before, during, and after epidemic rescue mission. To protect their health, a comprehensive prevention and control system is needed that covers both physical and mental health problems and involves the HCWs themselves, their families, hospitals, the government, and social organizations in each phase of the rescue missions.

Statements

Contributorship statement:

DF conceived of the study, participated in its design and coordination, and helped to draft the manuscript, XS participated in the data analysis and interpretation of the data and drafted the manuscript; ZW helped to draft the manuscript; HL participated in the data collection; MR helped to draft the manuscript.

Competing interests: All authors of this study declare no conflicts of interests.

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Data sharing statement: Data are available upon reasonable request.

Ethical approval: The study was approved by the Ethics Committee of the School of Nursing and Rehabilitation of Shandong University (No. 2020-R-39).

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Tables

Table1

Semi-structured interview guide

Questions
1. What worries did you have when you were informed that you were going to work in hospitals in Hubei Province?
2. Did you feel uncomfortable physically or mentally when you arrived in Hubei Province?
3. Did you feel uncomfortable physically or mentally when you worked in the isolation ward?
4. How has your physical and mental health changed after the rescue work compared with before the rescue work?

Table2

Sociodemographic data of interviewers

Gender	Woman	16 (51.6%)
	Man	15 (48.4%)
Age	21-30	3 (9.7%)
	31-40	17 (54.8%)
	41-50	11 (35.5%)
Education degree	Junior college	1 (3.2%)
	Undergraduate	16 (51.6%)
	Master's degree	5 (16.1%)
	PhD	9 (29%)
Profession	Doctor	13 (41.9%)
	Nurse	18 (58.1%)
Place of dispatch	Shandong Province	18 (58%)
	Hebei Province	2 (6.4%)
	Anhui Province	5 (8.3%)
	Guangdong Province	6 (19.4%)
COVID-19 ward start date	January 2020	9 (29.0%)
	February 2020	22 (71.0%)

Figure1: Preliminary codes, initial thematic framework, and final themes

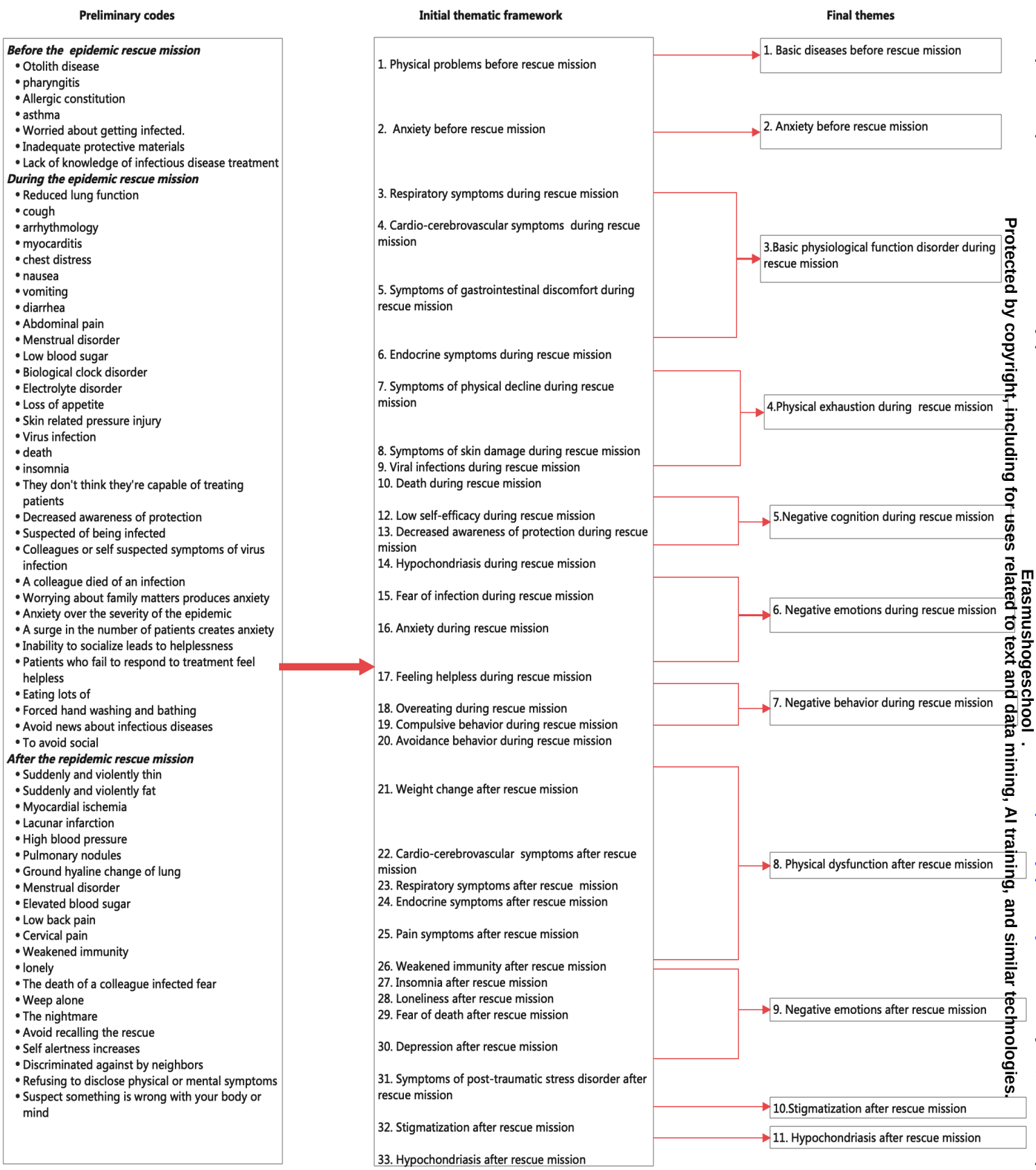

Figure1: Preliminary codes, initial thematic framework and final themes.

Table S1 Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No Item Guide questions/description	Page/Answers
Domain 1: Research team and reflexivity Personal Characteristics	
1. Interviewer/facilitator-Which author/s conducted the interview or focus group?	Page 4. All authors.
2. Credentials-What were the researcher's credentials? E.g. PhD, MD	PhD and MD
3. Occupation-What was their occupation at the time of the study?	Page 4. HCWs in COVID-19 mission.
4. Gender-Was the researcher male or female?	Both male and female.
5. Experience and training-What experience or training did the researcher have?	The researchers have participated in qualitative studies before.
Relationship with participants	
6. Relationship established-Was a relationship established prior to study commencement?	Page 4. No previous relationship.
7. Participant knowledge of the Interviewer-What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Page 4. Information was provided in recruiting.
8. Interviewer characteristics-What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Page 4-5. We explained several strategies of ensuring dependability, credibility, confirmability and transferability.
Domain 2: study design	
Theoretical framework	
9. Methodological orientation and Theory-What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, content analysis	Page 5. Phenomenological analysis.

Participant selection	
10. Sampling-How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 3. Purposive.
11. Method of approach-How were participants approached? e.g. face-to-face, telephone, mail, email	Page 4. face-to-face.
12. Sample size-How many participants were in the study?	Page 6. 31
13. Non-participation-How many people refused to participate or dropped out? Reasons?	Page 4. HCWs who agreed to participate in study contact researcher by mobile phone. We ended interviewing when date saturation. When date saturation and 31 HCWs were supposed to be reached and there was nobody dropping out.
Settings	
14. Setting of data collection Where was the data collected? e.g. home, clinic, workplace	Page4. Before interview, participants decided the peaceful interview places include workplace, meeting room and cafeteria by mobile phone.
15. Presence of non-participants Was anyone else present besides the participants and researchers?	Page 5. They were interviewed individually.
16. Description of sample-What are the important characteristics of the sample? e.g. demographic data, date	Page 6 and Table 2.
Data collection	
17. Interview guide-Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 4. A semi-structured format with open-ended questions was used.
18. Repeat interviews-Were repeat interviews carried out? If yes, how many?	Page 4-5. No repeat interview.

19. Audio/visual recording-Did the research use audio or visual recording to collect the data?	Page 4. Audio record.
20. Field note- Were field notes made during and/or after the interview or focus group?	Page 5. Field notes
21. Duration What was the duration of the interviews or focus group?	Page 4. 20–60 minutes.
22. Data saturation-Was data saturation discussed?	Page 4.
23. Transcripts returned-Were transcripts returned to participants for comment and/or correction?	Page 5. Yes.
Domain 3: analysis and findings	
Data analysis	
24. Number of data coders-How many data coders coded the data?	Page 6. Six
25. Description of the coding tree-Did authors provide a description of the coding tree?	Page 21. Table 3.
26. Derivation of themes-Were themes identified in advance or derived from the data?	Page 6. Yes
27. Software What software, if applicable, was used to manage the data?	Page 5. Nvivo 11.0
28. Participant checkin- Did participants provide feedback on the findings?	No additional feedback.
Reporting	
29. Quotations presented-Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number	Page 7-12. Yes
30. Data and findings consistent-Was there consistency between the data presented and the findings?	Page 7-12. Yes

31. Clarity of major themes Were major themes clearly presented in the findings?	Page 7-12. Yes
32. Clarity of minor themes Is there a description of diverse cases or discussion of minor themes?	Page 7-12. Yes