FACTORS AND HEALTH OUTCOMES OF JOB BURNOUT

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FACTORS AND HEALTH OUTCOMES OF JOB BURNOUT

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Editorial: Factors and health outcomes of job burnout

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Editorial on the Research Topic
Factors and health outcomes of job burnout

Burnout is a psychological syndrome caused by prolonged exposure to chronic interpersonal stressors in a job. The 11th revision of the International Classification of Diseases, published in 2019 by the World Health Organization, includes burnout syndrome as an occupational phenomenon in the chapter on factors affecting health status or contact with health services (1, 2). According to Maslach and Jackson, burnout syndrome is defined by four key factors: overwhelming exhaustion, feelings of cynicism, detachment from work, and a sense of ineffectiveness and lack of achievement (1, 2). The prevalence of burnout syndrome in the helping professions (such as teachers or clinical staff) seems to be higher than in other occupations. However, this phenomenon has also become relevant in other occupational sectors that are characterized by high levels of work-related stress.

Job burnout is a subject that has triggered widespread interest among the general public and the media, and has been the subject of research and policy responses across Europe. While some work-related psycho-social risks such as heavy workload, long working hours, and overtime seem to trigger burnout, the influence of other factors such as autonomy, the degree of influence of management, and the role of rewards is more ambiguous. Without detection and proper treatment, burnout symptoms can be chronic. Preventive actions include checklists and tools to aid early detection, training programs for high-risk jobs, awareness-raising actions, and good-practice guidelines (3). In addition, the significant increase in the prevalence of this syndrome in different occupational settings has been associated with the recent COVID-19 pandemic, particularly for healthcare workers, who are at a high risk of exposure to infection (4–7) and several psycho-social and work-related risk factors (8). Based on this, it is of paramount importance to identify workers who are prone to psychological disorders, and to design supportive interventions that promote wellbeing and coping in occupational settings which could be integrated into overall health, social, and economic care management in the current pandemic (9).

Healthcare is perceived as one of the most stressful work environments, as it requires intense personal interactions with patients and colleagues. Burnout is therefore a serious concern among healthcare workers (HCWs), and has received increased attention in recent years. In particular, the COVID-19 pandemic appears to have exacerbated mental health problems in healthcare workers; they were found to be more prone to depression, anxiety, stress, and insomnia, and in many cases may experience long-term effects following SARS-CoV-2 infection (10). The increased focus on burnout in HCWs also stems from negative consequences on patient safety, non-uniformity of care, healthcare system costs, and workflow, as well as the lack of safety and health monitoring for the workers themselves. Furthermore, a significant relationship between the risk of medical errors and burnout has been observed (Alijabri et al.).

The extremely high number of cases and deaths during the COVID-19 pandemic, and the need to implement new containment strategies to limit the spread of the infection, have increased awareness of the already difficult working conditions faced by healthcare workers (11). Therefore, the identification of new strategies to deal with burnout syndrome, by identifying possible solutions, is crucial (Leo et al.). Several factors seem to be associated with the incidence of burnout in HCWs. The importance of emotional intelligence as a protective factor against burnout suggests that lifestyle modifications contribute to an increase in emotional intelligence (Sharaf et al.). Therefore, emotional intelligence, as a measurable positive psychological resource and a key non-technical skill in mitigating burnout levels in HCWs, should receive increased attention (Cao et al.). Furthermore, it has been hypothesized that the management of physicians' workload related to paperwork during outpatient encounters could be of great importance in decreasing the risk of burnout, promoting physicians' physical and psychological wellbeing, and improving the quality of physician-patient interactions (Li et al.). Another factor related to a higher incidence of burnout, particularly during the pandemic, was the presentism rate of medical personnel, which is much higher than for other jobs; while saving the lives of others, medical personnel were more likely to neglect their own health (Jia et al.). Finally, the COVID-19 pandemic has forced millions of people worldwide to adopt remote working environments using a variety of online platforms, increasing the prevalence of technostress as a possible source of burnout, and highlighting negative emotional responses to technology, including those in medical students and residents (Kasemy et al.).

Among HCWs, a job group that is particularly exposed to burnout is nurses. Research has revealed how various working conditions such as an exhaustive job, being moved between different patient care units within an organization, high job demands, and ineffective relationships with co-workers, supervisors, and/or physicians may produce higher levels of burnout (Feleke et al.). Moreover, other conditions such as workplace bullying among nurses and its relationship

with organizational culture, the avoidance of a conflictive management style, low job satisfaction, and increased nurse-patient ratios have also been identified as burnout facilitators (12). Job satisfaction can be influenced by both psycho-social and organizational work factors. Consequently, improving nurses' specific job characteristics such as autonomy or nurse–physician collaboration could help to maintain an adequate degree of engagement in their job (Sanso et al.). Moreover, the spread of the COVID-19 pandemic and the increased number of cases and admissions have greatly influenced the wellbeing of hospital nurses, who may experience burnout due to physical and psychological work demands that exceed their ability to handle them (Kangarlou et al.). In particular, certain factors might have influenced the prevalence of burnout in these workers during the COVID-19 pandemic, for example, sickness presentism, which is considered a symbol of traditional dedication and diligence particularly in Eastern cultures. This can negatively affect nurses' physical and mental health, productivity, and work quality, and can increase the incidences of fatigue and job burnout therefore posing a threat to patient safety (Li et al.).

A high risk of burnout syndrome can also affect new types of workers such as organ donation coordinators, who travel between hospitals in search of potential organ donors that meet the criteria for brain- or heart-related deaths. As a link between organ donors and recipients, these professionals are also responsible for communicating with the families of patients; to help convince them to donate their organs so that potential organ donors can easily become actual donors. Currently, most organ donation coordinators suffer from varying degrees of anxiety, depression, and insufficient sleep due to constant work pressure (Luo et al.).

Cross-cultural research has also indicated a high incidence of burnout syndrome in social workers; another occupational field that faces several challenges. Social workers are generally called upon to perform administrative tasks, client visits, client contacts, case work, case management, teamwork, program planning, program implementation, community networking, evaluation, supervision, and training; however, their job identity has not yet been fully established, and the public often misperceives social workers as volunteers. The absence of adequate professional recognition often deprives social workers of professional respect, which affects their ability to perform their job to the best of their ability (Tuo et al.).

Burnout is not a phenomenon specific to only the healthcare sector, but extends to other jobs. Firefighters, for example, are frequently exposed to traumatic events and stressful situations, increasing their vulnerability to burnout and psychiatric conditions such as anxiety and depression. As first responders, firefighters have to deal with constantly evolving tasks including fire suppression and rescue services, which may cause serious injury or death. Witnessing long-lasting events and tragedies that endanger the lives of colleagues can negatively affect

an individual's mental and physical health, causing anxiety and depression. Without sufficient external assistance and organizational support, the mental health problems faced by firefighters become a challenging problem (Tao, Liu et al., Tao, Ma et al.).

Instant Delivery Service (IDS) workers are also considered to be at a high risk of work-related stress and burnout. This group of workers are responsible for delivering essential goods to residents during the pandemic, ignoring the risks to their health, completing much of their work outdoors with considerable exposure to adverse weather conditions, air pollution, and accidents. The demand for quick deliveries and the payment-per-delivery philosophy of some companies create additional stress that increases the risk of unsafe behaviors and accidents. Furthermore, IDS workers are temporarily employed and poorly paid, often receiving wages by the hour or by the number of deliveries. This tends to induce an intense work pace for extended time periods without breaks, as well as increased work stress, fatigue, and burnout (Chen et al.).

Finally, certain groups of workers such as deep-coal miners could experience unreasonable labor organization, failure to enforce rules, and inadequate technical specifications; these could become risk factors for job burnout (Yang et al.).

In conclusion, the high prevalence of burnout in several occupational contexts significantly impacts public health outcomes and health services, highlighting the need to initiate policies such as work-life balance in order to alleviate high physical workloads and to provide support to make emotional workloads more manageable. Significant importance should be placed on the cultivation of psychological resilience and the wellbeing of all workers, particularly those with chronic diseases, in order to improve their adaptability and ability to cope in the face of adversity (13). Specifically, workers should be given time to rest so that they can engage in self-regulation. They should be encouraged to cultivate their interests and hobbies in their spare time. Psychological training courses should be established for workers (Luo et al.). Redistributing the demand for mobility by, for example, expanding and diversifying the start times in workplaces, public offices, schools, and shopping centers, can be considered as an effective additional strategy to improve organizational wellbeing, to reduce burnout in several work settings, and to foster greater environmental sustainability with regard to transportation (14). It appears to be necessary to improve awareness regarding this topic, as numerous gaps in knowledge still exist. Despite over half a century of research on occupational burnout, little is known about its prevalence, etiology, treatment, or prevention. The lack of consensus on the nature of burnout has led to a proliferation of definitions and measures of the construct, precluding a reliable estimate of both its incidence and prevalence and adversely affecting the quality of research on this topic (15). Many studies on burnout have limited their analyses to emotional exhaustion, or have not reported findings on cynicism, personal accomplishment, or global burnout. In addition, most of these studies had a cross-sectional design, whereas well-conducted prospective studies could more appropriate for investigating the possible consequences of this syndrome. This is because these types of studies enable identification of the temporal relationship between the exposure (burnout syndrome) and the outcomes (consequences) (16, 17).

Finally, and particularly during the COVID-19 pandemic, there is an urgent need for policymakers to recommend applicable and appropriate burnout prevention strategies so as to ensure a healthy work environment for the healthcare force. Although HCWs rely heavily on the training and equipment provided by their organizations, managerial support and effective leadership must also contribute to the avoidance and mitigation of adverse psychological outcomes for HCWs (Aljiabri et al.).

Author contributions

AS and LV contributed in conceptualization and methodology. AS reviewed the literature and wrote the first draft. LV and JA-W reviewed and edited the final version of the manuscript. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

Publisher's note

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Qualitative Study on the Influencing Factors and Countermeasures Against Job Burnout Among Organ Donation Coordinators

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Background: Most organ donation coordinators suffer varying degrees of anxiety, depression and poor sleep caused by constant work pressure, and their professional identity is only at a medium level. All of this leads to a great risk of job burnout.

Objective: To identify the influencing factors of and effective countermeasures against job burnout among organ donation coordinators.

Method: Semistructured interviews were used for data collection. In-person or phone interviews were conducted from December 2017 to June 2018.

Results: 12 organ donation coordinators who came from 7 different provinces and cities in China were interviewed. The interview data were sorted, and relevant topics were extracted and summarized in terms of two aspects, namely, factors that influenced job burnout in organ donation coordinators and effective countermeasures for dealing with job burnout.

Conclusion: Factors influencing job burnout among organ donation coordinators include personal factors, job responsibilities, salary and benefit factors, and donor family factors. Measures to help organ donation coordinators effectively address burnout include self-regulation, social support, and positive events.

Keywords: organ donation coordinators, job burnout, influencing factor, countermeasure, semistructured interview

INTRODUCTION

Although organ donation rate has increased in recent years, organ shortage is still a very serious problem. There is another person added to the transplant waiting list every 10 min and 20 people die each day waiting for an organ transplant (1). Most studies on factors affecting organ donation rates have examined informed consent policies, religious and cultural beliefs, cognition of death, and misunderstandings about donation, and issues related to the application process itself (2–7). However, little attention has focused on the high turnover of organ donation coordinators (8). Organ donation coordinators are professionals who are equipped with specific professional

knowledge and travel bestween hospitals in search of prospective patients, namely, organ donors who meet the criteria for brain death, or cardiac death. These professionals, as the link between organ donors and recipients, are also responsible for communicating with these patients' families, who could help to convince the patient to donate his or her organs so that prospective organ donors can more easily become actual organ donors. In 2010, China officially established the professional position of organ donation coordinator. However, due to the influence of China's traditional culture, organ donation after death began only a few years ago. The limited media publicity given to organ donation and organ donation coordinators and the imperfections of the organ donation law result in low public awareness of organ donation coordinators and make it difficult for them to perform their job. At present, most organ donation coordinators suffer varying degrees of anxiety, depression, and poor sleep caused by constant work pressure, and their professional identity is only at a medium level (9, 10). All of this leads to a great risk of job burnout.

Burnout is a response to chronic strain within the workplace characterized by feelings of inefficacy (reduced personal accomplishment), cynicism (depersonalization), and emotional exhaustion (11). Maslach, an American social psychologist, proposed that job burnout is an unhealthy psychological state (12). Jesse et al. (11) performed a national cross-sectional survey of 218 transplant surgeons and found 40.1% reported high levels of emotional exhaustion, 17.1% reported high levels of depersonalization, and 46.5% reported low personal accomplishment. They found that lower decisional authority, lower coworker support, less frequent difficult patient interactions but greater discomfort with difficult patient interactions predicted lower personal accomplishment. Yang et al. found transplant nurses in China experience burnout and older age, being married, and having children may increase the risk of burnout (13). Bury et al. investigated the experience of professional burnout in a large group of Polish transplant coordinators (14). Exhaustion was positively correlated with years of working as a transplant coordinator but not with participants' age (14). Kader et al. (15) investigated the occupational burnout level of 122 organ donation coordinators in Turkey and found that a low level of emotional exhaustion and depersonalization of coordinators and a moderately decreased sense of accomplishment. Unmarried coordinators without medical backgrounds had a lower sense of accomplishment, while coordinators with a college degree had a higher level of depersonalization. Kim et al. (16) investigated 14 coordinators at an organ transplant center in the southeastern United States and found that they had an average level of job burnout; furthermore, the higher the coordinator's education level was, the lower his or her level of job burnout was. Gruener (17) investigated job burnout and its influencing factors among organ donation coordinators in Israel and found that the average job burnout level of coordinators was relatively low; furthermore, job burnout was negatively correlated with a sense of control but positively correlated with job satisfaction and self-realization. However, Kress et al. (8). conducted an online survey of 326 organ donation coordinators and found that

~26% of them were considering quitting and that those who had been working for 2 years had the strongest intention to quit their jobs. Our research group (18) preliminarily investigated 312 organ donation coordinators in China. The questionnaire included the following: the Chinese version of MBI-GS was used to evaluate the burnout levels of organ donation coordinators. We found that the incidence of job burnout was as high as 65.02%. Mild burnout was the main trend, and a decreased sense of accomplishment was the main manifestation (18). For a deeper understanding of the factors influencing job burnout among organ donation coordinators, purposive sampling was adopted. The organ donation coordinators from the preliminary study who had a moderate or severe degree of job burnout were selected as the interviewees. Semi-structured interviews were used for data collection. Colaizzi's seven-step analysis method was used to guide data analysis (19). The research purpose was to identify the influencing factors of and effective countermeasures against job burnout among organ donation coordinators.

STUDY OBJECT

Sample Selection

The inclusion criteria for the samples were as follows: ① organ donation coordinators who had obtained an organ donation coordinator qualification certificate; ② organ donation coordinators with at least 1 year of work experience as an organ donation coordinator; ③ registered and active organ donation coordinators; ④ organ donation coordinators who provided their informed consent to participate in the research. The exclusion criteria were as follows: ① organ donation coordinators who had not been involved in an organ donation coordination in the past year; ② organ donation coordinators who had not independently coordinated an organ donation case; ③ organ donation coordinators who were off-duty for various reasons.

Determination of Sample Size

Our research group preliminarily investigated 312 organ donation coordinators in China. We found that the incidence of job burnout was as high as 65.02%. Among them, 45.94% had mild job burnout, 16.96% had moderate job burnout, and 2.12% had severe job burnout (18). For a deeper understanding of the factors influencing job burnout among organ donation coordinators, the organ donation coordinators who had a moderate or severe degree of job burnout were selected as the interviewees. In qualitative research, the sample size depends on whether the data obtained reaches saturation. If new interviewees continue to be included but no new information is obtained, the data are said to have reached saturation, and sampling is complete. A total of 12 interviewees were selected for this study.

Research Tools

An interview outline was designed according to the relevant literature and our previous survey. Through consultations with two experts in psychology and preliminary interviews with two organ donation coordinators, we made some proper adjustments and then the final version of the interview outline was determined (**Table 1**). In our previous survey, when analyzing the results

TABLE 1 | Interview guide.

1. How do you become an organ donation coordinator?

2.What does being an organ donation coordinator bring? Like sense of accomplishment?

3. Did you experience burnout as a coordinator? What caused it?

4. What did you do to reduce the feeling of burnout (Psychologically and operationally)? Is it effective?

5. Have you ever thought of quitting the position of coordinator? Or have you tried seeking other positions?

6. What do you think of the working environment of the organ donation coordinator?

7. What do you think of your daily work?(Working time, workload, work process, work pressure, and sources, how to deal with the relationship between work and life)

8. Do you think your current job promotion opportunities are great? What are the reasons?

9. What do you think of the salary and benefits of the coordinator?

10. How do you get along with your colleagues and leaders?

11. What do your family and friends think about your current job as an organ donation coordinator?

12. In the process of coordinating organ donation, when you encounter unsatisfactory or urgent matters, how do you usually solve it (Including psychological and operational)? Is it effective?

13. When you encounter emergencies or difficulties in the process of coordinating organ donation, what kind of help do you most hope for? (Material assistance, spiritual assistance, legal and policy support related to organ donation, authorization from the state, and government)

14. What things do you think will affect your motivation at work?

15. Do you have any suggestions or expectations for the work of the organ donation coordinator?

of the job satisfaction of coordinators, we found that the coordinator had the lowest score in the promotion dimension and work process dimension (18). This indicated that the coordinator had the lowest satisfaction with promotion and work process. Therefore, when the coordinator mentions these two factors again, we can use follow-up methods to conduct in-depth discussions to improve the reliability of the research results.

Data Collection
Data Collection
In-person or phone interviews were conducted from December 2017 to June 2018. The semi-structured interviews with organ donation coordinators were conducted in Hunan Province, China. The interviewers contacted the interviewees in advance. Informed consent was obtained from the interviewees. Specific details such as the time and venue for interviews were determined to ensure the quality of the interview. Before the interview, the interviewers asked the interviewees whether they preferred for the interview to be recorded with a recording pen or by note-taking. During each interview, one interviewer was responsible for communicating with the interviewee. Another interviewer was responsible for recording the whole process and providing reminders about the progress of the interview.

Data Sorting and Analysis
Within 2 days after the interview, two interviewers performed open coding independently to generate the initial codes. These independently generated codes were discussed among all authors in group sessions, with differences reconciled through negotiated consensus and repeated consideration of our research questions. Colaizzi's seven-step analysis method was used to extract relevant content from the interview data.

Ethics
Approval for the study was obtained from the Institutional Ethics Committee of the Third Xiangya Hospital, Central South University.

RESULTS
General Information About the Interviewees
In this study, after interviewing 12 subjects, no new interview information was found, indicating that the data had reached saturation. Therefore, the sample size of the qualitative study was 12. These 12 subjects were numbered D1, D2,..., D12. They came from 7 different provinces and cities in China. Their general information is shown in **Table 2**.

Interview Results
The interview data were sorted, and relevant topics were extracted and summarized in terms of two aspects, namely, factors that influenced job burnout in organ donation coordinators and effective countermeasures for dealing with job burnout. The results are shown in **Tables 3**, **4**. Details are shown below.

Factors Influencing Job Burnout in Organ Donation Coordinators
Topic 1: Personal factors.

(1) The original intention of working as an organ donation coordinator
The interviews showed that many organ donation coordinators did not sign up for the job out of their desire. They started in the role due to work needs or as a result of orders from their superiors.

> *"The reason for becoming a coordinator is the demand for the line of work. I was assigned this job by my boss, who arranged for me to participate in the national training program. After I completed the training, I was asked to become a coordinator." (D7)*

Five of the interviewees said that they did not accept the job of their own free will. They showed a strong intention to quit their jobs and a high degree of job burnout, which affected the stability of the team of organ donation coordinators.

> *"I'm a doctor, and it's a personal loss for me to do this job. I've thought about quitting 10,000 times. However, within the (organ transplant) team, I have to follow orders from my boss." (D9)*

(2) Professional background

Number	Gender	Age	Education	Marital status	Years of service	Years of service as coordinator	Job type	Workplace
D1	Female	31	Master's degree	Married	10	3	Part-time	Hospital
D2	Male	60	Associate degree	Married	44	1	Full-time	The red cross
D3	Female	34	Master's degree	Married	15	4	Full-time	The red cross
D4	Female	28	Bachelor's degree	Single	6	2	Part-time	The red cross
D5	Female	31	Master's degree	Married	12	3	Part-time	Hospital
D6	Female	49	Bachelor's degree	Married	31	3	Full-time	The red cross
D7	Male	38	Bachelor's degree	Married	21	2	Part-time	The red cross
D8	Female	32	Bachelor's degree	Married	13	7	Full-time	Hospital
D9	Male	36	Master's degree	Married	11	6	Full-time	Hospital
D10	Female	50	Associate degree	Married	19	11	Full-time	The red cross
D11	Male	44	Master's degree	Married	19	8	Full-time	The red cross
D12	Male	34	Bachelor's degree	Married	12	11	Full-time	Hospital

TABLE 3 | Factors influencing job burnout in organ donation coordinators.

Category	Subcategory
Personal factors	(1) Original intention of working as an organ donation coordinator
	(2) Professional background
	(3) Psychological quality
Job responsibilities	(1) Work hours
	(2) Workload
	(3) Sense of responsibility
	(4) Failure cases
Promotion and salary and benefits	(1) Professionalization
	(2) Salary and benefits
Donor family factors	(1) Recognition by the donor's family
	(2) Grief from the donor's family

TABLE 4 | Countermeasures taken by organ donation coordinators against job burnout.

Category	Subcategory
Self-regulation	(1) Allowing time for rest and relaxation
	(2) Self-comfort
	(3) Empathy
	(4) Be rational about the work
Social support	(1) Social recognition
	(2) Support from family and friends
	(3) Support from superiors and peers at work
	(4) Seeking help from psychological counselors
Positive events	(1) Successful cases
	(2) Recognition from the donor's family

For those organ donation coordinators who had a medical- or psychology-related professional background, it was less difficult to carry out their work. Their rate of successful case coordination was higher than that of organ donor coordinators without such backgrounds, and their work pressure was comparatively low.

"If you have a medical background, it is better. Without a medical background, it is difficult to do your job, and it is easier for you to get frustrated." (D7)

(3) Psychological quality
The coordinators with poor mental endurance did not know how to self-regulate when they encountered difficulties and were prone to job burnout.

"The coordinator's mental endurance is very important. If he/she does not have certain work experience and has poor receptivity, he/she will encounter emotional breakdown when he/she is bombarded with questions from the patient's family members, who might have a hard time understanding." (D7)
"I don't think I'm suitable for this job because I'm not emotionally strong, and I'm susceptible to the grief of patients' families, and I have to witness the whole process of organ donation, including organ removal and wound suture. When rigor mortis sets in, I feel very, very uncomfortable." (D5)

Topic 2: Job responsibilities.

(1) Work hours
Organ donation coordinators are on call 24/7, with no regular breaks or holidays, and most cases are coordinated in the middle of the night. Many coordinators feel exhausted.

"What impresses me the most about this job is that I have to leave for another case when I just came back from a long-distance business trip and am getting ready for some sleep. I feel as if I have to keep working 24 hours without a break. I feel that I don't have time for anything else." (D1)
"More often than not, coordinators have to do their job at night. They will feel exhausted if they have to stay up late and work at night often." (D4)
"The work schedule of a coordinator is not fixed. They may have to go to work during the daytime or at night. They must keep their cellphones turned on all the time. They are under enormous stress." (D12)

(2) Workload

Within the organ transplant team, organ donation coordinators are responsible for the majority of the work during the organ donation process. The heavy workload exhausts them. In addition, coordinators often bear many responsibilities during this process, which leads to great psychological pressure.

> *"The main reason that I'm tired is the workload. For each case, you have to repeatedly answer all the questions raised by the patient's family, and you have to be patient with them. You are also supposed to try your best to meet the conditions and requirements raised by each family member." (D1)*
> *"I think that within the team, most of the work is done by the coordinator, who has to take on a lot of responsibilities and risks. All of this makes me feel stressed. The stress comes mainly from these responsibilities, and this job is about a matter of life and death. If anything goes wrong during this process, the coordinator has to take the blame." (D5)*

(3) Sense of responsibility
Four interviewees indicated that their job pressure mainly came from their sense of responsibility. If this kind of pressure could not be effectively alleviated, job burnout and resignation intention would occur.

> *"We haven't completed a single case in a while, and we haven't even got much information, so we feel a lot of pressure. My boss does not pressure me in any way, yet I just feel pressured out of nowhere." (D8)*

(4) Failure cases
Failure cases undermined the self-confidence of the organ donation coordinators, leading to a sense of frustration and a diminished sense of personal accomplishment.

> *"If you don't succeed in two or three cases, it's hard for you to continue doing it with 100% confidence and interest. Once you are affected by the failure of a case, you will try so hard to succeed in the next case. The pressure you have to face during this process is tremendous." (D7)*

Topic 3: Promotion and salary and benefits.

(1) Professionalization
Almost every interviewee expressed that the profession of organ donation coordinators lacks normalization, professionalization, promotion mechanisms, and incentive mechanisms. Hence, coordinators are not motivated. They see no future. It is easier for them to experience job burnout and have the intention to resign. The professionalization of organ donation coordinators could enhance their professional identity and their passion for this job.

> *"The problem of promotion channels has a big impact on me. If I'm still a coordinator in another ten years, I will feel that I have accomplished nothing." (D9)*
> *"In a large sense, the job burnout of coordinators mainly comes from the fact that the country does not pay enough attention to the job and does not lay out a clear career path*

for coordinators. Thus, coordinators do not have any goals for the future. They have no future career prospects." (D11)

(2) Salary and benefits
During the interviews, six organ donation coordinators mentioned problems with their salaries, which they hoped that the state could solve as soon as possible. However, coordinators' salaries and benefits standards are not stipulated at the national level. Many of the coordinators believed that they work a lot but are paid little. This, to a certain extent, affects job satisfaction among coordinators and causes them to experience job burnout.

> *"We have lost many coordinators, which is mainly because of the salary issue." (D6)*
> *"In our unit, the income of the coordinator is relatively low. It barely makes ends meet, so there must be an impact (on job burnout)." (D12)*

Topic 4: Donor family factors.

(1) Recognition by the donor's family
Recognition by and trust from the donor's family is a prerequisite for allowing the organ donation coordinator to carry out their work smoothly and directly affects the success of the case. Distrust and doubt from the donor's family are a major source of stress for organ donation coordinators that diminishes their passion for work and their sense of accomplishment.

> *"Some family members do not understand what you are doing, and some of them may even verbally attack you. Then, you don't even get a chance to explain. It can be very stressful. Some will ask for your work permit and your ID card before you communicate with them, which will make you feel very stressed and feel that your sincerity is not recognized." (D1)*

(2) Grief from the donor's family
Grief from the donor's family exerts a great impact on coordinators. The coordinator is the witness of the donor's organ donation and death. As a result, coordinators are in a state of constant stress and psychological pressure.

> *"I've been through so many cases. I probably shed tears in 50 to 60 cases of mine. Especially the children… I shed tears for children most of the time. Parents cry their hearts out seeing their children dying. It makes you cry too. Therefore, I think the psychological pressure may also come from these aspects." (D6)*

Countermeasures Taken by Organ Donation Coordinators Against Job Burnout
Topic 1: Self-regulation.

(1) Allowing time for relaxation
Proper relaxation may help organ donation coordinators relieve stress and self-regulate their mental state.

"When I'm in a bad mood, I try to think about happy things. I will go to eat, drink and entertain myself. Then, I'll be okay." (D4)

"When I'm stressed, I watch movies and get exercise." (D7)

(2) Self-comfort

Since the position of organ donation coordinator in China has been around for only a short time, many people are not clear about the nature and responsibilities of the work. Some coordinators expressed that when they confided in others, they were not always understood and supported. Therefore, coordinators mainly rely on self-comfort to alleviate their stress.

"It's always helpful to comfort yourself when something doesn't go your way. After all, it's just a job you do. When I encounter stress, I rely on self-comfort and self-regulation." (D7)

(3) Empathy

Empathy can significantly reduce the stress of organ donation coordinators. The respondents indicated that putting themselves in the shoes of the donor's family enabled them to handle any case properly, even failure cases.

"As a coordinator, I consider some practical issues by standing in the position of the donor's family whenever I try to communicate with them. It is all right, even if I fail a case." (D8)

(4) Be rational about the work

The organ donation coordinators indicated the importance of having a proper understanding of the work and approaching the dissatisfying part of the job rationally. They also recommended keeping work and life separate to reduce the impact of negative events at work that organ donation coordinators may experience.

"Sometimes, I may complain about my work and lose my temper on the way back home from a business trip, but I don't usually bring this state of mind back home. I tell myself that work and life are separate." (D1)

"At first, I felt depressed, but now I think it is okay as long as I have tried my best. If I try to explain the significance of organ donation to the donor's family, but they still don't agree to donate, I'll just have to give up. I am not as stressed as before." (D8)

Topic 2: Social support.

(1) Social recognition

Media publicity may help the public to understand organ donation and organ donation coordinators and may improve the social recognition of coordinators. Such results may make it easier for coordinators to gain the understanding and help of the public and obtain happiness from work.

"The media here pay more attention to organ donation. Most likely because I have done a lot in this area, I often get interviewed by the media. Like one time, when I was taking

a bus, the driver said that all the buses should not allow me to pay bus fares because I work for the public. If you have the trust, the approval, the motivation, and the understanding, why would you still feel tired?" (D10)

(2) Support from family and friends

More than half of the coordinators said that support and recognition from their family and friends motivate them during their work as coordinators and help them reduce the impact of negative emotions.

"It's important to have the support of your family and friends. Their recognition of your work makes you want to do it. I think this helps reduce the level of job burnout." (D8)

"There are so many good-hearted people, friends around me, friends I know or do not know… They understand me, support me and trust me. In the face of so many beautiful things and so much positive energy, I won't feel tired." (D10)

(3) Support from superiors and peers at work

Support from superiors can help coordinators solve problems, reduce stress, and increase their passion for their work.

"Your employer's support and approval of your work may have a big impact on job burnout. If your boss in your workplace does not support you and recognize your work, you certainly do not want to do this." (D8)

Peer support mainly refers to the cooperation and support of relevant hospitals and departments, who are the main sources of information about potential donors. These hospitals and departments also serve as the main venues for communication and coordination between coordinators and patients. Therefore, peer support may increase the professional identity of coordinators and reduce the degree of job burnout.

"The support and cooperation of the medical institutions and the provision of meeting rooms will affect coordinators' passion for work." (D7)

(4) Seeking help from psychological counselors

Some of the coordinators, when troubled by psychological problems, sought help from psychological counselors at the psychological association. This method proved to be effective.

"When I feel tired, or when I don't want to do it, I go to talk to the professionals at the local psychological association, who hold qualifications for psychological counseling. Talking to them sets your heart at ease." (D3)

Topic 3: Positive events.

(1) Successful cases

Successful cases and the recipient's restoration to health could increase the coordinators' sense of happiness and accomplishment.

"The patient's recovery has a positive effect on me." (D4)

"When the coordinated case is successful, the patient gets a donor organ, and the surgery is successful, I feel a great sense

of accomplishment, and I think this job is so meaningful. Whenever I might experience job burnout, I think of this aspect of work and become cheerful." (D8)

(2) Recognition from the donor's family

Recognition from the donor's family has a positive impact on coordinators, especially when the family regards the coordinator as a family member. This can enhance the coordinator's professional identity and significantly reduce his/her job burnout.

"Some families will consider you one of their relatives because you are the only bridge between the donor and the recipient. Through you, the donor's family may get some information about the recipient. They will be especially kind to you, and afterward, they will still be grateful for your work. Therefore, this kind of family recognition, I think, may also reduce the level of job burnout to some extent." (D1)

DISCUSSION

Analysis of Factors Influencing Job Burnout Among Organ Donation Coordinators

Through qualitative research, this study found that the factors influencing job burnout in organ donation coordinators include personal factors, job responsibilities, salary and benefit factors, and donor family factors. This finding is similar to the results of relevant studies on job burnout within and outside China (9, 10).

Personal Factors

Such factors mainly include the intention, professional background, and psychological quality of organ donation coordinators. Our conclusions are similar to those of Henriksen et al. (20). Organ donation coordinators who embark on this line of work in response to an order from their superiors instead of in response to their wishes have less passion and low efficiency when doing their job. They tend to feel exhausted and express a desire to leave the post. Different professional backgrounds also have an impact on job burnout among organ donation coordinators, which is consistent with Kader's conclusion (15). Perhaps because organ donation coordinators with a medical background often have the experience and skills to communicate with patients and their families, their words are more persuasive during their communication with potential donors' families. Organ donation coordinators with good psychological qualities will face all manner of difficulties with a positive attitude and make full use of available resources to resolve the difficulties and achieve their goals. Such behaviors help coordinators make full use of their strengths and prevent the occurrence of job burnout.

It is suggested that when employing organ donation coordinators, relevant departments should make the work responsibilities of the position open and transparent, fully respect the will of individuals, and avoid coercion. In addition, it is recommended that coordinators be selected from among those with a certain professional background. Finally, when recruiting talent, it is advised that psychological tests be conducted to locate candidates with positive psychological qualities that are conducive to the reduction of job burnout.

Job Responsibility Factors

Such factors mainly include the work hours, workload, work responsibility and failure cases of the organ donation coordinator. Among these factors, the impact of work time on job burnout was mentioned most often throughout the interviews. The reason for the emphasis on this factor may be that the working hours of organ donation coordinators are not fixed, and coordinators must be on standby 24 h a day, 7 days a week. This condition may lead to irregular routines and physiological problems. In addition, many organ donation coordinators are part-time medical staff who also need to work shifts in hospitals. Doing two jobs at the same time leads to severe physical exhaustion, which prevents the coordinators from devoting themselves to coordinating cases.

The establishment of a flexible time-off mechanism is recommended. Such a mechanism would ensure that coordinators, especially part-time coordinators, have plenty of time to rest, which will reduce the level of job burnout and improve their work efficiency.

Salary and Benefit Factors

These factors include professionalization and salary/benefits standardization for organ donation coordinators. As organ donation coordinators in China have not yet obtained professionalization (21, 22), their career prospects are unclear, which may be responsible for their low level of professional identity and lack of a sense of belonging. Moreover, the lack of promotion and incentive mechanisms leads to an absence of rank among organ donation coordinators. Coordinators feel no need to compete in their daily work, and thus they are prone to job burnout. Acceleration of the professionalization of organ donation coordinators is recommended to reduce job burnout. The interviewees pointed out that the salary and benefit problem was the most important reason for the loss of coordinators. Increasing the salaries and benefits of organ donation coordinators will greatly improve their job satisfaction and prevent job burnout.

Donor Family Factors

The main task of organ donation coordinators is to communicate and coordinate with potential donors' families. During the entire donation process, coordinators have the most contact with the donors' families and are highly susceptible to the influence of these families. These coordinators' compassion fatigue increases with the accumulation of cases. Studies have found (23) that the higher the level of compassion fatigue, the more likely an individual is to experience job burnout, which harms his or her physical and mental health. Job burnout among organ donation coordinators should be reduced through measures that reduce their compassion fatigue.

Analysis of Measures Taken by Organ Donation Coordinators to Cope With Job Burnout

Through the interviews, the current study found that the effective measures that organ donation coordinators use to deal with job burnout mainly include self-regulation, social support, and positive events.

Self-Regulation

Organ donation coordinators mainly self-regulate by giving themselves time to relax and rest; resorting to self-comfort; feeling empathy, and adopting a rational attitude toward work. This ability to recover from the stressful environment through self-regulation is called psychological resilience (24). Individuals with high psychological resilience can adapt well to adversity and adopt a positive attitude as a coping method, thus maintaining their own physical and mental health (25). A previous study confirmed (18) that individual psychological resilience is significantly correlated with job satisfaction. Therefore, improving the psychological resilience of organ donation coordinators may effectively prevent job burnout.

Great importance should be attached to the cultivation of psychological resilience by organ donation coordinators to improve their adaptability and ability to cope in the face of adversity. Specifically, such efforts should begin with the following factors: First, organ donation coordinators should be given time to relax and rest so that they can engage in self-regulation. Meanwhile, they should be encouraged to cultivate their interests and hobbies in their spare time. Next, psychological training courses should be established for coordinators to turn to for self-distraction. Third, coordinators should be encouraged to take a rational approach to their jobs by distinguishing work from life. Fourth, learn empathy. Fifth, coordinators should receive support in developing self-comfort skills. Finally, coordinators' should be helped to develop a sense of responsibility.

Social Support

The types of social support that organ donation coordinators receive include social recognition, support from family and friends, support from peers and superiors, and help from psychological counselors. The establishment of social support systems may help organ donation coordinators to effectively alleviate their stress and reduce job burnout. This finding is similar to that of Choi et al. (26). in a study on nurses. Public recognition helps to enhance professional identity among organ donation coordinators so that they can maintain their passion for work. Support from all sides may provide a good family environment and work atmosphere for coordinators. In case of trouble, coordinators may alleviate their stress by confiding to their family and friends; they may also try to solve their problems by seeking help from their peers and superiors at work. In this way, they can maintain a positive and optimistic attitude toward difficulties and reduce their psychological stress.

Positive Events

Positive events mainly refer to successful donation cases and recognition from donors' families. The main job of organ donation coordinators is to promote the transformation of potential organ donors into actual organ donors. The success of donation cases can significantly improve coordinators' sense of happiness and personal accomplishment. In addition, recognition from donors' family members can improve coordinators' passion for work and their self-confidence, which becomes their source of strength. In addition, positive events can enhance the professional identity of organ donation coordinators and increase their willingness to continue in this line of work.

Experience exchange activities should be organized for organ donation coordinators so that they can share in the successful cases of elite coordinators. Such efforts are conducive to improving organ donation coordinators' self-confidence and professional identity.

LIMITATIONS

As well as the significant contributions of the study, there are also some limitations that should be noted. The sample size of our study is small though we had good results. In addition, we mainly use two members of the research group to manually code the interview resources, without using software such as Nvivo to generate code. And future research could focus on intervention study to find out how to reduce the job burnout rate of organ donation coordinators.

CONCLUSION

Factors influencing job burnout among organ donation coordinators include personal factors, job responsibilities, salary and benefit factors, and donor family factors. Measures to help organ donation coordinators effectively address burnout include self-regulation, social support, and positive events.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Approval for the study was obtained from the Institutional Ethics Committee of the Third Xiangya Hospital, Central South University.

AUTHOR CONTRIBUTIONS

WX and AL designed this research and wrote the manuscript. WX, ZX, PC, HH, and PM collected and analyzed the data. WX, ZX, and PC did the literature search. HH provided the support for complete the manuscript. WX and HH revised the paper.

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Development and Psychometric Validation of the Brief Nurses' Practice Environment Scale and Its Relation to Burnout Syndrome and Job Satisfaction: A Study in Spanish Nurses

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Introduction: Nursing environment is a vast concept that traditionally has included a wide range of job characteristics and has been related to burnout and job satisfaction. For its measurement, the Practice Environment Scale of the Nursing Work Index (PESNWI) stands out. However, shorter instruments are needed. The purpose of the study is to develop and test the Brief Nurses' Practice Environment (BNPE) Scale.

Methods: The BNPE Scale was developed and tested in a sample of 210 Spanish nurses (data collection 2018).

Results: Cronbach's alpha was 0.702. The confirmatory factor analysis (CFA), with an excellent fit, offered evidence of internal validity. Regarding validity, the BNPE Scale predicted both burnout and job satisfaction. Finally, evidence pointed out a cutoff score of <12 for low levels of practice environment and a cutoff score of >15 for higher levels in practice environment.

Conclusions: The BNPE Scale is a short, easy-to-use measure that could be employed in major batteries assessing the quality of healthcare institutions.

Keywords: instrument development (MeSH), burnout - professional, practice nursing, factor analisys, job satisfaction

INTRODUCTION

Nursing environment is a vast concept that traditionally has included a wide range of job characteristics and has been defined as the organizational characteristics in the work environment that make the professional practice easier or more difficult, and it is considered favorable when the nurses have autonomy, control over the work environment, and good relationships with the health team (1). As such, the study of nursing environment has been traditionally carried out with two different but complementary approaches: the psychosocial and the organizational one (2–4). The first has focused on psychological and relational aspects related to the workplace, whereas the latter has pointed the importance of job characteristics in defining perceptions of nurses about

work environment. However, and as already pointed, these are not opposite but complementary parts of working environment of nurses, and they tend to interact between them (5). According to the American Organization for Nursing Leadership (6), the key elements of a healthy practice environment are (1) a collaborative practice culture, (2) a communication-rich culture, open and trusty, (3) a culture of accountability in which role expectations are clearly defined and everyone is accountable, (4) the presence of adequate numbers of qualified nurses, (5) the presence of competent leadership in which leaders support shared decision-making and allocate resources to support nursing, (6) shared decision-making at all levels, (7) the encouragement of professional practice and continued development, (8) recognition of the value of contribution of nursing, and (9) recognition by nurses for their meaningful contribution to practice. In summary, a healthy nursing environment is a workplace that is safe, empowering, and satisfying (7).

Within this framework, much efforts have been done to detect and improve work environment psychosocial and organizational factors that can be sources of burnout and job satisfaction, so that to improve work organization (8).

Regarding burnout of nurses, there is a vast body of research that has pointed how working conditions, such as low job control and high job demands, being moved among different patient care units within the organization, being short of essential resources, and having low supportive work relationships with co-workers, supervisors, and/or physicians, may produce higher levels of burnout (9–14). Indeed, a recent review (15) has pointed avoidance of conflict management style (16), low job satisfaction (17), and the increased nurse-patient ratios (18) as burnout facilitators. As regards job satisfaction, it is influenced by both work psychosocial and organizational factors (12, 19). Consequently, working environment characteristics of nurses, such as autonomy or nurse–physician collaboration, are clue for nurses to maintain an adequate degree of affect toward a job and its main components (19–22).

Because of its relation to burnout and job satisfaction of nurses, interest of researchers and managers on identifying the specific factors conforming practice environment of nurses has been stated, and many efforts on its measurement have been done in the scientific literature. Gershon et al. (23), for example, identified 12 instruments design to study culture, climate, and work environment of nurses. Some of them include, for example, the Dutch Essentials of Magnetism II© instrument, recently designed to assess nursing practice environments (24). Among the tools developed to assess work conditions of nurses, one of the first developed and internationally well-known indexes is the Nursing Work Index, originally designed by Kramer and Hafner (25). This scale included 65 items in its original version, but shortened versions with 57 (26) and 31 items (1) have been developed and widely used. The 31-item version developed by Lake, the Practice Environment Scale of Nursing Work Index (PESNWI), is one of the most used scales, with low respondent burden, adequate psychometric properties, and high discriminant ability (1, 27).

The PESNWI evaluates those factors in the work environment of nurses that may enhance or interfere with abilities of nurses to provide care, and it has grouped them into five dimensions: (1) nurse participation in hospital affairs; (2) nursing foundations for quality care; (3) nurse manager leadership, ability, and support; (4) adequate staffing and resources; and (5) collegial nurse–physician relationships (1, 5, 28, 29). Higher scores on the PESNWI have been associated with burnout (12, 22, 30), job satisfaction (12), better quality of care (31, 32), as well as better patient-reported experiences of care (33).

Therefore, the measurement of nursing practice environment is clue for health managers and institutions. However, conditions and outcomes to measure when working in the healthcare context are enormous, and having to answer so many questionnaires makes the workload of the nurses even greater, shortening their valuable time. For these reasons, it is very important to have short tools that allow us to screen and detect potential problems. And then, only then, apply the longer batteries in order to better determine and understand the conditions that aim to be solved. In this line of thought, and from a preventive point of view, a brief screening tool will serve also to periodically assess the several outcomes and dimensions of the healthcare system.

Purpose

The aim of this study was to develop and test the psychometric properties of the Brief Nurses' Practice Environment (BNPE) Scale for the Spanish population, a short measure of nursing practice environment, based on the traditional dimensions identified as important for maintaining adequate levels of stress, job satisfaction, and quality of patient care. For that purpose, a brief scale, based on the PESNWI, was developed, presented, and validated.

METHODS

Design, Setting, and Participants

The study had a cross-sectional design with a correlational approach. Data were gathered at one time point, during the months of June, July, and August of 2018. First, nursing managers of the health centers on the Balearic Islands were invited to participate, initially through a written letter and then through personal interviews where the research project was explained in detail. Once their permission had been obtained and the Ethical Research Committee of the University of the Balearic Islands approved the project, each nursing manager was asked to send the invitation letter to the nurses in the center. This invitation was sent by mail with the link to the survey, which was hosted on an online platform. On this same platform, the participating nurses signed the informed consent. Confidentiality of the data was ensured.

Sample size was estimated following Wolf et al.'s work (34), in which the authors carried out Monte Carlo data simulation techniques to evaluate sample size requirements for common applied structural equation modeling. Taking into account that the confirmatory factor analysis (CFA) was a one-factor, five-indicator model, but loadings were expected to be between 0.30 and 0.80, we took the most conservative data of 190 (34).

Assuming there could be participants with missing data in all the variables, we increased the sample size up to 210 participants.

Inclusion criteria: Participants were nurses working in the Healthcare Public System of the Balearic Islands at the moment of the study, including hospitals and primary healthcare centers. Regarding hospitals, there were two of them dedicated to the treatment of chronic disease. Exclusion criteria: Those nurses not working in the moment of the survey or working exclusively in administration tasks (not developing care activity) were excluded in order to address potential sources of bias.

Measures

The Brief Nurse's Practice Environment Scale is based on the original PESNWI dimensions, which included (1) nurse participation in hospital affairs; (2) nursing foundations for quality care; (3) nurse manager leadership, ability, and support; (4) adequate staffing and resources; and (5) collegial nurse–physician relationships. Taking these concepts as the key points of the practice nursing environment, two experts in nursing and psychometrics turned the dimensions into the five final items that composed the BNPE. The BNPE is composed of five sentences, representing the five dimensions of the PESNWI. The sentences were rated according to agreement, using a Likert-type, 4-point scale, from 1 (completely disagree) to 4 (completely agree). Total score was calculated by summing the scores in the five items and ranged from 5 to 20. Item content can be consulted in **Table 1**.

Two additional scales were also used: the short 9-item version of the Maslach Burnout Inventory (MBI) (35) and the General Work Satisfaction Scale from the Michigan Organizational Assessment Scale (36). Internal consistency estimates were 0.808 and 0.723, respectively.

Ethical Considerations

The study was approved by the Ethical Research Committee of the University of the Balearic Islands (82CER18). People who decided to participate voluntarily were told the reason and purpose for carrying out the study. The study was carried out in compliance with the ethical principles for research in health sciences established in the Declaration of Helsinki—Ethical principles for medical research involving human subjects (37). Anonymity, confidentiality, and protection of privacy were guaranteed. Participants voluntarily signed an informed consent authorizing the collection and processing of the information, and they were able to withdraw their consent at any time and without any consequences.

Analysis

Analyses included descriptive statistics and estimates of reliability, including Cronbach's alpha, item homogeneity, and alpha if item deleted.

As regards internal validity, and in order to study the factorial structure of the Brief PESNWI, a one-factor CFA model was tested. Evidence of external validity was gathered by studying the relation between BNPE and burnout and job satisfaction. A structural equation model (SEM) was tested, in which practice environment predicted the three dimensions of burnout, and these, together with the practice environment, predicted job satisfaction.

Fit of models was assessed using the following statistic and fit indexes: the chi-square, the comparative fit index (CFI), and the root mean-squared error of approximation (RMSEA). Adequate fit is generally assumed with CFI > 0.90 together with a RMSEA < 0.08, while values of CFI > 0.95 and RMSEA < 0.06 indicate an excellent fit (38). The method of estimation of both models was weighted least-squares mean and variance-corrected (WLSMV) (39).

Finally, in order to offer easy interpretation of the scale results when used by managers, cutoff criteria were offered. Quartiles were calculated, and those values corresponding to quartile 1 (lowest 25% of the sample) and quartile 3 (highest 25% of the sample) were chosen as cutoff criteria to classify participants into low, medium, and high practice environment levels. Participants were grouped following these cutoff points, and the distribution across gender were studied, and their means on age, years in nursing, years in current area/specialty, years in current job position, and the dimensions of burnout and job satisfaction were compared. Differences across genders were studied using chi square; differences across age, years in nursing, years in current area/specialty, and years in current job position were studied using ANOVA; a MANOVA studying the effect of the level of practice environment on job burnout was carried out; and also an ANOVA was conducted with job satisfaction as the dependent variable.

TABLE 1 | The brief nurses' practice environment scale (BNPE scale).

Instructions: mark the degree to which you agree with the following statements regarding your work environment. Take into account that 1 implies that you totally disagree with the proposed sentence and 4 means that you completely agree with the statement.						M	SD	α_{iid}	H
Item num.	Item content	Completely disagree	Disagree	Agree	Completely agree				
Item 1	Nurses participate in hospital affairs.	1	2	3	4	2.76	0.851	0.582	0.597
Item 2	Care is based on nursing foundations.	1	2	3	4	3.29	0.682	0.379	0.683
Item 3	Nurse manager shows leadership, ability, and support to nurses.	1	2	3	4	2.54	0.953	0.622	0.572
Item 4	Staff and resources are adequate.	1	2	3	4	2.06	0.889	0.334	0.708
Item 5	Collegial nurse-physician relationships are adequate.	1	2	3	4	2.49	0.722	0.397	0.677

M, mean; SD, standard deviation; α_{iid}, alpha if item deleted; H, item homogeneity.

TABLE 2 | Characteristics of the sample.

Variables		M	SD
Age		40.24	9.78
Years in nursing		3.75	2.05
Years in current area/specialty		2.40	1.74
Years in current job position		1.86	1.49

Variables	Categories	N	%
Gender	Women	158	75.2
	Men	29	13.8
	Missing data	23	11.0
Shifts	Without shifts	97	46.2
	With shifts	88	41.9
	Missing data	25	11.9
Working day duration	8 h	153	72.9
	10 h	5	2.4
	12 h	24	11.4
	Missing data	28	13.3
Job situation	Public worker	119	56.7
	Acting official	29	13.8
	Temporary worker	39	18.6
	Missing data	23	11.0

RESULTS

Two hundred and ten nurses answered the survey, working in 14 different centers on the Balearic Islands, including hospitals. One hundred and fifty-eight were women. Mean age was 40.24 years old. Characteristics of the sample are displayed in **Table 2**.

The study of the reliability estimates of the scores pointed adequate results. Estimate of the internal consistency of the scale by Cronbach's alpha was 0.702, and items showed adequate homogeneity and reliability (**Table 1**).

The CFA showed an excellent overall fit: $\chi^2_{(5)} = 8.627$ ($p = 0.124$), CFI $= 0.987$, and RMSEA $= 0.065$ (0.000, 0.136). All factor loadings were statistically significant ($p < 0.001$) (**Table 1**).

The SEM in which practice environment predicted burnout and job satisfaction showed an adequate overall fit: $\chi^2_{(109)} = 243.855$ ($p < 0.001$), CFI $= 0.940$, and RMSEA $= 0.085$ (0.071, 0.099). Results pointed adequate predictive power of practice environment on the dimensions of both burnout syndrome and job satisfaction, being all the proposed relations statistically significant ($p < 0.001$) and in the expected direction: Higher levels of practice environment, as measured with the BNPE scale, predicted higher scores in personal acceptance and job satisfaction, whereas lower levels predicted higher scores in emotional exhaustion and depersonalization (**Figure 1**).

Finally, cutoff criteria were offered. Quartiles were calculated, and participants were classified into low (<12), medium (12–15), and high (>15) practice environment levels and their means in sociodemographic characteristics and burnout and job satisfaction were compared.

Regarding the relation between practice environment levels and sociodemographic characteristics, no statistically significant relation was found with sex [$\chi^2_{(2)} = 1.564$, $p = 0.458$, Cramer's V $= 0.096$], age [$F_{(2, 163)} = 0.485$, $p = 0.617$, $\eta^2 = 0.006$], years in nursing [$F_{(2, 168)} = 0.328$, $p = 0.721$, $\eta^2 = 0.004$], years in current area/specialty [$F_{(2, 167)} = 0.187$, $p = 0.829$, $\eta^2 = 0.002$], or years in current job position [$F_{(2, 167)} = 0.137$, $p = 0.872$, $\eta^2 = 0.002$].

The MANOVA studying the effect of the level of practice environment on job burnout showed statistically significant differences between the means in burnout: $F_{(6, 334)} = 6.136$, $p = 0.001$, $\eta^2 = 0.063$. Follow-up ANOVAs showed statistically significant differences applying Bonferroni corrections between groups in emotional exhaustion [$F_{(2, 168)} = 9.798$, $p < 0.001$, $\eta^2 = 0.104$], depersonalization [$F_{(2, 168)} = 3.533$, $p = 0.031$, $\eta^2 = 0.040$], and personal acceptance [$F_{(2, 168)} = 4.192$, $p = 0.017$, $\eta^2 = 0.048$]. *Post-hoc* tests showed statistically significant mean differences in emotional exhaustion between low and medium ($p = 0.004$) and between low and high ($p < 0.001$) practice environment, with higher levels of emotional exhaustion for those nursing working in places with lower levels of practice environment. That is, the relation between emotional exhaustion and practice environment was negative: The lower the practice environment, the higher the emotional exhaustion. In depersonalization, *post-hoc* differences were found between those with low and those with high levels of practice environment ($p = 0.024$), with higher levels of depersonalization in nurses with lower levels of practice environment. Again, the lower the practice environment, the higher the depersonalization. And finally, in personal accomplishment, differences were found between those with low and high levels of practice environment, with higher levels of personal accomplishment for those nurses with higher levels of practice environment ($p = 0.013$). Thus, the relation between personal accomplishment and practice environment was positive: The higher the practice environment, the higher the personal accomplishment.

The ANOVA studying the effect of practice environment on mean scores of job satisfaction also resulted statistically significant difference: $F_{(2, 168)} = 9.161$, $p < 0.001$, $\eta^2 = 0.098$. *Post-hoc* statistically significant differences in job satisfaction were found between low vs. medium levels of practice environment ($p = 0.011$), and low vs. high levels of practice environment ($p < 0.001$). The higher the practice environment level, the higher the job satisfaction. Descriptive statistics are presented in **Table 3**.

DISCUSSION

The aim of the study was to develop and test the psychometric properties of the BNPE Scale, a short measure of nursing practice environment. The scale, composed by five items that represented the five original dimensions of the PESNWI, presented adequate evidence of reliability and both internal and external validity in a sample of Spanish nurses. Also, information for the interpretability and usage of the instrument was gathered.

Reliability was assessed, with also good results, at the level of the scale and also at the item level. Also, our results
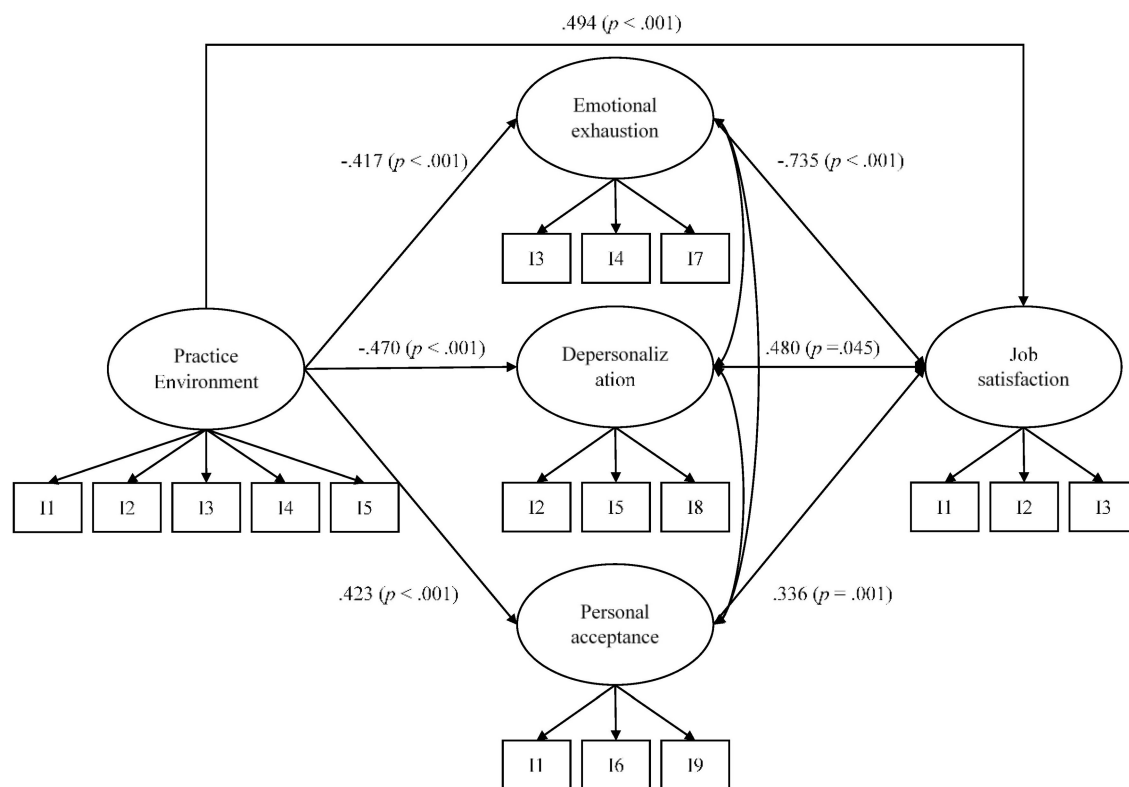
FIGURE 1 | Results of the predictive model with the BNPE scale. For the sake of clarity, only predictive relations are shown. All factor loadings were statistically significant ($p < 0.001$). Correlations among the burnout dimensions were: 0.768 ($p < 0.001$) between emotional exhaustion and depersonalization; −0.315 ($p < 0.001$) between emotional exhaustion and personal acceptance; and −0.486 ($p < 0.001$) between depersonalization and personal acceptance.

TABLE 3 | Descriptive statistics of practice environment, burnout dimensions and job satisfaction of the groups with low, medium and high levels of practice environment.

| | Practice environment | | Burnout dimensions | | | | | | Job satisfaction | |
| | | | Emotional exhaustion | | Depersonalization | | Personal accomplishment | | | |
	M	SD	M	SD	M	SD	M	SD	M	SD
Low PE (<12)	9.32	1.54	8.70	4.44	5.02	3.87	11.45	3.20	8.97	2.01
Medium PE (12–15)	13.47	1.12	6.12	4.26	4.26	3.24	12.68	3.14	9.86	1.56
High PE (>15)	17.13	1.01	4.30	3.83	2.90	2.80	13.57	2.85	10.63	1.19

PE, Practice environment; M, Mean; SD, Standard deviation.

pointed estimates of adequate internal validity, supporting the appropriateness of the one-factor structure of the BNPE scale. Its five items, named after the PESNWI dimensions, loaded into a single dimension of practice environment of nurses. The practice environment of nurses, as measured with the BNPE, showed evidence of test criterion validity in the context of a SEM, being a strong predictor of both burnout syndrome and job satisfaction. This is in line with previous research, which had already pointed how bad conditions in working environment of nurses can produce high levels of burnout (9–18), whereas, when adequate, working environment of nurses can lead to high levels of job satisfaction (12, 19, 20).

Finally, results regarding interpretability provided evidence for a cutoff score of <12 for detecting problems in working conditions of nurses (low levels of practice environments), whereas a cutoff score of >15 was proposed and adequately worked for detecting higher levels in practice environment. These criteria were found to be useful in detecting nurses with high levels of burnout and problems with job satisfaction, specifically with regard to those that showed low levels of practice environment.

Limitations of the study are mainly referred to the characteristics of the sample, which was not big and limited to the Spanish context. This could affect the generalizability of the results. As we did not gather information on ward distribution,

family status, or type of patients with whom the work activities are carried out, the relation of practice environment with these variables could not be studied. Also the briefness of the scale, although one of its main strengths, could be seen as a limitation. Capturing complex realities such as nursing working environment with a small group of items is difficult, and thus, we would like to highlight again the screening purpose of the scale, offering then a tool to detect problems in the working environment, but not to provide a specific diagnostic of them.

Based on the well-known and widely recognized model of the PESNWI, the BNPE scale is a short, easy-to-use measure that could be employed in major batteries assessing quality of Spanish healthcare institutions, with cutoff points for indicating the presence of practice environment problems and probably high levels of burnout and low job satisfaction. In such cases, deeper studies, with longer scales and personal interviews, are recommended.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study was reviewed and approved by the Ethical Research Committee of the University of the Balearic Islands (Reference number: 82CER18).

AUTHOR CONTRIBUTIONS

LG: conceptualization, methodology, formal analysis, and writing—original draft. GV-B: investigation and writing—review and editing. AO: formal analysis and writing—review and editing. NS: conceptualization, methodology, investigation, writing—review and editing, and project administration. All authors contributed to the article and approved the submitted version.

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Burnout Among Healthcare Workers in the COVID 19 Era: A Review of the Existing Literature

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In the current period of global public health crisis due to the COVID-19, healthcare workers are more exposed to physical and mental exhaustion – burnout – for the torment of difficult decisions, the pain of losing patients and colleagues, and the risk of infection, for themselves and their families. The very high number of cases and deaths, and the probable future "waves" raise awareness of these challenging working conditions and the need to address burnout by identifying possible solutions. Measures have been suggested to prevent or reduce burnout at individual level (physical activity, balanced diet, good sleep hygiene, family support, meaningful relationships, reflective practices and small group discussions), organizational level (blame-free environments for sharing experiences and advices, broad involvement in management decisions, multi-disciplinary psychosocial support teams, safe areas to withdraw quickly from stressful situations, adequate time planning, social support), and cultural level (involvement of healthcare workers in the development, implementation, testing, and evaluation of measures against burnout). Although some progress has been made in removing the barrier to psychological support to cope with work-related stress, a cultural change is still needed for the stigma associated with mental illness. The key recommendation is to address the challenges that the emergency poses and to aggregate health, well-being and behavioral science expertise through long term researches with rigorous planning and reporting to drive the necessary cultural change and the improvement of public health systems.

Keywords: COVID-19, burnout, healthcare workers, mental health, public health

INTRODUCTION

Burnout is a psychological syndrome described as a self-reported state of care- or work- related physical and mental stress (1) that induces emotional exhaustion (EE), depersonalization (DP), and a sense of reduced personal accomplishment (PA) (2). It is an unexpected consequence of an *organizational culture* unable to balance the personal identity of the worker with that of the work organization and the social context, and of the consequent continuous mental effort to cope with the perceived friction (3). Burnout was first applied to healthcare workers (HCWs) by Freudenberger in 1974 (4). Due to substantial disagreement in the health literature on what

exactly constitutes burnout and therefore on how to measure it (5), there is a great heterogeneity in the prevalence of this phenomenon: Rodrigues and colleagues, in their meta-analysis on different medical resident specialties (2), reported that the overall prevalence of burnout for all specialties was 35.1%; Rotenstein and colleagues, in their meta-analysis on practicing physicians (5), estimate an overall burnout ranging from 0 to 80.5% with pooled prevalence of 21.3% on overall burnout; they also calculate a pooled prevalence of 34.4% on EE, 25.8% on DP, and of 23.5% on PA.

In the recent period due to the coronavirus disease 2019 (COVID-19) pandemic (6) the world is experiencing an unprecedented global public health crisis with a significant strain on the healthcare system. In fact, the very high number of globally confirmed cases (195,266,156) and deaths (4,180,161) (7) and the probable additional "waves" to come as new variants emerge despite increased vaccination coverage (8) are having a serious impact on health systems: rationing or cessation of routine services, repurposing of clinical areas, redeployment of staff to unfamiliar clinical environments, shortage of personal protective equipment, extensive responsibilities, constant risk of complaints for negligence (9, 10) with medical resources and services placed at their maximum capacity due to unprecedented demands, especially for emergency departments (11). Frontline HCWs involved in the management and diagnosis of COVID-19 are more exposed to overwhelming pressure with consequent psychological stress. As referred in recent publications, medical staff report physical and mental exhaustion – due to the ethical dilemmas and moral injuries for the torment of life-or-death decisions required to be made fast and without the support of optimal care protocols, the pain of losing patients and colleagues, and the risk of infection for themselves and their families (12, 13). All these issues are especially true for residents and young HCWs who, as discussed in Zoorob et al. (14), received ever-changing information on protective measures, and are asked to work in services other than their specialty, particularly in frontline situations (15).

With this narrative review, we aim to discuss the magnitude of burnout among HCWs in the COVID-19 era analyzing emerging concepts to grasp the complexity of the problem. In particular we wanted to identify the health professionals exposed to a greater risk, the effects of burn-out on an individual and organization level and how it has been recommended to address this issue. We also wanted to highlight current research gaps that need to be filled so that health systems can be prepared for future challenges.

METHODS

With this broad perspective in mind, to grasp the complexity of the problem, we performed, as also suggested by Greenhalgh and colleagues (16), a narrative review. The of review of literature has been done without date restrictions; it was conducted on MEDLINE/Pubmed, ISI Web of Knowledge, Scopus, and Google Scholar by a multi-disciplinary team of socio-economists, methodologists, healthcare workers. We limited our search to works published in English or

Italian and used the following search terms: "healthcare workers," "physicians," "residents," "nurses," "burnout," "chronic pain," "pain syndrome," "painful disorders," "stress," "workloads," "suicide," "Covid19," "coronavirus disease," "pandemic". Study inclusion was assessed through visual inspection of abstracts. Forward citation of relevant papers was also adopted to increase the sensitivity of the search process.

Who Is Affected

Before COVID-19, Rodrigues and colleagues (2) reported an high variability of the prevalence of burnout across specialties: high prevalence (42.5%), when grouping general surgery, anesthesiology, obstetrics and gynecology, and orthopedics; moderate prevalence (29.4%), for internal medicine, plastic surgery and pediatrics; low prevalence (23.5%), for otolaryngology and neurology. Emergency routine results a key determinant of heterogeneity: prevalence is higher among residents from medical specialty schools who deal directly with life-threatening situations and shift overload. Age emerges as a protective factor: burnout levels in physicians tend to decrease with increasing age, possibly due to the more "idealistic" and empathic approach in younger physicians (17).

In the COVID-19 pandemic, more HCWs are facing life-threatening situations, pathogen exposure, and shift overload and other major changes in work organization (9). Moreover, increased supervision and regulation reduced autonomy of HCWs and their time with patients (18). Prevalence of burnout was higher in intensive care units and sub-intensive care wards, and for residents and nurses. In an Italian survey, higher levels of burnout were found in females, in young (aged <30 years) HCWs, in those who frequently change job duties and family habits, and in residents (19).

In a recent systematic review, Prasad and colleagues (20) found higher stress scores in US health organizations among women, black and Latino individuals, hospital workers and nursing assistants, medical assistants, and social workers. Stress and burnout were associated with fear of exposure or transmission, self-reported anxiety/depression, and work overload. The high exposure to risk for female workers may be linked to their predominance in patient-facing roles, gender discrimination, gender expectations in care, and inattention at "double shift" work with high workloads at home. The high exposure to risk for black and Latino HCWs was linked to a greater fear of exposure to COVID-19 due to racial concordance between workers and patients (black and Latino were overrepresented among patients hospitalized with COVID-19) and entry-level positions to their employment that expose them to a direct contact with patients and with few opportunities for advancement. The risk of infection may be higher in low- or middle-income countries due to a very limited access to personal protective equipment (21).

The above energy drain factors are summarized in **Figure 1** along with the consequences of burnout which are discussed in the next section.
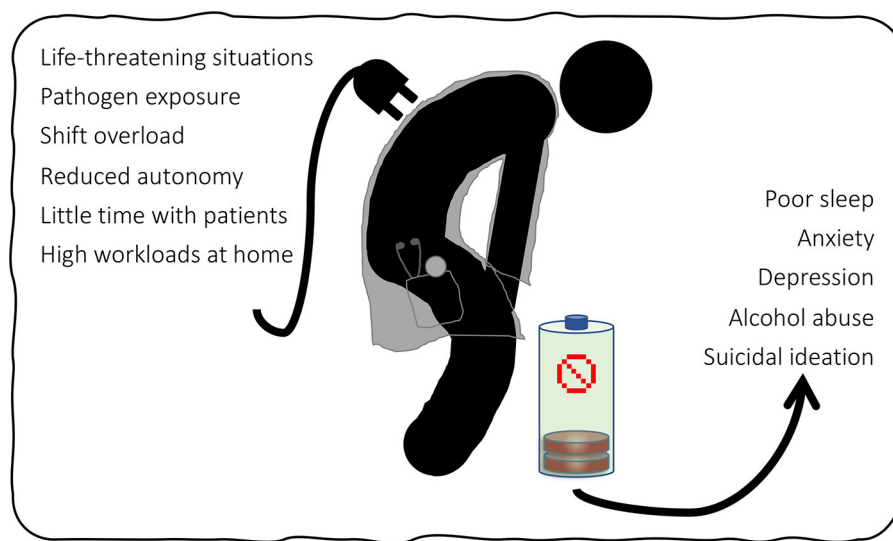
FIGURE 1 | Summary of energy drain factors and consequences of burnout on HCWs.

Effects on Healthcare Workers and on Healthcare Systems

A first direct effect of burnout is, of course, on HCWs' own care and safety. The rate of depressive disorder among HCWs is alarming when compared with that of the general population and is closely related to high levels of occupational stress (22). During the COVID-19 outbreak, a relatively high prevalence of anxiety (24.94%), depression (24.83%) and sleep disorders (44.03%) was reported in meta-analyses investigating the mental health of HCWs (23, 24). Healthcare workers tend to hide their difficulties due to the perceived stigma associated with mental illness as well as to the fear of an impact on their careers (25).

In turn, these mental conditions are associated with further criticalities, including a 25% increased odds of alcohol abuse or dependence and a doubled risk of suicidal ideation (18). When considering the extreme act, it is well known that the rates are higher among physicians than in the general populations (26). Dutheil and colleagues (27) recently reported an overall standardized mortality rate for suicide in physicians of 1.44 with an higher level in females of 1.99. They also found a higher risk for anesthesiologists, psychiatrists, general practitioners and general surgeons. Although, at present, no data sets regarding the impact of COVID-19 on physician mental health and suicide are available, the many news published in the newspapers of various countries about the suicide of doctors active in the pandemic leave no doubt that the situation is getting worse (28).

An indirect effect of burnout could be the lowering of the quality of healthcare systems in terms of adherence to guidelines, poor communication, medical errors, and patient outcomes and safety (29). However, as clearly stated by Tawfik and colleagues (30), the relationship between the two phenomena may be bi-directional: HCWs suffering from burnout may not be able to provide high-quality healthcare services, take more unnecessary risks, pay less attention to details, and, conversely, exposure to

adverse events or recognition of poor quality of care may lead to psychological distress. The authors conclude that the real strength of the relationship may be less than that reported and that more randomized trials with adequate power and design are needed to understand how exactly burnout and quality of care influence each other.

Burnout is a critical issue that generate inefficiency in healthcare organizations. Shanafelt and colleagues (31) reported that the economic cost of physicians' reduced wellbeing can be mainly assessed in terms of the organizational cost of replacing them, decreased productivity and other "blind" issues. They estimated these costs to be between $ 500,000 and $ 1,000,000 for replacing a single physician with the invaluable training and experience consequently lost. Moreover, they reported a 30% reduction in work effort for each 1-point increase in burnout (on a 7-point scale), and highlighted other costs arising from losing mentors for junior faculty and grants, or from managing medical errors and complaints of negligence.

How to Address It

Defining strategies to cope with HWC burnout is a relevant research topic regardless of the outbreak of COVID-19 (in the **Table 1** we have summarized the measures found that prevent and reduce physician burnout). In 2016, West and colleagues (32) performed a meta-analysis on interventions to prevent and reduce physician burnout. These were focused on both individuals and organizations: facilitating small group curricula, stress management, and training in self-care and communication skills, as interventions on individuals, and shortening the duration of attending rotation and resident shifts, and improvements in clinical work processes, as organizational strategies.

In addition, Epstein and Privitera (39), called for a radical change in the culture of work by countering the stereotype of

TABLE 1 | Measures to prevent and reduce physician burnout.

Impact level	Measures	References
Individual	○ Facilitate small group curricula ○ plan initiatives for stress management ○ train in self-care and communication skills	(32)
	○ Stimulate: • physical activity • physical relaxation • balanced diet • good sleep hygiene • family support • small group discussions	(33–36)
Organization	○ Shorten the duration of attending rotation and resident shifts ○ improve clinical work processes: • limited duration of shifts and on the periods at front line • alternated series of shifts with days off • planned vacations even during an outbreak	(32, 37)
	○ Involve all HCWs in management decisions ○ structure multi-disciplinary team for professional psychosocial support to HCWs ○ compensate HCWs with practical support (social services for child, elderly or animal care)	(37)
	○ Promote a principle of co-production with the involvement of patient to share responsibility	(38)
Cultural	○ Introduce a radical change in the culture of work by countering the stereotype of endurance, recognizing human limitations on a physical, cognitive and emotional level	(39–42)
	○ Adopt a blame-free environment to share incidents, ethical or emergency issues, challenges and advices	(37)

HCWs, Healthcare workers.

endurance which "overvalues stoicism and dismisses complaints as signs of weakness" and recognizing human limitations on a physical, cognitive and emotional level.

Since the COVID-19 outbreak, a great deal of evidence has been generated on burnout in HCWs, leading to extensive discussions on how to address it in this specific context.

Regarding individual measures, self-care is suggested as a line of defense for HCWs to manage requests for assistance of COVID-19 patients, especially when recovery times are short and long-terms efforts are required. Physical activity, physical relaxation, balanced diet, good sleep hygiene, family support, meaningful relationships (also maintained through digital channels), job satisfaction, self-awareness though reflective practices and small group discussions are the reported interventions with evidence of efficacy (33–36).

Based on a scoping review and expert interviews, several recommendations focused on organizations have been proposed to build and maintain the resilience of frontline HCWs exposed to COVID-19 (37). Authors invite to support communication, even during busy periods, by: (a) adopting a blame-free environment to share incidents, ethical or emergency issues, and challenges and advices; (b) involving nurses in management decisions (to promote a sense of togetherness and positivity

where every voice has the opportunity to be heard); (c) allowing someone to talk before, during and after a shift. In addition, they recommend structuring a multi-disciplinary team with psychologists, spiritual counselors, social professionals, occupational health and safety physicians for professional psychosocial support to HCWs based on natural coping strategies (acceptance, active coping, positive framing). They also suggest creating a safe area to provide HCWs with the opportunity to quickly withdraw from an emotionally stressful situation and get peer support. Authors propose planning time limitations on the duration of the shifts (distinguishing between day and night, and between light and intense tasks) and on the periods at front line, alternating series of shifts with days off, and planning vacations even during an outbreak. Finally, they report the importance of compensating HCWs with practical support such as social services for child, elderly or animal care.

Regarding the cultural dimension, it was noted that the widely adopted short-term mood boosters that contributed to depict HCWs as "healthcare heroes", while offering recognitions in the short, can obscure the human needs for support, especially in contexts where mental health is still perceived as a stigma across society (43). Even if some progress has been made in removing the barrier to seeking psychological support in coping with work-related stress (40, 41), a cultural change is still needed for the stigma (42). In our opinion, it is important to promote a principle of co-production (38) which also includes the involvement of patients in the effort to improve healthcare services through their feed-back on the quality and organization of services. Sharing responsibilities allows to reduce the work-related pressures that may lead to burnout.

Current Research Gap

Research plays a key role in transforming the challenges that the COVID-19 era poses to society, especially healthcare systems, into an opportunity for improvement. Although a large volume of studies since the COVID-19 outbreak have examined the impact of the pandemic on the mental health of HCWs (44), solid evidence on the effectiveness of interventions to support mental well-being during stressful situations is available only from previous healthcare crises and general contexts (45). To adequately address the burnout issue in times of crisis, both large-sized quantitative longitudinal studies and qualitative studies based on first-person reports are needed. These would allow to better understand the impact on mental health of HCWs during and after the pandemic and to identify the best solutions (46). Practice guidelines are needed (47) which also integrate organizational, social, personal, and psychological factors (45). Acceptability, resources, feasibility, long-term sustainability, the impact on patients, and potential harm are reported as additional key themes to be investigated. Due to the difficulty of conducting research during a pandemic, a great heterogeneity and suboptimal designs characterize the current body of evidence. It is advisable, for future researches, to realize rigorous, standardized and transparent protocols for replicability in other settings [better if using reporting standards such as the Template for Intervention Description and Replication, TIDieR (48)], to develop shared definitions of burnout, to

use standardized and validated measurement tools and more representative sample sizes, to include follow-up for long-term mental health implications and comparisons with other time periods (5, 44, 45, 49–51). However, one must be aware of the risks of considering only metrics, and health care organizations must focus on process rather than outcome alone, on goals that demonstrate effective improvement of working conditions and not just on achieving a specific threshold score or ranking (52).

CONCLUSION

Burnout was a major concern for HCWs since before the COVID-19 pandemic. The current emergency context has added new social and job-related factors that increase the risk of burnout with associated effects on quality of care and efficiency of the system. Based on our knowledge, this is the first work that discusses recently emerging concepts with a comprehensive

view. Several measures have been suggested to prevent or reduce this parallel epidemic that calls for action at individual, organizational or cultural level. The key recommendation is to take up the challenges that the emergency imposes and to aggregate competences in health, well-being and behavioral science through rigorously planned and reported long term researches to guide the necessary cultural change and the improvement of public health systems.

AUTHOR CONTRIBUTIONS

CL, SS, and PM conceived the work. All authors performed the search and analysis of the literature. CL, SS, and PM wrote the original draft of the manuscript. MT, AB, GP, and ES critically reviewed the manuscript. All authors have read and approved the final version of the manuscript.

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Serial-Multiple Mediation of Job Burnout and Fatigue in the Relationship Between Sickness Presenteeism and Productivity Loss in Nurses: A Multicenter Cross-Sectional Study

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Background: In China, sickness presenteeism, job burnout, and fatigue are common among nurses during the COVID-19 pandemic. We propose the prevalence of sickness presenteeism can adversely affect nurses' physical and mental health, negatively impact their work productivity and quality, and pose a threat to patients' safety. Therefore, this study examines the mechanism of productivity loss caused by sickness presenteeism, fatigue, and job burnout.

Objectives: To investigate the serial-multiple mediating effect of job burnout and fatigue in the relationship between sickness presenteeism and productivity loss among nurses.

Methods: A multicenter cross-sectional survey was undertaken by administering an online questionnaire from December 2020 to May 2021. Stratified cluster sampling was used to include 3,491 nurses from 14 hospitals in Shandong Province, China. Variables were measured using the Sickness Presenteeism Questionnaire, Stanford Presenteeism Scale, Chalder Fatigue Scale, and Maslach Burnout Inventory. Data analyses were carried out using descriptive statistics, one-way analysis of variance, independent-samples t-test, Pearson correlation analysis, hierarchical regression, and bootstrapping method.

Results: From the 3,491 nurses who volunteered in this online survey, only 2,968 valid questionnaires were returned. Sickness presenteeism exhibited a prevalence of 70.6% during the COVID-19 pandemic. The average score of health-related productivity loss was 15.05 ± 4.52, fatigue was 8.48 ± 3.40, and job burnout was 39.14 ± 19.64. Sickness presenteeism was positively associated with fatigue and job burnout while job burnout was positively associated with nurse fatigue. Sickness presenteeism, fatigue, and job burnout were also positively correlated with health-related productivity loss. Statistically significant paths via the single mediation of fatigue and job burnout

were established. A statistically significant serial-multiple mediating effect of fatigue and job burnout on the association between sickness presenteeism and productivity loss accounted for 35.12% of the total effect size.

Conclusions: There was a high incidence of sickness presenteeism and job burnout among Chinese nurses. High-frequency sickness presenteeism may result in increased productivity loss through the two mediating effects of fatigue and job burnout. Sickness presenteeism may increase fatigue, promote job burnout, and result in increased productivity loss among Chinese nurses during the COVID-19 pandemic.

INTRODUCTION

The COVID-19 pandemic has resulted in the increased vulnerability of medical workers to job burnout and fatigue because of the escalating number of patients, emotional loss of colleagues, and risk of infection (1). The lack of intervention to address these issues could have long-term risks for staff and patients. Accordingly, institutions should focus on the determinants of job burnout and fatigue and explore their effects on health workers. Job burnout is defined by the three dimensions of exhaustion, cynicism, and inefficacy and is a prolonged response to chronic stressors on the job (2). Studies have found job burnout to be related to job performance and health-related productivity so it can significantly impact both employees and the organization (2). Fatigue begins gradually, can last more than 6 months, and is relieved only by rest (3). Studies have shown fatigue can be divided into physical fatigue and mental fatigue (4).

Despite suffering from physical and mental symptoms such as job burnout and fatigue, nurses have continued to work during this crisis due to feelings of responsibility and professionalism (5). Most scholars define the situation of people who continue to work while in an unhealthy state as sickness presenteeism (6–8). However, sickness presenteeism behaviors are considered a symbol of traditional dedication and diligence in eastern cultures and are perceived as meritorious service by Chinese mainstream media. Recently, scholars have began examining the work-related death of medical staff and explored the role of sickness presenteeism, overwork, and exhaustion (8–10). While the overall level of sickness absence has recently declined, this does not portend a healthier working population since there is a corresponding increase in overall sickness presenteeism (11). Evidence suggests that nurses are a susceptible group for sickness presenteeism (12). According to a review by Freeling et al., the prevalence of sickness presenteeism in nurses ranged from 15.7 to 87.0% (13).

Sickness presenteeism behaviors among nurses tend to reduce patients' quality of care and negatively affect their treatment, rehabilitation, and safety (14). Sickness presenteeism behaviors may also negatively affect nurses mental and physical health,

reduce their work engagement and job satisfaction, increase job burnout (15), induce future health issues, enhance the chance of long-term absenteeism, and impose direct and indirect financial burdens on healthcare organizations (16). Moreover, while previous research has linked sickness presenteeism with job performance or productivity, the mechanism of psychological burnout and physical fatigue in this relationship has not been explored in detail (7, 17–19). Nurses play an important role in universal healthcare, thus clarifying the mechanisms and links between nurse sickness presenteeism and health-related productivity loss is important (13). Consequently, paying attention to occupational health of nurses has profound implications for promoting public health and improving the overall quality of health care in the country (20). Although the mechanisms and links in the fields of occupational health and human resource management have attracted the wide attention of scholars, these related studies were mainly conducted in the USA and European countries, but rarely in the context of Chinese culture (13).

Studies found that employee job burnout was closely associated with sickness presenteeism and caused loss of productivity (21–23). In addition, Aboagye et al. proved that sickness presenteeism independently enhanced the risks of moderate or severe fatigue and worsened work performance in the past year (17). Fatigue was also strongly associated with lost productivity (17). Physical and mental fatigue were positively correlated with job burnout as highlighted in a previous study (24). Therefore, we hypothesized that some factors might mediate between sickness presenteeism and a loss of productivity. Therefore, the hypotheses of this study are as follows: (i) sickness presenteeism, fatigue, and job burnout have different effects on productivity loss, (ii) fatigue acts as a moderator between sickness presenteeism and productivity loss, (iii) job burnout acts as a moderator between sickness presenteeism and productivity loss, and (iv) fatigue and job burnout have serial-multiple mediating effect between sickness presenteeism and productivity loss. This study aims to investigate the serial-multiple mediating effect of job burnout and fatigue in the relationship between sickness presenteeism and productivity loss among nurses. The study also aims to provide a theoretical basis for alleviating significant productivity loss among these health care professionals.

TABLE 1 | Descriptive statistics of the nurses' sickness presenteeism ($N = 2,968$).

Item	Never (n, %)	Once (n, %)	2–5 times (n, %)	>5 times (n, %)
Has it happened over the previous 12 months that you have gone to work despite feeling that you really should have taken sick leave due to your state of health	873 (29.4)	939 (31.6)	867 (29.2)	289 (9.7)

MATERIALS AND METHODS

Design, Setting, and Participants

This multicenter cross-sectional research used data from the first survey of Chinese nurses conducted December 2020 to May 2021 from the Nurses' Health Cohort Study of Shandong (registration number: ChiCTR2100043202). A multistage sampling method was adopted as follows: (a) Shandong Province was divided geographically into eastern, western, southern, northern, and central regions, (b) at least two hospitals in each region were selected by convenience sampling, and (c) all nurses at selected hospitals received invitations and were recruited (cluster sampling).

Inclusion criteria were registered nurses with nurse qualification certificates and who volunteered. Exclusion criteria were (a) retired, refresher, and student nurses, (b) nurses who suffered from severe mental illness or took psychotropic drugs; (c) nurses who had been working for <6 months; and (d) nurses who were on leave during the investigation.

Measures

Demographic Variables

Demographic characteristics included gender, age, marital status, education level, department, employment type, professional title, position, and monthly income.

Sickness Presenteeism

The Sickness Presenteeism Questionnaire developed by Aronsson includes a single item "Has it happened over the previous 12 months that you have gone to work despite feeling that you really should have taken sick leave due to your state of health?" Responses are evaluated on a 4-point scale: never (1 point), once (2 points), two to five times (3 points), and >5 times (4 points). A higher score indicates a higher frequency of working while sick (6). Hou et al. conducted cross-cultural adaptation and validation of the questionnaire among Chinese medical professionals (25). The Sickness Presenteeism Questionnaire has been extensively used in the measurement of sickness presenteeism of Chinese medical staff (26–28).

Health-Related Productivity Loss

Productivity loss due to health issues was evaluated with the 6-item Stanford Presenteeism Scale (29), translated into Chinese by Zhao et al. (30). The Cronbach's alpha coefficient was 0.76–0.90 and the scale is extensively used in the measurement of work productivity activity. The scale contains two dimensions of work energy and work limits. A 5-point Likert scale is adopted to score each item: completely disagree (1 point), totally agree (5 points). The total score ranges from 6 to 30 points. A higher score from the scale means a greater loss of productivity due to health issues brought about by sickness presenteeism among nurses. In the present study, the Cronbach's alpha coefficient of the scale was 0.795.

Job Burnout

Job burnout was assessed by the 22-item Maslach Burnout Inventory (31), which has three dimensions of low personal accomplishment, depersonalization, and emotional exhaustion. The Chinese version of the Maslach Burnout Inventory exhibited sufficient validity and reliability in Chinese nurses. The Cronbach's alpha coefficient was 0.788 and the re-test reliability coefficient was 0.713 (32). A 7-point Likert scale is adopted to rate each item, with completely inconsistent (1 point) and completely consistent (7 points). A higher score represents more severe job burnout. The Cronbach's alpha coefficient of the Chinese version of the Maslach Burnout Inventory in this study was 0.896.

Fatigue

The 14-item Chalder Fatigue Scale developed by T Chalder determines the severity of fatigue (33). The scale was translated into a Chinese version by Wang et al. (34). The Cronbach's alpha coefficient was 0.773 and the re-test reliability coefficient was 0.745 (34), which was found to be valid, and culturally sensitive (35). The scale consists of 14 "yes" (1 point) or "no" (0 point) questions, which are divided into two dimensions: physical fatigue and mental fatigue. A higher score from this scale suggests a higher level of fatigue. The Cronbach's alpha coefficient of this scale in this study was 0.803.

Data Collection

Trained nurses with a master's degree and a professional background in medicine served as researchers. Permission was attained from the head of each nursing administrative department before the start of the investigation. All heads were subject to research-related training on the background, aim, and study methods. All queries were clarified in detail. Liaisons were set in test hospitals and functioned as regulators to ensure questionnaire completion and communicate with respondents on unresolved problems. Since the survey was web-based, the invitation for participation was disseminated in the form of a two-dimension code. Questionnaires were distributed via WeChat (a widely used instant messaging app used in China) in batches to allow respondents the opportunity to be relaxed, forthcoming, and detailed when responding to questions. We anticipated each of the eight questionnaires would be completed in approximately 10–15 min. Only professionals who signed non-disclosure agreements had direct access to the data. To ensure

TABLE 2 | Respondent characteristics and univariate analysis of demographic factors related to job burnout in nurses.

Variables	n (%)	Job burnout (x ± SD)	t/F value[†]	p-value
Total	2,968 (100.00)	39.14 ± 19.64		
Gender				
Male	137 (4.62)	47.30 ± 19.50	**24.999**	**<0.001***
Female	2,831 (95.38)	38.75 ± 19.56		
Age, years				
<30	745 (25.10)	43.52 ± 19.99	**34.419**	**<0.001***
30–39	1,652 (55.66)	39.38 ± 19.03		
40–49	460 (15.50)	33.33 ± 19.73		
≥50	111 (3.74)	30.34 ± 16.87		
Marital status				
Unmarried	637 (21.46)	43.77 ± 19.76	**15.670**	**<0.001***
Married	2,273 (76.58)	37.95 ± 19.43		
Divorced	39 (1.31)	35.74 ± 17.17		
Others	19 (0.64)	33.95 ± 21.78		
Education[‡]				
Secondary vocational degree	789 (26.58)	35.80 ± 18.75	**12.262**	**0.001***
Associate's degree	1,613 (54.35)	39.97 ± 20.00		
Bachelor's degree	557 (18.77)	41.25 ± 19.26		
Master's degree	9 (0.30)	52.67 ± 14.16		
Professional title				
Junior	1,579 (53.20)	41.58 ± 19.85	**23.232**	**<0.001***
Intermediate	1,198 (40.36)	37.21 ± 19.03		
Assistant senior	184 (6.20)	31.18 ± 18.18		
Senior	7 (0.24)	28.71 ± 17.42		
Employment type				
Permanent staff	886 (29.85)	36.79 ± 19.12	**8.254**	**<0.001***
Personnel agency	1,534 (51.68)	39.28 ± 19.57		
Contract staff	356 (11.99)	40.88 ± 19.62		
Labor dispatch	133 (4.48)	46.84 ± 20.60		
Filing staff	38 (1.28)	45.92 ± 22.54		
Others	21 (0.71)	37.14 ± 17.87		
Department				
Internal medicine	849 (28.61)	40.58 ± 19.36	**4.739**	**<0.001***
Surgery	624 (21.02)	39.04 ± 19.26		
Emergency	183 (6.17)	42.49 ± 19.89		
Gynecology	76 (2.56)	35.38 ± 19.43		
Obstetrics	144 (4.85)	33.67 ± 19.18		
Pediatrics	264 (8.89)	38.59 ± 19.91		
Operating room	235 (7.92)	39.80 ± 19.26		
ICU	175 (5.90)	41.13 ± 19.69		
Outpatient	87 (2.93)	30.00 ± 17.38		
Administration	6 (0.20)	29.33 ± 18.18		
Others	325 (10.95)	38.51 ± 20.63		
Position				
Clinical nurse	2,620 (88.27)	40.09 ± 19.61	**11.176**	**<0.001***
Deputy head nurse	150 (5.05)	32.13 ± 18.82		
Head nurse	185 (6.23)	32.15 ± 18.37		
General head nurse	4 (0.13)	41.75 ± 5.68		
Deputy director of nursing department	5 (0.17)	19.20 ± 8.82		

(Continued)

TABLE 2 | Continued

Variables	n (%)	Job burnout (x ± SD)	t/F value[†]	p-value
Director of nursing department	4 (0.13)	29.00 ± 16.51		
Monthly income, CNY				
<3,000	195 (6.57)	42.53 ± 20.82	**4.193**	**0.002***
3,000–5,999	1,504 (50.67)	39.76 ± 19.85		
6,000–8,999	944 (31.81)	38.34 ± 19.26		
9,000–19,999	280 (9.43)	37.26 ± 18.80		
≥12,000	45 (1.52)	39.14 ± 19.64		

SD, standard deviation; ICU, intensive care unit; CNY, China Yuan.
Bold value for p < 0.05.
*Statistically significant differences in the variables after application of Bonferroni correction (p < 0.006).
[†]One-way ANOVA was carried out for more than two groups, and independent-samples t-test was adopted for two groups.
[‡]Secondary vocational degree: Having a 4-year senior high school study experience of professional training; associate's degree: Having a 3-year college study experience of professional training; bachelor's degree: Having a 4- or 5-year undergraduate course of training.

TABLE 3 | Correlations between sickness presenteeism, fatigue, job burnout and health-related productivity loss (N = 2,968).

Variables	1	2	3	4
1. Sickness presenteeism	1.000			
2. Fatigue	0.201***	1.000		
3. Job burnout	0.164***	0.447***	1.000	
4. Health-related productivity loss	0.282***	0.392***	0.488***	1.000
Mean	2.193	8.475	39.140	15.055
Standard deviation	0.969	3.401	19.635	4.524

***p < 0.001.
Covariates include age, gender, marital status, education, professional title, employment type, department, position, and monthly income.

data quality, we adopted the required questions and data logic control design for the electronic questionnaires.

Ethical Considerations

Participation was voluntary, and nurses provided written informed consent. The study was approved by the Shandong University Qilu Hospital Medical Ethics Committee (Registration number KYLL-202011-085).

Data Analysis

Statistical analyses were carried out using R software version 4.0.5 (R Development Core Team, Vienna, Austria). The steps for analysis were as follows: (1) Descriptive statistics were applied on continuous variables mean and standard deviation (SD) and categorical variables (frequency and percentage). One-way analysis of variance (ANOVA) and independent-samples t-test compared sickness presenteeism, job burnout, fatigue, and health-related productivity loss from nurses with varying demographic variables from different groups. Bonferroni correction was applied for correcting the multiple test and p value < 0.006 was considered statistically significant for the

TABLE 4 | Hierarchical linear regression analysis of variables related to health-related productivity loss (N = 2,968).

Variables	Health-related productivity loss			
	Model 1 (coef)	Model 2 (coef)	Model 3 (coef)	Model 4 (coef)
Control variables				
Gender	**−1.262***	**−1.195***	**−1.093***	−0.553
Age	**−0.399**	−0.302	−0.312	−0.119
Marital status	0.323	0.163	0.119	0.300
Education	0.167	0.171	0.150	0.081
Professional title	−0.135	−0.229	−0.246	−0.152
Employment type	0.041	0.097	0.069	0.027
Department	−0.048	**−0.054**	−0.041	−0.026
Position	**−0.617***	**−0.702***	**−0.470***	**−0.398***
Monthly income	−0.037	−0.103	−0.165	−0.138
Independent variable				
Sickness presenteeism		**1.307***	**0.981***	**0.848***
Mediating variables				
Fatigue			**0.461***	**0.248***
Job burnout				**0.087***
$R^{2\dagger}$	0.026	0.104	0.218	0.326
$F^{\ddagger}$	**8.925**	**34.226**	**74.981**	**119.173**
$\Delta R^{2\S}$	0.026	0.077	0.114	0.108
$\Delta F^{\P}$	**8.925**	**255.034**	**432.581**	**473.460**

coef, nonstandard regression coefficient.

Bold value for p < 0.05.

*Statistically significant differences in the variables after application of Bonferroni correction (p < 0.013).

$^{\dagger}R^2$ refers to the proportion of variations in the dependent variable explained by the variables in the regression equation.

$^{\ddagger}F$ is the value that evaluates whether the regression equation holds.

$^{\S}\Delta R^2$ represents the increased value of the proportion of variations in the dependent variable explained by the regression equation as new variables are entered into the model.

$^{\P}\Delta F$ is the value that evaluates whether the regression equation changes significantly as new variables continue to be introduced into the model.

univariate analysis. (2) We adopted a Pearson correlation analysis to examine the associations between variables. (3) We verified the important serial-multiple mediating effect of fatigue and job burnout on the relationship between sickness presenteeism and health-related productivity loss. We adopted bootstrap method that bias-corrected 95% confidence intervals (CIs) estimated based on 5,000 bootstrapped samples from the Serial-Multiple Mediation Model 6 of PROCESS macro version 3.5 in R produced by Hayes (36). In the analysis, all variables were incorporated into the tested model and the unstandardized coefficients of paths were generated to decrease Type 1 errors caused by data distribution (36). (4) We considered health-related productivity loss a dependent variable and performed a hierarchical linear regression analysis of variables to determine the variation of sickness presenteeism, fatigue, and job burnout for the regression equation. The demographic variables were included in the first layer of linear regression analysis (Model 1). Additionally, sickness presenteeism as an independent variable was entered into the second layer of linear regression analysis (Model 2). Finally, the mediating variable fatigue was entered the third layer

as a new variable (Model 3) and then the mediating variable job burnout was entered the fourth layer as a new variable (Model 4). According to Bonferroni correction, p value < 0.013 was considered statistically significant for the regression analysis.

RESULTS

Nurses' Demographic Characteristics Related to Sickness Presenteeism, Fatigue, Job Burnout, and Health-Related Productivity Loss

The present study involved a total of 3,491 nurses from 14 hospitals in Shandong Province, China. Questionnaires that were incomplete or logically inconsistent were eliminated, which led to the exclusion of 15% (n = 523) respondents. Of the remaining 2,968 participants, approximately 88.27% were clinical nurses and 95.38% were female. **Table 1** summarizes the descriptive statistics of the participants' sickness presenteeism scores, of which the average score was 2.19 (SD = 0.97). Specifically, 70.6% (2,095) of the participants had sickness presenteeism behaviors. The demographic characteristics associated with nurses' sickness presenteeism are shown in **Supplementary Table 1**. The results indicated that the average score of health-related productivity loss was 15.05 (SD = 4.52), the average score of fatigue was 8.48 (SD = 3.40), and the average score of job burnout was 39.14 (SD = 19.64). Descriptives of demographic characteristics associated with nurses' fatigue or productivity loss are shown in **Supplementary Tables 2, 3**. **Table 2** shows respondents' demographic characteristics and univariate analysis of job burnout.

According to the data, job burnout was significantly associated with gender as male nurses suffered greater job burnout than female nurses (t = 29.999, p < 0.001). Job burnout also varied by age (F = 34.419, p < 0.001) and marital status (F = 15.670, p < 0.001). Further *posthoc* analysis showed younger nurses experienced higher levels of job burnout, and unmarried nurses had higher levels of job burnout than married nurses. Additionally, nurses of different education backgrounds obtained significantly different job burnout scores (F = 12.262, p < 0.001). A *posthoc* analysis showed that job burnout of respondents with a higher educational level was significantly more severe. In addition, one-way ANOVA revealed significantly different degrees of job burnout between different employment types (F = 8.254, p < 0.001), professional titles (F = 23.232, p < 0.001), and positions (F = 11.176, p < 0.001). Further *posthoc* analysis showed that permanent staff nurses suffered lower levels of job burnout than other types of nurses employed. Conversely, nurses with lower professional titles experienced higher levels of job burnout, and clinical nurses suffered a higher level of job burnout than head nurses.

Correlation Analysis

The statistics of means (SDs) and correlations between the four investigated variables, namely sickness presenteeism, fatigue, job burnout, and productivity loss, are summarized in **Table 3**. Consistent with our expectation, health-related productivity loss
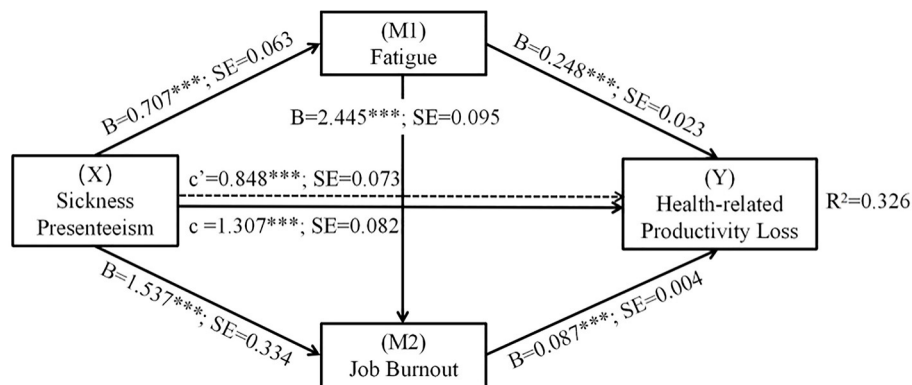
FIGURE 1 | Serial-multiple mediating effect of fatigue and job burnout on the correlation between sickness presenteeism and health-related productivity loss. SE, standard error. B refers to the unstandardized path coefficients; X refers to the independent variable; M1 and M2 refer to mediating variables; Y refers to the dependent variable; Covariates include age, gender, marital status, education, professional title, employment type, department, position, and monthly income. ***p<0.001.

was positively correlated with the nurses' sickness presenteeism ($r = 0.282$, $p < 0.001$), fatigue ($r = 0.392$, $p < 0.001$), and job burnout ($r = 0.488$, $p < 0.001$). Sickness presenteeism was positively associated with fatigue ($r = 0.201$, $p < 0.001$) and job burnout ($r = 0.164$, $p < 0.001$). Job burnout was positively associated with nurses' fatigue ($r = 0.447$, $p < 0.001$).

Hierarchical Linear Regression Analysis of Variables Associated With Health-Related Productivity Loss

We then considered health-related productivity loss a dependent variable and performed hierarchical linear regression analysis of variables (**Table 4**). Model 1 ($R^2 = 0.026$, $F = 8.925$, $\Delta R^2 = 0.026$, $\Delta F = 8.925$, $p < 0.001$) included only demographic variables, showed that gender ($B = -1.262$, $p = 0.002$), age ($B = -0.399$, $p = 0.026$), and position ($B = -0.617$, $p < 0.001$) were statistically significantly associated with health-related productivity loss, respectively. Additionally, Model 2 ($R^2 = 0.104$, $F = 34.226$, $\Delta R^2 = 0.077$, $\Delta F = 255.034$, $p < 0.001$) included demographic variables and sickness presenteeism, and showed that health-related productivity loss was statistically significantly associated with sickness presenteeism ($B = 1.307$, $p < 0.001$), gender ($B = -1.195$, $p = 0.002$), department ($B = -0.054$, $p = 0.022$) and position ($B = -0.702$, $p < 0.001$), respectively. Model 3 ($R^2 = 0.218$, $F = 74.981$, $\Delta R^2 = 0.114$, $\Delta F = 432.581$, $p < 0.001$) included demographic variables, sickness presenteeism and fatigue, and showed that health-related productivity loss was statistically significantly associated with sickness presenteeism ($B = 0.981$, $p < 0.001$), fatigue ($B = 0.461$, $p < 0.001$), gender ($B = -1.093$, $p = 0.002$), and position ($B = -0.470$, $p = 0.002$), respectively. Finally, Model 4 ($R^2 = 0.326$, $F = 119.173$, $\Delta R^2 = 0.108$, $\Delta F = 473.460$, $p < 0.001$) included demographic variables, sickness presenteeism, fatigue, and job burnout, and showed that health-related productivity loss was statistically significantly associated with sickness presenteeism ($B = 0.848$, $p < 0.001$), fatigue ($B = 0.248$, $p < 0.001$), job burnout ($B = 0.087$, $p < 0.001$), and position ($B = -0.398$, $p = 0.002$), respectively. The

results of Model 4 suggested that sickness presenteeism, fatigue and job burnout could explain 30.0% of the variation of the final regression equation ($\Delta R^2 = 0.300$, $p < 0.001$).

Mediation Analysis

According to **Figure 1** and **Table 5**, a significant direct effect [c' $= 0.848$, standard error (SE) $= 0.073$, $t = 11.656$, $p < 0.001$] of sickness presenteeism on health-related productivity loss was observed. Significant direct paths from sickness presenteeism to fatigue ($B = 0.707$, $SE = 0.063$, $t = 11.140$, $p < 0.001$) and from fatigue to productivity loss ($B = 0.248$, $SE = 0.023$, $t = 10.905$, $p < 0.001$) were established. Statistically significant paths via the single mediation of fatigue [point estimate (PE) $= 0.176$; 95% bias corrected (BC) CI: 0.133–0.222] and job burnout (PE $= 0.134$; 95% BC CI: 0.073–0.193) were also established. Additionally, the paths from sickness presenteeism ($B = 1.537$, $SE = 0.334$, $t = 4.605$, $p < 0.001$) to job burnout and from job burnout ($B = 0.087$, $SE = 0.004$, $t = 21.759$, $p < 0.001$) to health-related productivity loss were of statistical significance. Finally, the path from fatigue (the first mediator) to job burnout (the second mediator) ($B = 2.445$, $SE = 0.095$, $t = 25.807$, $p < 0.001$) and that through both mediators (PE $= 0.150$; 95% BC CI: 0.119–0.184) were all of statistical significance.

When we entered sickness presenteeism and the two mediators into the model, we found a significant total effect of sickness presenteeism on productivity loss (c $= 1.307$, $SE = 0.082$, $t = 15.970$, $p < 0.001$). Taken together, our findings revealed a serial-multiple mediating effect and a statistically significant total indirect effect (PE $= 0.459$; 95% BC CI: 0.369–0.549) that accounted for 35.12% of the total effect size. Additionally, three pairs of contrasting results were observed. There was no statistical difference in the power of mediating effect among the paths through single mediation by fatigue and job burnout and the path through serial-multiple mediation, which accounted for 13.47, 10.25, and 11.48% of the total effect, respectively.

TABLE 5 | Comparison of indirect effects of sickness presenteeism on health-related productivity loss mediated by fatigue and job burnout ($N = 2,968$).

	Product of coefficients		Bootstrapping 95% BC CI		Percentage of total effect (%)
	Point estimates	Boot SE	Boot LL CI	Boot UL CI	
Model pathways					
Total effect: X→ Y	1.307	0.082	1.147	1.468	100.00
Direct effect: X→ Y	0.848	0.073	0.705	0.990	64.88
Total indirect effect: X→ Y	0.459	0.046	0.369	0.549	35.12
Indirect effect 1: X→ M1→ Y	0.176	0.023	0.133	0.222	13.47
Indirect effect 2: X→ M2→ Y	0.134	0.030	0.073	0.193	10.25
Indirect effect 3: X→ M1→ M2→ Y	0.150	0.017	0.119	0.184	11.48
Contrasts					
Ind 1 minus Ind 2	0.042	0.038	−0.031	0.118	—
Ind 1 minus Ind 3	0.025	0.022	−0.017	0.068	—
Ind 2 minus Ind 3	−0.017	0.034	−0.083	0.049	—

BC, bias corrected; CI, confidence interval; SE, standard error; LL, lower level; UL, upper level; Ind, indirect effect.
Number of bootstrapped samples for BC CI: 5,000.
Level of confidence for all CIs: 95%.
X, presenteeism; M1, fatigue; M2, job burnout; Y, health-related productivity loss.

DISCUSSION

Relationship Between Sickness Presenteeism and Health-Related Productivity

Our data indicated that the incidence of sickness presenteeism in Chinese nurses was 70.6%, which is similar to the 74% reported in Saudi Arabia (37). This incidence of sickness presenteeism is markedly higher than those observed in Croatia (6.82%) (38), Korea (23.2%) (39), and the USA (42.1%) (40). Some possible reasons for this discrepancy were as follows. First, according to the statistical report released by the National Bureau of Statistics of China in 2020, the number of registered nurses in China was 4.4 million in 2019 and the number of nurses was 3/1,000 of the total population, a ratio that is much lower than western countries (41). The shortage of nursing human resources may lead to the sickness presenteeism of nurses (5). Second, the disparity in incidence reporting may be due to the different sickness presenteeism measurement tools used in diverse studies. For example, some studies chose the single-item sickness presenteeism questionnaire as used in this study (37, 39), the World Health Organization's health and work performance questionnaire (38), or created a self-made questionnaire (40). Third, nurses' workload increased significantly due to the need for vaccination, nucleic acid collection, and epidemiological investigations for COVID-19 prevention and control. An overwhelming workload is harmful to nurses' physical and mental health. However, nursing is believed to be an altruistic profession in Chinese culture, and working with sickness is considered an honorable and noble act (42).

The study revealed a strong positive correlation between sickness presenteeism and productivity loss due to health issues in nurses from China, which is consistent with the finding of a previous study (7, 17–19). Previous investigations also demonstrated that sickness conditions were a positive predictor of productivity loss in nurses (7, 43). This suggests that the more frequently nurses continue to work with sickness, the greater the total health-related productivity loss. Therefore, sickness presenteeism in clinical nursing work should not be encouraged, and ensuring nurses' health-related productivity should be the priority of nursing management.

Demographic characteristics such as age, employment type, and nurses' position were significantly associated with productivity loss in the univariate analysis. Nurses aged <40 years experienced a greater health-related productivity loss than nurses aged ≥40 years, which supported the previous result (44). Due to the current work environment, permanent staff nurses tended to have less occupational competitive pressure and better work benefits than other types of nurses (45). Employment disparity was highlighted in areas such as labor relations, social security, work assessment, and other aspects (45). Therefore, when health affects work, permanent staff nurses might be more effective in reducing the degree of health productivity loss. It is worth noting that the health-related productivity loss of clinical nurses was greater than head nurses. This could be because clinical nurses undertake work that requires more physical and mental strength, and meticulous clinical work has higher requirements for nurses' physical and mental health (45).

Mediating Role of Job Burnout and Fatigue

We then investigated job burnout as a mediator and found that nurses with more sickness presenteeism behaviors were prone to a higher level of job burnout. This in turn resulted in reduced health-related productivity. This finding is consistent with the results of previous studies, which suggested that sickness presenteeism behaviors would be positively correlated with employees' burnout (8, 27). In addition, several prospective high-quality investigations exhibited the occupational outcomes of job burnout, including its adverse effects on health-related

productivity (46). Our examination of the relationship between job burnout and health-related productivity loss confirmed a significant association between them. The impact of job burnout highlighted the necessity of preventive interventions and early recognition of these health conditions to avoid productivity loss. In addition, demographic characteristics as identified in this study were significantly associated with job burnout in the univariate analysis. This provided a basis for us to ascribe job burnout among nurses with different characteristics.

We also investigated fatigue as an additional mediator and found nurses with more sickness presenteeism behaviors were prone to a higher level of physical and mental fatigue, which in turn resulted in more health-related productivity loss. Employees who work with sickness tend to feel tired, have low work morale and a negative opinion of the job, which collectively resulted in impaired work productivity and poor work quality (9, 38). Based on a study by Lee et al., fatigue was one of the most important health conditions that induced productivity loss (43). Moreover, Espahbodi et al. (47) confirmed that sickness presenteeism and work productivity loss were both associated with higher fatigue levels.

Finally, to clarify the potential mechanism of fatigue and job burnout underpinning the correlation between sickness presenteeism and health-related productivity loss, we proposed a serial-multiple mediation model. We concluded that fatigue may result in job burnout, so sickness presenteeism is sequentially correlated with fatigue and job burnout, which may result in health-related productivity loss. Therefore, our result was somewhat supported by a previous study stating that physical and mental fatigue were positively correlated with job burnout (24). Our study confirmed that sickness presenteeism may increase or induce mental and physical fatigue among nurses, reduce their job engagement and job satisfaction, and increase job burnout (15). In addition, sickness presenteeism may also induce future physical and mental health problems, and impose a direct and indirect financial burden on health-care institutions through health-related productivity losses (16), which supported our conclusions.

Since nurses play an important role in universal healthcare, clarifying the mechanisms and links between nurse sickness presenteeism and health-related productivity loss is important. These determiners have profound implications for promoting public health and improving the overall quality of health care in the country (13, 20). This finding provides a reference to establish work health regulations, especially those on sickness presenteeism, and health-related productivity loss theories. Our study also suggests possible interventions that reduce health-related productivity loss among nurses could be achieved by decreasing sickness presenteeism, relieving fatigue, and reducing job burnout. Similarly, the reduction of sickness presenteeism and fatigue relief can help reduce job burnout.

Limitations

First, the cross-sectional nature of this analysis hindered the establishment of a causal model to explain the correlations investigated in this study. Therefore, some caution should be exercised when interpreting the findings. Further investigations adopting experimental or longitudinal models are warranted to verify our conclusions. Second, this study only included hospitals in Shandong Province, China, thus limiting the generalization of the findings to other regions. Third, all measurement indexes were subjective data, which should be combined with economic indexes to objectively describe the loss of productivity. Fourth, since we adopted self-reported measures such as the instrument of sickness presenteeism in this study, response biases may have been inevitably introduced. Finally, the use of certain medications and the presence of previous psychopathology may affect the variables' assessment. Despite these limitations, to our knowledge, this is the first time researchers have explored the role of job burnout and fatigue between sickness presenteeism and health-related productivity loss among Chinese nurses using a serial-multiple mediation model.

CONCLUSION

The incidence of sickness presenteeism among Chinese nurses was quite high. Additionally, demographic characteristics such as age, gender, education, professional title, employment type, department, position, and monthly income of nurses were significantly associated with sickness presenteeism, job burnout, fatigue, and productivity loss. Our findings also revealed that the high frequency of sickness presenteeism, after controlling for demographic variables, may result in increased productivity loss through the two mediating effects of fatigue and job burnout. In addition, sickness presenteeism may first increase fatigue, then promote job burnout, and finally, result in increased productivity loss among Chinese nurses.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data from the Nurses' Health Cohort Study of Shandong needs time for data clearing and establishment of guidelines. We are planning on opening this data to the public in the future. Requests to access the datasets should be directed to caoyj@sdu.edu.cn.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Scientific Research of Shandong University Qilu Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.812737/full#supplementary-material

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Sociodemographic and Occupational Factors Associated With Burnout: A Study Among Frontline Healthcare Workers During the COVID-19 Pandemic

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Purpose: To describe the prevalence of burnout among frontline healthcare workers (HCWs) during the COVID-19 pandemic and the associated sociodemographic and occupational factors.

Methods: A cross sectional survey study was carried out to study HCWs burnout using the 19-item Full Copenhagen Burnout Inventory (CBI) that includes personal, work, and patient-related burnout subscales. Bivariate analysis was used to test for associations and $p < 0.05$ was considered statistically significant.

Results: A total of 207 responses received; where the mean score of personal burnout was 67.23, the mean of work-related burnout was 61.38, and the mean of patient-related burnout was 54.55. Significant associations were found; where female HCWs, those working in rotating day-and-night shifts, working more than 55-h per week, and who had their shift time and hours changed during the pandemic, had higher levels of personal and work-related burnout ($P < 0.05$). Patient-related burnout was higher among those who were single (divorced or separated), nurses, non-Citizens, those with fewer years of experience, and who were infected by COVID-19 and have been quarantined ($P < 0.05$). Age was not a significant factor of burnout in any of the CBI subscales.

Conclusions: There is a prevalent level of burnout among frontline HCWs during the COVID-19 pandemic. Findings highlight key sociodemographic and occupational factors affecting burnout; which can help planning for psychological support strategies. Furthermore, effective administrative control is important to institute policies and mechanisms to identify, and freely report burnout symptoms among HCWs to promote their wellbeing.

Keywords: Copenhagen Burnout Inventory (CBI), burnout, healthcare workers, sociodemographic factors, occupational health

INTRODUCTION

Burnout is defined as a psychological disorder characterized by an adverse emotional reaction to a job resulting from working in a stressful environment (1–3). Healthcare is perceived as one of the most stressful working environments as it requires intensive personal interactions with patients and other healthcare workers (HCWs) (4). Thus, among HCWs, burnout is a well-known severe problem that has received increased attention in recent years (5). Former studies have reported that HCWs can experience anxiety and depression symptoms due to stressful working conditions and high volumes of work, which consequently develops negative outcomes such as burnout (6, 7). Among studies that investigated the association between burnout and working in healthcare settings, burnout was a significant problem in excess-work settings such as emergency and critical care (5, 8).

The increased attention to HCWs burnout is driven by its negative consequences on patient safety, consistency of care, health system costs and workflow, and HCWs own safety and care (9, 10). Further, many studies confirmed that a significant relationship exists between the risk of medical errors and burnout (11–13). Shanafelt et al. (8) reported that a high number of major medical errors has been significantly associated with burnout among physicians. In addition, a significant association was reported between high burnout and therapeutic and diagnostic errors (13). Medical errors among physicians with either a few or significant burnout symptoms are higher compared with physicians who do not have burnout symptoms (14). The risk among nurses should not be underestimated, as burnout can impact their productivity and reduce the quality of care provided, especially with them being at higher risk of insomnia and sleep disturbance (15, 16). Thus, the burnout effect is not limited to losses among humans but also the whole healthcare system (17).

Not long after COVID-19 emerged in China, in late 2019, the World Health Organization (WHO) considered it a pandemic, a severe problem endangering human health (18). The first case reported in Saudi Arabia was on March 2nd, 2020. The spread of COVID-19 infection has created higher demands on the global healthcare systems and frontline HCWs have been playing an instrumental role by providing the necessary care for confirmed or suspected COVID-19 patients during the pandemic (19). Literature from previous pandemics, such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) epidemics, showed a wide range of psychological morbidities experienced by HCWs, including trauma and burnout that might last for months after the pandemic (20, 21). In addition, traumatic life events are highly related to suicidal ideation in stressful work environments (22). Perceptions of "infection stigma" from the community and social isolation also contribute to psychological distress (23). Yet, although frontline HCWs anxieties during outbreaks can lead to absence and high turnover rates, there is suggested evidence that HCWs feel a strong professional commitment and obligation to continue providing healthcare services (24). In addition, the pressure that HCWs feel to maintain high-quality healthcare during a pandemic might relate strongly to presenteeism, which is being physically present but work insufficiently because of illness (25).

There are emerging studies around the world exploring the prevalence of burnout, stress, and anxiety disorders during the COVID-19 pandemic (26, 27). A systematic review reported that the prevalence of burnout can differ between geographical regions. In Iran, over half of HCWs had high levels of burnout (28). Similarly, frontline HCWs in Italy had higher levels of emotional exhaustion than non-pandemic periods (29). On the contrary, Central Asia reported the lowest burnout symptoms (30, 31). A recent study in SA used the Maslach Burnout Inventory (MBI) to assess burnout prevalence and risk factors among HCWs. On the MBI, 38.5% of HCWs showed high emotional exhaustion, 31.2% showed high depersonalization, and 33.6% showed reduced personal achievement. The high burnout in this study was due to direct contact with infected cases and changes in the working patterns during the pandemic. Another study in SA investigated the prevalence of burnout among urologists using the Copenhagen Burnout Inventory (CBI), and found the mean personal burnout as 57.92, while the mean work-related burnout was 55.26 (32).

To fulfill high quality of care for patients and mitigate negative outcomes, there is a further a need to address healthcare workers' burnout. This study utilized the Copenhagen Burnout Inventory instead of the most common Maslach Burnout Inventory scale to assess burnout among a national sample of frontline HCWs during the COVID-19 pandemic. As the MBI considers burnout as a syndrome consisting of emotional exhaustion, depersonalization, and reduced personal accomplishment; this definition has been criticized as exhaustion alone is believed to be the core definition of burnout (33). Thus, CBI, focuses primarily on exhaustion in personal, work-related, and client-related scales (34). Furthermore, the study attempts to identify the main factors associated with the increasing burnout symptoms among frontline HCWs in Saudi Arabia.

METHODS

Study Design and Sample

This is a cross-sectional descriptive study involving all frontline HCWs who were in direct contact with COVID-19 patients during the pandemic in Saudi Arabia. This includes physicians, nurses, pharmacists, respiratory therapists, other allied health professionals, and administrative staff.

Data Collection

Quantitative data were collected through an anonymous self-administered questionnaire broadcasted via WhatsApp and Twitter during October 2020. Voluntary and anonymous participation was sought to complete the online survey. The invitation message included a message that explains the purpose of the study, confirmation of confidentiality of all personal information, and the study principal investigator contact details. Consent was assured by selecting *"I consent to participate in the study and have the data published in journal article"* before starting the survey.

Study Instrument

The study questionnaire was distributed in English language as it's the official language of communication among healthcare workers. Data was collected in four sections: The first section included HCWs demographics and professional characteristics such as age, gender, nationality, HCW type, and years of experience. The second section included HCWs personal experiences with COVID-19, such as whether they have been infected with COVID-19 or quarantined due to a suspicion of being infected. The third section included HCWs work-related experiences, such as changes in their work hours, and shift times during the pandemic and their use of personal protective equipment (PPE). The fourth section included the full 19-item Copenhagen Burnout Inventory (CBI), which is a standardized scale for measuring burnout with good reliability and validity and is widely used in social science research (34, 35).

The CBI uses three subscales: personal burnout, work-related burnout, and client-related burnout. Personal burnout scale measures the participant's degree of physical and psychological exhaustion, and includes six items, such as "How often do you feel tired?" and "How often do you feel worn out?" The work-related burnout scale measures the extent of the participant's physical and psychological exhaustion with their workplace, and includes seven items, such as "Do you feel burnt out because of your work?" and "Do you feel worn out at the end of the workday?." The client, i.e., patient-related burnout scale measures the extent of the participant's physical and psychological exhaustion with their patients, and includes six items, such as "Do you find it hard to work with patients?" and "Are you tired of working with patients?." The scale's response options were "always," "often," "sometimes," "seldom," and "never." The responses were converted to scores ranging from 0 to 100 (*always* = 100, *often* = 75, *sometimes* = 50, *seldom* = 25, *never* = 0) according to the previously published CBI scoring system; where higher scores means a high level of burnout (35). It is important to note that one question in the work-related scale was negatively worded "Do you have enough energy for family and friends during leisure time?," and thus, scored reversely.

Instrument Validity and Reliability

Several studies have provided considerable evidence to support the CBI's validity in terms of its content, internal structure (i.e., internal consistency), response process (i.e., clarity and ease of understanding), and relation to other aspects such as vitality and mental health (36). In this study, a pilot study among 15 frontline HCWs was conducted and revealed satisfactory validity levels. Internal consistency of the CBI subscales was assessed in this study with Cronbach's alpha coefficient and ranged between 0.86 and 0.90, suggesting high internal consistency.

Statistical Analysis

For analysis, data were analyzed using IBM SPSS® Statistics. Categorical data were summarized using frequency and proportions, and mean scores with standard deviations (SDs) were calculated for each burnout subscale: personal, work-related, and patient-related domains using the 0- to 100-point scale. To explore sociodemographic and occupational factors associated with each burnout domain, bivariate analysis was used using t-test and one-way ANOVA, as appropriate, and $p < 0.05$ was considered statistically significant.

RESULTS

Responses were received from 207 HCWs. All respondents were over the age of 21 years. Most HCWs were female (55%) and between 36 years and 40 years of age (35%). The majority were nurses (31%), followed by physicians (24%) and other allied workers (29%). Most respondents were working in full-time shifts (88%). Nearly 34% tested positive for COVID-19 and 83% felt at risk of being infected (**Table 1**).

Personal Burnout

Around 41% reported that they "often feel worn out," while 39% "often feel tired." Also, 31.4% reported always feel physically exhausted and 30.4% always feel emotionally exhausted. Furthermore, 34.8% often think that they can't take it anymore (**Table 2**).

Work-Related Burnout

Among study participants, 41.7% felt they are worn out at the end of the working day. Additionally, 41.5% feel that every working hour is tiring, 41.5% feel frustrated and 36.6% feel emotionally exhausted because of their work. Around 35.7% reported that they seldom have the energy for family and friends during leisure time (**Table 2**).

Patient-Related Burnout

Concerning patient-related burnout, 36.2% often find it hard to work with patients and 33.8% reported that working with patients drain their energy. Around 30% are often tired of working with patients and 34.3% sometimes wonder how long they will be able to continue working with them (**Table 2**).

As presented in **Table 3**, the majority of participants reported considerable burnout on at least one of the CBI subscales. The mean personal burnout was 67.23, while the mean work-related burnout was 61.38, and the mean patient-related burnout was 54.55. Associations were found between the study variables and burnout subscales, where female HCWs, those working in rotating day and night shifts, those working more than 55 h per week, and those who had their shift time and shift hours changed due to the pandemic, had significantly higher burnout scores in both the personal and work-related domains ($P < 0.05$). In addition, personal burnout was significantly higher among allied health professionals, and those wearing adequate PPE while interacting with COVID-19 patients; while work burnout was higher among nurses ($P < 0.05$) (**Supplementary Table 1**). Patient-related burnout was the highest among divorced or separated HCWs, nurses, non-Saudi citizens, those with less years of experience, and those who have been tested positive for COVID- and quarantined ($P < 0.05$). Age was not a significant factor of burnout in any of the CBI sub-scales.

TABLE 1 | Characteristics of study participants.

Characteristics	*n* (%)
Gender	
Male	91 (43)
Female	116 (55)
Age in years	
25–30	20 (9.6)
31–35	38 (18.2)
36–40	73 (34.9)
41–45	38 (18.2)
46–50	19 (9.1)
50+	19 (9.1)
Marital status	
Single	38 (18.2)
Married	129 (61.7)
Divorced/separated	30 (14.4)
Widowed	10 (4.8)
Nationality	
Saudi	174 (83.3)
Non-Saudi	33 (15.8)
Profession	
Physician	50 (23.9)
Nurse	65 (31.1)
Allied health professional	61 (29.2)
Administration	17 (8.1)
Other	14 (6.7)
Years of experience	
1–5	22 (10.5)
5–10	62 (29.7)
10–15	70 (33.5)
16+	51 (24.4)
Work status	
Full-time	185 (88.5)
Part-time	16 (7.7)
Work shift	
Day shift	87 (41.6)
Night shift	26 (12.4)
Rotating day and night	93 (44.5)
Work hours per week	
Less than 45	40 (19.1)
45–55	128 (61.2)
56–65	26 (12.4)
More than 65	12 (5.7)

DISCUSSION

The study findings demonstrate considerable levels of burnout among frontline healthcare workers during the COVID-19 pandemic. Our result is consistent with several international studies conducted to investigate the psychological effect of COVID-19 and other infectious disease epidemics on burnout among frontline HCWs, as they encounter tremendous pressure

to provide timely care (37–42). Indeed, rapid decision-making is key to proper COVID-19 diagnoses, isolation, and successful treatment, which in turn increases the burden on HCWs to establish quality healthcare (41). In India, about half of the respondents (52%) had pandemic-related burnout (43). In Iran, 53% experienced high levels of burnout (28). In Saudi Arabia's early months of the pandemic (June-August, 2020), the prevalence of burnout among HCWs was 75% (44). This current study (October 2020) found that HCWs are scoring the highest burnout on personal and work-related burnout, while patient-related burnout is the lowest. This is similar to a recent study done in Denmark that indicated that patients may only have a minor role in burnout among healthcare workers (45).

Regarding the association between sociodemographic and burnout the study found that age was not significantly associated with burnout in all three burnout scales, while marital status, nationality, and years of work experience were significant factors associated with patient-related burnout. These findings are consistent with a study by Chemali et al. (17) that showed inconsistent relation between burnout, age, and years of experience. In addition, Barello et al. (29) suggest that some of the critical factors that might trigger burnout are the decreased social support, and the insufficient material and human resources.

Few studies reported that older age and more work experience were positively associated with burnout and psychological stress (46–50). Whereas other studies found that younger HCWs were more vulnerable to psychological disorders and older adults were less likely to develop burnout during pandemics (51, 52).

In terms of gender, females had significantly higher burnout level than males in both personal and work-related scales. Although this relationship is inconsistent in the literature, our finding was similar to studies that reported females at increased risk for burnout (38, 39, 53, 54). In contrast, other studies reported that the male gender is a predictor of depersonalization and is at higher risk of burnout (9, 55, 56). Few other studies reported no association at all between burnout and gender, such as a study in Turkey among medical students by Sevencan et al. and a study by Amiri in Iran among primary care physicians (9, 56).

Among HCWs in this study, nurses were found to be at greater risk of high burnout across work and patient-related scales. This finding is consistent with the results of previous studies in earlier pandemics (6, 7, 40). During the SARS epidemic, a study carried out among healthcare professionals in emergency departments showed that nurses were more likely to experience behavioral disengagement and develop distress than other healthcare professionals (49). Lai et al. (57) assessed mental health outcomes in frontline healthcare professionals during the COVID-19 pandemic in China. Their findings showed that frontline nurses caring for COVID-19 patients had a higher level of mental health disorders because of their frequent and close contact with patients and increased number of working hours (57). On the other

Questions	Always (%)	Often (%)	Sometimes (%)	Seldom (%)	Never (%)
Personal burnout (α = 0.89)					
1.How often do you feel tired?	33.3	39.1	21.3	1.9	4.3
2.How often are you physically exhausted?	31.4	31.4	30.0	5.3	1.9
3.How often are you emotionally exhausted?	30.4	30.4	27.1	9.2	2.9
4.How often do you think: "I cannot take it anymore"?	18.4	34.8	25.1	15.0	6.8
5.How often do you feel worn out?	18.8	41.1	23.7	10.1	6.3
6.How often do you feel weak and susceptible to illness?	23.2	34.3	26.1	10.1	6.3
Work-related burnout (α = 0.86)					
7.Do you feel worn out at the end of the working day?	24.8	41.7	20.9	8.7	3.9
8.Are you exhausted in the morning at the thought of another day at work?	17.0	38.3	22.8	11.7	10.2
9.Do you feel that every working hour is tiring for you?	15.5	41.5	21.7	13.0	8.2
10.Do you have enough energy for family and friends during leisure time?	5.8	15.0	34.3	35.7	9.2
11.Is your work emotionally exhausting?	22.0	36.6	28.8	8.8	3.9
12.Does your work frustrate you?	13.5	41.5	24.6	11.6	8.7
13.Do you feel burnt out because of your work?	12.6	39.6	29.0	9.7	9.2
Patient-related burnout (α = 0.90)					
14.Do you find it hard to work with patients?	14.5	36.2	28.0	12.1	9.2
15.Does it drain your energy to work with patients?	11.6	33.8	32.9	15.9	5.8
16.Do you find it frustrating to work with patients?	9.8	30.2	30.2	17.1	12.7
17.Do you feel that you give more than you get back when you work with patients?	11.3	32.4	32.4	14.2	9.8
18. Are you tired of working with patients?	7.7	30.0	31.4	18.4	12.6
19.Do you sometimes wonder how long you will be able to continue working with patients?	12.6	26.6	34.3	15.9	10.6

hand, few studies reported that physicians were the most exposed to burnout amongst all healthcare professionals (58, 59).

Furthermore, irregular working shifting schedule was found to be positively related to burnout during the pandemic. A study among medical staff who work night shifts found them to be more vulnerable to psychological distress (17, 60, 61). Another study among nurses in a university hospital in Egypt, reported that working in a night shift and the number of shifts were predictors for high levels of burnout (53). Another study among Turkish nurses found that working in night shifts was more positively associated with burnout than working day shifts or occasional night shifts (60). The higher level of burnout among night shift nurses was attributed to the shortage of nurses working at night shifts, causing unbalanced nurse-to-patient ratios (61). Also, sleep deprivation is a well-reported causative factor for clinical burnout (62).

In contrary to studies suggesting that inadequate PPE can be a considered a principal stressor increasing the burnout (19, 63), our findings showed that those wearing adequate PPE while interacting with COVID-19 patients had higher personal burnout. As frontline HCWs are the first responders for COVID-19 patients, they can be physically and mentally exhausted during their prolonged wear of PPE given its limitations of comfort and reduced ability to communicate. Particular features of PPE can impose physiological and personal burden especially

if accompanied with long work hours with few breaks for self-care, nutrition, and hydration (64). In addition, other factors such as obesity and respiratory conditions can exacerbate the PPE burden, and could cause heat stress, skin irritation, headache and dizziness which compromise HCWs wellbeing and patient safety (64, 65).

Further studies found elevated levels of burnout among HCWs working in a COVID-19 unit, those with low self-confidence in self-protection, those who reported uncertainty about future availability of PPE, and those who were unsure whether the type of PPE provided was appropriate for their role (66–68). In addition, the possibility of developing burnout symptoms increased two folds among physicians in Egypt who needed to buy their own PPE (69). Yet, the current study found that perceived threat for exposure to COVID-19 was not significantly related to any of the burnout scales, which is inconsistent with other studies (29).

As the work nature of HCWs is challenging, they are also a vulnerable group of which their mental health and wellbeing must be safeguarded. Earlier studies have indicated that nurses with high sources of social support reported less burnout (70, 71). However, although social and family support is important in coping, HCWs are cautious when spending time with their close family members due to the fear of spreading infection. In addition, many HCWs are reluctant to reveal their challenges and difficulties even when encountering significant

TABLE 3 | Association between study variables and CBI subscales.

Variable	n (%)	Personal burnout		Work-related burnout		Patient-related burnout	
		M (SD)	Sig. (p-value)	M (SD)	Sig. (p-value)	M (SD)	Sig. (p-value)
All Study Sample	207 (100%)	67.23 (21.66)	-	61.38 (21.6)	-	54.55 (23.4)	-
Gender							
Male	91 (43)	62.450 (23.01)	**t = −2.85**	55.55 (21.79)	**t = −2.63**	53.20 (23.83)	t = −0.73
Female	116 (55)	70.97 (19.85)	**(<0.001)[a]**	62.95 (18.51)	**(0.02)[a]**	55.61 (23.12)	(0.38)[a]
Age in years							
25–30	20 (9.6)	61.87 (20.64)	f = 1.79 (0.12)[b]	58.75 (19.44)	f = 1.23 (0.34)[b]	62.08 (24.02)	f = 1.27 (0.47)[b]
31–35	38 (18.2)	70.83 (20.08)		62.51 (20.62)		56.79 (20.76)	
36–40	73 (34.9)	70.43 (19.97)		62.80 (19.12)		55.63 (22.29)	
41–45	38 (18.2)	67.10 (23.00)		56.20 (20.75)		48.22 (25.36)	
46–50	19 (9.1)	64.25 (25.77)		57.14 (20.92)		55.83 (25.47)	
50+	19 (9.1)	56.57 (22.70)		52.72 (22.74)		49.34 (25.01)	
Marital status							
Single	38 (18.2)	73.02 (21.41)	f = 1.66	61.56 (19.39)	f = 0.68	57.23 (26.57)	**f = 2.92**
Married	129 (61.7)	65.18 (21.08)	(0.15)[b]	58.46 (20.85)	(0.37)[b]	51.41 (21.76)	**(0.02)[b]**
Divorced/separated	30 (14.4)	70.27 (19.86)		63.57 (17.17)		64.77 (20.71)	
Widowed	10 (4.8)	62.50 (31.73)		56.96 (25.64)		54.16 (31.67)	
Nationality							
Saudi	174 (83.3)	67.02 (21.09)	t = −0.31 (0.51)[a]	58.94 (20.29)	t = −1.23 (0.08)[a]	52.95 (23.38)	**t = −2.28 (0.01)[a]**
Non-Saudi	33 (15.8)	68.30 (24.78)		63.69 (20.18)		63.00 (22.01)	
Profession							
Physician	50 (23.9)	62.33 (23.32)		56.35 (22.40)		53.833 (23.71)	
Nurse	65 (31.1)	70.76 (20.63)	**f = 7.60 (<0.001)[b]**	65.14 (19.77)	**f = 6.22 (<0.001)[b]**	60.94 (20.80)	**f = 2.29 (0.05)[b]**
Allied health	61 (29.2)	74.93 (16.83)		63.64 (14.52)		52.24 (24.41)	
Administration	17 (8.1)	49.50 (23.65)		46.21 (23.09)		45.49 (23.91)	
Other	14 (6.7)	56.25 (17.95)		45.57 (19.20)		48.51 (24.54)	
Years of experience							
1–5	22 (10.5)	61.17 (20.420)	f = 0.85 (0.38)[b]	54.6 (21.14)	f = 0.63 (0.59)[b]	61.55 (24.42)	**f = 3.49 (0.04)[b]**
5–10	62 (29.7)	69.620 (19.44)		61.46 (19.217)		60.71 (19.62)	
10–15	70 (33.5)	67.91 (23.37)		60.28 (21.08)		49.57 (23.45)	
16+	51 (24.4)	67.32 (21.18)		59.74 (19.73)		52.12 (24.66)	
Work status							
Full-time	185 (88.5)	68.08 (21.05)	t = 1.29 (0.24)[a]	60.45 (19.94)	**t = 3.45 (0.00)[a]**	54.77 (23.04)	t = 0.10 (0.83)[a]
Part-time	16 (7.7)	60.93 (22.96)		52.86 (20.53)		54.16 (26.70)	
Work shifts							
Day shift	87 (41.6)	62.97 (21.812)	**f = 4.94 (0.00)[b]**	56.71 (19.29)	**f = 3.85 (0.00)[b]**	52.95 (25.24)	f = 0.61 (0.62)[b]
Night shift	26 (12.4)	64.743 (20.79)		55.58 (19.20)		58.23 (20.19)	
Rotating day and night	93 (44.5)	72.53 (20.09)		64.13 (20.48)		55.60 (21.94)	
Work hours per week							
<45 h.	40 (19.1)	54.06 (22.35)	**f = 7.33 (<0.001)[b]**	48.76 (21.30)	**f = 6.82 (<0.001)[b]**	51.85 (23.90)	f = 2.01 (0.16)[b]
45–55 h	128 (61.2)	70.21 (19.88)		61.38 (19.20)		54.30 (23.32)	
56–65 h	26 (12.4)	72.91 (21.99)		64.01 (17.49)		54.80 (20.29)	
More than 65 h	12 (5.7)	71.87 (14.33)		72.61 (16.63)		70.13 (21.38)	
Do you feel at risk of being infected by (COVID-19)?							
Yes	170 (81.3)	67.57 (21.13)	t = 0.43 (0.91)[a]	59.69 (20.05)	t = 0.01 (0.29)[a]	54.22 (23.10)	t = −0.57 (0.44)[a]
No	36 (17.2)	65.85 (24.51)		59.65 (21.98)		56.68 (25.13)	
Have you tested positive for COVID-19?							
Yes	72 (34.4)	69.61 (21.17)	t = 1.15 (0.23)[a]	62.2 (19.94)	**t = 1.53 (0.05)[a]**	60.20 (23.99)	**t = 2.57 (0.01)[a]**
No	135 (64.6)	65.95 (21.89)		58.32 (20.43)		51.53 (22.61)	

(Continued)

TABLE 3 | Continued

Variable	n (%)	Personal burnout		Work-related burnout		Patient-related burnout	
		M (SD)	Sig. (p-value)	M (SD)	Sig. (p-value)	M (SD)	Sig. (p-value)
Have you ever been quarantined?							
Yes	86 (41.1)	67.53 (21.00)	$t = 0.22$ (0.97)[a]	59.95(20.66)	$t = 0.18$ (0.29)[a]	59.56 (24.94)	**$t = 2.59$ (0.01)**[a]
No	120 (57.4)	66.84 (22.22)		59.42 (20.18)		51.06 (21.74)	
Was anyone in your family found to be COVID-19 positive?							
Yes	157 (75.1)	68.57 (20.84)	$t = 1.59$ (0.16)[a]	59.99 (19.98)	$t = 0.36$ (0.46)[a]	54.80 (24.19)	$t = 0.27$ (0.78)[a]
No	50 (23.9)	63.00 (23.78)		58.78 (21.45)		53.75 (20.98)	
During your interaction with COVID-19 patients, were you wearing adequate PPE?							
Yes	166 (79.4)	69.10 (21.24)	**$t = 2.09$ (0.02)**[a]	61.00 (20.37)	$t = 1.52$ (0.10)[a]	54.47 (23.96)	$t = -0.46$ (0.60)[a]
No	39 (18.7)	61.21 (20.83)		55.55 (18.71)		56.41 (19.91)	
Did your shift time change during the pandemic?							
Yes	157 (75.1)	69.66 (21.62)	**$t = 2.91$ (0.00)**[a]	61.37 (20.39)	**$t = 2.12$ (0.02)**[a]	56.02 (23.16)	$t = 1.61$ (0.15)[a]
No	50 (23.9)	59.583 (20.13)		54.44 (19.28)		49.91 (23.83)	
Did your work hours change during the pandemic?							
Yes	156 (74.6)	69.89 (21.64)	**$t = 3.16$ (0.00)**[a]	61.27 (20.61)	**$t = 1.96$ (0.01)**[a]	55.10 (23.43)	$t = 0.59$ (0.65)[a]
No	51 (24.4)	59.06 (19.80)		54.87 (18.71)		52.85 (23.48)	

Bold values indicates significance at the 0.05 level.
[a]t-test, [b]ANOVA.

psychological distress (72). Reducing the stigma of impaired mental health and promoting support and sharing among colleagues in the work environment can foster help-seeking attitudes and behaviors (73). For example, regular check-ins by frontline supervisors to support staff and assess their symptoms or concerns is a potential method to identify early signs of burnout. In addition, administrative control should be more effective by instituting policies and procedures for workload, workhours, and breaks especially among HCWs working in the ICU. Furthermore, a mechanism for timely reporting of burnout symptoms without fear of judgement or penalty can reinforce care for HCWs.

This study provides a significant addition to the literature on frontline HCWs burnout during the COVID-19 pandemic in the personal, work, and patient-related scales using a validated assessment tool. However, some of the encountered limitations include the limitation of the questionnaire to identify the cause of the burnout, and what could be ways to mitigate personal, work, or patient-related burnout among HCW. In addition, the nature of the study's cross-sectional design is a limitation, as causality between variables cannot be concluded. Also, there might be a risk of selection bias as the questionnaire was distributed online, and thus, did not reach HCWs who were busy or offline during the e-distribution period. Moreover, frontline HCWs experiencing a high level of burnout may be more interested in filling out the survey, making the results overestimate. However, the study builds on current literature to add an extensive assessment about HCW's factors that are associated with each burnout sub-scale, providing a holistic understanding of factors associated with frontline HCWs psychological health.

There is an urgent need to inform policymakers about this critical situation and recommend applicable and appropriate burnout prevention for the healthcare force. Although HCWs heavily rely on the training and equipment provided by their organizations, managerial support and effective leadership must be contributed to avoid and mitigate HCWs adverse psychological outcomes (73). Policy-makers need to adopt interventions to promote a healthy work environment and prevent burnout among HCWs during pandemics and emergencies.

CONCLUSIONS

Frontline HCWs in Saudi Arabia face considerable burnout during the COVID-19 pandemic. Several sociodemographic and occupational factors have contributed to increasing HCWs burnout levels during the pandemic. Findings emphasize the need for urgent strategies on the individual and organizational level to discuss burnout factors and invest in psychological interventions that reduce the risk of burnout and promote HCWs wellness in facing prolonged pandemics.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Research Board of Imam

Abdulrahman Bin Faisal University: IRB# PGS-2021-03-167. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.854687/full#supplementary-material

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Risk Factors Identification of Unsafe Acts in Deep Coal Mine Workers Based on Grounded Theory and HFACS

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The risk factors affecting workers' unsafe acts were comprehensively identified by Human Factors Analysis and Classification System (HFACS) and grounded theory based on interview data and accident reports from deep coal mines. Firstly, we collected accident case and field interview data from deep coal mines issued by authoritative institutions. Then, the data were coded according to grounded theory to obtain relevant concepts and types. The HFACS model was used to classify the concepts and categories. Finally, the relationship between core and secondary categories was sorted out by applying a story plot. The results show that risk factors of unsafe acts of deep coal mine workers include environmental factors, organizational influence, unsafe supervision and unsafe state of miners, and the main manifestations of unsafe acts are errors and violations. Among them, the unsafe state of miners is the intermediate variable, and other factors indirectly affect risky actions of coal miners through unsafe sates. Resource management, organizational processes and failure to correct problems are the top three risk factors that occur more frequently in unsafe acts. The three most common types of unsafe act are unreasonable labor organization, failure to enforce rules, and inadequate technical specifications. By combining grounded theory and the HFACS framework to analyze data, risk factors for deep coal miners can be quickly identified, and more precise and comprehensive conceptual models of risk factors in unsafe acts of deep coal miners can be obtained.

Keywords: coal miners, unsafe acts, coal mine accidents, grounded theory, HFACS model

INTRODUCTION

As one of the most important global energy sources, coal plays a vital role in the world's energy structure. Still, the frequent occurrence of coal mining accidents dramatically threatens the safety of coal production and workers' lives. Studies have shown that more than 90% of coal mine accidents are caused by human factors. These factors often manifest in various unsafe behaviors of people [1, 2]. At the same time, with the continuous deepening of coal mining depth, the risk factors inside and outside the mine impacting workers' unsafe acts become complex and diverse. Once workers engage in risky behaviors, it may lead to a series of hazardous events and then to significant coal mining accidents. Therefore, it is an essential prerequisite to ensure safe production in deep coal mines to identify the risk factors of dangerous acts of deep coal miners and reduce the occurrence of unsafe behaviors.

Recently, scholars have carried out studies on the influencing factors of coal miners' unsafe acts. For example, Kapp et al. (3) studied the impact of fatigue on workers' dangerous acts, pointing out that it harms workers' safety performance. Workers are more prone to make mistakes under a fatigued state. Ren et al. (4) also pointed out that with the increase of physical consumption of coal miners, their enthusiasm and efficiency of work decreased significantly. Aliabadi et al. (5) point out that organizational deficiencies are the leading cause of accidents in the mining industry and directly correlate with workers' safety violations and errors. In addition, Li et al. (6) pointed out that the safety attitudes of coal miners positively impact preventative behaviors. Employee attitudes have a significant effect on safety performance, and a good attitude can improve the industrial safety performance of an entire organization. Yu et al. (7) also pointed out that the psychosocial safety climate can reduce miners' risky behaviors through the mediating effect of job stress and burnout. In addition to analyzing the influence of a single or several factors on miners' risky behaviors, scholars investigated multiple risk factors on miners' hazardous actions from a systematic perspective. For example, Wang et al. (8) pointed out that individual perception, environmental support, organizational management system, and experience components are significantly correlated with the unsafe behaviors of coal miners and suggested that young, inexperienced coal miners are more likely to engage in safe behaviors. Yu et al. (9) also used ANP (Analytic Network Proces) and system dynamics models to analyze the influence of individual and group factors, physical environment, safety leadership, and risk management factors on coal miners' unsafe behaviors ranked their importance. In addition, Based on the HFACS model and SEM model, Liu et al. (10) analyzed the influencing factors of coal mine workers' unsafe behaviors. They pointed out that the impact of the external environment, inadequate leadership, preconditions of unsafe behaviors, and organizational influence on workers' dangerous behaviors weakened successively. Fa et al. (11) also used HFACS models, text segmentation technology, and Apriori association algorithms to study risk factors related to coal mine workers' unsafe behaviors from the perspective of individuals and organizations. Their findings indicated that external and organizational influences, inadequate supervision, and dangerous behavior preconditions were the main factors affecting coal mine workers' unsafe behaviors.

Previous research has been enlightening that the study on the risk factors of deep coal mine workers' unsafe act needs to be carried out from many aspects, such as individual workers, organization, management, and environment. The risk factors affecting the unsafe act of deep coal miners are complex and diverse, and few scholars systematically analyze them from multiple levels. Although some scholars have used the HFAC model to analyze the risk factors of the unsafe act of miners, the risk factors are not comprehensive, and there is a lack of analysis of the unsafe state of workers (11, 12). Therefore, it is a challenge to capture the systemic factors that influence the risky act of deep coal miners, which is necessary to adopt systematic thinking and appropriate methods to accomplish this task. HFACS framework offers advantages in a systematic

analysis of the role of human factors in accidents, which has been successfully applied in coal mine safety management (10, 11). The framework can be used to explore the unsafe actions of front-line miners and their preconditions and analyze the impact of organizational influence, inadequate supervision, external environment, and other hazardous conditions on human factors. It is a comprehensive and in-depth cause analysis model with powerful applications in determining the human factors in accidents and formulating preventive measures (13). Although human factors were divided under the original HFACS framework, it remained impossible to observe primary and secondary factors or detect any causal relationships. Thus, underlying risk factors for workers' unsafe behaviors could not be comprehensively analyzed. The HFACS and grounded theory combination provide a complementary advantage in risk factor identification. The grounded theory identifies specific risk factors and clarifies their relationships (14). However, factors identified by grounded theory alone may have overlapping concepts and different scales, and the HFACS compensates for this defect. Therefore, the combination of grounded theory and HFACS creates the conceptual model of the risk factors for hazardous actions by deep coal miners and makes abstract and hierarchical relationships between them more apparent. Although some scholars have used grounded theory and the HFACS model to classify and analyze the human error of various risk accidents, this method has not been applied to identify and analyze unsafe risk factors of workers in deep coal mines (12, 15). In addition, coal mine accident reports issued by authoritative institutions at home and abroad are usually used to preliminarily identify the risk factors of unsafe acts of coal miners. Currently, scholars worldwide also use this report to conduct statistical analysis on coal mine accident data (14, 16, 17). Scholars used the HFACS model and coal mine accident report to study the core of coal mine workers' unsafe behavior, mainly focusing on human factor identification, accident cause analysis, and control measures formulation. However, there remains a deficit of research literature on the unsafe act of deep coal mine workers, making it challenging to analyze the potential causes of deep coal mine accidents.

Based on the above analysis, the purpose of this study is to use grounded theory and the HFACS model to analyze the interview data of deep coal mine workers and coal mine accident reports to identify the risk factors affecting workers' unsafe acts. The HFACS model combined with grounded theory can accurately identify the human factors in coal mine accidents and find out the causes of hazardous behaviors of coal miners. It is hoped that this study can improve the depth and breadth of accident analysis methods of deep coal mines, clarify the causes of unsafe acts of deep coal miners, and provide a theoretical basis for formulating intervention strategies. The Improved HFACS-CM model constructed in this study can point out various risk factors of unsafe acts of deep coal miners and point out the interaction of factors at different levels. It can also point out how various factors of human factors ultimately lead to coal mine accidents. The research results of this paper enrich the research methods of unsafe behavior of deep coal miners and lay a particular theoretical foundation for future scholars in this field. Since the

research of this paper is based on the accident report of deep coal mines and the interview of deep coal mine workers, the research results of this paper have more practical guiding value for the prevention and control of unsafe acts of deep coal mine workers. Based on the Improved HFACS-CM model constructed in this study, coal mine safety managers can deeply understand the causes of workers' unsafe acts and how human factors lead to coal mine accidents. Based on this, they can establish more effective measures to prevent and control workers' unsafe acts to reduce the occurrence of workers' unsafe acts and coal mine accidents.

METHOD

HFACS Model

HFACS Original Model

Shappell and Wiegmann established the HFACS model based on the Swiss cheese model (18). This model identifies the vulnerabilities in cheese and has been widely used in various fields (13). In the chemical industry, based on the HFACS framework, Wang et al. (19) obtained a new model, HFACS-CSMEs (Human Factor Analysis and Classification System for Chemical Small and Medium-sized Enterprises), which can effectively identify and distinguish the causes of chemical accidents, providing a new idea for accident prevention of small and medium-sized chemical enterprises. In the power industry, based on the HFACS framework and fuzzy analytic hierarchy process, Karthick et al. (20) analyzed the internal human factors affecting the operators' performance in nuclear power plants. They pointed out that the key factors leading to human error were cognitive and organizational. In public health, Bickley et al. (21) applied the improved HFACS model to public health to reduce potential errors at different levels in public health systems. Tang et al. (22) proposed an enhanced HFACS personalized safety management model to analyze the impact of human error on construction accidents. Their results indicated that the model was superior to the traditional safety management model. Yildiz et al. (23) pointed out that the transportation industry can employ the HFACS-PV (Human Factor Analysis and Classification System for Passenger Vessel) structure for continuous analysis of ship accidents and qualitative and quantitative analysis combined with other methods. The application of the HFACS model in the mining industry has been relatively mature. For example, Liu et al. (24) conducted a qualitative and quantitative evaluation of major coal mine accidents based on the AHP (Analytic Hierarchy Process) and HFACS-CM (Human Factor Analysis and Classification System for China's Mines) models. They systematically studied the adverse safety behaviors of coal miners and other related factors. Based on the HFACS and SEM (Structural Equation Model) models, Liu et al. (10) analyzed the influencing factors of coal mine workers' risky behaviors. They pointed out that the degree of influence of the external environment, negligent leadership, preconditions of unsafe behaviors and organizational influence on workers' unsafe acts weakened successively. Based on the HFACS model, text segmentation technology, and Apriori association algorithm, Fa et al. (11) studied the factors influencing the unsafe behavior of coal miners from the perspective of individual and organizational

factors. They pointed out that external influence, organizational influence, negligent supervision, and risky behavior prerequisite conditions were the main factors influencing the unsafe behavior of coal miners.

In the original HFACS model, human error is divided into four levels (25). From high to low, these levels are organizational influence, unsafe supervision, preconditions for unsafe acts, and unsafe behaviors. Each level is divided into several sub-levels, whose definition is used to classify identified causal factors (26). The four levels comprised e19 factor categories, as shown in **Figure 1**. The original HFACS model did not require expert advice in classifying accident causes and causal factors. Thus, researchers who have mastered the major structures and infrastructure can gradually delineate the occurrence of accidents (27). Explanations of the various levels of the original HFACS model are described below.

The first layer is organizational influence, which refers to the weak organizational framework, defects, lack of team culture, and other factors, laying a foundation for accidents. This level is divided into three subcategories: resource management, organizational climate, and organizational processes. Resource management refers to misguided decisions made by an enterprise in terms of workforce, equipment, and investment, such as improper staffing, lack of education and training, and insufficient equipment and investment. Organizational climate refers to the working environment of an organization, which is defined as the internal factors that affect individual performance, such as teamwork and communication. Finally, organizational processes include internal administrative factors such as formal processes, methods, and oversight, for example, work commitments, reward and punishment systems, and safety procedures.

The second layer is unsafe supervision, which refers to poor operation habits, worker process mistakes, and behaviors that violate rules set by the appropriate supervision and management system. This layer primarily includes inadequate supervision, planned inappropriate operations, failed to correct problems, and supervision violations. Inadequate supervision refers to the failure of work and performance supervision of workers. Planned inappropriate operations are defects in the pre-set operation plan, such as unreasonable labor organization and ineffective implementation of risk response measures. Failure to correct problems refers to management personnel's negligence of effective preventive measures against the improper operation of workers, equipment defects, management errors, and other issues. Finally, supervision violations refer to workers' behaviors who disregard the supervision and management systems, for example, allowing unqualified people to work in high-risk mines.

The third layer is the precondition for unsafe acts, which describes the psychological and physiological states and operational skills that cause hazardous actions. This level includes three sub-categories: environmental factors, conditions of operators, and personnel factors. Environmental factors refer to the factors that adversely affect worker productivity, including the physical and technical environments. Physical environment refers to physical factors such as temperature, noise, and lighting. Technical environment refers to worker performance factors, including equipment, mining design, safety
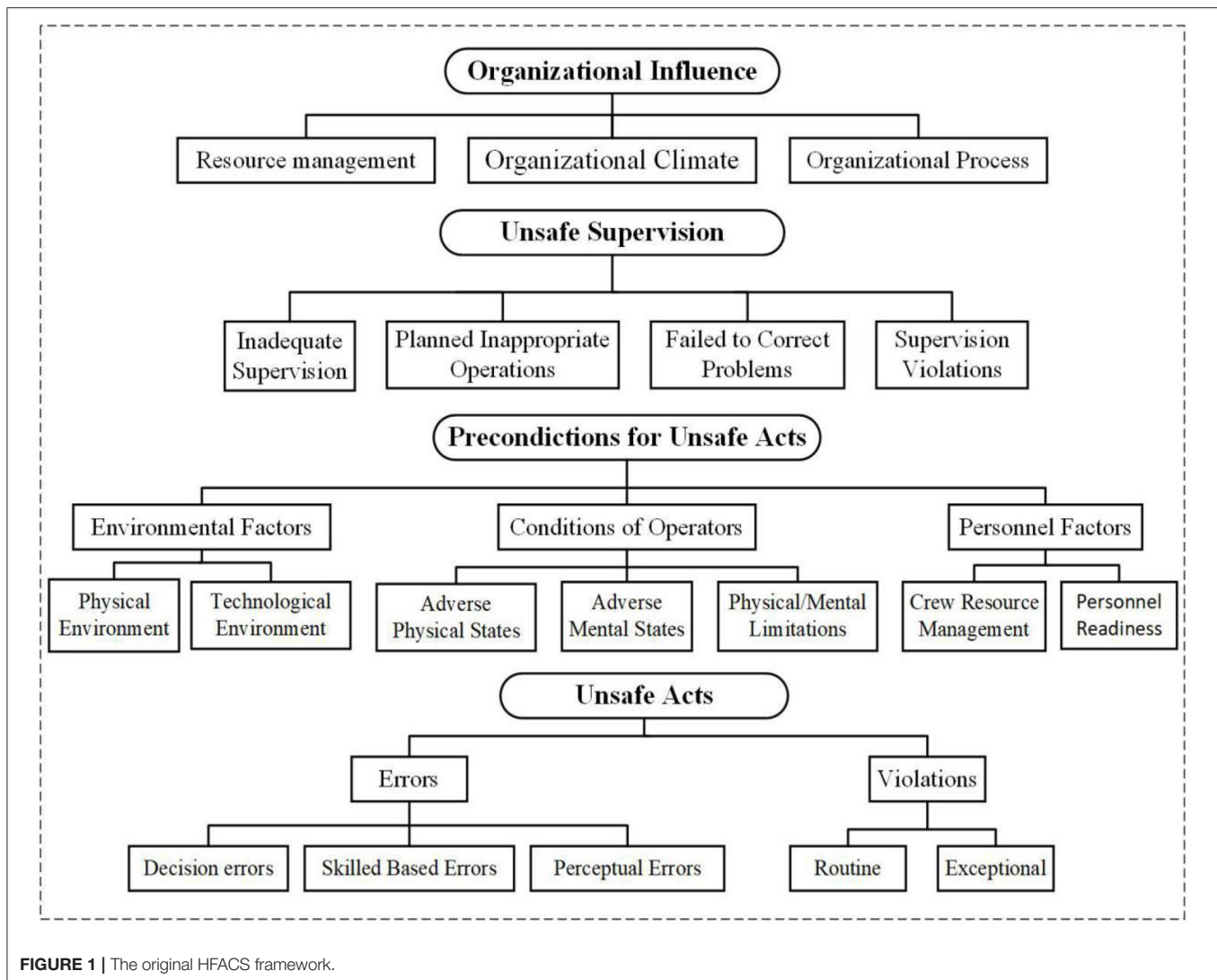
FIGURE 1 | The original HFACS framework.

monitoring systems, among others. Operator conditions refer to psychological and physiological states that negatively affect the individual performance of workers. Finally, personnel factors are bad decisions due to a lack of coordination among team members and inadequate personal preparation, for example, a lack of safety equipment.

The fourth layer is unsafe acts, which refers to personally risky actions. There are two types of unsafe acts: errors and violations. Errors refer to unintentional actions, divided into three types: decision, skill, and perceptual errors. Violations refer to intentional disregard of rules and regulations, divided into regular and exceptional types. Regular or routine violations are those tolerated by managers, such as eliminating work steps, risky operations, and disregarding rules and regulations. Exceptional violations refer to those that occur under particular circumstances. These violations are unusual because they occur outside regulations and laws, such as the production organization during the COVID-19 (Corona Virus Disease 2019) pandemic.

Improved HFACS-CM Model

Although the original HFACS model factors are an excellent fit, some of them do not fully apply to components of risk associated with unsafe acts of deep coal miners. The model should be improved according to the characteristics of the mining industry and the specific accident site situation (24, 28). The purpose of this paper is to identify the risk factors affecting the unsafe act of miners. The unsafe act layer in the HFACS model refers to the hazardous behaviors of coal mine employees, including front-line workers and related management personnel. Higher-level problems in the model can lead to lower-level problems and risky worker behaviors. Therefore, the HFACS model is suitable for comprehensively identifying risk factors for unsafe acts of deep coal miners. The unsafe act layer in the model has been modified to the unsafe act of the deep coal mine workers to make the model more suitable for this study.

In deep coal mining, physical conditions, such as geological structure, temperature, humidity, and other environmental characteristics, significantly influence workers' unsafe behaviors.

FIGURE 2 | The improved framework of HFACS-CM.
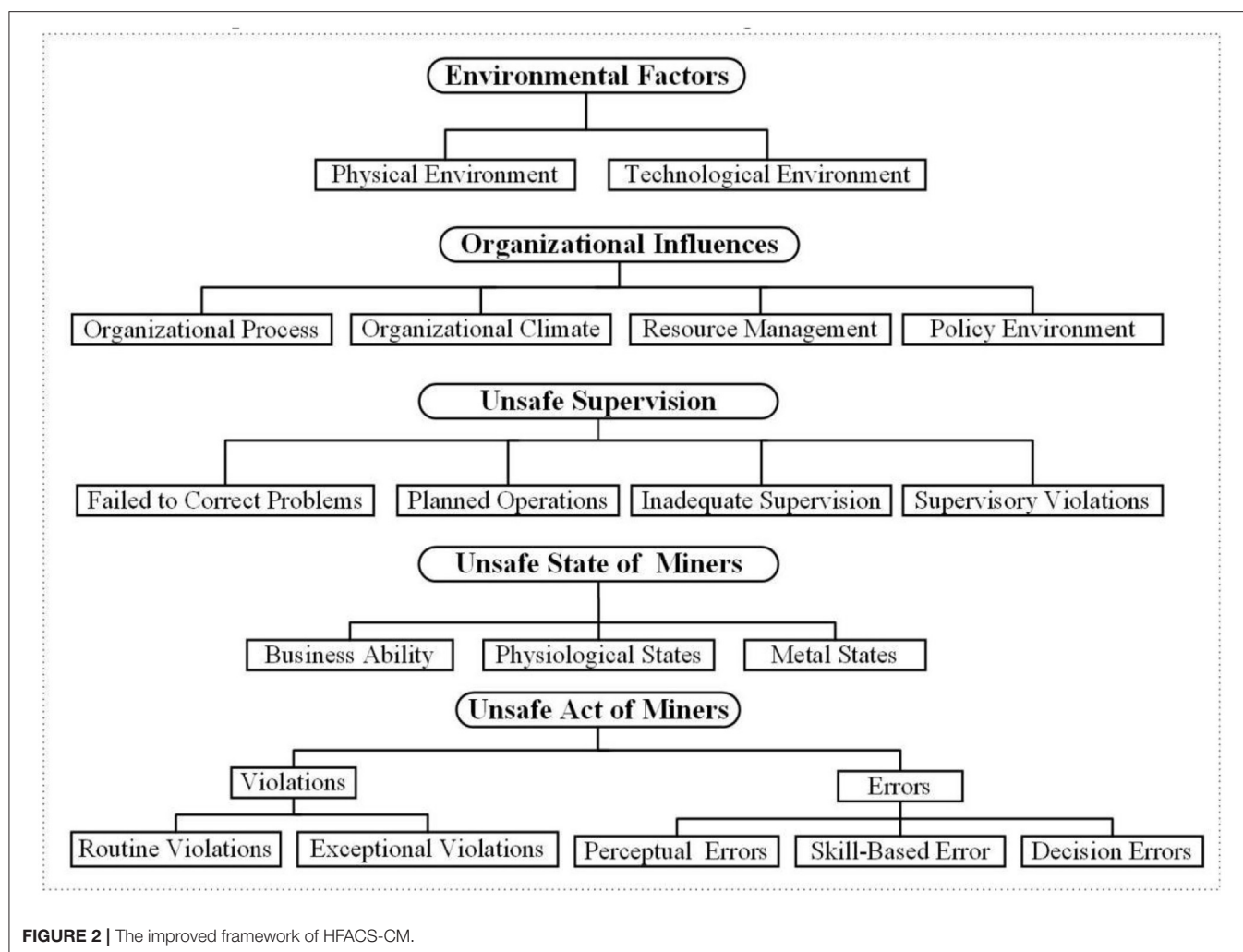
In addition, with the continuous progress of mining technology and the rapid development of society, coal miners' behaviors are not only affected by internal factors and the external environment, such as information technology, economy, and politics. Therefore, in this study, the environmental factors included in the preconditions of unsafe acts in the original model are moved to the first layer. The new level (Level 1) consists of the physical, technical, and policy environments, which are summarized as environmental factors. In real-world coal mine production, the premise of unsafe acts in the original model is changed to the unsafe state of miners, including workers' mental and physiological states and business ability. Achieving coal mine production objectives requires cooperation and communication between team members. Therefore, this study adds teamwork and communication to the original HFACS model and classifies them within the organizational climate. The improved HFACS-CM model is shown in **Figure 2**.

In the improved HFACS-CM model, the causes of accidents in deep coal mines are divided into five levels, including environmental factors, organizational influence, unsafe supervision, unsafe state of miners, and the unsafe acts of

miners. Compared with the traditional HFACS model, the new model takes environmental factors as the first level and changes the precondition for the unsafe acts to the unsafe state of miners according to the real-world situation. According to the types of hazardous acts in the improved HFACS-CM model (26) and the actual conditions of coal mine production, this study defines the concept of unsafe acts of miners, as shown in **Table 1**.

Grounded Theory

Grounded theory is a bottom-up analytical method based on experience and materials, which focuses on the treatment of problem situations and can produce solutions to problems (14, 29). This theory is a mature approach to exploring the nature of research, allowing concepts and categories to emerge naturally with greater objectivity. This theory has been successfully applied in some fields. For example, Lcaa et al. (30) analyzed the reasons for the shoddy work of some electricians by using the grounded theory. They suggested that electricians' work requires high cognitive ability. Chung et al. (31) also used grounded theory to analyze the health problems of middle school students using smart devices for learning. They concluded that

if students' health problems were well monitored and managed, they could form the ideal smart-device use habits. In addition, Malakoutikhah et al. (14) analyzed the causes of Iranian workers' unsafe behaviors using grounded theory. They proposed that the factors influencing workers' unsafe behaviors could be divided into organizational, personal, and socioeconomic factors.

The analytical steps of grounded theory mainly include data acquisition, open, axial, and selective coding and model saturation testing, as shown in **Figure 3**. Open coding requires researchers to conduct an in-depth analysis of the original data with an open mind and code according to the state of the data. Open coding is divided into two stages: conceptual analysis and classification analysis. Conceptual analysis decomposes the interview data, and unsafe accident report data expresses the meaning of the original sentence in more refined sentences and conceptualizes the original data. The concepts obtained through concept analysis are scattered and similar, so they need to be connected to establish categories. Classification analysis refers to finding connections between the above concepts and further generalizing them into categories. Axial coding is the clustering analysis of the categories formed by open coding, and the correlation between different categories is established to create a larger category, namely the main category. Selective coding is based on axial coding, combing the relations between

TABLE 1 | Types and contents of unsafe acts of miners.

Types	Contents
Decision errors	It is usually manifested as improper implementation of work procedures, risky operation and improper choice of risk response measures.
Skill-based errors	Usually manifested as a lack of safety knowledge, professional knowledge and basic operation skills, resulting in errors in the work.
Perceptual errors	It is usually manifested by the lack of safety awareness and poor self-protection and mutual protection awareness, for example, the failure to take safety protection measures when disasters occur.
Routine violations	It is usually manifested as the behavior in violation of rules and regulations, which is often a habit and not easy to be supervised and managed.
Exceptional violations	This usually manifests itself in the violation of specific regulations, such as those related to COVID-19.

the main categories, abstracting the core categories that can summarize all categories, and illustrating the relations between the core categories and the sub-categories in the way of a story. A saturation test is needed to ensure the reliability and integrity of model construction. The original conceptual model is theoretically saturated if concepts or categories generated from newly collected data are incorporated into current concepts or categories, and no new concepts or categories are generated.

As shown in **Figure 3**, the research steps of the grounded theory include ① Phenomenon definition. ② Data collection. ③ Data collation. ④ Open coding, axial coding, and selective coding for data. ⑤ Preliminary theory establishment. ⑥ Test whether the theory is saturated. ⑦ If the theory is saturated, a new theoretical framework will be formed. ⑧ If the theory is not saturated, go back to step 2 and start again. The advantage of grounded theory is that it discovers, refines, and summarizes real-world problems from the bottom up based on experience and multiple sources. It is frequently used to study influencing factors (31, 32). Therefore, grounded theory based on data modeling is suitable for research to identify risk factors for unsafe acts in deep coal mine workers.

HFACS model and grounded theory are used together in this study to construct a conceptual model of risk factors for the unsafe acts of deep coal miners. First, based on grounded theory, we fully extracted coal miner workers' risk factors and types of hazardous actions of coal mine workers from coal mine accident reports and workers' interviews. Next, the factors were mapped according to the improved HFACS-CM model. Finally, the conceptual model of the risk factors of unsafe acts of deep coal mine workers was formed. In the process of extracting as many risk factors and types of hazardous acts of workers as possible, this study also analyzes the action path of these factors on unsafe acts and coal mine accidents.

RESULTS

Data Collection

The range of data in grounded theory is so broad that everything is data (29). In other words, there is no limit to the types of data that could be examined, including textual materials such as literature, interview transcripts, accident reports, news, and other types of video and audio materials. Due to the limited literature on unsafe actions of deep coal miners, our study data comprises interview records and coal mine accident reports. These are

FIGURE 3 | The process of grounded theory.

TABLE 2 | Interview outline.

Outline numbers	Interview
1	In your opinion, what factors may cause workers to have unsafe behaviors in the production process?
2	For the risk factors you list, can you point out how they contribute to the unsafe act of workers?
3	Can you point out the specific unsafe act of workers and managers at all levels in the daily production process?
4	What measures do you think can be taken to improve the unsafe act of workers?
5	What impact do you think the unsafe behavior of workers will have on the safety of coal payment?
6	In your opinion, from the perspective of coal payment safety, what measures should be taken to intervene in the unsafe act of workers?

TABLE 3 | Sociodemographic characteristics of interviewees.

Survey Content	Item	Frequency	Percentage (%)
Gender	Male	20	100
	Female	0	0
Age	18–24 years old	4	20
	25–34 years old	11	55
	35–44 years old	3	15
	45 years old and above	2	10
Degree	Junior high school and below	0	0
	A high school diploma	4	20
	College degree	4	20
	Bachelor's degree	10	50
	Master degree and above	2	10
Work time	1 year or less	2	10
	1–3 years (including 3 years)	10	50
	3–5 years	5	25
	5 years and above	3	15
Income (RMB/month)	3,000 RMB and less	1	5
	3,000–5,000 RMB (including 5,000 RMB)	8	40
	5,000–10,000 RMB	8	40
	10,000 RMB and above	3	15
Jobs	Middle management	2	10
	Safety supervisor	3	15
	First-line team leader	3	15
	Front-line workers	12	60
Marriage	Married	14	70
	Unmarried	6	30

textual data, which can be combined with and complement each other. Their combined use makes the conceptual model more comprehensive and consistent with the real-world conditions of a deep coal mine.

Interview Data Collection

Based on previous studies, this study designed an interview outline for risk factors of unsafe acts of deep coal mine workers from three aspects: influencing factors, unsafe behaviors, and their results, as shown in **Table 2**. We conducted one field survey and three online surveys from December 2021 to January 2022. The field survey unit was a deep coal mine in Huainan Area. The survey consisted of face-to-face interviews and one-to-one online video interviews, and the average interview time was 1 h. An on-site face-to-face interview was a primary way to collect interview data. The research object of this paper was the identification of the risk factors for hazardous action of deep coal mine workers, and these often occur in the production line. Therefore, the interviewees in this study are mainly ordinary employees, team leaders, and safety officers who are closely related to front-line production in coal mining enterprises. These employees understand unsafe acts and can provide a large amount of information. At the same time, to make the information obtained representative enough, the interviewees of this study are all from the lead majors in charge of front-line production. The interviewees included two middle-level leaders of the coal mine, three safety supervisors, three first-line team leaders, and 12 miners, altogether 20 people. In addition to asking questions according to the interview outline, the interviewees were also asked to talk about their views on the risk factors of unsafe acts according to their professional knowledge and work experience to obtain more research materials. Before the interview, we introduced the purpose and content of this survey. After getting the consent of the interviewee, we recorded the interview content. After the interview, the interviewees were numbered in Arabic numerals and edited into Word documents for further analysis.

The sociodemographic characteristics of respondents in this study are shown in **Table 3**. As shown **Table 3**, all interviewees are male, which also is determined by the particularity of mining work. The respondents were generally between 25 and 34 years old, accounting for 55% of the total respondents. Most respondents have a bachelor's degree or above, accounting for 60% of the entire survey population. Most respondents, 60 percent of the total, had worked for 3 years or less. Respondents with a monthly income of 5, 000 yuan or more accounted for more than 55 percent of the total respondents, and 60% of respondents were front-line employees, while the rest were managers at all levels. The vast majority of respondents were married, accounting for 70% of the total.

Deep Coal Mine Accident Report Collection

In grounded theory, original data is crucial for establishing new theoretical systems, and the information released by authoritative institutions is more reliable and accurate. Therefore, the coal mine accident report issued by China Coal Mine Safety Production Network is selected as the original data. This website has accumulated a large number of coal mine accident cases. These data contain detailed process descriptions and cause analysis of accidents, which apply to grounded theory analysis. Furthermore, the accident investigation report can reveal the

FIGURE 4 | Statistics of coal mine accidents.
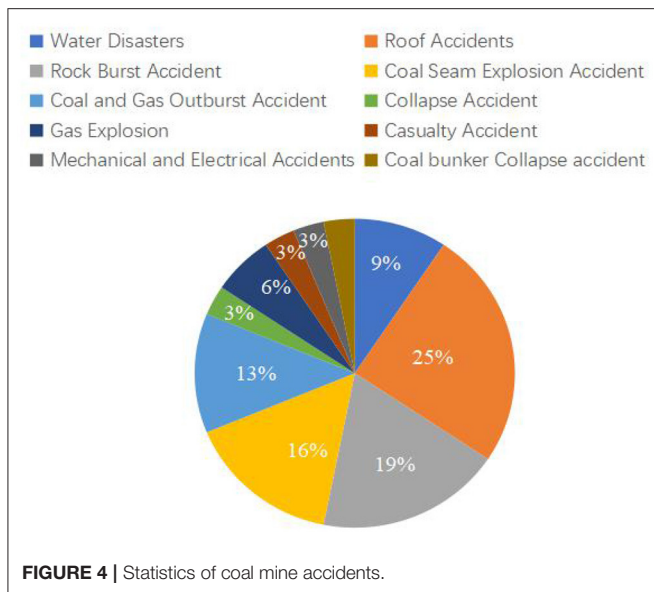
cause of the accident in detail, the fault in the risk management process of the coal mine enterprise, and the defects of various constructive documents. Therefore, this paper uses accident investigation reports as the original data of grounded theory. Only the deep coal mine accident report with a mining depth over 600 m is selected in selecting coal mine accident reports. After screening, 40 accident reports from 2016 to 2021 are selected. The accident types mainly include ten major accident types, including rock-burst accidents, coal seam explosion accidents, water disasters, collapse accidents, mechanical and electrical accidents, coal and gas outburst accidents, roof accidents, and so on, as shown in **Figure 4**.

Coding Process
Open Coding
Open coding requires researchers to conduct an in-depth analysis of the original data with an open mind and code the data according to the state of the data. Open coding is divided into two steps: conceptual analysis and classification analysis. The first step of conceptual analysis is to conceptualize the original data by disassembling the data and using more refined sentences to express the meaning of the original sentence. In this step, similar and identical statements in the original material are combined, some direct and vague statements are deleted, and only the statements related to the topic are retained. The second step of classification analysis is based on the core theme of risk factors of unsafe acts of deep coal mine workers, classifying and analyzing the types and risk factors of unsafe acts caused by interview data and accident reports sentence by sentence. This study combines the method of expert consultation with the technique of personal coding, reducing the number of personal subjective opinions. With the help of the expertise and experience of experts in the field, the subjectivity of coding is reduced. Nvivo 11 software is used to improve the scientific nature of the coding process. The coding materials were derived from 32 accident reports and

20 interview records. Through conceptual analysis and repeated arrangement and adjustment of original data, 327 concepts and 52 categories were abstracted. Then the similar categories of the 52 categories were combined to get 32 categories. This study obtained 52 secondary and 32 primary categories after open coding of the original data, as shown in **Table 4**.

Axial Coding
After open coding, we identified the main concept categories from 32 unsafe acts categories. The correlations between the main concept categories were established. These are the key content of axial coding. The process of axial coding further analyzed causal relationships and logical connections between categories obtained in open coding, and concepts that cannot be grouped with other concepts are deleted. Through the repeated comparisons and systematic clustering of 32 categories, 15 main categories were obtained, as shown in the third column of **Table 4**.

Selective Coding
Selective coding sorts out the relationships among the main categories, abstracts the core categories that summarize all categories and clarifies the relations between the core categories and sub-categories using a storyline. The core category is the thread of a fishnet, connecting all other categories. It serves as an outline. Through selective coding, five core categories of environmental factors, organizational influence, unsafe supervision, unsafe state of miners, and unsafe acts of miners were obtained, as shown in the fifth column of **Table 4**.

The storyline categorizes the risk factors influencing the unsafe actions of deep coal miners into four core categories: organizational influence, unsafe supervision, unsafe state, and environmental factors, which significantly impact the unsafe actions of miners. After analysis, the following storyline was be obtained. On the one hand, with the recent depletion of shallow coal mines, the depth of deep coal mines is increasing. The complex and changeable mine environment makes the mining of coal more difficult. It also makes supervision and administration of management departments difficult. Inadequate management of miners occurs due to the lack of oversight provided by management departments, weak risk awareness, imperfect supervision systems, and other reasons. For example, due to the unreasonable staffing of the management department, appropriate department leaders are frequently transferred to other positions. As a result, leaders are not focused and unwilling to manage the front-line miners, which may increase the likelihood of errors, violations, and other unsafe outcomes. On the other hand, the complex deep mine environment requires coal mining enterprises to increase investment in industrial processes, such as introducing advanced equipment, advanced technology, and hiring high-end talent. However, due to the lack of safety investment, the miners' skills and psychological quality will be significantly tested, greatly impacting worker performance and safety-related behaviors. Environmental factors affect organizational factors, organizational factors affect unsafe supervision, and unsafe supervision affects the worker conditions, thus affecting the

TABLE 4 | Summary of coding results.

Item	Category	Open coding	Axial coding	Selective coding
1	Natural causes	Natural facts	Physical environment	Environmental factors
2	Complex geological conditions			
3	Equipment lack	Mechanical defects	Technological environment	
4	Equipment failure			
5	Unreliable safety ventilation	Ventilation system defects		
6	Lack of automatic ventilation system			
7	Poor safety monitoring system	Incomplete safety monitoring system		
8	Lack of security monitoring system			
9	Weak government regulation	Lack of government oversight	Policy environment	
10	Lack of emergency drills	Lack of education and training	Resource Management	Organizational influences
11	Inadequate safety education			
12	Unreasonable personnel allocation	Unreasonable staffing		
13	Inadequate staffing levels			
14	Underinvestment of equipment	Underinvestment in safety		
15	Underinvestment			
16	Emphasize production over safety	Emphasize production over safety	Organizational climate	
17	Superpower mining	Superpower production		
18	Give out a superpower indicator			
19	Lack of communication between management levels	Lack of communication		
20	No communication during shift			
21	Lack of cooperation among team members	Lack of teamwork		
22	poor guidance of technical measures	Imperfect technical specifications	Organizational process	
23	Failure to modify technical measures in time			
24	Failure to modify the management system in time	Imperfect rules and regulations		
25	Lack of relevant regulations			
26	Failure to revise the operating procedures in time			
27	Lack of guidance on worker behavior	Lack of guidance	Inadequate supervision	Unsafe supervision
28	Failing to detect and stop illegal behaviors in time	Failure to intervene in unsafe behavior		
29	Poor supervision of violations			
30	Disorganization of working labor	Unreasonable labor organization	Planned operations	
31	Blind organization of production			
32	Disaster prevention and control measures are not fully implemented	Poor risk management ability	Failed to correct problems	
33	Lack of Disaster response measures			
34	Poor risk assessment skills	Poor risk identification and assessment skills		
35	Poor identification ability of hazard sources			
36	Violation of operation procedures and requirements	Failed to enforce rules	Supervisory violations	
37	Illegal mining	Illegal business		
38	Fake information			
39	Operating personnel without a license			
40	Poor safety awareness	Poor safety awareness	Mental sates	Unsafe states of miners
41	Poor awareness of self-insurance and mutual insurance			
42	Lack of concentration	Lack of concentration		
43	Fatigue	Pressure of work		
44	Weak sense of responsibility	Lack of responsibility		
45	Avoid monitoring	Fluke mind		
46	Overburdened body	Physical fatigue	Physiological states	
47	Lack of basic safety knowledge	Lack of safety knowledge	Business ability	
48	Lack of disaster expertise	Lack of expertise		
49	Lack of basic protective skills	Lack of operational skills		
50	Adventure homework	Poor decisions	Errors	Unsafe acts of miners
51	Violation of rules and regulations	Acts against regulations	Violations	
52	Violation of laws and regulations			

FIGURE 5 | The conceptual model of risk factors of the miners' unsafe acts.
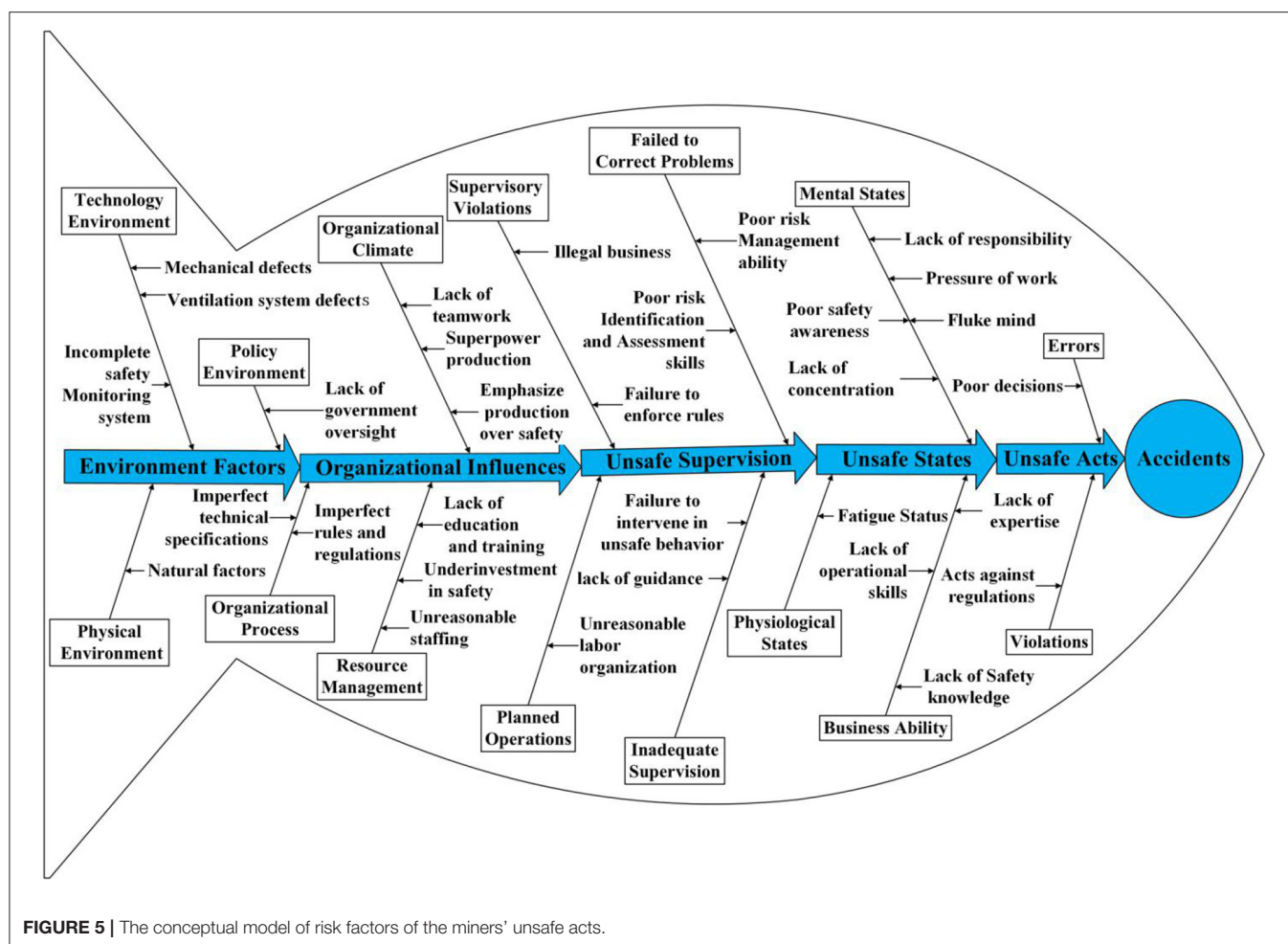
workers' unsafe actions. The five core categories above dominate the other categories. They are ultimately summed up as a storyline that describes the risk formation process of unsafe behaviors of deep coal miners.

Conceptual Modeling of Risk Factors

A conceptual model of risk factors for unsafe acts of deep coal mine workers is constructed by summarizing the coding results of accident reports and interview records, including five core categories and 32 sub-categories of factors, as shown in **Figure 5**. According to the story, environmental factors, organizational influence, unsafe supervision, and the unsafe state of the miners interact with each other, causing hazardous worker behaviors, mainly manifested as errors and violations, frequently leading to coal mine accidents.

The improved HFACS-CM model has similarities with many published HFACS models, but there are also some differences. First of all, the classification and description of the original HFACS model are relatively general. In contrast, the improved HFACS-CM model describes the risk factors of workers' unsafe acts at different levels according to the characteristics of the mining industry. Secondly, the hierarchy of human factors

in the original HFACS model is divided. Still, the primary and secondary factors and the causal relationship between them cannot be identified. The improved HFACS-CM model elucidated the primary and secondary factors and the causal connection. Finally, the enhanced HFACS model analyzes human errors and violations at all system levels. This study has obtained a conceptual model of the risk factors of the unsafe act of workers in the deep coal mine, which has a more apparent conceptual relationship and hierarchical relationship.

Model Saturation Test

A saturation test is needed to ensure the reliability and integrity of the conceptual model. If no new categories and logical relations appear in the original conceptual model by adding new data, the initial conceptual model is considered theoretically saturated. Otherwise, data collection must continue. The study's saturation test was performed 2 weeks after we formed the theoretical model. The saturation test was carried out by another member of the research group to eliminate the subjective influence of the researchers. The test data were eight previously prepared deep-coal mine accident reports. The test results showed that there were no new concepts. Furthermore, logical relations appear after
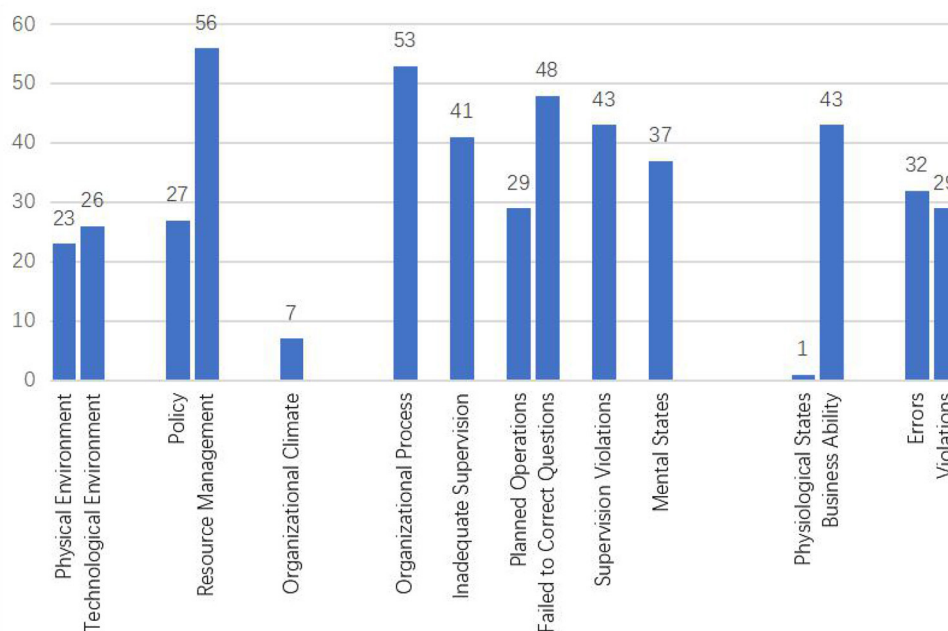
FIGURE 6 | Statistics of influencing factors of unsafe acts.

the tests of the three coding processes of the grounded theory, indicating that the theoretical model previously constructed was saturated and there was no need to add data for analysis.

Statistical Analysis of Risk Factors

Through statistical analysis of accident reports in deep coal mines, we obtained the frequency of risk factors of workers' unsafe acts, as shown in **Figure 6**. The top five risk factors for miners' unsafe acts are Resource Management (56), Organizational Processes (53), Failure to Correct Questions (48), Supervision Violations (43), and Business Ability (43), indicating that Resource Management is the most critical risk factor. Therefore, Resource Management should be strengthened to prevent and control hazardous actions of miners. The Influence of Unsafe Supervision (161), Organizational Influence (116), Unsafe State of Miners (81), and Environmental Factors (76) on the unsafe act of miners gradually decreases, which shows that Unsafe Supervision is the most important risk factor. In preventing and controlling coal mine workers' unsafe acts, managers should strengthen the supervision and management of workers' safety-related behaviors. Therefore, resource management and organizational process are the two most important risk factors affecting miners' unsafe acts, indirectly reflecting the importance of Organizational Influence. Organizational Influence is an indirect risk factor that affects workers' unsafe acts.

According to the improved HFACS-CM model, the unsafe acts of deep coal mine workers are classified. These unsafe acts can be divided into five categories. They are Decision errors, Skill-based errors, Perceptual errors, Routine violations, and Exceptional violations. Decision errors include Adventure Work; Skill-based

errors include Imperfect Technical Specifications and Lack of Protection; Perceptual errors include Lack of Safety Awareness, Lack of Concentration, Fluke Mind, and Weak Sense of Responsibility. Routine violations include Unreasonable Staffing, Unreasonable Labor Organization, and Failure to Enforce Rules; Exceptional violations include Poor Risk Identification and Assessment Ability and Poor Risk Management ability. Through statistical analysis of accident reports in deep coal mines, the frequency of various unsafe acts is shown in **Figure 7**. The frequency of violation act of deep coal mine workers is 127 times, and the frequency of error act is 87 times, indicating that the violation act of workers is higher. The most common violation was the Unreasonable Labor Organization, with 29, followed by Failure to Enforce Rules, with 28. The frequency of Imperfect Technical Specifications and Lack of Safety Awareness is 26 and 23 times, respectively, ranking first and second in all unsafe acts.

DISCUSSION

Based on the HFACS model and grounded theory, we established the improved HFACS-CM model. It was mapped by analyzing deep coal mine workers' accident reports and interview records. Finally, the conceptual model of risk factors for the unsafe acts of deep coal mine workers was established. Based on grounded theory, we concluded that risk factors affecting the unsafe actions of deep coal miners are mainly environmental factors, organizational influence, unsafe supervision, and unsafe state of miners. Among these factors, workers' unsafe state is direct, all
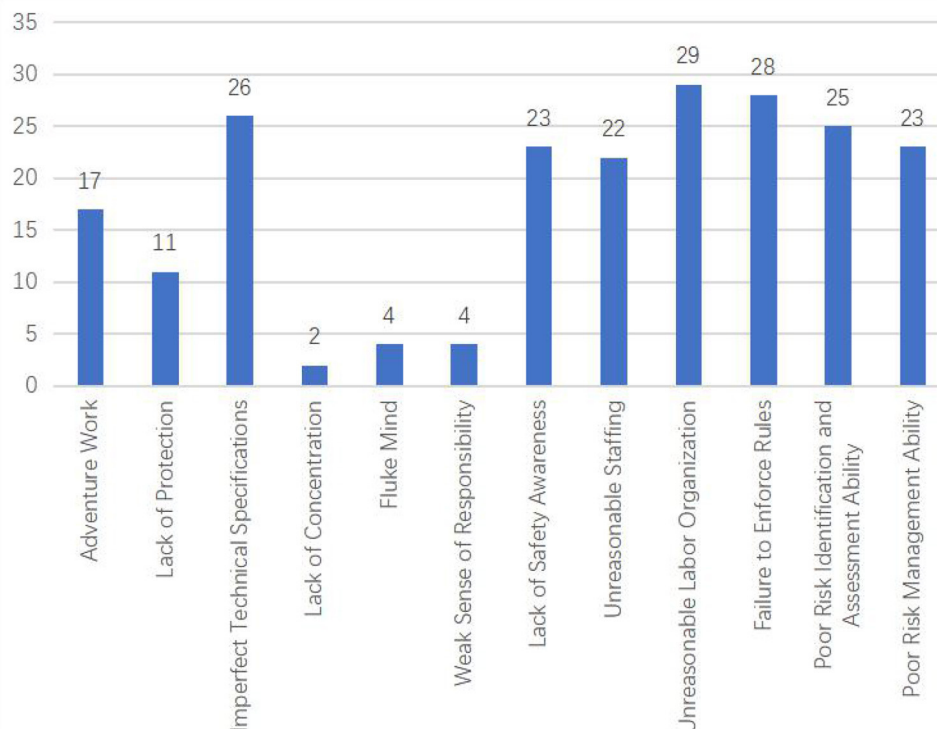
FIGURE 7 | Statistics of miners' unsafe acts types.

others are indirect. The technique used in this study identified risk factors and systematically analyzed them.

Theoretical Implications

The contributions of this study to coal mining safety include the following:

This research object of the study is deep coal mine workers. Our findings guide effectively addressing their unsafe behaviors. The unsafe acts of deep coal miners is the direct factor leading to coal mine accidents. However, previous research focused more on the miners' errors (5, 33), while research on regulatory violations of miners has been relatively limited, especially related to the unsafe actions of deep coal miners. Risk factors affecting the unsafe worker behaviors in deep mines have significantly increased compared to shallow ones. Previous studies on factors affecting the unsafe acts of miners are insufficient for analysis of unsafe behaviors of deep miners. Therefore, we should study the unsafe acts of deep miners. This study identifies their unsafe acts' risk factors and provides a theoretical basis for intervention strategies to prevent hazardous actions. Thus, our findings will help reduce the coal mine accidents caused by the unsafe acts of coal miners.

In this study, the HFACS model and grounded theory were used comprehensively, enriching the identification methods of risk factors for unsafe acts of miners and revealing the formation mechanisms of hazardous behaviors. The factors influencing coal mine workers' unsafe acts are complex and varied. Previous

studies focused on unilateral factors such as fatigue, physical condition, and organizational defects (3–5, 24). In contrast, few studies have taken a systematic approach to analyzing the unsafe actions of miners from multiple perspectives. This study constructs a clear and comprehensive risk factor conceptual model for analyzing unsafe acts of deep coal miners from a systematic perspective. In addition, it clarifies the mechanism of risk factors on unsafe acts. Therefore, our findings provide a starting point for more detailed research in the future (34, 35).

This study provides a more profound and broader analysis of deep coal mine accidents. Although previous studies also statistically analyzed causes of accidents in coal mines from a human perspective (9, 36), they did not describe how various factors interact with each other. Based on its conceptual model of risk factors, our study provides a statistical analysis of types of unsafe acts and risk factors for miners, which indicates the degree of risk associated with each factor from a quantitative perspective. It also reveals the interactions between each factor. Therefore, the results provide a theoretical basis for future scholarly research (37).

Practical Significance

The results provide valuable information for coal mine safety management practices.

Coal mine safety managers should pay attention to the complex factors contributing to workers' unsafe acts. They should work to reduce the occurrence of coal mine workers'

unsafe behaviors from a systems perspective. The administration department of coal mine safety should take measures to intervene in the organizational factors that influence workers' behavior and in supervisory factors that impact working conditions. At the same time, managers should also consider the influence of these factors on workers' unsafe actions through their unsafe state. The conceptual model of risk factors constructed in this study shows that environmental factors, organizational factors, supervision factors, and workers' unsafe state interact, ultimately resulting in workers' unsafe actions. The coal mine safety managers can create safer conditions for workers and reduce the possibility of risky behaviors by improving the underground working environment, strengthening the organizational management, and enhancing supervision inside the mine.

Resource management for deep coal miners should be the critical content of unsafe acts intervention. It includes safety education and training, personnel allocation, and safety investment. Safety education and training often appeared among the risk factors of unsafe acts. For example, when education and training are incomplete, workers lack safety awareness and knowledge, which will affect workers' ability to identify and respond to risks (6, 8). Therefore, it is necessary to establish a sound safety education and training system at the organizational level. This strategy will strengthen safety education and training for workers and improve workers' safety awareness, knowledge, and operating skills, reducing the occurrence of errors and violations. In addition, due to the complexity of deep mining conditions, coal mining enterprises should increase investment and introduce advanced equipment, technology, and expert professionals to reduce the occurrence of unsafe acts of workers.

Supervision and preventative management of unsafe actions of coal miners also need to be strengthened. Based on the conceptual model of risk factors, Managers of coal mines can take the following measures to improve the supervision of workers' unsafe acts. First, strengthen the education and training of managers to let them timely guide miners' work and correct their unsafe acts. Second, improve legal standards and operating procedures to help workers reduce errors and violations. More detailed and comprehensive operational practices can help workers reduce the number of unsafe acts. More comprehensive rules and regulations would make it easier for managers to regulate miners' acts and reduce workers' violations. Finally, strengthen safety education and training for front-line miners, especially safety and professional knowledge. Rich professional knowledge and safety knowledge can enhance miners' safety awareness and professional skills and reduce the occurrence of safety acts.

Unreasonable labor organization and failure to enforce rules are the core risk factors of unsafe acts of deep coal mine workers. In the process of intervening in unsafe acts of miners, the manager should emphasize controlling these two factors. Reasonable labor organization is the result of making good operation plans. Therefore, coal mining enterprises need to introduce professional management personnel. Experienced managers can develop scientific, reasonable work plans but efficiently find loopholes in the management process, effectively preventing unsafe worker behavior. Managers of coal mines can

adopt intelligent devices to monitor compliance on the job for those who fail to enforce rules. For example, Managers can use wearable devices to monitor workers' physical and psychological indicators to judge their condition.

CONCLUSION

In this study, the HFACS model and grounded theory were used to analyze interview records and case reports of deep coal mine accidents to identify risk factors and manifestations of workers' unsafe actions. This comprehensive risk identification method can accurately find the factors implicit in the text data, which can investigate and analyze the risky behaviors of deep coal miners. The risk factor conceptual model constructed accurately describes the causes of unsafe acts of miners and provides a theoretical basis for safety improvements. Scholars can also apply the research methods in this paper to other fields to identify risk factors for workers' unsafe actions, such as crews and pilots.

There may be some limitations to this study. First, the conceptual model of risk factors constructed in this study was obtained by qualitative methods, and the influence of each factor on the unsafe act was not quantitatively analyzed. Based on this conceptual model, subsequent studies can quantitatively analyze the impact of various factors on workers' unsafe acts. In addition, the analysis process of grounded theory used in this paper was carried out manually with the help of Nvivo software. However, the amount of data collected and summarized manually is limited. Conducting manual analysis on large amounts of data is difficult. In the future, it should be considered to introduce data mining technology into the grounded theory to achieve rapid acquisition of crucial information from massive data and combine it with research content for coding.

This study provides a valuable basis and enlightenment for coal mine enterprises to supervise and manage unsafe behaviors of employees in practice and has practical guiding significance. Combined with occupational health-related laws and regulations and ISO 45001:2018, this paper puts forward some suggestions on the supervision and management of coal mine workers' unsafe behaviors from two aspects of control measures and supervision and management.

In terms of measures to control workers' unsafe behaviors, the risk factor identification model of coal mine workers' unsafe behaviors constructed in this paper can help managers of coal mine enterprises better understand the factors leading to coal mine workers' unsafe behaviors. According to the risk identification model, managers of coal mine enterprises can take measures to improve the unsafe situation of workers from three aspects: environmental factors, organizational influence, and organizational supervision, to reduce the occurrence of unsafe behavior. ① Improve the working environment for workers. Managers constantly improve and optimize the operating environment to eliminate and reduce workers' adverse psychological and physiological reactions caused by the negative environment. A good environment can make the operator work happily to avoid unsafe behavior. ② Strengthen safety education and training and enrich workers with safety

knowledge. Safety education and training can continuously improve workers' safety awareness and skill quality to improve the overall quality of workers and reduce the occurrence of unsafe behaviors. ③ Strengthen safety culture and create an excellent safe atmosphere to infect staff. Good safety culture and atmosphere can help workers establish safety concepts, make workers take the initiative to abide by rules and regulations and laws and regulations from the ideological point of view, and reduce unsafe behavior. ④ Enterprises strengthen communication within the organization. Good communication within the organization can help employees solve various problems encountered in the work process to maintain a stable working mood and avoid unsafe behavior. ⑤ Strengthen supervision and strictly restrict workers' behavior. Adequate on-site safety supervision is an essential means to standardize workers' safety behavior and ensure the implementation of safety systems and measures. Strict supervision and management of workers' safety behavior is the most direct way of effectively eliminating all kinds of unsafe behavior. ⑥ Enterprises strengthen reward and punishment mechanisms. A perfect safety reward and punishment mechanism can timely punish workers' unsafe behaviors and effectively reward workers' outstanding performance, promoting workers to take the initiative to reduce the occurrence of unsafe behaviors.

The managers of coal mining enterprises can take the following measures to supervise and control the unsafe acts of coal miners. ① Establish and improve the mechanism for discovering, reporting, and appealing to workers' unsafe behaviors. ② Improve the education and evaluation system for workers with unsafe behaviors, and carry out professional intervention for workers with unsafe behaviors. ③ Establish a system of returning and visiting workers who have performed unsafe behaviors to avoid the recurrence of unsafe behaviors. ④ Conduct statistical analysis on various unsafe behaviors of workers to analyze the causes of unsafe behaviors and formulate effective control measures. ⑤ Perfect the accountability system of workers' unsafe behavior to reasonably punish workers who have shown unsafe behavior.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Raw data can only be used by journal editors and reviewers, not publicly by others. Requests to access these datasets should be directed to Xue Wang, 102455019@qq.com.

AUTHOR CONTRIBUTIONS

XW designed and conceptualized the study, and wrote the manuscript. LY supervised the project and obtained funding. XW, JZ, and ZQ downloaded the related papers and also obtained funding. All authors participated in screening the articles and provided critical feedback, significantly contributed to the study, and approved the final manuscript.

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Neuroticism Trait and Mental Health Among Chinese Firefighters: The Moderating Role of Perceived Organizational Support and the Mediating Role of Burnout—A Path Analysis

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Perceived organizational support (POS) in the relationship between neuroticism and job burnout among firefighters received little attention in China. A sampling of 716 firefighters in China, we drew on perceived organization support theory and the notion of support as a buffer in job burnout, examining moderating effects of POS on the relationship between neuroticism and three components of burnout (emotional exhaustion, depersonalization and reduced personal accomplishment). Also, this study explored the mediating effect of burnout on the relationship between neuroticism and mental health (i.e., anxiety and depression). We found that two components (depersonalization and emotional exhaustion) of burnout have significantly mediated the relationship between neuroticism and anxiety and depression. At the same time, POS reinforced the relationship between neuroticism and depersonalization and emotional exhaustion. Therefore, organizations can take our analysis into account when taking actions to improve firefighters' mental health. The implications of these findings were discussed.

Keywords: neuroticism, job burnout, perceived organization support, anxiety, depression

INTRODUCTION

The Chinese government faces the challenge of an increasing number of disasters and accidents along with its rapid economic and social development. As a result, Chinese firefighters need to tackle increasing fires and respond to other emergencies, resulting in a high death rate (1). Firefighters are working as first responders who face emergent tasks, including fire suppression and rescue services which may cause severe injuries or deaths. Witnessing long-lasting life-threatening

events and tragedies occur on colleagues can negatively affect a person's mental and physical health (2), causing anxiety (3, 4) and depression (5, 6). Moreover, without enough external assistance and organizational support, firefighters' mental problems become a more challenging issue that needs to be tackled urgently.

The overarching idea of our study was to find the impact of organizational support and how personality traits, especially neuroticism, influences firefighters' mental health. Neuroticism is a negative emotional trait characterized by proneness to anxiety, emotional instability, and self-consciousness (7). The personality trait of neuroticism is associated with anxiety and depression (8–12). A body of research has identified neuroticism as a vulnerable factor in both depressions (13, 14) and anxiety (15, 16).

The Moderating Role of Perceived Organizational Support

Perceived Organizational Support (POS) is defined as employees' perception about how their organization values their contribution and cares about their wellbeing (17). A previous study found that POS was negatively correlated with job burnout of employees, meaning that the less POS, the fewer satisfaction employees would feel, resulting in more severe burnout (18). According to Cohen and Wills (19), support can promote personal self-esteem and provide sufficient information to individuals to help them define, understand, and respond to stressful events. Meanwhile, support has a function to provide physical resources and has a social companionship function to satisfy people's need to be accompanied and feel a sense of belonging (20). Organizational support is especially meaningful for researching burnout, which has long been recognized as a combination of work-related symptoms, including generalized fatigue and loss of motivation (21). Although burnout is linked to general personality factors (22), there has been little research on the relationship between firefighters' neuroticism and burnout. Particularly, firefighters who perceive their organizations are supportive will perform better, believing that organizations will provide them with resources to cope with the stress leading to less burnout.

The Mediating Role of Burnout

Burnout is a psychological syndrome characterized by emotional exhaustion, feelings of cynicism, and reduced personal accomplishment (23). A recent study has shown that job burnout is one of the risk factors for anxiety and depression (24). Different elements of burnout contribute to mental health issues, in which exhaustion was positively correlated with depression,

TABLE 1 | Means, standard deviations, and correlations with confidence intervals for the main study variables.

Variable	M	SD	1	2	3	4	5	6	7	8
1. Age	26.39	6.00								
2. Work experience	31.08	45.10	0.35** [0.29, 0.41]							
3. SAS	1.86	0.40	−0.07 [−0.14, 0.00]	−0.04 [−0.11, 0.04]						
4. SDS	2.22	0.42	−0.05 [−0.12, 0.02]	−0.09* [−0.16, −0.01]	0.49** [0.43, 0.54]					
5. POS	3.14	0.69	0.03 [−0.04, 0.11]	−0.01 [−0.08, 0.07]	0.03 [−0.04, 0.10]	−0.08* [−0.15, −0.00]				
6. EE	2.76	1.34	−0.09* [−0.16, −0.01]	0.00 [−0.07, 0.07]	0.59** [0.54, 0.63]	0.28** [0.21, 0.34]	0.01 [−0.07, 0.08]			
7. DE	2.29	1.39	−0.10* [−0.17, −0.02]	−0.06 [−0.13, 0.01]	0.62** [0.57, 0.66]	0.28** [0.21, 0.35]	−0.00 [−0.08, 0.07]	0.79** [0.76, 0.81]		
8. RPA	4.66	1.76	0.12** [0.05, 0.19]	0.12** [0.05, 0.19]	−0.26** [−0.33, −0.19]	−0.17** [−0.24, −0.09]	0.12** [0.05, 0.19]	−0.38** [−0.44, −0.32]	−0.41** [−0.47, −0.35]	
9. Neuroticism	2.30	0.68	−0.10** [−0.18, −0.03]	−0.03 [−0.10, 0.04]	0.50** [0.44, 0.55]	0.29** [0.22, 0.36]	−0.09* [−0.17, −0.02]	0.44** [0.38, 0.50]	0.42** [0.36, 0.48]	−0.34** [−0.40, −0.27]

M and SD are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (48).

*Indicates p < 0.05.

**Indicates p < 0.01.

SAS, Self-Rating Anxiety Scale; SDS, Self-rating depression scale; POS, perceived organizational support; EE, emotional exhaustion; DE, depersonalization; RPA, reduced personal accomplishment.

TABLE 2 | Regression results using EE (Model 1), DE (Model 2), and RPA (Model 3) as the criterion.

Model	Predictor	b	b 95% CI (LL, UL)	sr^2	sr^2 95% CI (LL, UL)
Model 1	Neuroticism	0.87**	[0.74, 1.00]	0.19	[0.14, 0.24]
	POS	0.08	[−0.05, 0.21]	0.00	[−.00, 0.01]
	Neuroticism *POS	0.26**	[0.07, 0.44]	0.01	[−0.00, 0.02]
Model 2	Neuroticism	0.86**	[0.72, 1.00]	0.18	[0.13, 0.23]
	POS	0.06	[−0.07, 0.20]	0.00	[−0.00, 0.00]
	Neuroticism *POS	0.20*	[0.01, 0.40]	0.00	[−0.00, 0.01]
Model 3	Neuroticism	−0.84**	[−1.02, −0.67]	0.11	[0.06, 0.15]
	POS	0.24**	[0.06, 0.42]	0.01	[−0.00, 0.02]
	Neuroticism *POS	−0.09	[−0.34, 0.17]	0.00	[−0.00, 0.00]

b Represents unstandardized regression weights. sr^2 represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

*Indicates $p < 0.05$.

**Indicates $p < 0.01$.

EE, emotional exhaustion; DE, depersonalization; RPA, reduced personal accomplishment; POS, perceived organizational support.

TABLE 3 | Regression results using SAS (Model 4) and SDS (Model 5) as the criterion.

	Predictor	b	b 95% CI (LL, UL)	sr^2	sr^2 95% CI (LL, UL)
Model 4	Neuroticism	0.16**	[0.12, 0.20]	0.06	[0.03, 0.08]
	POS	0.03	[−0.00, 0.06]	0.00	[−0.00, 0.01]
	Neuroticism*POS	0.01	[−0.03, 0.06]	0.00	[−0.00, 0.00]
	EE	0.06**	[0.03, 0.08]	0.01	[0.00, 0.03]
	DE	0.10**	[0.08, 0.13]	0.05	[0.03, 0.07]
	RPA	0.01	[−0.00, 0.03]	0.00	[−0.00, 0.01]
Model 5	Neuroticism	0.12**	[0.07, 0.16]	0.03	[0.00, 0.05]
	POS	−0.04	[−0.08, 0.01]	0.00	[−0.00, 0.01]
	Neuroticism*POS	0.02	[−0.04, 0.08]	0.00	[−0.00, 0.00]
	EE	0.03	[−0.01, 0.06]	0.00	[−0.00, 0.01]
	DE	0.04*	[0.00, 0.07]	0.01	[−0.00, 0.02]
	RPA	−0.00	[−0.02, 0.02]	0.00	[−0.00, 0.00]

b Represents unstandardized regression weights. sr^2 represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

*Indicates $p < 0.05$.

**Indicates $p < 0.01$.

EE, emotional exhaustion; DE, depersonalization; RPA, reduced personal accomplishment; POS, perceived organizational support; SAS, anxiety; SDS, depression; Neuroticism*POS, the interaction between Neuroticism and POS.

and the sense of professional inefficacy was positively correlated with anxiety (25). Vasilopoulos (26) found that participants who reported a high level of social anxiety also reported a high level of burnout. Mark and Smith (27) revealed that job demands, external efforts, and over-commitment were related to increased anxiety levels. Burnout might be a risky factor for developing depression (28, 29). Therefore, job burnout may be used as a diagnostic standard to assess employees' mental health conditions, such as anxiety and depression. Neuroticism, as a susceptible personality trait, is positively related to anxiety and depression, which means neurotic employees have higher tendency to experience job burnout. Research for firefighters, a particular group for our society, is critical but rare, especially for neurotic firefighters. Hence, our study took neurotic personality into account to establish models to explore how burnout can mediate the relationship between such personality and anxiety or depression.

METHODS

Participants

The current study recruited 716 full-time male professional firefighters in China who voluntarily participated in this study. The mean age was 26.39 years old, and the average month of work experience is 31.08 within the final data. The ethics committees from all authors' universities approved this study. Informed consent was obtained from participants before they started.

Measures

Big Five Inventory−2

The BFI-2 is a 60-item self-report measure of personality traits (30), and each item is rated on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). The BFI-2 consists of five subscales with 12 items each: extraversion, agreeableness, conscientiousness, negative emotionality (neuroticism), and open-mindedness. The higher scores on one trait, the more probable the subject has such trait.

A previous study indicated that the Chinese version of the BFI-2 questionnaire to evaluate personality traits has good reliability and structural validity (31). The current study showed good internal consistency, α = 0.74, 0.84, 0.85, 0.82, 0.76 for extraversion, agreeableness, conscientiousness, negative emotionality (neuroticism) and open-mindedness, respectively.

Maslasch Burnout Inventory-General Survey

Maslach and Schaufei's MBI-GS has a good validation across occupational groups and nations (32). The Chinese version (CMBI-GS) was revised by Li Chaoping (33). It consists of 15 items, and all were rated on a 7-point Likert scale (1 = never, 7 = every day). The CMBI-GS composes of three subscales: emotional exhaustion, depersonalization, and reduced personal accomplishment. The higher the score of emotional exhaustion and depersonalization and the lower score in reduced personal achievement, the higher the probability for the subject to have job burnout.

In this study, Cronbach's alpha coefficient for emotional exhaustion, depersonalization, and reduced personal accomplishment were 0.92, 0.93, and 0.91, respectively.

TABLE 4 | Test of mediating effects.

Paths	Unstandardized B (SE)	Unstandardized 95% CI	
		Low	High
Direct paths			
Neuroticism—SAS	0.16*** (0.02)	0.12	0.20
Neuroticism—SDS	0.12*** (0.03)	0.07	0.16
Indirect paths			
Neuroticism—EE—SAS	0.05*** (0.01)	0.03	0.07
Neuroticism—DE—SAS	0.09*** (0.01)	0.06	0.12
Neuroticism—RPA—SAS	−0.01 (0.01)	−0.02	0.001
Neuroticism—EE—SDS	0.02 (0.02)	−0.01	0.06
Neuroticism—DE—SDS	0.03** (0.02)	0.003	0.06
Neuroticism—RPA—SDS	0.00 (0.01)	−0.01	0.02

EE, emotional exhaustion; DE, depersonalization; RPA, reduced personal accomplishment; SAS, anxiety; SDS, depression.
** Indicates p < 0.01.
*** Indicates p < 0.001.

Self-Reported Anxiety Scale and Depression Scale

Zung (34) and Zung (35) designed the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS), respectively, to quantify the degree of anxiety and depression symptoms. These scales both include 20 self-report items (4-point Likert scale). Mean values were calculated. The higher the scores, the higher the inclination for the subject to have anxiety or depression.

The Chinese versions have been validated in epidemiological surveys (36, 37). The current study showed good internal consistency (α = 0.83, 0.85, respectively) for anxiety and depression.

Perceived Organizational Support Scale

The perceived organizational support (POS) was measured by using the 8-item scale (38). The short version of the POSS has been widely applied among Chinese occupational groups with good reliability and validity (39).

In the present study, the alpha coefficient for this scale was 0.70.

Statistical Analysis

In the present study, all analyses were calculated in R 4.1.1 (40). Common method deviation tests, descriptive analyses, and normal distribution were performed using the *psych* package (41). The correlation matrix table was made by using the *apaTables* package (42). We conducted multiple-level mediation analysis by using the *lavaan* package (43) and visualized the pathway by the *lavaanPlot* package (44).

Neuroticism was regarded as an independent variable (IV). Depression and anxiety were set as dependent variables (DV). Job burnout consisted of three components: emotional exhaustion (EE), depersonalization (DE), and reduced personal accomplishment (RPA), and they were regarded as mediation variables (MV). The moderation variable was the perceived organizational support (MDV: POS). Before analysis, we used *G*Power 3.1* software (45) to calculate the sample size. The result showed that the minimum sample size should be 191 for path analysis with an effect size of 0.3 (46), and the degree of freedom was 3. In this study, we had a sample size of 716 firefighters, which is much more than the critical value.

RESULTS

Common Method Deviation Test

The Harman single factor test showed that the eigenvalues of 18 factors were more outstanding than one without rotation, and the explanatory variation of the first factor was 23.56%, lower than the critical value of 40% (47). Therefore, there was no obvious common methodological bias in this study.

Descriptive Statistics and Correlations Among Main Measures

As **Table 1** shows, the neuroticism trait was significantly positive correlated with anxiety ($r = 0.50$, $p < 0.01$) and depression ($r = 0.29$, $p < 0.01$). As expected, firefighters with higher neuroticism, anxiety and depression would experience more burnout ($p < 0.01$). The perceived organizational support was significantly negatively correlated with depression ($r = 0.08$, $p < 0.05$) and neuroticism ($r = -0.09$, $p < 0.01$), while it was not strongly correlated with anxiety ($r = 0.03$, $p > 0.05$). Age was significantly negatively correlated with the neuroticism trait ($r = -0.10$, $p < 0.05$).

Moderation Analysis

Corresponding with the multiple regression analysis (49) and following the recommendation by Aiken et al. (50), we mean-centered the two continuous variables (Neuroticism and POS) and tested the independent variable (Neuroticism), moderation variable (POS), and the interaction of independent and moderation variables (Neuroticism*POS) to predict mediation variables (EE, DE, RPA). The path analysis model was conducted, and overall fitness of the path model was acceptable {$\chi^2/df = 41.03$, $p < 0.01$; $RMSEA = 0.24$ [CI (0.20, 0.29)]; $CFI = 0.95$; $GFI = 0.96$; $SRMR = 0.07$}. Just as depicted in **Tables 2**, **3** illustrate the hypothetic model's unstandardized regression coefficients. **Figure 1** shows the moderation results.

As shown in **Table 2** and **Figure 1**, neuroticism (EE: $B = 0.87$, $p < 0.01$; DE: $B = 0.86$, $p < 0.01$) and Neuroticism*POS ($B = 0.26$, $p < 0.01$; DE: $B = 0.20$, $p < 0.01$) were reliable predictors of EE (Model 1) and DE (Model 2). Neuroticism was a negative predictor about RPA ($B = -0.84$, $p < 0.01$), while POS was a positive predictor ($B = 0.24$, $p < 0.01$). The interaction of neuroticism and POS was not significant ($p > 0.05$).

In terms with the statistical significance of the interaction between neuroticism and POS for emotional exhaustion and

FIGURE 1 | Unstandardized regression coefficients of the hypothesized model ($N = 716$). POS, perceived organizational support; EE, emotional exhaustion; DE, depersonalization; RPA, reduced personal accomplishment. (A) Indicates model 1. (B) Indicates model 2. (C) Indicates model 3. (D) Indicates model 4. (E) Indicates model 5. * indicates $p < 0.05$; ** indicates $p < 0.01$; na indicates $p > 0.05$.

FIGURE 2 | Interaction of neuroticism and POS on emotional exhaustion and depersonalization ($N = 716$). POS, perceived organizational support. (A) Indicates the interaction of neuroticism and POS on emotional exhaustion. (B) Shows the interaction of neuroticism and POS on depersonalization.

depersonalization, this result indicated that the association between neuroticism and emotional exhaustion increased in magnitude as the levels of POS increased from low [−1SD; $\beta = 0.77$, $SE = 0.08$, $p < 0.001$, 95% $CI = (0.61, 0.92)$] to moderate [Mean; $\beta = 0.86$, $SE = 0.07$, $p < 0.001$, 95% $CI = (0.73, 0.99)$] to high (+1SD; $\beta = 0.99$, $SE = 0.08$, $p < 0.001$, 95% $CI = (0.84, 1.14)$]. The positive relationship between neuroticism and emotional exhaustion was reinforced for the firefighters with higher levels of POS, which was an unexpected result (see **Figure 2A**).

The results also indicated that the association between neuroticism and depersonalization increased in magnitude as the levels of POS increased from low [−1SD; $\beta = 0.78$, $SE = 0.08$, $p < 0.001$, 95% $CI = (0.62, 0.94)$] to moderate [Mean; $\beta = 0.86$, $SE = 0.07$, $p < 0.001$, 95% $CI = (0.72, 0.99)$] to high [+1SD; $\beta = 0.96$, $SE = 0.08$, $p < 0.001$, 95% $CI = (0.80, 1.12)$]. The positive relationship between neuroticism and depersonalization was reinforced for the firefighters with higher levels of perceived organizational support, which was an unexpected result (see **Figure 2B**).

Multiple Mediation Analysis

The next step was to evaluate the mediating role of job burnout in the relationship between neuroticism and mental health (see **Table 4**). Results revealed that neuroticism positively predicted EE and DE ($p < 0.01$) and negatively predicted RPA ($p < 0.01$). The direct effect of neuroticism on anxiety ($B = 0.16$, $p < 0.01$) and depression ($B = 0.12$, $p < 0.01$) were significant.

The indirect association between neuroticism and anxiety through EE [$\beta = 0.05$, $SE = 0.01$, $p < 0.001$, 95% $CI = (0.03, 0.07)$] and DE [$\beta = 0.09$, $SE = 0.01$, $p < 0.001$, 95% $CI = (0.07, 0.11)$], was statistically significant, respectively. Similarly, the indirect association between neuroticism and depression through DE [$\beta = 0.03$, $SE = 0.01$, $p < 0.001$, 95% $CI = (0.01, 0.05)$], was statistically significant, respectively. The indirect role of RPA for anxiety and depression was not significant ($p > 0.05$).

DISCUSSION

Our results suggested that firefighters with the neurotic trait are more prone to experience anxiety and depression, which is consistent with the general population (12, 51). The relationship among neuroticism, depression and anxiety has been widely discussed (11, 52). Neuroticism is widely defined as a long-term tendency to experience negative emotions, especially when a person is threatened, depressed, or experiencing loss. High level of neuroticism results in skeptical emotional disorders and maladapted social or interpersonal relationships.

Inconsistent with our expectations, POS positively regulates the relationship between neuroticism and job burnout. For neurotic firefighters, the more organizational support they perceive can result in a higher level of burnout, especially in the dimensions of emotional exhaustion and depersonalization. In China, firefighters are recruited from the army. Under such circumstances, once soldiers perceive that their organizations or commanders are concerned, they feel anxious instead of support. Supposedly, organizational structure and cultural differences

lead to such a phenomenon. Therefore, perceived organizational support may have a reverse inhibitory effect on firefighters (53).

In line with the rich literature of previous studies, we found a strong correlation between burnout and anxiety, depressive symptoms. Interestingly, we found that depersonalization could mediate the relationship between neuroticism and both anxiety and depression. According to Melamed et al. (23), depersonalization is characterized by employees' tendency to regard others as objects. High level of depersonalization indicates that employees tend to be cynical, detached, or emotionally indifferent to colleagues and customers (i.e., rescuers and survivors) (54). Undertaking complex and heavy rescue tasks, firefighters experience many negative events frequently, which can easily lead to mental problems and emotional disorders.

Moreover, incorrectly understanding the will of organizations might worsen the situation. In sum, our study did well in researching the relationship between the neuroticism trait and mental health by considering the moderating role of POS and the mediating role of the three components of burnout among Chinese firefighters. Thereby current study can reveal some facts about the mental health condition of firefighters in China. Also, leaders or decision-makers can take action in terms of our models.

Limitations and Future Directions

Some limitations in this study should be noted. First, our analysis does not infer causality between variables as in all the cross-sectional designs. Though we found the indirect association between neuroticism and anxiety through EE and DE was significant, DE played an indirect role through neuroticism to depression. In future research, network analysis (55) may be an excellent choice to explore the causality among main variables.

Second, we rely on the "subjective" measurement of anxiety and depression and occupational level variables. Some firefighters were mentally defensive in post-survey interviews though we repeatedly told them that this study was confidential and no results would be given to their senior commanders. This situation required us to use "objective" indicators (i.e., indicators that do not involve the perception or evaluation of respondents) to reduce the impact of various response deviations (such as social expectation deviation) (56).

CONCLUSION

Reducing firefighters' job burnout can benefit their physical and mental health and our society. Hence, it is crucial to explore the mediating mechanisms of job burnout influencing mental health, especially considering the moderating role of perceived organizational support among firefighters.

Our findings demonstrated that neuroticism traits influenced anxiety and depression through job burnout, and the role of perceived organizational support moderated the effects of neuroticism on emotional exhaustion and depersonalization in the same direction. Future research should explore other contextual and individual mediators and moderators of the relationship between firefighters' personality traits and mental health to clarify the matter further.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by School of Psychology, Nanjing Normal University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CS: study design. LZ and CL: data collection. YT: analysis, interpretation, and drafting of the manuscript. ZM, WH, and YZ: critical revision of the manuscript. All authors contributed to the article and approved the submitted version.

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A Latent Profile Analysis of Chinese Physicians' Workload Tethered to Paperwork During Outpatient Encounters

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Background: Physician dissatisfaction with more time spent on related paperwork but less time available for direct interaction with patients is increasing internationally. Increased physician workload resulting from paperwork might negatively affect their interaction with patients and increase the risk for burnout. This study aimed to investigate the level of physician workload tethered to paperwork during outpatient encounters and explore its latent workload subgroups among Chinese physicians.

Methods: A cross-sectional survey was conducted via online questionnaire primarily in 24 hospitals in 6 provinces in Eastern, Central, and Western China from November 2020 to February 2021. The Chinese physician mental workload scale developed by our research team was used for assessment of physician workload tethered to paperwork. Physicians were categorized into different subgroups of workload via latent profile analysis. Multinomial logistic regression was subsequently performed to examine how demographic variables differ among physicians belonging to different subgroups.

Results: A total of 1,934 valid questionnaires were received. Chinese physicians reported medium levels of workload while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters. Four latent workload subgroups were identified: "low workload group" (8.8%), "medium workload group" (34.0%), "high workload group" (42.1%) and "very high workload group" (15.1%). Compared with the other latent workload subgroups, physicians belonging to the "very high workload group" were more likely to be younger, married, those who had worse health status, lower educational levels and lower average monthly incomes, those who worked more years in the current institution, more hours per week and longer outpatient hours per week, and those who worked in public general hospitals, tertiary B hospitals and Obstetrics and Gynecology, and saw more than 50 outpatients per day, with more time spent on per patient.

Conclusions: There exit four latent workload subgroups among Chinese physicians tethered to paperwork during outpatient encounters along with great individual variations among these subgroups. The characteristics of the latent "very high workload group"

can help permit more targeted guidance for developing interventions with optimized human resource allocation to, in turn, increase the time available for direct interaction with patients, thereby resulting in improved quality of physician-patient interactions and decreased risk for physician burnout.

INTRODUCTION

With the increasing aging population with chronic and age-related diseases, along with its subsequently increasing health care requirements worldwide (1, 2), alarming increasing trends of physician workload have received much attention from health care providers and decision makers, as well as researchers in recent years (3–6). The well-known physician shortage issue in China [2.04 practicing physicians per 1,000 residents in 2017 (7), compared with the international average of 3.5 (8)] could further contribute to a much heavier workload for Chinese physicians. Heavy workload in physicians can contribute to an increased risk for burnout (9, 10), negatively affect their health (11–13), and further lead to an inferior quality of patient care (3, 14), negative patient satisfaction (15) and even medical errors (10), eventually endangering patient safety (16).

Workload is a multidimensional and multifaceted construct (17), comprising objective workload that is simply reflected by the quantity of work tasks, and mental workload that reflects the mental strains resulting from performing a work task under a specific environmental or operational condition as well as the capability of the human operator to respond to those demands (11). Compared to the objective workload, mental workload not only reflects different aspects of a human operator's workload, but also explains the relation between the nature of a work task and the characteristics of the operator (18, 19); and currently, the European Pact for Mental Health and Welfare is devoted to conducting the mental workload assessments to promote physical and mental well-being (11). To date, various methods for quantifying mental workload have been developed, mainly including the following three large groups: subjective evaluations through rating scales, task performance measures, and physiological measures (e.g., heart rate, galvanic skin resistance, and breathing rate) (20, 21); and the NASA-Task Load Index (NASA-TLX) scale provides a well-validated and widely-used tool for measuring or diagnosing subjective mental workload (22, 23), and has been used to quantify perceived workload of healthcare workers in various healthcare settings (24).

In China, heavy workload in physicians is a major problem for the current health care system (10), seriously threatening their health. Not surprisingly, the issue of overwhelming workload for physicians has attracted great public concern because of continuous cases involving young and middle-aged physicians' sudden death in recent years. And the current COVID-19 epidemic has further contributed to an increased work burden for Chinese medical workers including physicians than

before, especially in the center of the breakout of COVID-19 epidemic, where they suffered significant mental health problems during the COVID-19 outbreak (25–27). However, Chinese patients still tend to go to high-level hospitals even for mild symptoms owing to their lack of confidence in the quality of health care provided in primary hospitals (10, 28); and with the growing aging population with chronic and age-related diseases rapidly, resulting in subsequently increasing health care requirements in China (2), along with the increasing patients' utilization of health services (29), physicians especially in high-level hospitals on the one hand tend to have an increasingly heavier outpatient workload with worse physical health (30), and on the other hand have less service time spent with each patient averagely (31), which further contributes to inadequate communication between physicians and patients and negatively contributes to patients' perceived quality of medical services during outpatient encounters, ultimately resulting in patient dissatisfaction. When gaining insight into outpatient communication patterns, a qualitative study regarding the structure, style and focus of physician-patient communication revealed that Chinese physicians generally work alone in the outpatient clinic, and have to handle all of the work procedures by themselves during outpatient encounters, including direct interaction with their patients and paperwork (such as, recording medical history and issuing prescriptions) (32). Subsequently, our previous observational research regarding a real-time task analysis of 32 physicians in Chinese tertiary general public hospitals during outpatient encounters further revealed that during an almost 4 min outpatient encounter, a considerable amount of physician service time per patient (38.04%) was spent on non-physician-patient communication work tasks characterized by paperwork (e.g., recording medical records, and issuing prescriptions) (33). Such a high rate of physician service time was allocated to the related paperwork, which on the one hand increases the unnecessary workload (clerical burden) to physicians with occupying part of their brain resources, and on the other hand leads to less time available and brain resources for direct physician-patient interaction and further an inferior quality of medical services, ultimately resulting in physician and patient dissatisfaction (34).

When reviewing existing research on the related paperwork, there is more and more research showing that physician dissatisfaction with more time spent on paperwork and the computer but less time available for direct interaction with patients is increasing internationally (35–39) and that an increasing paperwork burden has adversely affected quality of health service delivery (40) and has become one of the important

risk factors resulting in physician burnout (41, 42). Reducing the time spent on doing paperwork has become a concern to physicians as well as researchers. Hence, assessment and management of physician workload tethered to the related paperwork during outpatient encounters is of great importance to promote physical and mental well-being for physicians and decrease the risk for burnout, as well as to increase the time available for direct interaction with patients and further improve the quality of physician-patient interaction, thereby improving physician and patient satisfaction. Although current studies regarding the clerical burden of physicians have assessed the impact of adoption of electronic health records on physician workload (43–46), no previous studies have investigated the level of workload among physicians tethered to the related paperwork during outpatient encounters and its characteristics, and have assessed whether there exist distinctive workload clusters or patterns in these physicians, especially in China. Therefore, this study focused on the physician workload while performing the related paperwork during outpatient encounters.

Existing studies often simply adopted several objective workload indicators (e.g., work time, and the number of patient seen) for physician workload assessments in China, but ignored an important aspect of workload, that is, mental workload (11); and such an evaluation for physician workload is inadequate, since it cannot reflect and capture the different aspects of a physician' workload, and further explain the relation between the nature of a work task and the characteristics of the physician. Moreover, when considering paying attention to assessments of physician workload, for hospital managers, a key concern is that how to group physician workload and accurately find out individuals with high workload among the evaluated physicians to permit more targeted guidance for developing interventions to, in turn, facilitate their physical and mental health and the quality of medical services. However, internationally, there is lack of consensus on what should be considered as a threshold value for a high or excessive workload (47, 48); and current studies tend to identify individuals with high workload among the evaluated physicians by using single workload indicators (49) through the quartiles (50), or threshold values for workload [e.g., 50% of overall workload (51), >55 (12), or >60 (52) of NASA-TLX composite workload scores]. Such kind of study based on "variable-centered" methods along with human interferences on identification of physicians with high workload, although important, has obscured individual variations in the different aspects of physician workload and therefore failed to reveal the distinctive physician workload subgroups or patterns and further capture the individual characteristics associated with different physician workload groups; and thus, a "person-centered" approach may be more effective. One of the most popular and useful methods involves latent profile analysis (LPA), which provides a methodology to group individuals who share similar patterns of personal and professional characteristics, traits or behaviors into subtypes based on a set of the variables of interest (53, 54). This statistical analysis method is rather novel in the mental workload research among medical workers, and it has been shown to be usable and valid for exploring the patterns of mental workload among pandemic frontline nurses during

the COVID-19 pandemic (18, 53), as well as the identification of the subtypes of physicians' mental workload in outpatient practice since the normalization of prevention and control of the COVID-19 pandemic in China (54).

There are few previous studies that further explores whether there exist distinctive workload subgroups or patterns among physicians tethered to the related paperwork during outpatient encounters. This study aimed to investigate the workload level of Chinese physicians while performing the related paperwork (such as recording medical history, and issuing prescriptions), classify the subgroups of physician workload and further examine how demographic variables differ among physicians belonging to distinctive subgroups. We hypothesized that physicians can be separated into distinctive workload subgroups based on the assessment of workload tethered to the related paperwork during outpatient encounters using the Chinese physician mental workload scale developed by our research team, and that key factors including demographic characteristics differed across distinctive subgroups. This study is the first of its subgroups of physician workload tethered to paperwork during outpatient encounters conducted in China, and can provide more targeted guidance for hospital managers to accurately find out individuals with high workload among physicians and therefore develop interventions to increase the time available and brain resources for direct interaction with patients during outpatient encounters, while lightening their paperwork burden and decreasing the risk for burnout.

METHODS

Study Sampling and Population

This cross-sectional survey study recruited physicians in Eastern, Central, and Western China using stratified convenience sampling. To ensure sufficient representativeness, two provinces were selected in the Eastern, Central, and Western regions at the time of sampling, respectively, that is, a total of six provinces were selected. According to the standard for the division of China Eastern, Central, and Western regions from the current China Health Statistics Yearbook (7), with the consideration of the availability of sampling physicians in this survey study, Guangdong and Zhejiang provinces were selected in Eastern China, Hubei and Henan provinces were selected in Central China, and Chongqing municipality and Guangxi Zhuang autonomous region were selected in Western China. Typical sampling was then applied to select two tertiary public hospitals and two secondary public hospitals in each selected province. That is, a total of 24 public hospitals were mainly selected nationwide in China, including 12 tertiary and 12 secondary public hospitals. Among the selected hospitals, internal, surgical, obstetrics and gynecology, and pediatrics were further selected as main research departments, where targeted physicians were selected by random sampling.

Given that our survey study aimed to investigate the level of workload among Chinese physicians while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters, the setting of the research was confined to the consulting room in outpatient

clinics. Therefore, the target population was physicians who provided medical services to outpatients in outpatient clinics, those who had to have been working for at least 4 months in the outpatient clinics, and those who had to be employed full-time for at least 1 year in their current medical institution, whereas physicians who provided medical services to outpatients in outpatient clinics for <4 months, those who only provided inpatient service, and those who were graduate students or trainees were excluded in this study.

To measure the workload tethered to the related paperwork during outpatient encounters, our previous research decomposed and further divided all of the work procedures performed by physicians themselves to provide complete medical services to outpatients into the following two large groups based on a real-time task analysis of 32 Chinese physicians during outpatient encounters: "physician-patient communication work tasks" characterized by direct patient interaction, and "non-physician-patient communication work tasks" characterized by paperwork (33); and these non-physician-patient communication work tasks mainly included recording medical history, issuing medical examinations, and issuing prescriptions (33). Therefore, above-mentioned non-physician-patient communication work tasks physicians themselves performed was considered as "paperwork" during outpatient encounters in this study. Given that different types of work tasks might result in different cognitive demands and resources demands, this survey study clearly explained the detailed work tasks involved with assessed workload to the targeted physicians before they filled in the questionnaire.

Questionnaire Design

The Chinese physician mental workload scale developed by our research team in 2018 based on the combination of dimensions of NASA-TLX scale and Subjective Workload Assessment Technology (SWAT) frameworks (11) was the basis of our developed questionnaire survey in this study, which included six dimensions (mental demands, physical demands, temporal demands, perceived risk, frustration level, and performance), 12 items, and physician characteristics (e.g., gender, age, marital status, average monthly income, educational level, professional title, working years in the current medical institution, hospital level, hospital nature, personnel, department, working hours per week, number of outpatients serviced per day, self-rated health status) with good reliability and validity (Cronbach alpha = 0.81); and moreover, pairwise comparisons of these six dimensions constituted a total of 15 comparisons, and these comparisons were used to determine the weighting coefficient for each comparison, where the weight of each dimension was equal to the number of times that dimension was selected divided by 15 (11). In the questionnaire, we added several questions to collect other demographic information on working hours per week in outpatient clinics, amount of time spent per patient and self-rated outpatient satisfaction, reported by the participating physicians.

Then, we conducted a pre-survey on site in October 2020, to validate the developed measurement tool in 10 physicians who just finished the provision of the outpatient services in the outpatient clinic of a tertiary public hospital in Wuhan,

Hubei. According to their comments or feedback, context-specific adjustments were then made to improve the accuracy and clarity of the questionnaire. Because of the impact of the COVID-19 epidemic in 2020, we further used wenjuanxing, a widely-used website for conducting surveys in China, to create an electronic questionnaire with which to survey physicians in this study.

Data Collection

This nationwide survey was conducted from November, 2020 to February, 2021. To improve the efficiency of data collection in the selected hospitals, a unique two-dimensional code of the electronic questionnaire was generated for each hospital. Prior to the beginning of the survey, an informed consent of the outpatient managers in each selected hospital was first requested and obtained, and they were then invited and volunteered to play the role of the project manager in their hospitals in this questionnaire survey. Subsequently, we sent the unique two-dimensional code of the electronic questionnaire to these outpatient managers of the corresponding hospital, and they then sent the two-dimensional code to the targeted department groups of physicians via WeChat or Tencent QQ group, where physicians who met the inclusion criteria for the targeted population were further invited to participate in this survey. Participants could scan the two-dimensional code of the electronic questionnaire via their phones to access and complete the electronic questionnaire. Before the formal survey, we introduced the purpose of the survey, provided the definition of physician workload and its involved non-physician-patient communication work tasks characterized by paperwork during outpatient encounters, and guaranteed that the survey data would not be used for other purposes. After an individual's consent was obtained, the survey was conducted accordingly. A WeChat or Tencent QQ account and mobile Internet Protocol address could be used to complete the electronic questionnaire only once. Given that the sample size should be recommended to be at least 10–15 times as many as the items of the scale (55) and should be also generally recommended to be at least 20 times as many as the variables which are considered to be included in the regression model, to improve the scale of the sample, these physicians who completed the questionnaire were also encouraged to share the survey website link to their Wechat Circle of Friends, WeChat or Tencent QQ group, where some physicians who met the inclusion criteria for the targeted population could participate in this questionnaire survey. The study was approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science & Technology (No. IORG0003571).

Workload Measure

Given that it's difficult to objectively quantify physicians' workload tethered to paperwork during outpatient encounters, we therefore used the Chinese physician mental workload scale to measure the physician workload while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters. That is, we only used the mental workload as the measure of physician workload while performing non-physician-patient communication work

tasks characterized by paperwork during outpatient encounters. The response to each of the 12 items was given based on a 10-point bipolar scale, ranging from 0 to 100; and for five of the six dimensions, i.e., mental demands, physical demands, temporal demands, perceived risk and frustration level, a score of 0 presents the lowest task load, whereas the dimension of performance is reverse-scored, with a score of 0 indicating the most successful performance of the task and the highest level of satisfaction with his/her performance (11). In this study, the calculation of physician workload followed the method from NASA-TLX scale (22); and therein the average score of all items of a corresponding dimension was the dimension score, whereas each dimension score was multiplied by the weight of the corresponding dimension and the sum of the scores was the total score of physician workload (11).

Statistical Analysis

We performed exploratory latent profile analysis (LPA) based on the six dimension indicators of physician workload tethered to non-physician-patient work tasks characterized by paperwork during outpatient encounters in this study, where we explored homogenous subgroups in a heterogeneous group and then observed continuous variables in each subgroup. LPA, a "person-centered" statistical approach, belongs to finite mixture modeling, which can identify and describe "hidden groups" within a population (18, 54, 56). Data for the six dimension indicators of physician workload were input into the LPA, with one class initially and additional classes added incrementally, until a unique solution could not be determined; and therein the maximum parameter estimates with standard errors were applied. The model identification was checked using 200 initial stage starts and 200 final stage starts.

We tested different latent class models that categorized the physician workload patterns into one, two, three, four, five, and six groups. To determine the most appropriate latent class model, the best fit model was identified using the following key model indexes: Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-size Adjusted BIC (ABIC), Lo-Mendell-Rubin (LMR), adjusted likelihood ratio test and bootstrap likelihood ratio test (BLRT) and Entropy. A lower value of AIC, BIC and ABIC represents better fitness of data into the estimated model (18, 54, 56); LMR and BLRT compare the model fit between two neighboring models (for example, k-1class model vs. k-class model), and a significant p value indicates that the k-class model fits the data better than the k-1-class model (54, 56). Entropy was used to assess the accuracy of classification in the estimated model, with a higher value indicating better classification, and the smallest group should have a minimum of 5% of the total sample in order to avoid over-stratification (56). A four-class model was identified in the LPA. Each participating physician was assigned into one of the physician workload subgroups with the highest probability.

Then, differences in physician workload scores among different workload subgroups were tested using the one-way analysis of variance (ANOVA) or Kruskal-Wallis rank tests. Subsequently, multinomial logistic regression analysis was

performed to examine the potential relationship between the latent workload subgroups and demographic variables; and therein all demographic variables were set as independent variables since there was no collinearity problem between these demographic variables in this study, where the variance inflation factor was <10 (range: 1.07–2.65). The statistical analyses were performed using STATA (version 15.0) and Mplus (version 7.0).

RESULTS

Participant Characteristics

In total, 2,038 online responses were received; of these, 104 responses were excluded because the time taken to answer the questionnaire was <60 s, or because they were not physicians, or they were physicians, but did not provide medical services to outpatients in outpatient clinics, and therefore, 1,934 eligible responses were remained. The detailed demographic characteristics of the 1,934 participating physicians are presented in **Table 1**. Among these physicians, 45.9% (887/1,934) were female, 44.1% (852/1,934) aged 31–40 years, 82.0% (1,585/1,934) were currently married, 63.8% (1,234/1,934) were from tertiary A hospitals, 38.0% (735/1,934) were from Eastern China, and 46.6% (902/1,934) rated health status as "moderate". Moreover, the total mean physician workload score was 62.92 (SD = 14.70) while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters (**Table 3**).

Identification of the Subgroups of Physician Workload Tethered to Paperwork During Outpatient Encounters

In order to classify and identify the optimal model, this study extracted and compared the model solutions from the one-class to six-class models. According to model indexes, the best fitting LPA was the four-class model (**Table 2**), which had the lowest AIC (95,620.337), BIC (95,804.059), and ABIC (95,699.218). The p-values of the LMR test (<0.001) and BLRP test (<0.001) indicate that the four-class model was statistically significant. Moreover, the Entropy value (0.866 > 0.800), the proportion of physicians of the least class (8.8% > 5.0%) (**Table 2**) and the average profile probabilities of physicians in each category ascribed to each potential category (range: 0.920–0.930) also indicate a better classification in the four-class model.

Therefore, LPA identified four distinctive latent subgroups of physician workload tethered to the non-physician-patient communication work tasks characterized by paperwork during outpatient encounters. **Figure 1** shows the latent subgroups of physicians (Classes 1, 2, 3, and 4), and their proportion (8.8, 34.0, 42.1, 15.1%, respectively), and the mean levels of six dimensions of physician workload, which can be distinguished as having relatively low (Class 1), medium (Class 2), high (Class 3) and very high levels (Class 4) of physician workload. That is, 8.8% (n = 170) were identified as low workload physicians (Class 1), 34.0% (n = 658) as medium workload physicians

TABLE 1 | Detailed demographic characteristics of the 1934 participating physicians.

Characteristics	Number (%)	Characteristics	Number (%)
Gender		Department	
Male	1047 (54.1)	Internal	585 (30.2)
Female	887 (45.9)	Surgical	481 (24.9)
Marital status		Obstetrics and gynecology	192 (9.9)
Unmarried	305 (15.8)	Pediatrics	163 (8.4)
Married	1585 (82.0)	Other	513 (26.5)
Divorced	36 (1.9)	Hospital level	
Widowed	8 (0.4)	Tertiary A hospital	1234 (63.8)
Age (years)		Tertiary B hospital	215 (11.1)
20–30	433 (22.4)	Secondary hospital	447 (23.1)
31–40	852 (44.1)	First-tier hospital	38 (2.0)
41–55	587 (30.4)	Working hours per week	
>55	62 (3.2)	≤ 40	180 (9.3)
Educational level		41–60	1062 (54.9)
PhD	228 (11.8)	>60	692 (35.8)
Postgraduate	776 (40.1)	Number of outpatients serviced per day	
Undergraduate	857 (44.3)	≤25	497 (25.7)
Junior college	59 (3.1)	26–40	582 (30.1)
Other	14 (0.7)	41–50	381 (19.7)
Professional title		>50	474 (24.5)
Senior	212 (11.0)	Outpatient working hours per week	
Deputy Senior	548 (28.3)	≤8	584 (30.2)
Intermediate	699 (36.1)	8–16	440 (22.8)
Junior	450 (23.3)	16–24	440 (22.8)
Other	25 (1.3)	24–40	268 (13.9)
Average monthly income (RMB)		>40	202 (10.4)
≤5000	376 (19.4)	Amount of time spent per patient (minutes)	
5001–10000	903 (46.7)	≤5	601 (31.1)
10001–15000	406 (21.0)	5–10	867 (44.8)
>15000	249 (12.9)	10–15	274 (14.2)
Working years in the current medical institution		>15	192 (9.9)
1–5	596 (30.8)	Self-assessed outpatient satisfaction	
6–10	503 (26.0)	Low	24 (1.2)
11–15	335 (17.3)	Medium	210 (10.9)
16–20	206 (10.7)	High	1700 (87.9)
>20	294 (15.2)	Self-assessed health status	
Area		Very poor	23 (1.2)
Eastern China	735 (38.0)	Poor	105 (5.4)
Central China	685 (35.4)	Fair	902 (46.6)
Western China	514 (26.6)	Good	624 (32.3)
Hospital nature		Very good	280 (14.5)
Public general hospital	1812 (93.7)	Personnel	
Public specialized hospital	98 (5.1)	Authorized strength	1313 (67.9)
Private general hospital	11 (0.6)	Personnel agency	201 (10.4)
Private specialized hospital	13 (0.7)	Contract	396 (20.5)
		Other	24 (1.2)

(Class 2), 42.1% ($n = 814$) as high workload physicians (Class 3) and 15.1% ($n = 292$) as very high workload physicians (Class 4). **Table 3** shows comparisons of between different workload subgroups on physician workload scores, and these significant differences in total physician workload score and its dimensions scores were all found between different workload subgroups, indicating a reliable and valid grouping for physician workload tethered to the non-physician-patient

Model	AIC	BIC	ABIC	Entropy	LMR *p*-value	BLRP *p*-value	Proportion of physicians in the least class
1-class	1,02,147.568	1,02,214.376	1,02,176.252	—	—	—	—
2-class	97,880.448	97,986.227	97,925.864	0.867	<0.001	<0.001	44.2%
3-class	96,537.576	96,682.327	96599.725	0.833	0.0130	<0.001	23.8%
4-class	**95,620.337**	**95,804.059**	**95,699.218**	**0.866**	**<0.001**	**<0.001**	**8.8%**
5-class	95,407.784	95,630.478	95,503.397	0.813	0.1098	<0.001	5.6%
6-class	95,153.562	95,415.228	95,265.908	0.868	0.0305	<0.001	6.4%

AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; ABIC, Sample-size-adjusted Bayesian Information Criterion; LMR, Lo-Mendell-Rubin Adjusted Likelihood Ratio Test; BLRT, Bootstrap Likelihood Ratio Test. The bold values indicate significant, and could help the readers quickly find the significant factors.
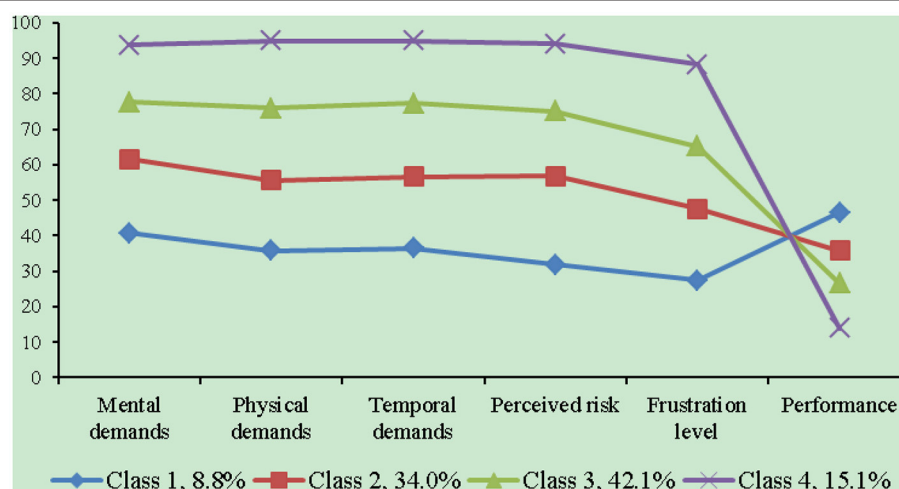
FIGURE 1 | Physician workload scores in different latent classes.

communication work tasks characterized by paperwork during outpatient encounters.

Specifically, the "very high workload group" was characterized by the highest scores on the dimensions of mental demands, physical demands, temporal demands, perceived risk and frustration level, and the most successful performance of the task and the highest level of satisfaction with his/her performance, also named the "very high workload perception & very high self-evaluation group". The "high workload group" further distinguished itself from the medium and low workload groups through higher scores on these five dimensions and more successful performance of the task and higher level of satisfaction with his/her performance, also named the "high workload perception & high self-evaluation group", "medium workload perception & medium self-evaluation group", and "low workload perception & low self-evaluation group", respectively. Moreover, the gap in the physician workload scores reached 2.15 times between the very high and low workload subgroups [80.82 (SD = 12.08) vs. 37.55 (SD = 8.16), $p < 0.001$] (**Table 3**).

Differences in the Latent Subgroups of Physician Workload by Characteristics

To further determine differences between different latent subgroups of physician workload across the demographic characteristics, multinomial logistic regression was performed to identify the significant determinants of the subgroups. Using "very high workload group" as the base outcome, we had following results (**Table 4**). Age, marital status, educational level, average monthly income, working years in the current medical institution, area, hospital level, hospital nature, department, working hours per week, outpatient working hours per week, number of outpatients serviced per day, amount of time spent per patient, self-assessed health status and self-assessed outpatient satisfaction were all significant factors that influenced the subgroups of physician workload tethered to non-physician-patient communication work tasks characterized by paperwork during outpatient encounters.

Specifically, compared to those aged 20–30 years, physicians aged 31–40 years or 41–55 years were more likely to belong to

TABLE 3 | Comparisons of physician workload scores between different latent workload subgroups.

Dimension indicators	Mean ± SD[a]	Low workload group (N = 170)	Medium workload group (N = 658)	High workload group (N = 814)	Very high workload group (N = 292)	P value[b] Low vs. Medium	Low vs. High	Low vs. Very high	Medium vs. High	Medium vs. Very high	High vs. Very high	Overall
Mental demands	71.39 ± 18.33	40.8 ± 13.81	61.56 ± 12.61	77.72 ± 10.58	93.72 ± 8.46	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Physical demands	68.36 ± 19.71	35.71 ± 13.32	55.58 ± 11.64	75.98 ± 9.69	94.97 ± 6.62	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Temporal demands	69.37 ± 19.29	36.53 ± 13.47	56.64 ± 10.64	77.34 ± 9.08	94.97 ± 6.94	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Perceived risk	67.96 ± 21.00	31.82 ± 16.98	56.76 ± 14.01	75.18 ± 11.61	94.11 ± 8.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Frustration level	59.35 ± 22.82	27.41 ± 14.43	47.52 ± 15.55	65.24 ± 16.49	88.2 ± 13.68	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Performance	29.55 ± 17.62	46.62 ± 21.56	35.79 ± 15.55	26.55 ± 12.56	13.89 ± 16.59	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total score	62.92 ± 14.70	37.55 ± 8.16	54.41 ± 6.73	68.68 ± 8.34	80.82 ± 12.08	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

[b]SD: Standard deviation.

[a]ANOVA and post-hoc pairwise Bonferroni tests for the dimensions with a normal distribution; Kruskal-Wallis equality-of-populations rank tests and post-hoc pairwise Dunn's tests for the dimensions without a normal distribution.

the "low (RRR (Relative Risk Ratio) = 2.498, $p = 0.016$; RRR = 2.923, $p = 0.024$, respectively) or medium (RRR = 2.061, $p = 0.010$; RRR = 1.977, $p = 0.058 < 0.10$, respectively) workload groups" as compared with the odds of the "very high workload group". Physicians being married were less likely to be assigned into the "low (RRR = 0.492, $p = 0.047$) or medium (RRR = 0.592, $p = 0.056 < 0.10$) workload groups". For educational level, physicians with higher educational levels were less likely to have a higher level of workload; compared to those with a PhD degree, physicians with undergraduate degrees were less likely to belong to the "medium (RRR = 0.386, $p = 0.005$) or high (RRR = 0.514, $p = 0.045$) workload groups", and physicians with a postgraduate degree were less likely to be assigned into the "medium workload group" (RRR = 0.458, $p = 0.015$) as compared with the odds of the "very high workload group". Physicians with an average monthly income of <5,000 RMB or 5,001–10,000 RMB were less likely than those with an average monthly income of 10,001–15,000 RMB to belong to the "medium workload group" (RRR = 0.601, $p = 0.084 < 0.10$; RRR = 0.639, $p = 0.046$, respectively).

Compared to those working in the current medical institution for 1–5 years, physicians who worked 6–10 years or 16–20 years in the current medical institution were less likely to belong to the "low (RRR = 0.477, $p = 0.026$; RRR = 0.583, $p = 0.030$, respectively) or medium (RRR = 0.294, $P = 0.009$; RRR = 0.335, $p = 0.002$, respectively) workload groups". For area, physicians who were from Eastern China were less likely than those from Central China to belong to the "low (RRR = 0.600, $p = 0.058 < 0.10$) or high (RRR = 0.707, $p = 0.073 < 0.10$) workload groups". Physicians in tertiary A hospitals or secondary hospitals were more likely than those in tertiary B hospitals to be assigned into the "high workload group" (RRR = 1.645, $p = 0.069 < 0.10$; RRR = 1.810, $p = 0.043$, respectively). Physicians in public specialized hospitals were more likely than those in public general hospitals to belong to the "low workload group" (RRR = 2.735, $p = 0.047$). Moreover, compared to those in Obstetrics and Gynecology, physicians in Internal or Pediatrics were more likely to belong to the "medium (RRR = 2.244, $p = 0.004$; RRR = 2.974, $p = 0.004$, respectively) or high (RRR = 2.091, $p = 0.006$; RRR = 3.061, $p = 0.002$, respectively) workload groups" as compared with the odds of the "very high workload group".

For working hours per week, physicians who had longer working hours per week were likely to be assigned into the "very high workload group"; compared to those with more than 60 working hours per week, physicians who worked no more than 40 h or 41–60 h were more likely to belong to the "low (RRR = 6.243, $p < 0.001$; RRR = 2.510, $p < 0.001$, respectively), medium (RRR = 5.639, $p < 0.001$; RRR = 2.176, $p < 0.001$, respectively) or high (RRR = 3.160, $p = 0.003$; RRR = 1.632, $p = 0.003$, respectively) workload groups" as compared with the odds of the "very high workload group". Compared to those who worked 16–24 h per week in outpatient clinics, physicians with 8–16 outpatient working hours per week were more likely to be assigned in to the "low (RRR = 2.001, $p = 0.035$), medium (RRR = 2.468, $p < 0.001$), or high (RRR = 1.881, $p = 0.006$) workload groups", and physicians who worked no more than 8 h in outpatient practice were more likely to belong to the "medium

TABLE 4 | Multinomial logistic regression results: significant determinants of latent subgroups of physician workload tethered to non-physician-patient communication work tasks characterized by paperwork during outpatient encounters (base outcome = "very high workload group").

Variables	Low workload group		Medium workload group		High workload group	
	RRR (95% CI)	*p*-value	RRR (95% CI)	*p*-value	RRR (95% CI)	*p*-value
Age (ref: 20–30 years)						
31–40	**2.498 (1.189, 5.249)**	**0.016**	**2.061 (1.189, 3.572)**	**0.010**	**1.680 (0.988, 2.856)**	**0.056**
41–55	**2.923 (1.150, 7.429)**	**0.024**	**1.977 (0.976, 4.004)**	**0.058**	1.688 (0.858, 3.322)	0.129
>55	2.345 (0.542, 10.147)	0.254	1.223 (0.391, 3.886)	0.720	1.021 (0.339, 3.078)	0.971
Marital status (ref: unmarried)						
Married	**0.492 (0.244, 0.992)**	**0.047**	**0.592 (0.346, 1.014)**	**0.056**	0.801 (0.474, 1.355)	0.409
Divorced	N/A	N/A	N/A	N/A	N/A	N/A
Widowed	N/A	N/A	N/A	N/A	N/A	N/A
Educational level (ref: PhD)						
Postgraduate	0.711 (0.310, 1.634)	0.422	**0.458 (0.245, 0.859)**	**0.015**	0.775 (0.421, 1.431)	0.416
Undergraduate	0.604 (0.249, 1.463)	0.264	**0.386 (0.198, 0.753)**	**0.005**	**0.514 (0.268, 0.985)**	**0.045**
Junior college	2.499 (0.499, 12.502)	0.265	2.079 (0.541, 7.988)	0.286	0.858 (0.213, 3.459)	0.830
Other	N/A	N/A	N/A	N/A	N/A	N/A
Average monthly income (ref: 10,001–15,000 RBM)						
≤5,000	0.760 (0.351, 1.648)	0.488	**0.601 (0.337, 1.071)**	**0.084**	0.776 (0.447, 1.345)	0.366
5,001–10,000	0.712 (0.390, 1.301)	0.270	**0.639 (0.412, 0.992)**	**0.046**	**0.674 (0.442, 1.028)**	**0.067**
>15,000	1.426 (0.635, 3.202)	0.390	1.010 (0.538, 1.898)	0.974	1.290 (0.707, 2.355)	0.408
Working years in the current medical institution (ref: 1–5 years)						
6–10	**0.477 (0.249, 0.914)**	**0.026**	**0.583 (0.358, 0.950)**	**0.030**	0.786 (0.489, 1.265)	0.322
11–15	0.641 (0.294, 1.397)	0.263	0.688 (0.376, 1.260)	0.226	1.125 (0.627, 2.020)	0.693
16–20	**0.294 (0.117, 0.741)**	**0.009**	**0.335 (0.168, 0.668)**	**0.002**	0.632 (0.329, 1.214)	0.168
>20	0.473 (0.181, 1.235)	0.126	**0.523 (0.248, 1.104)**	**0.089**	0.838 (0.407, 1.724)	0.631
Area (ref: central China)						
Eastern China	**0.600 (0.353, 1.018)**	**0.058**	0.886 (0.595, 1.318)	0.549	**0.707 (0.484, 1.032)**	**0.073**
Western China	0.694 (0.399, 1.207)	0.196	0.880 (0.579, 1.338)	0.550	0.757 (0.507, 1.130)	0.173
Hospital level (ref: tertiary B hospital)						
Tertiary A hospital	1.445 (0.685, 3.050)	0.334	1.146 (0.659, 1.992)	0.630	**1.645 (0.962, 2.814)**	**0.069**
Secondary hospital	1.376 (0.619, 3.059)	0.433	1.604 (0.890, 2.889)	0.116	**1.810 (1.019, 3.217)**	**0.043**
First-tier hospital	0.851 (0.203, 3.568)	0.825	0.570 (0.169, 1.926)	0.365	0.571 (0.165, 1.983)	0.378
Hospital nature (ref: public general hospital)						
Public specialized hospital	**2.735 (1.013, 7.386)**	**0.047**	**2.031 (0.881, 4.684)**	**0.096**	1.687 (0.738, 3.857)	0.215

(Continued)

TABLE 4 | Continued

Variables	Low workload group		Medium workload group		High workload group	
	RRR (95% CI)	p-value	RRR (95% CI)	p-value	RRR (95% CI)	p-value
Private general hospital	N/A	N/A	N/A	N/A	N/A	N/A
Private specialized hospital	N/A	N/A	N/A	N/A	N/A	N/A
Department (ref: obstetrics and gynecology)						
Internal	1.782 (0.837, 3.794)	0.134	**2.244 (1.288, 3.910)**	**0.004**	**2.091 (1.237, 3.537)**	**0.006**
Surgical	0.994 (0.432, 2.288)	0.989	1.654 (0.901, 3.037)	0.104	**1.687 (0.948, 3.002)**	**0.075**
Pediatrics	1.558 (0.541, 4.489)	0.412	**2.974 (1.405, 6.295)**	**0.004**	**3.061 (1, 508, 6.213)**	**0.002**
Other	1.804 (0.829, 3.924)	0.137	**2.281 (1.272, 4.089)**	**0.006**	**2.288 (1.315, 3.980)**	**0.003**
Working hours per week (ref: >60)						
≤40	**6.243 (2.558, 15.240)**	**<0.001**	**5.639 (2.630, 12.091)**	**<0.001**	**3.160 (1.485, 6.722)**	**0.003**
41–60	**2.510 (1.574, 4.001)**	**<0.001**	**2.176 (1.556, 3.045)**	**<0.001**	**1.632 (1.187, 2.244)**	**0.003**
Outpatient working hours per week (ref: 16–24)						
≤8	1.473 (0.820, 2.648)	0.195	**1.799 (1.177, 2.750)**	**0.007**	1.428 (0.955, 2.136)	0.083
8–16	**2.001 (1.049, 3.815)**	**0.035**	**2.468 (1.543, 3.946)**	**<0.001**	**1.881 (1.204, 2.939)**	**0.006**
24–40	1.820 (0.883, 3.751)	0.105	1.268 (0.712, 2.258)	0.421	**1.650 (0.962, 2.30)**	**0.069**
>40	1.046 (0.490, 2.233)	0.908	0.944 (0.540, 1.652)	0.841	0.927 (0.548, 1.566)	0.777
Number of outpatients serviced per day (ref: 26–40)						
<25	0.982 (0.552, 1.746)	0.950	**1.508 (0.966, 2.355)**	**0.071**	1.074 (0.696, 1.657)	0.746
41–50	0.674 (0.371, 1.226)	0.196	0.796 (0.502, 1.263)	0.333	0.776 (0.500, 1.204)	0.258
>50	**0.421 (0.223, 0.795)**	**0.008**	**0.579 (0.362, 0.925)**	**0.022**	0.712 (0.456, 1.110)	0.134
Amount of time spent per patient (ref: 10–15 min)						
≤5	1.768 (0.867, 3.607)	0.117	**1.991 (1.169, 3.391)**	**0.011**	**1.812 (1.087, 3.020)**	**0.023**
5–10	**1.748 (0.924, 3.309)**	**0.086**	**1.773 (1.099, 2.860)**	**0.019**	**1.616 (1.022, 2.553)**	**0.040**
>15	1.178 (0.488, 2.841)	0.715	1.475 (0.771, 2.822)	0.241	1.613 (0.863, 3.016)	0.134
Self-assessed health status (ref: good)						
Very poor	N/A	N/A	N/A	N/A	N/A	N/A
Poor	0.460 (0.182, 1.163)	0.101	**0.373 (0.181, 0.766)**	**0.007**	0.679 (0.351, 1.314)	0.250
Fair	**0.487 (0.298, 0.796)**	**0.004**	**0.522 (0.359, 0.758)**	**0.001**	**0.658 (0.459, 0.942)**	**0.022**
Very good	0.703 (0.371, 1.335)	0.282	**0.577 (0.347, 0.960)**	**0.034**	**0.478 (0.290, 0.789)**	**0.004**
Self-assessed outpatient satisfaction (ref: high)						
Low	N/A	N/A	N/A	N/A	N/A	N/A
Fair	**3.569 (1.845, 6.904)**	**<0.001**	**2.981 (1.721, 5.164)**	**<0.001**	1.394 (0.802, 2.425)	0.239

RRR, relative risk ratio; CI, confidence interval; ref, reference group; N/A, not applicable. The bold values indicate significant, and could help the readers quickly find the significant factors.

workload group" (RRR = 1.799, p = 0.007) as compared with the odds of the "very high workload group".

Physicians who saw more than 50 outpatients per day were less likely than those with 26–40 outpatients serviced per day to be assigned into the "low (RRR = 0.421, p = 0.008) or middle (RRR = 0.579, p = 0.022) workload groups". For amount of time spent per patient, the odds of belonging to the "very high workload group" increased with the time that the participating physicians spent on per patient; compared to those with 10–15 min spent per patient, physicians with no more than 5 min or 5–10 min spent per patient were more likely to be assigned into the "medium (RRR = 1.991, p = 0.011; RRR = 1.773, p = 0.019, respectively) or high (RRR = 1.813, p = 0.023; RRR = 1.616, p = 0.040, respectively) workload groups" as compared with the odds of the "very high workload group". For self-assessed health status, physicians with worse self-assessed health status were more likely to belong to the "very high workload group"; compared to those with good health status, physicians who rated health status as "fair" were less likely to be assigned into the "low (RRR = 0.703, p =.004), medium (RRR = 0.522, p = 0.001), or high (RRR = 0.658, p = 0.022) workload groups", and physicians who rated health status as poor were also less likely to be assigned into the "medium workload group" (RRR = 0.373, p = 0.007). Moreover, physicians who rated outpatient satisfaction as "fair" were more likely than those who rated outpatient satisfaction as "high" to belong to the "low (RRR = 3.569, p < 0.001) or medium (RRR = 2.981, p < 0.001) workload groups" as compared with the odds of the "very high workload group".

Therefore, according to the results of multinomial logistic regression analysis, compared with the other latent workload groups, physicians belonging to the "very high workload group" were more likely to be younger, married, those who had worse health status, lower educational levels and lower average monthly incomes, those who were from Eastern China, and worked more years in the current institution, more hours per week and longer outpatient hours per week, and those who worked in public general hospitals, tertiary B hospitals and Obstetrics and Gynecology, and saw more than 50 outpatients per week with more time spent on per patient, but with high outpatient satisfaction.

DISCUSSION

Principal Findings

Overall, Chinese physicians reported medium levels of workload while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters. In this study, we identified four distinctive latent workload classes (that is, workload subgroups) among Chinese physicians: 15.1% were identified as very high workload physicians, compared with 8.8% as low workload physicians, 34.0% as medium workload physicians, and 42.1% as high workload physicians. This is a result of the combined effect of the six dimension indicators of physician workload. The "very high workload group" contributed disproportionally across all the six dimension indicators. Previous studies usually identified individuals with high workload among the evaluated physicians using single

workload indicators (49) through the quartiles (50), or threshold values for workload [e.g., 50% of overall workload (51), >55 (12), or >60 (52) of NASA-TLX composite workload scores].

This study further showed that great variations in the latent workload subgroups among Chinese physicians across demographic characteristics exist. Compared with the other latent workload groups, physicians who were younger, married, those who had worse health status, lower educational levels and lower average monthly incomes, those who worked more years in the current institution, more hours per week and longer outpatient hours per week, those who worked in public general hospitals, tertiary B hospitals and Obstetrics and Gynecology, and those who saw more than 50 outpatients per day with more time spent on per patient were more likely to belong to the "very high workload group", while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters.

Comparison With Prior Work

Level of Physician Workload Tethered to Paperwork

To the best of our knowledge, this is the first survey study to investigate the level of physician workload tethered to non-physician-patient communication work tasks characterized by paperwork during outpatient encounters and further explore its latent subgroups among Chinese physicians and identify the differences between the subgroups across demographic characteristics. Existing studies often simply adopted several objective workload indicators (e.g., work time, and the number of patient seen) for physician workload assessments in China (11), and currently, in China Health Statistics Yearbook, physicians' workloads were generally counted and measured using the average daily number of outpatients and average number of hospital beds per day that an physician undertakes (7); and none of them have examined the physician workload tethered to paperwork during outpatient encounters, whereas internationally current studies regarding the clerical burden of physicians have focused on the effect of adoption of electronic health records on physician workload (43–46).

Our study found that the total mean score of workload physicians perceived was 62.92 (SD = 14.70), and the latent workload subgroups by LPA showed that the total mean physician workload score in the "very high workload group" was 80.82 (SD = 12.08), indicating a high level of physician workload tethered to non-physician-patient work tasks characterized by paperwork during outpatient encounters, whereas lower levels of physician workload tethered to the adoption of electronic health records were reported not only in the study conducted by Pollack et al. (range 29.1–48.5) (44) but also in another study of Mazur et al. (53 ± 14/49 ± 16) (45). The possible reason for this difference might be due to that although all were related paperwork, detailed work tasks with different natures or aspects (e.g., detailed content and scopes of work tasks involved) might result in different cognitive demands and resources demands, thereby leading to different levels of workload. Another possible reason might be relevant to the fact that according to the definition of mental workload [that is, mental workload can be defined as the amount of cognitive resources used per unit time

to reach the performance required by the task (57)], even if the same work task, different completion times require different levels of cognitive resources, and the shorter the time required to complete the task, the higher the mental resources required, whereas the time of access to completion of the non-physician-patient communication work tasks characterized by paperwork during outpatient encounters is rather limited (<2 min) (33), therefore resulting in a higher level of physician workload in this study. Moreover, as the survey in this study was conducted during the COVID-19 pandemic, indicating that physicians could serve fewer outpatients than normal in the outpatient clinics, the assessed results of physician workload tethered to paperwork might be lower than before the normal, thereby resulting in an underestimated difference compared to above previous studies. Therefore, hospital managers should consider paying more attention to work burden for physicians resulting from the non-physician-patient communication work tasks characterized by paperwork during outpatient encounters.

Although electronic health record is expected to improve the quality of health care, the use of electronic medical records is found to be associated with increased physician workload reported in several studies (45, 58, 59), resulting in an increased risk for burnout and less time available to spend with patients (42). With the widespread use of the electronic health records, it's generally critical that physician-patient interaction is maintained and clerical burden is minimized. Chinese physicians general work alone and handle all the related paperwork by themselves during outpatient encounters and only very senior physicians who have an assistant at their sides receive any help with these procedures (such as recording medical history using electronic health records system and issuing prescriptions on the computer) (32), and China has promoted and accelerated nationwide adoption of electronic health records in hospitals for more than a decade (60), thereby increasing the clerical burden for younger physicians in outpatient clinics, which contributed to the overall higher physician workload in this study than that reported in previous studies (44, 45), indicating a higher risk for burnout in Chinese physicians. Therefore, hospital managers should pay attention to the effect of the paperwork burden during outpatient encounters on physician burnout.

Identification of the Latent Subgroups of Physician Workload Tethered to Paperwork During Outpatient Encounters

In this study, four distinctive latent workload subgroups among Chinese physicians tethered to paperwork during outpatient encounters were identified through the LPA. Great variations in the overall workload score and its six dimensions scores across the four groups were revealed. The gap in the physician workload scores reached 2.15 times between the "very high and low workload groups" [80.82 (SD = 12.08) vs. 37.55 (SD = 8.16)], when significant differences in both total physician workload score and its dimensions scores were all found between different workload subgroups. These findings suggest a reliable and valid grouping for physician workload tethered to the non-physician-patient communication work tasks characterized by paperwork during outpatient encounters. However, no previous

research has explored and identified the latent subgroups of physician workload tethered to paperwork during outpatient encounters, although some studies have identified the patterns or subtypes of mental workload among pandemic frontline medical workers during the COVID-19 pandemic (18, 53), as well as physicians in outpatient practice (54). A previous study on the mental workload level of physicians in outpatient practice since the normalization of prevention and control of the COVID-19 pandemic in China revealed that the latent profile analyses identified three different subtypes of physicians in their mental workload tethered to communication work tasks characterized by direct patient interaction in outpatient clinics (54). These findings suggest that different types of work tasks might lead to different latent subgroups of physicians in their workload, respectively, and therefore, we suggest that hospital managers should consider from the task level strengthening the management of physicians' workload, thereby possibly resulting in a better outcome.

Internationally, there is lack of consensus on what should be considered as a threshold value for a high or excessive workload (47, 48), and therefore, in a medical culture of outpatient clinics that provides only limited time for physician and patient interactions, how to identify and determine individuals with high workload within a specific group is still an important research topic for hospital managers to, in turn, take targeted interventions to effectively increase the time available for direct interaction with patients, therefore improving the quality of medical services. Previous research tends to identify individuals with high workload among the evaluated physicians by using single workload indicators (49) through the quartiles (50), or threshold values for workload [e.g., 50% of overall workload (51), >55 (12), or >60 (52) of NASA-TLX composite workload scores]. As noted in the Introduction, compared to such kind of study based on "variable-centered" methods with human interferences on identification of physicians with high workload (12, 49–52), LPA can provide a methodology to group individuals who share similar patterns of personal and professional characteristics, traits or behaviors into subtypes based on a set of workload indicators and further relatively distinguish workload among the different subgroups, where there is no need to set threshold values for workload for identifying individuals with high workload (18, 54). Therefore, the evaluated results by LPA can be more easily accepted by physicians as well as hospital managers, and can also help identify individuals with high workload who would otherwise be missed in single workload indicators.

The LPA analysis further indicated that 15.1% of Chinese physicians experienced the highest level of workload tethered to non-physician-patient communication work tasks characterized by paperwork during outpatient encounters in this study, whereas a higher share of physicians (33.8%) with the highest level of mental workload tethered to physician-patient communication work tasks in outpatient clinics was reported in the previous research (54). For physicians with limited resources, a higher workload tethered to non-physician-patient communication work tasks might mean that fewer both cognitive and time resources were available for physician-patient communication during outpatient encounters, ultimately

resulting in further poorer quality of communication with patients, lower work performance of physicians and even adverse effects on the physician-patient relationship (34). There exist several approaches, such as physician assistants, nurses and medical scribes, to lighten the paperwork burden for physicians and increase efficiency, resulting in increased time for their interaction with patients, and improved quality of patient care, patient satisfaction and safety (36, 38, 61).

Given that China is still in a great demand for professional health workers (62), and it is therefore difficult to have sufficient human resources in a short time for assistant supports to reduce clerical burden for all physicians, how to efficiently utilize the limited human resources to improve the quality of physician-patient interactions during outpatient encounters while improving the clerical burden for physicians is of great concern to hospital managers. Our findings suggest that hospital mangers should consider these physicians belonging to the "highest workload group" as individuals who need interventions in priority to, in turn, increase the time and cognitive resources available for their interaction with patients during outpatient encounters, thereby resulting in improved quality of physician-patient communication, and a decreased risk for physician burnout, while lightening physician workload tethered to paperwork during outpatient encounters. Moreover, such a strategy should be based on the identification of the characteristics of individuals with high workload among the evaluated physicians.

Differences in the Latent Subgroups of Physician Workload by Characteristics

Previous studies have not yet revealed the association of demographic variables and the subgroups of physician workload tethered to paperwork during outpatient encounters (40–46). Our findings further indicated the characteristics of the different latent workload subgroups among Chinese physicians tethered to non-physician-patient communication work tasks characterized by paperwork during outpatient encounters, which can provide more targeted guidance for accurately determining individuals with high workload among the evaluated physicians, and therefore further develop targeted interventions for individual differences across physicians to increase the time and cognitive resources available for their interaction with patients while lightening physician workload tethered to paperwork during outpatient encounters. Among the four latent workload subgroups, the "very high workload group", where physicians had relatively highest level of task load but with the most successful performance of the task, was also referred to as the "very high workload perception & very high self-evaluation group", as these individuals tended to be younger, married, those who had worse health status, lower educational levels and lower average monthly incomes, those who worked more years in the current institution, more hours per week and longer outpatient hours per week, those who worked in public general hospitals, tertiary B hospitals and Obstetrics and Gynecology, and those who saw more than 50 outpatients per week with more time spent on per patient, but with high

outpatient satisfaction. These results were partly supported by the findings of a previous study regarding relationship between physician-perceived electronic health record usability and physician workload that being married and more working hours per week were all significantly associated with higher physician workload (63), and another study regarding the relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction that more working hours per week was associated with lower physician satisfaction with clerical burden (37). Moreover, some results were also consistent with the finding of the study of Melnick et al. that being older was associated with lower physician workload (64), but inconsistent with the finding of the study of Shanafelt et al. that being older was associated with lower physician satisfaction with clerical burden (37). One possible reason for this difference might be relevant to the fact that younger physicians in China tend to have lower professional titles, thereby undertaking general outpatient services with a greater number of patients, and generally work alone in the outpatient clinic without an assistant for the related paperwork (except for the very senior ones, who have assistants) but with increasing use of electronic health records, thereby resulting in increased paperwork burden during outpatient encounters.

Our study also indicated that compared to those in tertiary A hospitals, physicians in tertiary B hospitals tended to have a higher level of workload tethered to paperwork during outpatient encounters; one possible explanation was that Chinese physicians in higher-level hospitals, although tended to undertake more outpatient visits (10), might gain more supports from assistants or more optimized outpatient doctor workstation for the related paperwork in outpatient practice, thereby optimizing their workload. Our research also found that being worse health status was associated with higher levels of workload tethered to paperwork during outpatient encounters. This is not surprising since that physicians' health is highly associated with their workload, and excessive workload contributes to poorer wellness of physicians reported in previous studies (10, 11). Thus, hospital managers should attach great importance to the impact of physician workload tethered to paperwork during outpatient encounters on their health. Previous research also revealed that increased paperwork burden has adversely affected quality of health service delivery (40) and become one of the important risk factors resulting in physician burnout (41, 42). These findings suggest that hospital managers should consider paying more attention to physicians belonging to the "very high workload group", monitoring their workload in real time and taking measures to strengthen the management of their workload tethered to paperwork outpatient encounters to prevent and reduce the adverse effects of paperwork burden during outpatient encounters on the quality of physician-patient interactions, as well as to lighten their workload, thereby resulting in a decreased risk for burnout and achieved better job performance in outpatient practice. Furthermore, when further drawing insight into all work tasks performed by physicians to provide complete medical services to outpatients, we need further consider the level of physician

workload tethered to physician-patient communication work tasks during outpatient encounters. That is, among the physicians belonging to the "very high workload group" as individuals who need interventions in this study, we need further identify and select these physicians who also have high levels of workload tethered to physician-patient communication work tasks during outpatient encounters as individuals who are intervened in priority finally. Such an outcome could more effectively decrease the risk for physician burnout and further achieve higher performance for the healthcare organizations when improving the quality of physician-patient interactions during outpatient encounters.

Moreover, when gaining insight into the impending issues the current health care system is facing in China, these existing issues, such as the hierarchical diagnosis and treatment system of China has not yet achieved effective triage of patients, whereas Chinese patients can freely choose a hospital for a visit, and still tend to go to high-level hospitals even for mild symptoms owing to their lack of confidence in the quality of health care provided in primary hospitals (10, 28), as well as the ever-increasing patient demands for health services but with lack of a proportional growth in the number of high-quality physicians, may be the root cause of unbalanced workload among physicians from different levels of hospitals, especially in high-level hospitals, where they tend to have an increasingly heavier outpatient workload. The key to balancing the workload among physicians from different levels of hospitals is to build an effective triage of Chinese patients. Therefore, policy makers should strengthen the construction of primary hospitals and improve service capabilities to, in turn, enhance patients' confidence in prioritizing the use of medical services in primary hospital and thereby promote the further development of the hierarchical diagnosis and treatment system of China to achieve effective triage of Chinese patients. Such an outcome based on the improvement of the external environment would help fundamentally ease the workload of physicians, especially in high-level hospitals.

LIMITATIONS

This study was an early study investigating the level of physician workload tethered to non-physician-patient communication work tasks characterized by paperwork during outpatient encounters, and further identifying individuals with high workload among physicians. However, there are several limitations to be mentioned in this study. First, although stratified convenience sampling was primarily used to recruit physicians nationwide in China, because of the impact of the COVID-19 pandemic, we only employed an online questionnaire platform to collect data, and lower responsiveness was received in some selected hospitals, which may have limited the generalizability of our conclusions, and therefore, a unique two-dimensional code of the electronic questionnaire for each selected hospital was generated, and the outpatient managers in each selected hospital were invited to play the role of the project manager in their hospitals in this questionnaire survey. Second,

data collection was self-reported by participating physicians via online survey, and therefore, there was no guarantee that the participating physicians filled out the questionnaire just after finishing the provision of the outpatient services in outpatient practice, which may result in a recall bias and thereby impact the generalizability of our conclusions, and therefore, we would extend our study by conducting survey on site in the future, where some variables (e.g., number of outpatients serviced per day, amount of time spent per patient, and outpatient satisfaction) could be measured by observations or by computer time spent on per patient averagely.

CONCLUSION

Overall, Chinese physicians reported medium levels of workload while performing non-physician-patient communication work tasks characterized by paperwork during outpatient encounters. There exit four latent workload subgroups among physicians tethered to paperwork during outpatient encounters (named "low workload group", "medium workload group", "high workload group" and "very high workload group") along with great individual variations among these subgroups. The characteristics of the latent "very high workload group" can help permit more targeted guidance for developing interventions with optimized human resource allocation to increase the time available for direct interaction with patients, thereby improving the quality of medical services and patient satisfaction during outpatient encounters, while lightening their paperwork burden and decreasing the risk for burnout. Therefore, we suggest that hospital managers should consider these physicians belonging to the highest workload group as individuals who need interventions in priority during outpatient encounters. Moreover, we also suggest that hospital managers should consider from the task level strengthening the management of physicians' workload, thereby possibly resulting in a better outcome. Furthermore, policy makers should promote the further development of the hierarchical diagnosis and treatment system of China to achieve effective triage of Chinese patients and thereby balance the workload among physicians from different levels of hospitals.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on a reasonable request. Requests to access the datasets should be directed to hyh288@hotmail.com.

ETHICS STATEMENT

Ethics approval was obtained from the Ethics Committee of Tongji Medical College of Huazhong University of Science & Technology (No. IORG0003571). All the survey data were kept confidential and anonymous.

AUTHOR CONTRIBUTIONS

YH designed the study, obtained funding, and participated in the collection. DL contributed to the design of this study, the acquisition, analysis, interpretation of survey data, and drafted the manuscript. SLi and CL participated in the data cleaning. SLi, CL, and YH performed revisions of the manuscript. SLi, CL, JL, and JZ contributed to the interpretation of the results. YZ, JL, JZ, and SLu were involved in data cleaning. All authors have read and approved the final version of the manuscript.

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Levels of Burnout and Its Determinant Factors Among Nurses in Private Hospitals of Addis Ababa, Ethiopia, Ethiopia, 2020. A Multi Central Institutional Based Cross Sectional Study

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Background: Burnout among nurses is a significant problem in healthcare establishments and has negative implications on clinical outcomes. International studies have shown the prevalence of burnout ranged from 10 to 70%. However, this is unknown among nurses in private hospitals in Addis Ababa. The study was intended to assess the levels of burnout and the associated factors among nurses working in private hospitals in Addis Ababa, Ethiopia, 2020.

Methods: An institution-based cross-sectional study was used. A probability sampling, specifically, a simple random sampling technique was employed to collect data, and the Maslach burnout inventory human services survey (MBI-HSS) instrument was adapted to measure the levels of burnout. The data obtained was edited manually and entered into EPI-data version 4.6 and then exported to SPSS version 25 for analysis. Logistic regression was used to identify the association between the dependent and independent variables and variables with $p < 0.25$ on bivariate analysis were taken into multivariate logistic regression, and then variables with $p < 0.05$ were considered statistically significant.

Result: A total of 385 questionnaires were distributed to participants, but only 368 (96%) of them were collected and included in this study. The majority 56% and 69.8% of them were females and belonged to the age group of 20–29 years, respectively. Two hundred seven (56.5%) of them reported suffering from a high level of burnout. In the multivariate logistic regression analysis, night duty shift [AOR = 2.699; 95% CI: (1.043–6.987)], excessive workload [AOR = 6.013; 95% CI: (3.016–11.989)], staff

shortage [AOR = 6.198; 95% CI: (3.162–12.147)], persistent interpersonal conflict [AOR = 2.465; 95% CI: (1.225–4.961)], and nurses' poor health status [AOR = 3.4878; 95% CI: (1.815–8.282)] demonstrated a statistical significant association with the professional burnout.

Conclusions and Recommendations: Nurses' burnout in private hospitals of Addis Ababa was highly prevalent. Therefore, ensuring adequate staffing and minimizing the workload of nurse professionals are mandatory to prevent it.

Keywords: burnout syndrome, nurses, Maslach burnout inventory, Ethiopia

INTRODUCTION

Burnout is conceptualized as a psychological syndrome that occurs in response to interpersonal stressors in the work environment. It is an individual-level phenomenon and can be viewed as a negative emotional experience which is a chronic, ongoing affective response (1). Burnout syndrome does not have immediate manifestations, but appears as a gradual reaction of emotional breakdown due to the prolonged exposure to stress factors, which leads to an increase in dehumanization levels and professional dissatisfaction (2).

Nursing burnout is more likely related to job demands, and burned out health professionals believed that their objectives are not achieved, which is accompanied by physical depletion, feelings of helplessness, disillusionment, decreased motivation, dysfunctional behavior, negative self-concepts, and negative attitudes toward work and life itself. To prevent further energy depletion, employees distance themselves mentally from their work by developing depersonalizing attitudes. Due to this reason, their work performance tends to diminish and they may feel incompetent and in efficacious, leading to a decrease in the quality of the health care facilities, which ultimately affects the satisfaction of the patient. Most of the time, burnout can occur due to a widening gap between the individual and demands of the job (3).

Burnout can affect every occupation. However, it is thought to be more prevalent among human professionals as the services offered by them are in response to the needs of the society. Among health professionals, professional nursing, in particular, is a service for the promotion of human and social welfare. Comparatively, nurses are the first line of contact; they spend the most time with patients and are constantly exposed to the emotional strains of dealing with the sick and dying. Such stressors when left unchecked lead to burnout. Burnout syndrome among nurses in hospitals has become a worldwide phenomenon that negatively impacts the quality of care, safety of patients and working staff. An estimated range of 10–70% of nurses are affected by burnout throughout the world (4, 5).

Abbreviations: AA, Addis Ababa; B.Sc, Bachelor of Science; BOS, Burnout Syndrome; CNE, Continuous Nursing Education; DP, Depersonalization; ED, Emergency Department; EE, Emotional Exhaustion; ICU; Intensive Care Unit; MBI-HSS, Maslach's Burnout inventory Human Service Survey; M.Sc., Master of Science; NGO, Non-Governmental Organizations; SPSS, Statistical Package for Social Sciences; USA, United States of America.

In a multi-country, cross-sectional study conducted in 10 European countries among staff nurses, high levels of burnout were reported in England (42%) and low levels of burnout were in Switzerland (15%) (6). Moreover, nurses' burnout is a real concern in African hospitals. A high prevalence rate of burnout, around 70%, was reported in Senegal and Malawi. In Tunisia, two nurses out of three are affected by burnout, while in Morocco it affects one in every two nurses working in hospitals (7). Nurses' burnout has led to emotional exhaustion as well as a loss of compassion for others (depersonalization) and a sense of low personal accomplishment due to the presence of job demands like heavy work overload; lack of social support from management, supervisor, or colleagues; limited promotion; nurse–patient ratio imbalance; confronting with the death of patients; shift work; and being underpaid (1).

Burnout has been associated with reduced organizational efficiency and work-related problems such as low morale, poor quality of care, lowered productivity, absenteeism, interpersonal problems, and employee turnover (6). A 10% increase in nurse's turnover results in a 9.4–17.4% increase in the discharge death rate due to nurse burnout (8). The above situation may lead to such an extent that can affect the reputation of the health care facilities because, in most cases, health care facilities are evaluated by communities through the quality of health care they provide and the trust that can be placed into its professionals.

Despite the existence of numerous studies conducted in Ethiopia on the prevalence and associated factors of burnout among nurses who are working in public hospitals, as far as our knowledge, there is found a lack of studies conducted in private hospitals in Addis Ababa administration. Although the healthcare industry in Addis Ababa expanded drastically, this expansion has taken place mostly in the private sector. Many hospitals are established throughout the city which opened employment opportunities for the professionals in large numbers, but at the same time could not meet the demand of the number of hospitals required to provide better services to the people at large. In private hospitals, a high number of patients is seen in every hospital from morning till late evenings and this increases the number of duties of the nursing staff because most of the private hospitals in Addis Ababa cover many tasks with the minimum number of nurses. The current duty shift during data collection period was alternate, day, night. In our study, the nurses perception about the presence of work-load burnout was 79.7%. The variation of burnout across the various nursing

disciplines/departments were the nurses' perception about the presence of work load, nurses' perception about the presence of nursing staff shortage, the presence of persistent interpersonal conflicts, nurses' perception about the management of their organization's support nursing staff, whether or not they got any professional recognition, respect, or reward from their hospital administrator. The information from the study result provided input for the planner and policymaker to consider the extent of the problem and develop a well-standardized guideline and policy to tackle the problems that cause burnout among nurses to improve its work-related consequences. To address the gap in the research for various health care institutions, the study was intended to assess burnout syndrome and its determinant factors among nurses in private hospitals of Addis Ababa, Ethiopia.

METHODS AND MATERIALS

Study Area and Period

The study was conducted at private hospitals in AA city. Addis Ababa is the capital city of Ethiopia and seat of the Africa Union. It is the largest city in Ethiopia, with a population of 3,475,952 according to the 2007 population census with an annual growth rate of 2.7%. In Addis Ababa, there are around 40 private hospitals that provide health care services not only for Addis Ababa residents but also serve as referral facilities for the nation. Out of these ten hospitals (Korea Hospital, Nordic Hospital, T/Haymanot Hospital, Haleluya Hospital, Bethezatha Hospital, Kadisco Hospital, Yerer Hospital, Addis Hiwot Hospital, Landmark Hospital, and Girum Hospital) were selected for this study, and data collection working units were ward (inpatient department), intensive care unit, emergency department, outpatient department, and operation Room. The study was conducted from 1 November to 30 December 2019.

Study Design and Participant's Characteristics

An institutional based cross-sectional study was employed. For this study, the source population was all nurses who are working in Addis Ababa private hospitals. The study population was all nurses who are working in different departments in selected private hospitals of Addis Ababa, which fulfill the inclusion criteria. All nurses who are assigned in the departments with work experience of 12 months and above were included in this study.

Sample Size Determination and Sampling Procedure

To determine the sample size, the following assumption was used. Prevalence and determinant factors of nurse's burnout were taken from a previous related study which is 54.8%, with confidence levels 95%, and 5% margin of error (9).

$$n = \frac{(1.96)^{2*} 0.548 \ (1 - 0.548)}{(0.05)^2}$$

where $n = 380.6 \approx 381$. Since the total population was 4,273 nurses, which is <10,000, we used the correction formula: nf = $\frac{ni}{1+\frac{ni}{N}}$, where; nf = final sample size, ni = initial sample size, N = total population (10, 11). Applying the values, nf = $\frac{381}{1+\frac{381}{4273}}$, $n = 349.8 \approx 350$.

The non-response rate (absenteeism and refusal) was taken to be 10% using previous related research response rate = 350*0.1 = 35, then (350 + 35), the final sample size was 385. To achieve the representativeness of the study participant simple random sampling technique was employed to draw the sample size from 40 private hospitals currently functioning in Addis Ababa. Due to the scarcity of resources, only ten hospitals were selected by the lottery method and considered to participate in the study. The ten hospitals were (Korea hospital 248 nurses, Nordic hospital 101 nurses, T/Haymanot hospital 88 nurses, Halelujah hospital 104 nurses, Bethzatha hospital 51 nurses, Kadisco hospital 86 nurses, Yerer hospital 65 nurses, Adishiwot hospital 43 nurses, Landmark hospital 47 nurses, and Girum hospital 91 nurses). Then the final sample was selected from the respective hospitals by using proportional to size allocation formula:

$$\frac{ni^* nf}{N}$$

where; ni: number of nurses in each selected hospital, nf: final sample of the study, N: total number of nurses in the selected hospitals.

Korea hospital = 248*385/924 = 103, Nordic hospital = 101*385/924 = 42, T/Haymanot hospital = 88*385/924 = 37, Halelujah hospital = 104*385/924 = 43, Bethzatha hospital = 51*385/924 = 21, Kadisco hospital = 86*385/924 = 36, Yerer hospital = 65*385/924 = 27, Addis Hiwot hospital = 43*385/924 = 18, Landmark hospital = 47*385/924 = 20, Girum hospital = 91*385/924 = 38.

Then systematic sampling was performed to select samples from each hospital by using the formula K = N/n, where N: the population sample size in the selected hospital, n: required sample size, and K: interval.

Korea hospital = 248/103 = 2.4 ≈ 2, Nordic hospital = 101/42 = 2.4 ≈ 2, T/Haymanot hospital = 88/37 = 2.37 ≈ 2, Halelujah hospital = 104/43 = 2.42 ≈ 2, Bethzatha hospital = 51/21 = 2.43 ≈ 2, Kadisco hospital = 86/36 = 2.39 ≈ 2, Yerer hospital = 65/27 = 2.41 ≈ 2, Adishiwot hospital = 43/18 ≈ 2, Landmark hospital = 47/20 = 2.35 ≈ 2, and Girum hospital = 91/38 = 2.39 ≈ 2. Therefore, the selection was every second unit in the population in each hospital from the nurse's roster.

Data Collection Method and Procedure

Data were collected through 24 h, both in working time and night duty time. Data collection was conducted by the trained data collectors and the supervisor. Training was given to data collectors and supervisors for 1 day. Two B.Sc. data collectors and one M.Sc. supervisor were recruited based on previous experience of data collection. After identifying the study subjects, informed consent was obtained to confirm willingness, and

confidentiality was ensured to all the study subjects and the self-administered structured questionnaire was administered. Non-respondents were encouraged to fill in the questionnaire and were revisited at least twice. The respondents were encouraged to respond to all items in the questionnaire within the time they devoted as much as possible to minimize a large non-response rate.

Data Collection Tool

A self-administered standardized questionnaire was adapted by the principal investigator after reviewing different related literature. The questionnaire has two sections that is used to obtain information relevant to the study: the first section asked about participant's personal information which includes sociodemographic, work related, and organizational related factors of an individual. The second section was a standard question used to assess the levels of burnout, the English version of Maslach's Burnout Inventory Human Services Survey (MBI-HSS), which comprises 22 items regrouped into 3 sub-scales: emotional exhaustion (EE; nine items), depersonalization (DP; five items), and personal accomplishment (PA; eight items). Each item was answered on a 7-point Likert scale ranging from "never" (=0) to "daily" (=6). The results of the inventory consisted of three separate scores, one for each factor or subscale. A combination of high scores on EE and DP, and a low score on PA, were considered to correspond to a high level of burnout. Scores were considered high if they are in the upper third of the normative distribution, middle if they are in the middle third, and low if they are in the lower third. The MBI-HSS was a self-administered questionnaire, which has been reliable (reported 0.83 with a Cronbach's alpha method) in the pretest.

Study Variables
Dependent Variable
Burnout syndrome.

Independent Variables
Sociodemographic characteristics: age, sex, marital status, educational qualification, years of work experience, salary/wages.

Work-related factors: work load, working unit, inter-personnel conflict, and night shift duty.

Organizational factors: lack of management support, lack of professional recognition, respect, or reward, and personal/material resources.

Measurements of Variables
Emotional exhaustion: low ($\leq$16), moderate (17–26), high ($\geq$27).

Depersonalization: low ($\leq$6), moderate (7–12), high ($\geq$13).

Personal accomplishment: low ($\leq$31) moderate (32–38), high ($\geq$39) (9).

Operational Definition
Burnout: It is a psychological condition characterized by emotional exhaustion (EE), depersonalization (DP), and low personal achievements (LPA) (12).

Emotional exhaustion: Leading indicator of burnout and defined as feelings of fatigue and of being drained by one's work.

Depersonalization: The negative attitude toward and a dehumanizing treatment of one's clients in the workplace (having a negative view about their clients).

Low personal accomplishment: Reduced competence and achievements in one's work a feeling of lower capability in doing personal duties) (9).

High levels of burnout: High scores on emotional exhaustion (EE) and depersonalization (DP) subscales, and a low score on personal achievement (PA) subscale.

Moderate level of burnout: Represents burnout score an average number on three dimensions [emotional exhaustion (EE), depersonalization (DP) subscales, and personal achievement (PA) of subscale].

Low levels of burnout: Low scores on emotional exhaustion (EE) and depersonalization (DP) subscales, and a high score on personal achievement (PA) subscale (13).

Data Processing and Analysis
The data was checked for its completeness, cleaned, entered, and coded into EPI-data version 4.6 computer programs to minimize data entry errors. The data that are appropriate for analysis were exported to SPSS version 25 and the analysis was done. The outcome (dependent) variable was measured on a dichotomous scale and had multiple independent variables; it used logistic regression. Prior to performing regression analysis, data were checked for multicollinearity, normality, linearity, independence of residuals and outliers. No major violations of the assumptions of the regression analysis were found. Model adequacy was checked by omnibus tests of coefficients and Hosmer-Lemeshow goodness-of-fit test. The squared multiple correlation coefficients were 0.564, which was between zero (0) and one (1), and indicated that 56.4% of the variation in an outcome variable is explained by the variation in the predictor variables. To explain the study population in relation to relevant variables, descriptive statistics such as frequencies and percentages were calculated. The data were analyzed by using logistic regression with step-wise model selection method to identify the association between burnout and determinant factors. To control confounder, all predictors that have been associated with the outcome variable on bivariate logistic regression with a $p < 0.25$ were included in the logistic regression model of multivariate analysis and presented in the table. For all analysis a $p < 0.05$ is considered statistically significant in all the cases.

Data Quality Assurance
To maintain the reliability of the questionnaire, Cronbach's alpha test was done and reliability reported at 0.83, 0.76, and 0.80 for emotional exhaustion, depersonalization, and personal accomplishment sub-scale, respectively. The quality of data was assured through careful design and pretesting of the questionnaire. A pretest was conducted on 5% of the sample size on the same source population in Yordanos hospital. The result of the pretest was analyzed and modification was made prior to the actual data collection. A 1-day training was given for both the data collectors and supervisor on the objective of the study and methods of data collection. The supervisor and principal investigator closely followed the day-to-day data

collection process and ensured completeness and consistency of the collected questionnaires on a daily basis.

Ethical Consideration

Ethical clearance was obtained from the Ethical Review Committee of Debre Berhan University, Institution of Medicine and Health Sciences, College of Health Sciences prior to beginning of the study. A letter of cooperation to secure permission of access was given to the selected hospitals included in the study. After obtaining permission from the hospital directors and unit coordinators, informed (written) consent was obtained from the study subjects who have equal chance to participate in the study. To ensure the autonomy of the study participants, their willingness prior to their participation was confirmed after explaining the objective of the study. Information obtained from individual participants was kept secure and confidential. Names and other identifying data of respondents were made anonymous or eliminated throughout the study process to maintain confidentiality.

RESULTS

Socio-Demographic Characteristics of the Respondents

A total of 385 questionnaires were distributed to the nurses working in ten different private hospitals in different departments, three hundred sixty-eight (96%) participants responded to the questionnaires and were considered for the study. Two hundred six (56.0%) of the respondents were females. Majority (69.8%) of them belonged to the age group of 20–29 years. With respect to the respondent's marital status, 205 (55.7%) were single. With regard to their educational status, 291 (79.1%) were B.Sc. in nursing. The result illustrates that in regard to years of work experience of the respondents in their facilities, 152 (41.3%) had between 3 and 5 years of work experience. With regard to the working unit, 179 (48.6%) were in inpatient departments (ward). In the duty shift, 236 (64.1%) were in alternate shifts, whereas, the rest 56 (15.2%) were in the night shift. Participants were asked a question, "Do you perceive satisfied with the current monthly salary?" Three hundred forty-six (94.0%) of the respondents were dissatisfied with their current monthly salary. Participants were asked a question, "Do you think to leave the current working unit within the next 12 months related to your work?" Two hundred nine (56.8%) of them reported having the intention to leave their current working unit. Participants were asked a question, "How do you perceive your current health status?" One hundred and fifty-eight (42.9%) of the respondents perceived their health status as fair and 135 (36.7%) as good, while the rest 75 (20.4%) perceived their health status as poor. Participants were asked a question, "How do you perceive health problems have you experienced in relation to your work?" One hundred and seventy-nine (48.6%) of the respondents perceived as experiencing backache, 110 (29.9%) had depression, and 108 (29.3%) had headache. While the rest, 28 (7.6%) and 2 (0.5%) were perceived as experiencing insomnia and hypertension, respectively (see **Table 1**).

TABLE 1 | Socio-demographic characteristics of respondents in private hospitals of Addis Ababa, 2020.

Variables	Category	Frequency	Valid percent
Sex	Female	206	56.0
	Male	162	44.0
Age	20–29	257	69.8
	30–39	89	24.2
	40–49	22	6.0
Marital status	Single	205	55.7
	Married	157	42.7
	Divorced	6	1.6
Educational level	B.S.c	293	79.1
	Diploma	63	17.1
	M.S.c	14	3.8
Work experience	3–5 years	152	41.3
	≤2 years	126	34.2
	6–10 years	66	18.0
	11–15 years	24	6.5
Working unit	Ward	179	48.6
	ICU	82	22.3
	ED	64	17.4
	OPD	24	6.5
	OR	19	5.2
Current duty shift	Alternate	236	64.1
	Day	76	20.7
	Night	56	15.2
Nurses perception about their salary	Dissatisfied	346	94.0
	Satisfied	22	6.0
Intention to leave current unit within the next 12 months related to your work	Yes	209	56.8
	No	159	43.2
Nurses perception about their current health status	Fair	158	42.9
	Good	135	36.7
	Poor	75	20.4
Nurses perception on health problems they experienced	Bache ache	179	48.6
	Headache	108	29.3
	Depression	110	29.9
	Insomnia	28	7.6
	hypertension	2	0.5

Nurses Levels of Burnout

Two hundred seven (56.5%) of the participants were suffering from high levels of burnout (PB) during the study period. Two hundred nine (56.8%), 84 (22.8%), and 75 (20.4%) of them had high, moderate, and a low scale of emotional exhaustion (EE), respectively. On the other hand, 207 (56.3%), 94 (25.5%), and 67 (18.2%) of them had high, moderate, and low scale of depersonalization (DP), respectively. Regarding the scale of personal accomplishment (PA), 79 (21.5%), 82 (22.3%), and

207 (56.3%) of them rated as having high, moderate, and low scores, respectively.

Determinants of Nurse's Burnout

To investigate the association of independent variables with burnout, both bivariate and multivariate analyses were used. Those variables that showed association with outcome variables in the bivariate analysis (at $p < 0.25$) were selected as candidate variables for multivariable logistic regression analysis. Nurses age, educational level, service area, service year, current duty shift, presence of work overload, presence of interpersonal conflict, staff nurses shortage, presence of management support, professional recognition/respect or reward, intention to leave within 12 months, nurses perception about their current health status, and depression were significantly associated with nurse professional burn out (at $p < 0.25$). All variables that have association (at a significance level of 0.25) with the outcome variables in bivariate logistic regression analyses were included in the multiple logistic regression models. After controlling for the effects of potentially confounding variables using multiple logistic regression, duty shift, workload, staff nurse's shortage, interpersonal conflict, and nurse's perception about their current health status were significantly associated with nurse professional burnout (at $p < 0.05$).

Nurses who were working in night duty shifts were 2.7 times [AOR = 2.699; 95% CI: (1.043–6.987)] more likely to develop professional burnout as compared to those who were working at day duty shift, and nurses who were working at alternate duty shifts were 81% [AOR = 0.193; 95% CI: (0.065–0.570)] less likely to develop professional burnout as compared to those who were working in day duty shifts. Nurses who had suffered from excessive work overload [AOR = 6.013; 95% CI: (3.016–11.989)] and not working with the standard proportion [AOR = 6.198; 95% CI: (3.162–12.147)] were comparatively 6 times more likely to develop professional burnout. Moreover, burnout levels were comparatively 2 times [AOR = 2.465; 95% CI: (1.225–4.961)] higher among nurses those who had persistent interpersonal conflict at their workplace. In addition to the above factors, staff nurses those who had perceived their health status as poor [AOR = 3.4878; 95% CI: (1.815–8.282)] and fair [AOR = 2.863; 95% CI: (1.171–7.003)] were 3.8 and 2.8 times more likely to develop professional burnout as compared to staff nurses who had perceived their health status as good, respectively (see **Table 2**).

DISCUSSION

To successfully tackle burnout problems in Ethiopia, particularly in the present study area, there appears a need to investigate the level of burnout and associated factors among nurses. The finding of this study showed that from the total, 56.5% of nurses who were working in Addis Ababa private hospitals experienced burnout. Among the study participants, 56.8 and 56.3% were high on emotional exhaustion (EE) and depersonalization (DP) sub-scale, respectively. On the other hand, 56.3% was low on the personal accomplishment (PA) sub-scale.

Nurses' level of burnout in this study was higher compared to a previous finding reported in Thailand and Singapore, which were 50.2 and 55%, respectively (14, 15). Furthermore, the level of burnout in this study was higher than the findings reported from the two multi-national studies conducted in Saudi Arabia, which revealed 45 and 45.9% (16). Moreover, this study finding is lower than the study conducted in Lebanese nurses in regard to emotional exhaustion (EE) but higher in regard to depersonalization (DP) and personal accomplishment (PA) sub-scale which were 77.5, 36, and 33%, respectively (17). Additionally, this finding was higher compared to a report from South Africa which was 16, 13, and 10% high on emotional exhaustion (EE) and depersonalization (DP) sub-scale and low on personal accomplishment (PA) sub-scale, respectively (18). The possible reason for the difference might be due to an imbalance between nurses and patient ratio which increases the responsibility, level of duty, and stress on nurses. The second aim of this study was to determine whether there were determinant factors (sociodemographic, work-related, and organization-related factors) significantly associated with burnout status the participants experienced. None of the sociodemographic variables used under the study, such as age, sex, marital status, work experience, educational qualifications, and working area, showed any significant difference in terms of their burnout score. These findings were in line with a previous study conducted in Delhi (10). Moreover, these findings were also supported by a previous study done in Palestine with regard to educational level and burnout (18). Nonetheless, these findings are consistent with the previous studies done in Portugal, Brazil, US, and Greece (12, 19–21).

In this study, a work-related factor has an association with the nurse's professional burnout, which was in the selected private hospitals, for example, nurses who had night duty shifts were significantly associated with burnout as compared to day duty shift. This finding is consistent with the findings of previous studies done in Portuguese (3). The possible reason might be working at night shift disturbs an individual's circadian cycle and their rest and sleep. Those working in night shifts have to sleep in the daytime, when it is not possible to have a deep and good quality sleep. It affects the individual's physiologic balance. Excessive work overload was also found to be one of the strong predictors of burnout. Nurses, those who perceive the presence of excessive workload in their respective units, were significantly more vulnerable to develop professional burnout than their counterparts. This finding is consistent with the findings of previous studies done in America, China, Saudi Arabia, and India (17, 22–24). The possible reason might be the absence of a clear job description; nurses who are working at selected private hospitals were prone to extraordinary practice other than the nursing care, i.e., professionally nurses act as doctors, laboratory technicians, pharmacists, physiotherapists, nutritionists, and mechanically they act as a porter, oxygen technician, cleaner, operator, etc. The presence of persistent interpersonal conflict at the work place was significantly associated with nurse professional burnout than their counterparts. This finding is supported by the previous study done in Australia (25).

TABLE 2 | Bivariate and multivariate analysis of factors associated with nurses' levels of burnout in Addis Ababa, 2020.

Variables	Nurse burnout		COR (95% CI)	AOR (95% CI)	P-value
	Yes	No			
Age					
20–29	149	108	2.959 (1.166–7.519)	2.370 (0.217–25.932)	0.480
30–39	51	38	2.873 (1.068–7.752)	4.884 (0.524–45.530)	0.164
40–49	7	15	1	1	
Educational level					
BSc	171	120	1.783 (1.029–3.086)	3.616 (0.526–24.853)	0.191
Diploma	28	35	1	1	
Service area					
Ward	75	104	1	1	
ED	47	17	3.834 (2.045–7.194)	1.271 (0.197–8.197)	0.801
ICU	68	14	6.736 (3.521–12.821)	3.831 (0.770–19.231)	0.101
Service year					
</=2 years	76	50	3.040 (1.211–7.631)	3.384 (0.313–36.567)	0.315
3–5	88	64	2.747 (1.110–6.803)	2.513 (0.234–27.010)	0.447
6–10	35	31	2.257 (0.850–5.988)	1.744 (0.194–15.662)	0.620
11–15	8	16	1	1	
Duty shift					
Day	19	57	1	1	
Night	45	11	12.345 (5.291–28.571)	2.699 (1.043–6.987)	**0.041***
Alternate	143	93	4.608 (2.577–8.264)	0.193 (0.065–0.570)	**0.003***
Nurses perception about presence of work load					
Yes	165	50	8.696 (5.435–14.085)	6.013 (3.016–11.989)	**0.000***
No	42	111	1	1	
Nurses perception about presence of nursing staff shortage					
Yes	171	36	12.631 (7.666–20.810)	6.198 (3.162–12.147)	**0.000***
No	44	117	1	1	
Presence of persistent interpersonal conflict					
Yes	115	58	2.222 (1.456–3.390)	2.465 (1.225–4.961)	**0.011***
No	92	103	1	1	
Nurses perception about mgt.					
of their organization support nursing staff					
Yes	26	32	1	1	
No	181	129	1.727 (0.982–3.037)	2.715 (0.707–10.429)	0.146
Nurses perception on whether					
or not got any prof. recognition, respect					
or reward from their hospital administrator					
Yes	13	17	1	1	
No	194	144	1.761 (0.829–3.745)	0.975 (0.159–5.969)	0.978
Nurses perception about their current health status					
Poor	56	19	4.292 (2.299–8.000)	3.878 (1.815–8.282)	**0.000***
Fair	96	62	2.252 (1.408–3.600)	2.863 (1.171–7.003)	**0.021***
Good	55	80	1	1	
Leave current unit within					
the next 12 months related to your work					
Yes	124	85	1.335 (0.881–2.024)	0.998 (0.487–2.046)	0.996
No	83	76	1	1	
Nurses perception on					
whether experience depression					
Yes	73	37	1.825 (1.147–2.907)	1.426 (0.689–2.950)	0.339
No	134	124	1	1	

NB: p-value < 0.05, AOR, adjusted odd ratio; COR, crude odd ratio.*

In this study, the organization-related factor has an association with the nurse's professional burnout, which was the selected private hospitals, where staff nurses' shortage has significant association with professional burnout in the study population. Nurses who had not worked with standard proportion were more vulnerable to experience professional burnout than their counterparts. This finding is consistent with the findings of previous studies done in the USA and South Africa (22, 26). The possible reason might be the majority of selected private hospitals of Addis Ababa cover their many tasks with minimum nursing staff.

In addition to the above factor's burnout is significantly associated with nurse's perception about their health status. Perception of the health status of the participant nurses, indicating that nurses who perceived their health status as poor have high levels of burnout and vice versa. Decreased wellbeing among nursing staff was associated with burnout syndrome. This finding is supported by a study done in Lebanese and South Africa (26, 27). It is obvious that there exists a health issue whenever it can be an indicator of the presence of burnout among professionals.

Strength

The strength of the present study is that it utilized a strong theoretical basis, using reliable and valid instruments to collect data.

Limitation

The primary limitation of the study is that this study is a cross-sectional study design and can only reflect experiences of nurses at the time of assessment, and therefore, a causal relationship cannot be established between burnout and its predictors.

The other limitation of the study is the utilization of self-reported measures, which may increase the possibility of response bias.

CONCLUSION

This study presents strong evidence that a significant proportion of nurses working in private hospitals in Addis Ababa experienced high levels of burnout. There was noted a significant association identified between nurse's burnout with certain work profile (work load, duty shift, and interpersonal conflict), organizational factor (nursing staff shortage), and nurses' perception about their health status. On this ground, it can be concluded that a lot of reforms are required at the organizational and work environment levels.

Recommendations

Based on the results of this study, the following recommendations are forwarded by the researcher.

For Policymakers

Reforms for the human resources for health: One of the major recommendations is for the policymakers to increase the nursing strength as per the current patient load of the hospital. This requires a time-to-time revising of the nursing positions in hospital as per emerging demands, that is, reforms in terms of recruitment rules.

Clear job description: Clear-cut guidelines for nursing duties and role clarification at all the levels of staff nurse help them prevent vulnerable to extraordinary pressure at the workplace.

For Hospitals Administrator

The hospital's nursing managers and authorities in different levels should be paid for making a friendly communication with the staff, team work encouragement, and reducing occupational conflicts at workplace.

They should ensure adequate staffing of nurses to minimize their workload.

They should reduce the number of night duty shifts of staff nurses and make alternate shifts.

Finally, further and rigorous studies about levels of burnout among nurses in private hospitals in Addis Ababa using other study designs are recommended.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical clearance was obtained from Ethical Review Committee of Debre Berhan University, Institution of Medicine and Health Sciences, College of Health Sciences prior to beginning of the study. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

ACKNOWLEDGMENTS

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Technostress Creators and Outcomes Among Egyptian Medical Staff and Students: A Multicenter Cross-Sectional Study of Remote Working Environment During COVID-19 Pandemic

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Objectives: This study aimed to investigate the technostress creators and outcomes among University medical and nursing faculties and students as direct effects of the remote working environment during the COVID-19 pandemic.

Background: Due to the current COVID-19 pandemic, shifting to virtual learning that implies utilizing the information and communication technologies (ICTs) is urgent. Technostress is a problem commonly arising in the virtual working environments and it occurs due to misfitting and maladaptation between the individual and the changeable requirements of ICTs.

Methods: A multicenter cross-sectional study was conducted in medicine and nursing colleges of 5 Egyptian universities and included both staff members and students. The data were collected through personal interviews, from January to May 2021. All the participants took a four-part questionnaire that asked about personal and demographic data, technostress creators, job or study, and technical characteristics and technostress outcomes (burnout, strain, and work engagement). Furthermore, participants' blood cortisol and co-enzyme Q10 (CoQ10) levels were tested in a random sample of the students and medical staff.

Results: A total of 3,582 respondents participated in the study, 1,056 staff members and 2,526 students where 33.3% of the staff members and 7.6% of students reported high technostress. Among staff members, total technostress score significantly predicted Cortisol level (β = 2.98, CI 95%: 0.13–5.83), CoQ10(β = −6.54, CI 95%: [(−8.52)–(−4.56)], strain (β = 1.20, CI 95%: 0.93–1.47), burnout (β = 0.73, CI 95%: 0.48–0.97)

and engagement (β = −0.44, CI 95%: [(−0.77)–(−0.11)]) whereas among students, total technostress score significantly predicted cortisol level (β = 6.64, CI 95%: 2.78–10.49), strain (β = 1.25, CI 95%: 0.72–1.77), and burnout (β = 0.70, CI 95%: 0.37–1.04). Among staff members and students, technology characteristics were significantly positive predictors to technostress while job characteristics were significantly negative predictors to technostress.

Conclusion: The Egyptian medical staff members and students reported moderate-to-high technostress which was associated with high burnout, strain, and cortisol level; moreover, high technostress was associated with low-work engagement and low CoQ10 enzyme. This study highlighted the need to establish psychological support programs for staff members and students during the COVID-19 pandemic.

INTRODUCTION

The COVID-19 pandemic has forced millions of people around the world to adopt a remote work environment using a variety of online platforms. Previous research reported that due to the current pandemic, nearly 50% of the employees were working from home compared with 12% before the pandemic (1).

Among the sectors that have been negatively affected by this transformation are health care, in particular, the capabilities of staff and academics (2).

In general, virtual work negatively affected human emotional and behavioral characteristics. For example, reported adverse effects include social isolation, breakdown of social relationships, and increased family and work conflicts (3–5).

The transition to a virtual work and learning environment requires the adoption of information and communication technologies. However, despite the potential advantages and benefits of using ICTs in higher education, the capabilities of human beings to keep pace with the rapid changes in ICTs are still limited. Among other populations, healthcare workers and medical students are highly exposed to what is known as technical stress which is the stress they are exposed to as a result of their inability to adapt to the changing demands of technology (6, 7).

Stress is the negative feeling of vulnerability due to environmental requirements exceeding existing resources. Given this, technical stress is the negative feeling resulting from the inability of individuals to handle advanced technology to meet business demands (8, 9).

Technostress has been a common feature among people who work in virtual environments. Researchers have documented the negative effects of technology on human health. Aside from the behavioral strain caused by constant exposure to ICT, documented negative effects of technostress include frequent eye strain, headaches, high blood pressure, back pain, stomach problems, irritability, and heart attacks (10). It has been found that these ill-effects reduce employee quality of performance, job satisfaction, and ongoing commitment (7).

Although previous researchers have recognized in different learning contexts and sought to express technological stressors,

the scientists have not provided any empirical findings about the links between technostress and workplace outcomes (11–13).

The Aim of the Work

Through current research, we contribute to the current literature by extending estimates of the prevalence of technostress, determining its consequences in unpredictable work environments, and highlighting negative emotional responses to technology. Additional objectives of this study were to provide a model for predicting the continued use of online platforms among healthcare staff and medical students and to assess the relationships between emotional and motivational aspects (burnout, strain, and work engagement) and continued use of ICTs. Adding to the previous literature, we have investigated the harmful effects of technology on human biological systems.

METHODS

Study Design and Setting

A cross-sectional, multicenter study was conducted from January to May 2021 on 3,582 participants recruited from five randomly selected medical and nursing schools.

Sampling and Sample Size

Since the prevalence of technostress was not known among the students or the staff, and the occurrence and non-occurrence were equal to 0.50, the sample size at 95% CI was calculated using the following equation: $n = Z^2 P(1-P)/d^2$ where n represents the sample size, Z is the confidence level, and P stands for the expected proportion. For staff members, the sample size was estimated at 1,114 participants. The expected dropout rate was 10%, and 1,127 questionnaires were distributed. We received 1,056 completed questionnaires, with a response rate of 93.7%. The student sample size was estimated at 2,144; therefore, we distributed 2,600 surveys based on an expected dropout rate of 15%. We received 2,526 completed questionnaires from students, which is an astounding response rate of 97.2%.

Among the five randomly selected medical schools, a proportional allocation method was applied to determine the appropriate number of participants, so all the students and staff members in these five schools of medicine and nursing were assigned. Each contributing school has an academic and clinical department with different academic degrees. Accordingly, staff members were selected proportionately according to department and academic degree. In parallel, participating students were selected in the same way in proportion to the college and year.

Data Collection

Between educational sessions and during break times, students and staff were interviewed at randomly selected schools. Rest time was defined as the time off from work or study before work or during the day. It should not be at the end of the day. It was chosen to encourage participants to participate freely without creating an undue burden. The data were collected by a qualified team consisting of dedicated students, staff, and nurses from each college and accustomed to the schedule of staff and students in their school. This team underwent a two-day training workshop on applied questionnaires followed by testing to avoid inter-observer and intra-observer bias. A nurse was attending with the team to draw the blood sample. Members of the trained team interviewed staff and students from five different colleges of medicine and nursing and then left questionnaires for staff to complete; for the students, the trained team collected data on the spot using an interview-based questionnaire.

Inclusion and Exclusion Criteria

Being an Egyptian staff member or student affiliated with the college of Medicine or Nursing was the main inclusion criteria. Additional criteria were added for staff members including working as regular full-time employed, according to their contract with the University, with no minimum years of experience. For students, they should be regularly registered for the previous levels without withdrawal or postponing any previous level.

Exclusion criteria were being non-Egyptian, affiliated with other affiliations, previous withdrawal or postponing level(s) for students, and working as a part timer or adjunct staff.

Data Collection Tool

A pilot study was conducted with 20 University staff members and 25 students to validate the questionnaire. Participants in

FIGURE 1 | Conceptual theoretical framework of the current study.
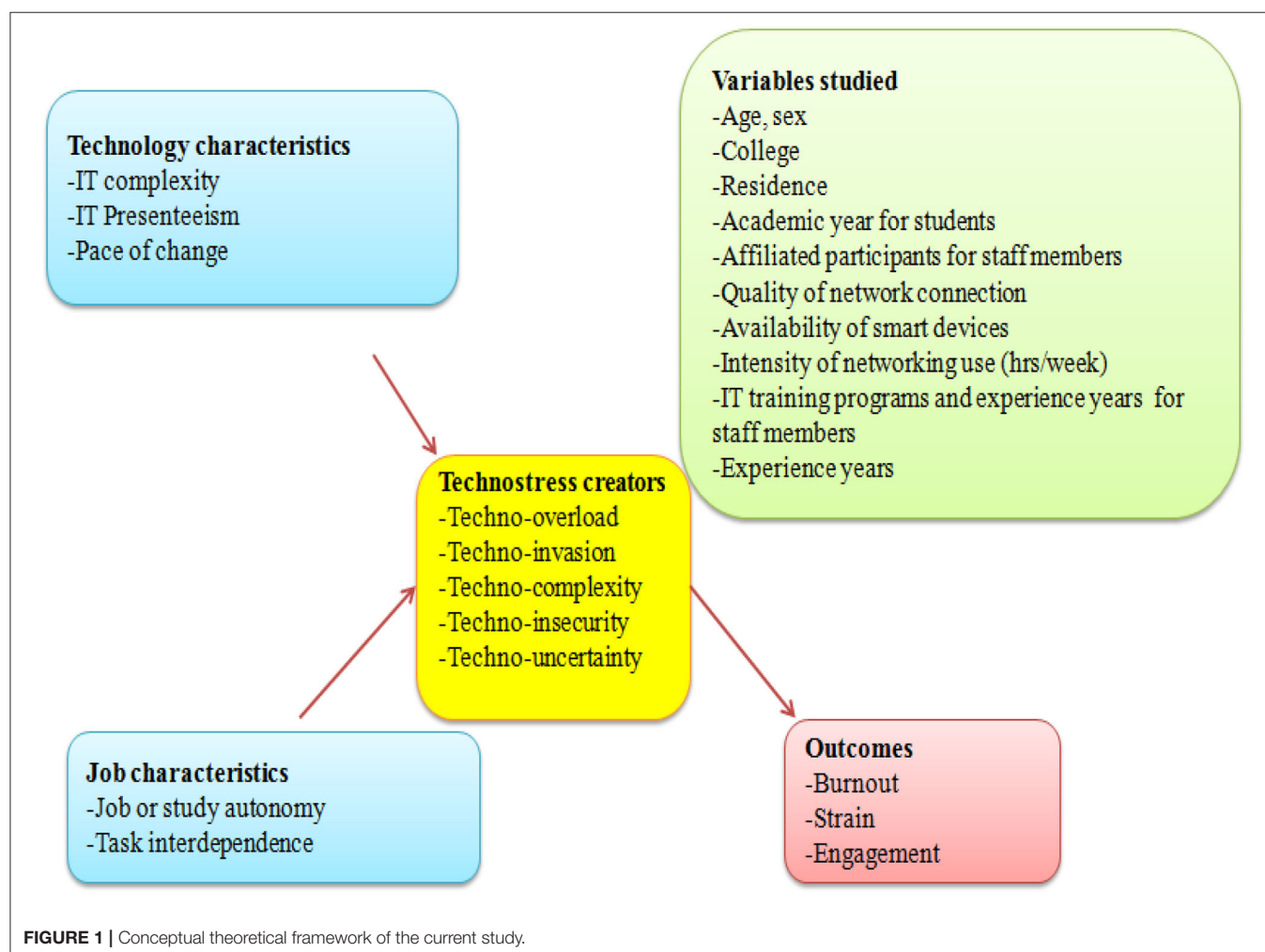
the pilot study were excluded from the study. Public health and family medicine professionals evaluated the questionnaire for its suitability, ability to properly measure technostress, and its effects on work and study outcomes. Cronbach's alpha calculated for the study survey was 0.81, indicating good reliability.

Figure 1 presents the theoretical and conceptual framework for this study. All the participants underwent the following:

Completing a Predesigned Questionnaire Composed of Four Parts

Personal and demographic data (nine questions on student questionnaire, 11 on staff questionnaire): This questionnaire included age, gender, college, University, residence (urban and rural), perceived quality of network connection, availability of smart devices, and an average number of hours spent using ICT, in addition to the academic year for student participants. Staff participants were asked their affiliated department (academic or clinical), whether they had attended any ICT training programs and their years of experience.

Technostress (23 Questions)

To measure technostress, we used the scale developed by Ragu-Nathan et al. (12), which measures the phenomenon on five dimensions: techno-overload (five questions), techno-invasion (four questions), techno-complexity (five questions), techno-insecurity (five questions), and techno-uncertainty (four questions) (14). Respondents rate the items on 5-point Likert scales that range from 1 (strongly disagree) to 5 (strongly agree), and higher total scores indicate greater technostress (15).

Job or Study and Technology Characteristics (16 Questions)

Job or study autonomy (three questions), task interdependence (three questions), IT complexity (three questions), IT presenteeism (four questions), and pace of IT change (three questions) (16).

Technostress Outcomes (21 Questions)

We measured strain (three questions) by asking participants about feeling drained from activities that require using IT, feeling tired from IT activities, and whether working all day with IT is a strain. We measured burnout using (17) burnout questionnaires (nine questions), and we measured engagement with the Utrecht Work Engagement Scale (nine questions) (18). Participants rated all technostress outcomes on 5-point Likert scales that ranged from 1 (strongly disagree) to 5 (strongly agree).

Blood Sampling

A team of nurses collected the blood sample under sterile conditions. AM samples were collected from 151 staff members and 122 students who were randomly selected from those who answered the questionnaires and then the sample was categorized according to standard protocols. We measured serum cortisol using an electrophoretic immunoassay in a Cobas e601 automatic analyzer (Roche Diagnostics, Mannheim, Germany). The collected samples were gently inverted 5 times immediately after withdrawal without shaking, allowing the blood to clot within 30 min, then centrifuged for 10 min, and then

the serum was stored at 2–8°C. Because of the diurnal difference in cortisol levels, blood samples were drawn at a specific time of day (6–10 am). We measured CoQ10 using an ELISA (Sino Gene Clon Biotech Co., Ltd) with cut-off ranges of 1.56 ng/ml, 1.56 ng/ml, and 50 ng/ml (19).

Statistical Analysis

We used SPSS version 22(SPSS Inc., Chicago, IL, USA) to analyze the study data. Qualitative data were expressed as number (%), while quantitative data were expressed as mean ± SD and range. Linear regression analysis was performed to assess the predictors of burnout, strain, and engagement as outcomes to technostress creators. Then, we finally analyzed the risk factors associated with technostress through binary logistic regression between low + moderate technostress vs. high technostress either among

TABLE 1 | Characteristics of the studied staff and students.

Staff (No = 1,056)	Mean ± SD	Range
Age (y)	36.1 ± 9.7	26–65
Experience years	11.3 ± 8.2	0–35
Technical hours/ week	35.5 ± 24.4	0–84
	no	%
Gender		
Male	320	30.3
Female	736	69.7
Department		
Academic	264	25.0
Clinical	792	75.0
Residence		
Rural	516	48.9
Urban	540	51.1
Program training	711	67.3
Smart devices	993	94.0
Good network connection		
Yes	679	64.3
Sometimes	377	35.7
Students (No = 2526)	**Mean ± SD**	**Range**
Age (y)	20.2 ± 1.3	18–24
Technical hours/ week	40.1 ± 27.8	2–140
	no	%
Gender		
Male	492	19.5
Female	2,043	80.5
Education stage		
Pre-clinical	1,860	73.6
Clinical	666	26.4
Residence		
Rural	1,562	61.8
Urban	964	38.2
Smart devices	2,481	98.2
Good network connection		
Yes	1,691	66.9
Sometimes	835	33.1

students or the staff. Multiple comparisons were tested using Holm-Bonferroni Sequential Correction: An EXCEL Calculator © Justin Gaetano, 2013, and *p*-values are statistically significant after this correction.

Compliance With Ethical Standards

This study was commenced after obtaining ethical approval from the Research Ethical Committee (REC) of Menoufia Faculty of Medicine, Menoufia University (ID: 06/2021FAM). The REC approved the holistic approach including the questionnaire and withdrawing blood samples, for blood cortisol and co-enzyme Q10 levels, under aseptic sterile conditions which were considered a minimally invasive low risk intervention. Moreover, informed consent was taken from every participant after being informed of all aspects of the study. The data, including responses to the questionnaire and the laboratory workup, were handled anonymously to maintain the confidentiality of the participants.

RESULTS

We recruited a total of 3,582 participants, 1,056 staff members aged 36.1 ± 9.7 years, and 2,526 students aged 20.2 ± 1.3 years. Among the staff members, 69.7% were females and 51.1% were urban residents; they spent a mean of 35.5 ± 24.4 h/week using ICTs. Among the students, 80.5% were females and 61.8% were urban residents. The students spent a mean of 40.1 ± 27.8 h/week with ICTs (**Table 1**).

TABLE 2 | Technostress creators, job and technology characteristics among the studied staff and students.

		Staff (No = 1,056)		Students (No = 2,526)	
		Mean ± SD	Range	Mean ± SD	Range
Techno–stress creators	• Techno–overload	3.74 ± 0.70	2–5	3.98 ± 0.83	1–5
	• Techno–invasion	3.91 ± 0.93	1–5	3.93 ± 0.87	1–5
	• Techno–complexity	3.47 ± 0.87	1.4–5	3.45 ± 0.85	1–5
	• Techno–insecurity	3.10 ± 0.69	1.5–5.0	2.56 ± 0.67	0.8–4.4
	• Techno–uncertainty	3.0 ± 0.47	2–5	0.64 ± 0.16	0.2–1.10
	• Total	3.44 ± 0.48	2.16–4.60	2.91 ± 0.50	0.95–4.0
Technology characteristics	• IT complexity	2.41 ± 0.99	1–5	2.62 ± 0.97	1–5
	• IT presenteeism	3.94 ± 0.95	1–5	3.95 ± 0.80	1–5
	• Pace of IT change	3.99 ± 0.82	1–5	3.74 ± 0.81	1–5
Job characteristics	• Job autonomy	3.50 ± 0.84	1–5	3.21 ± 1.01	1–5
	• Task interdependence	3.85 ± 0.76	1.33–5.0	3.95 ± 0.75	1–5

FIGURE 2 | Distribution of the studied groups regarding the prevalence of technostress.

FIGURE 3 | Values of β and CI 95% for linear regression analysis of technostress items and job and technology characteristics as a predictor to burnout among staff.
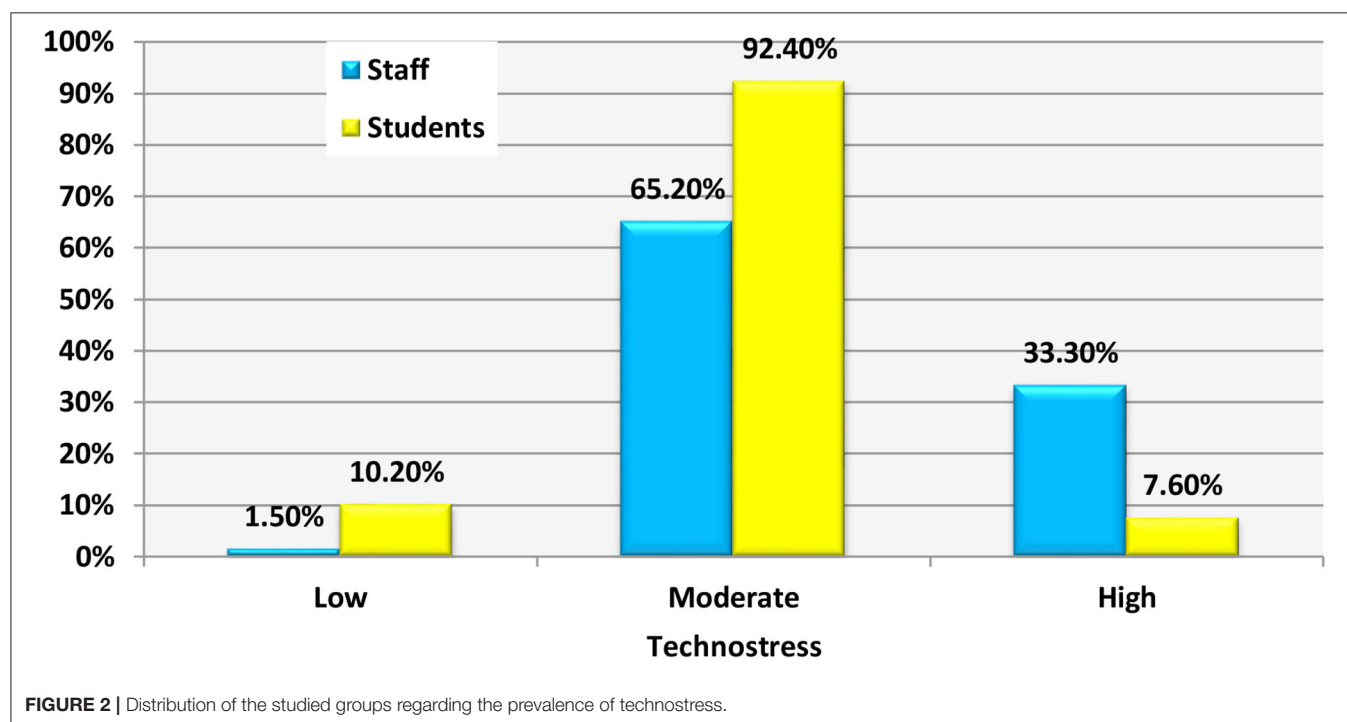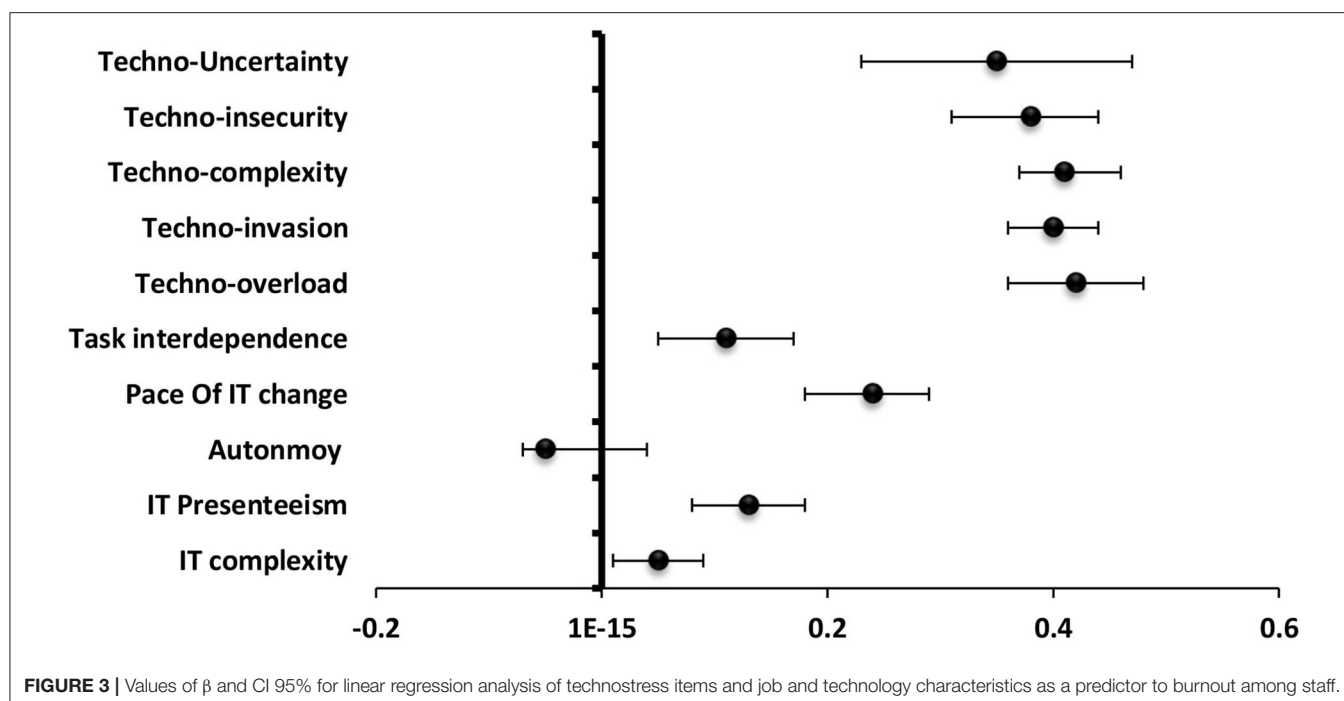
The mean total technostress score was 3.44 ± 0.48 vs. 2.91 ± 0.50 among medical students. For the technical characteristics, the staff gave high scores to IT presenteeism (3.94 ± 0.95) and pace of IT change (3.99 ± 0.82), whereas they gave task interdependence a high score (3.85 ± 0.760) for the job characteristics vs. 3.95 ± 0.80, 3.74 ± 0.81, and 3.21 ± 1.01, respectively, among students (**Table 2**).

The technostress score was distributed as 33.3% high, 65.2% moderate, and 1.5% low technostress among the medical staff while among the students, it was high in 7.6% of them, 92.4% moderate, and 10.2% low (**Figure 2**).

Among the Medical Staff

Linear regression analysis was conducted to assess the predictors to burnout, strain, and engagement as outcomes to technostress creators and job and technology characteristics:

Burnout

The most significantly positive predictor to burnout among technostress creators was techno-overload (β = 0.42) followed by techno-invasion (β = 0.40), techno-complexity (β = 0.41), techno-insecurity (β = 0.38), and techno-uncertainty (β = 0.35). For **job and technical characteristics, the** pace of IT change (β = 0.24) was the most significantly positive predictor to burnout followed by IT presenteeism (β = 0.13) and task interdependence (β = 0.11) (**Figure 3**).

Strain

The most significantly positive predictor to strain among **technostress creators** was techno-overload (β = 0.72), techno-invasion (β = 0.64), techno-uncertainty (β = 0.64), techno-complexity (β = 0.57), and techno-insecurity (β = 0.41). For

job and technology characteristics, the pace of IT change (β = 0.45) was the most significantly positive predictor followed by task interdependence (β = 0.37), IT presenteeism (β = 0.25), and job autonomy (β = 0.13) while IT complexity (β = −0.11) served as a significantly negative predictor to strain (**Figure 4**).

Engagement

The most significantly negative predictor to engagement among **technostress creators** was techno-insecurity (β = −0.16) followed by techno-overload (β = −0.14), techno-invasion (β = −0.09) and techno-complexity (β = −0.09). For **job and technology characteristics,** job autonomy (β = 0.36), and task interdependence (β = 0.24) were significantly positive predictors while IT presenteeism (β = −0.14) and pace of IT change (β = −0.08) were significantly negative predictors (**Figure 5**).

Among the Medical Students

Linear regression analysis was conducted to assess the predictors to burnout, strain, and engagement as outcomes to technostress creators and job and technology characteristics:

Burnout

The most significantly positive predictor to burnout among **technostress creators** was techno-uncertainty (β = 1.06) followed by techno-overload (β = 0.43,), techno-invasion (β = 0.34), techno-complexity (β = 0.27), and techno-insecurity (β = 0.26). For **job and technology characteristics,** IT complexity (β = 0.17) served as a significantly positive predictor to burnout while, job autonomy (β = −0.18), IT presenteeism (β = −0.11), and task interdependence (β = −0.08) were significantly negative predictors in order (**Figure 6**).
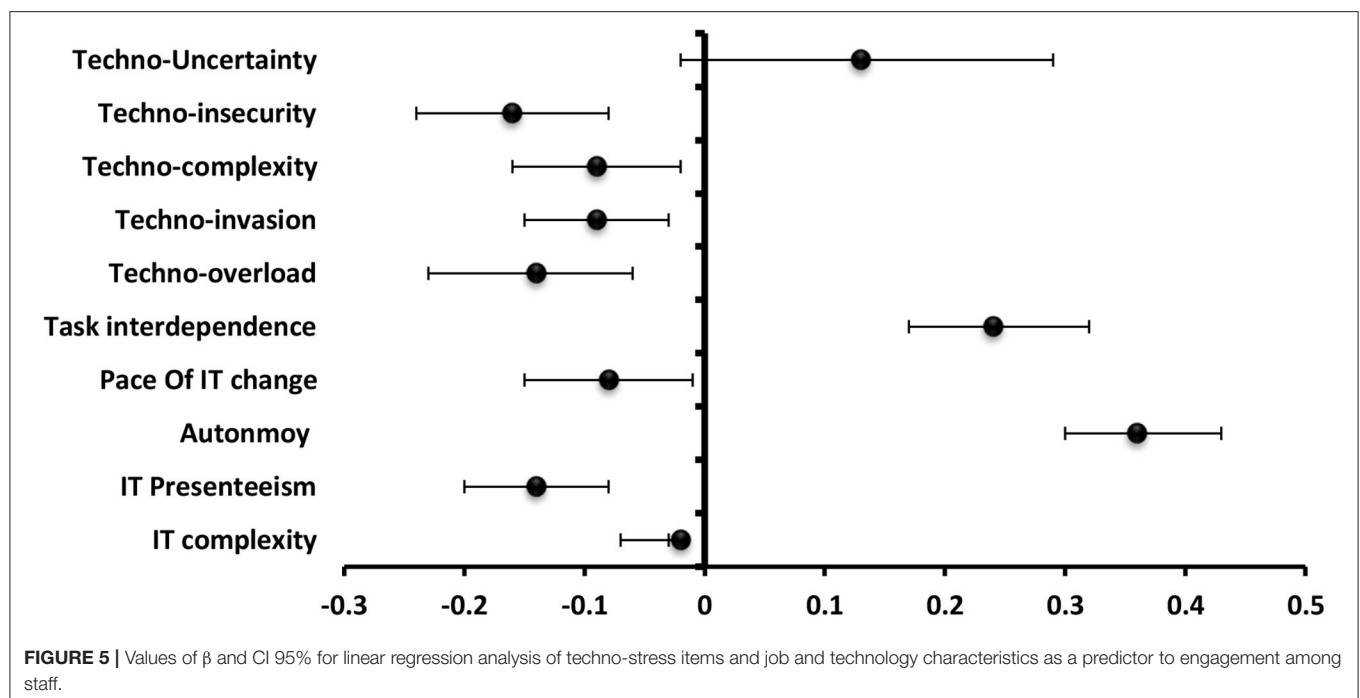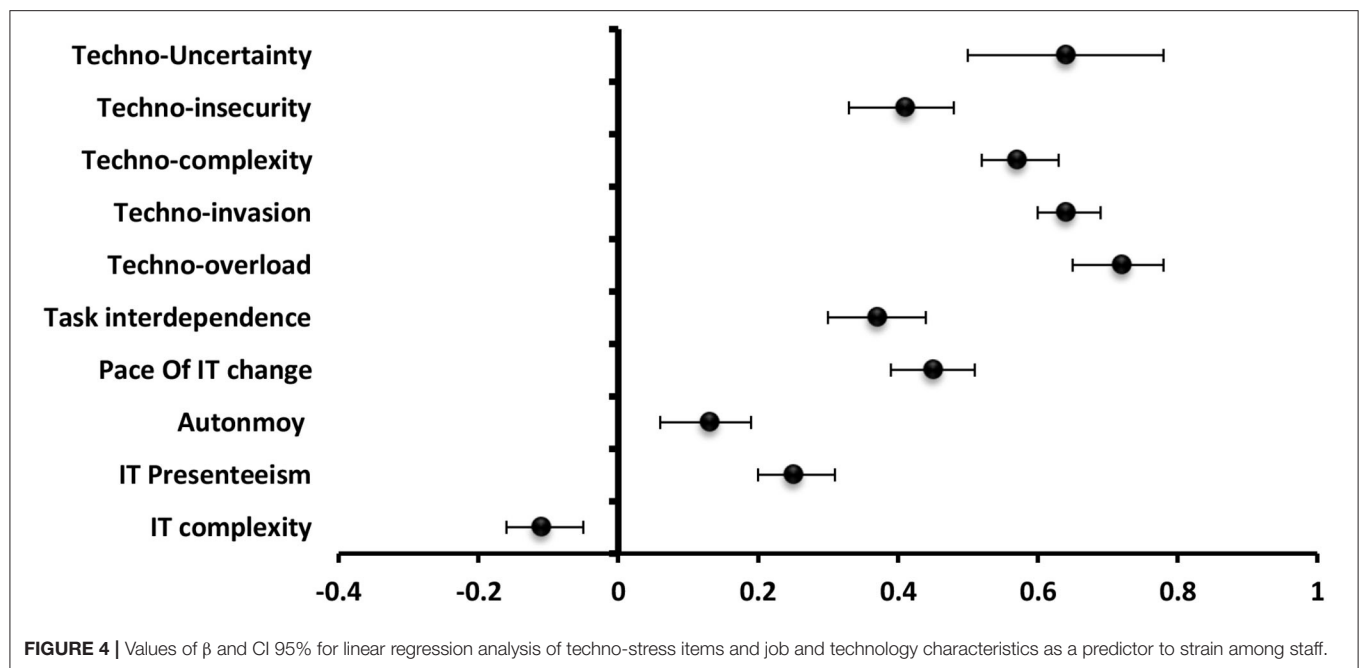
FIGURE 4 | Values of β and CI 95% for linear regression analysis of techno-stress items and job and technology characteristics as a predictor to strain among staff.

FIGURE 5 | Values of β and CI 95% for linear regression analysis of techno-stress items and job and technology characteristics as a predictor to engagement among staff.

Strain

The most significantly positive predictor to strain among **technostress creators** was techno-uncertainty (β = 1.62) followed by techno-overload (β = 0.61), techno-complexity (β = 0.58), techno-invasion (β = 0.53), and techno-insecurity (β = 0.40). For **job and technology characteristics,** IT complexity (β = 0.33) served as a significantly positive predictor to strain while job autonomy (β = −0.31) was the most significantly negative predictor (**Figure 7**).

Engagement

The most significantly positive predictor to strain among **technostress creators** was techno-uncertainty (β = −0.66) followed by techno-invasion (β = −0.25), techno-overload (β = −0.24), techno-insecurity (β = −0.16). For **job and technology characteristics,** job autonomy (β = 0.27), and IT presenteeism (β = 0.14) was the most significantly positive predictor while techno-complexity (β = −0.11) was the most significantly negative one to engagement (**Figure 8**).

FIGURE 6 | Values of β and CI 95% for linear regression analysis of techno-stress items and job and technology characteristics as a predictor to burnout among students.

FIGURE 7 | Values of β and CI 95% for linear regression analysis of techno-stress items and job and technology characteristics as a predictor to strain among students.
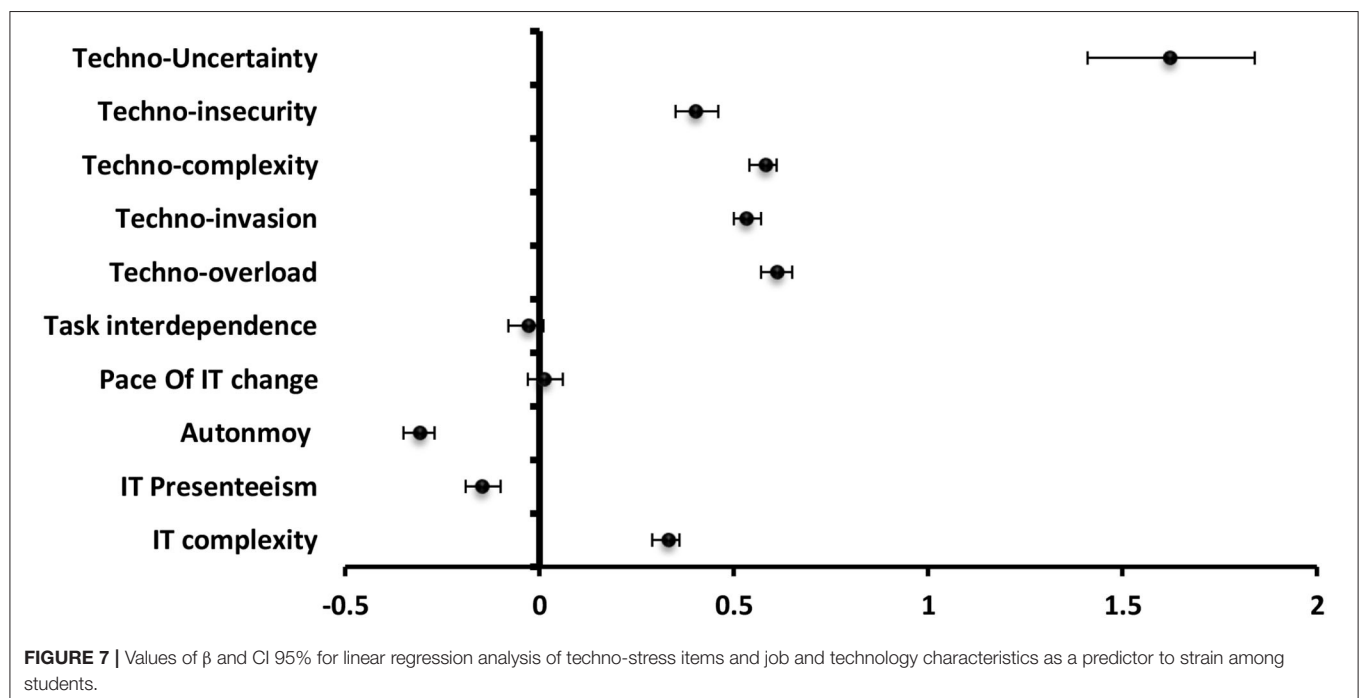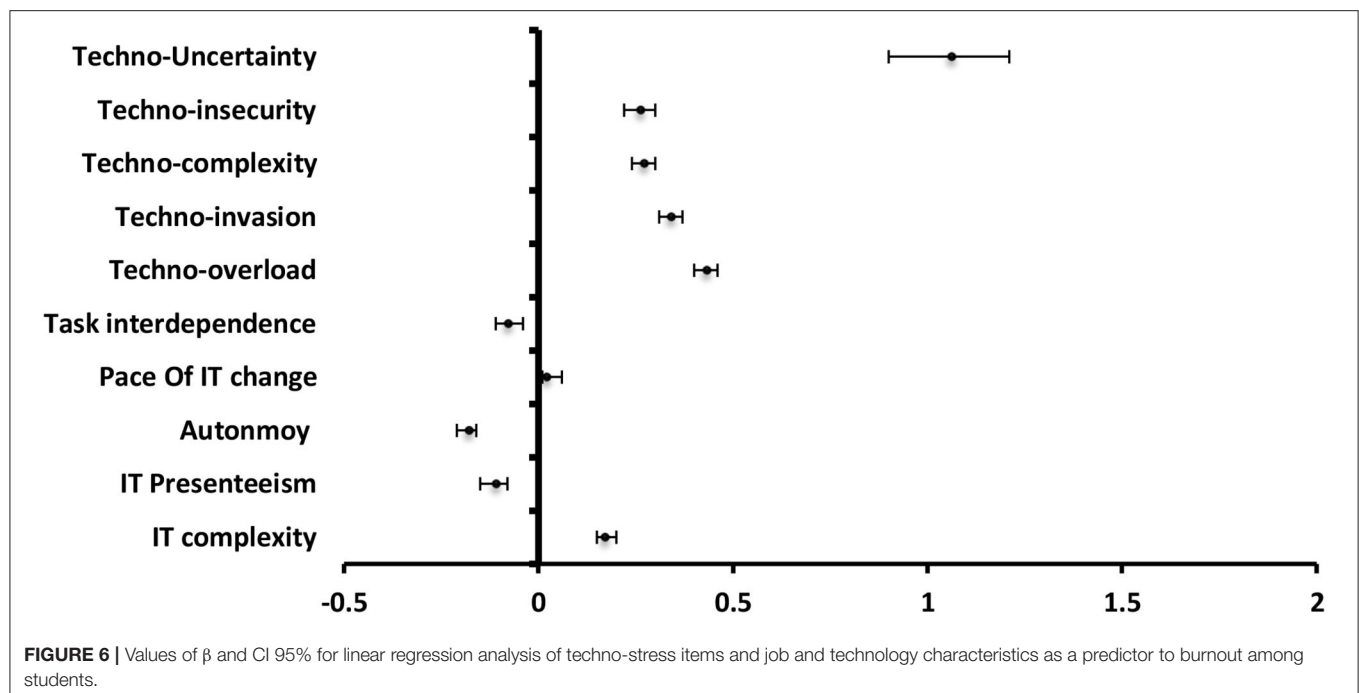
Linear regression analysis was conducted to assess the predictors to burnout, strain, engagement, and biomarkers (Cortisol and CoQ10) as outcomes to technostress total score.

- Among staff members, total technostress score significantly positive predictor to predicted cortisol level (β = 2.98), strain (β = 1.20), and burnout (β = 0.73) and significantly negative predictor to engagement (β = −0.44) and CoQ10 (β = −6.54) (**Figure 9**).

- Among the students, total technostress scores significantly positive predictor to cortisol level (β = 6.64), strain (β = 1.25), and burnout (**Figure 10**).
- Technology characteristics were significantly positive predictor to technostress among staff members and students (β = 0.39 and β = 0.17), respectively, while job characteristics were significantly negative technostress predictors (β = −0.23 and β = −0.12,) respectively (**Figure 11**).

FIGURE 8 | Values of β and CI 95% for linear regression analysis of techno-stress items and job and technology characteristics as a predictor to engagement among students.

FIGURE 9 | Values of β and CI 95% for linear regression analysis of total techno-stress score as a predictor to biomarkers, burnout, strain, and engagement among staff.
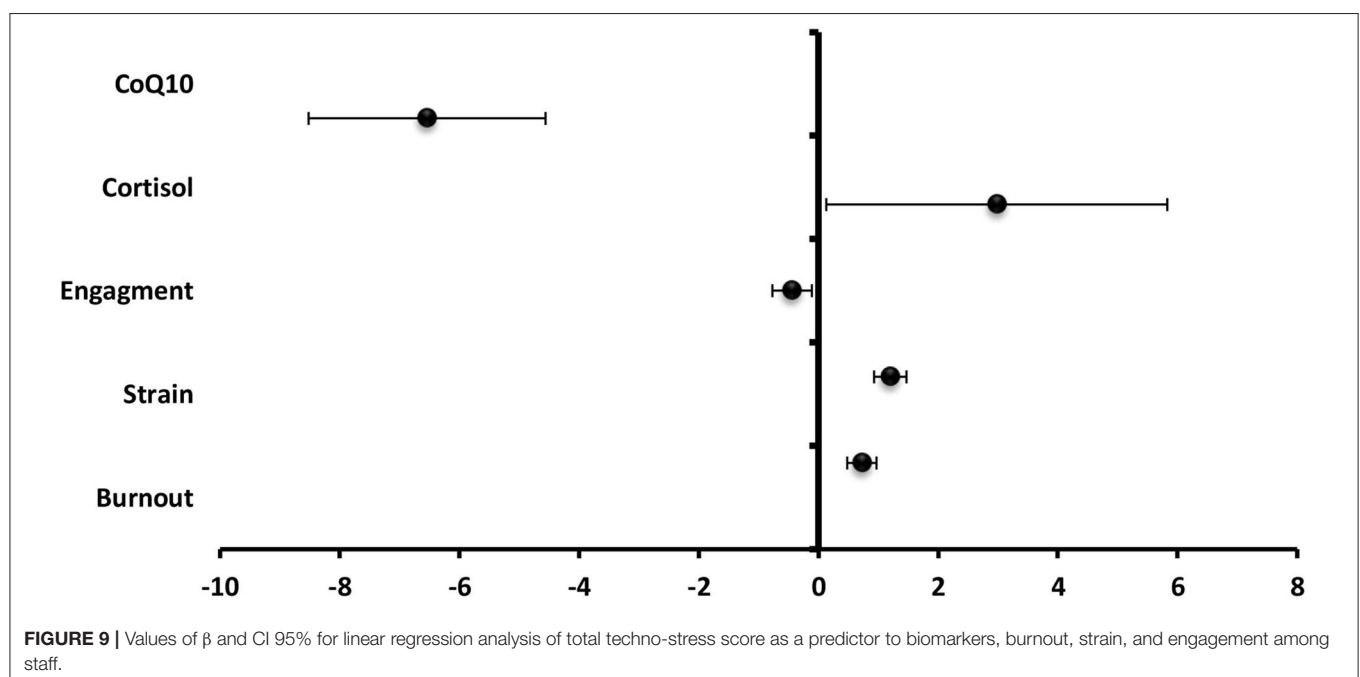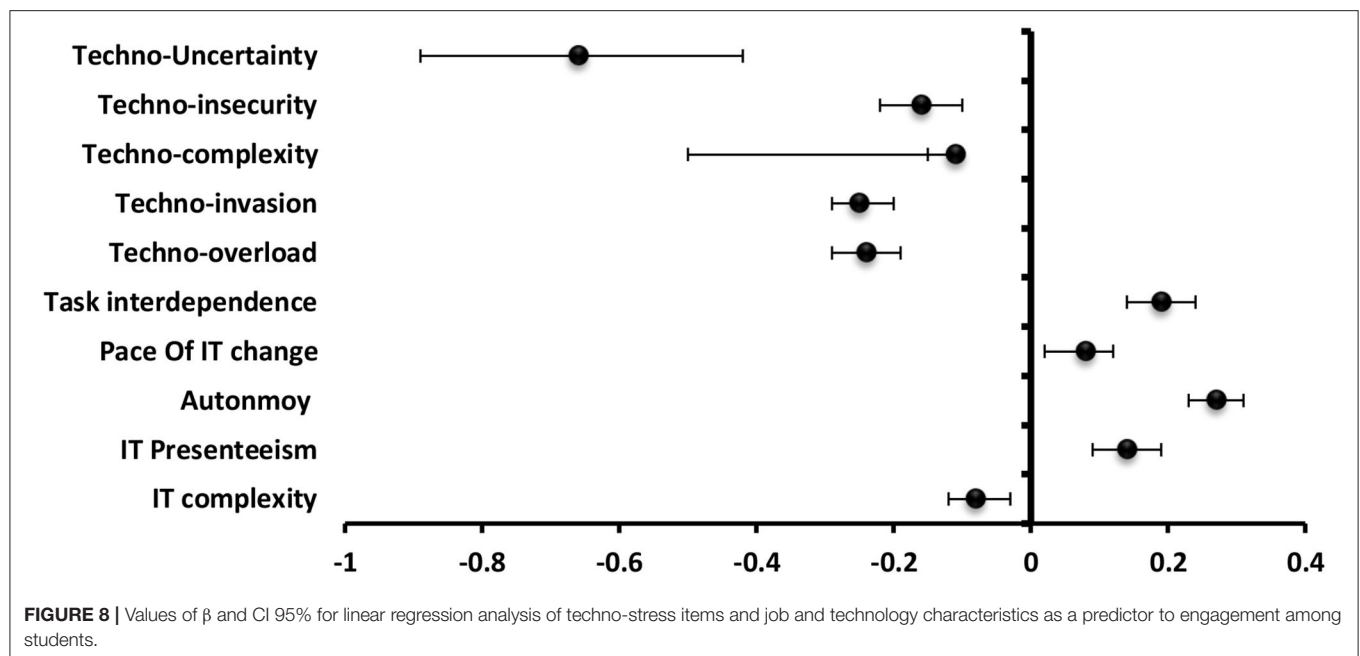
- Binary logistic regression analysis was conducted to assess the risk factors associated with technostress and it revealed that rural residence, increasing technical hours/week, IT complexity, the pace of change, job autonomy, and task interdependence were significant risk factors for technostress among the studied staff members ($p < 0.001$) whereas female gender, rural residence, low-educational stage, increasing technical h/week, the pace of change, and job autonomy were significant risk factors among the studied undergraduate medical students (**Table 3**).

DISCUSSION

One of the consequences of the global COVID-19 pandemic has been the dramatic changes to working environments globally. In 2020, for many employees, remote work using ICTs became a need rather than a luxury. In the previous research, healthcare workers (staff and students) reported high stress owing to this shift (7, 20). Technostress has been described by scientists as the dark side of technology use (21). This study examined technostress

FIGURE 10 | Values of β and CI 95% for linear regression analysis of total techno-stress score as a predictor to biomarkers, burnout, strain, and engagement among students.

FIGURE 11 | Values of β and CI 95% for linear regression analysis of job characteristics and technology characteristics as predictors to total techno-stress score among staff and students.
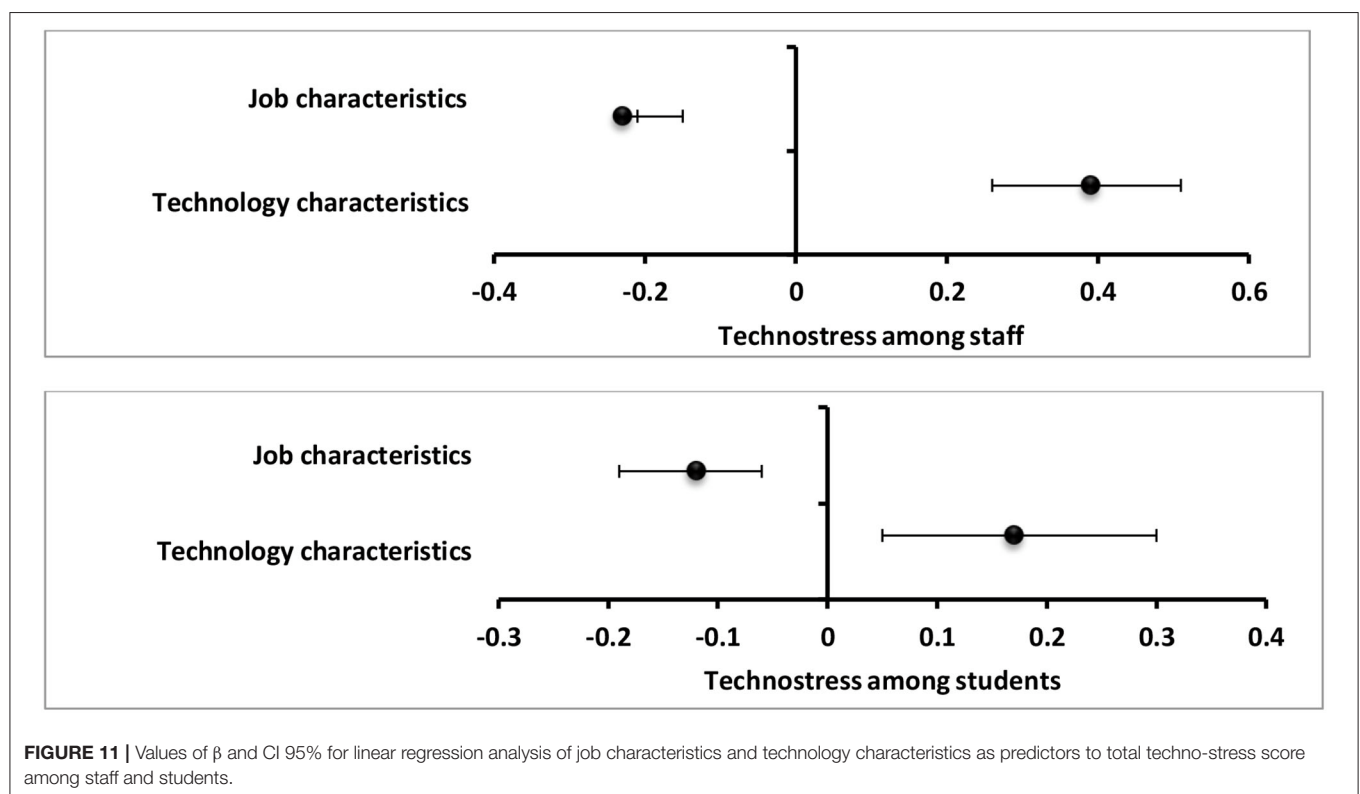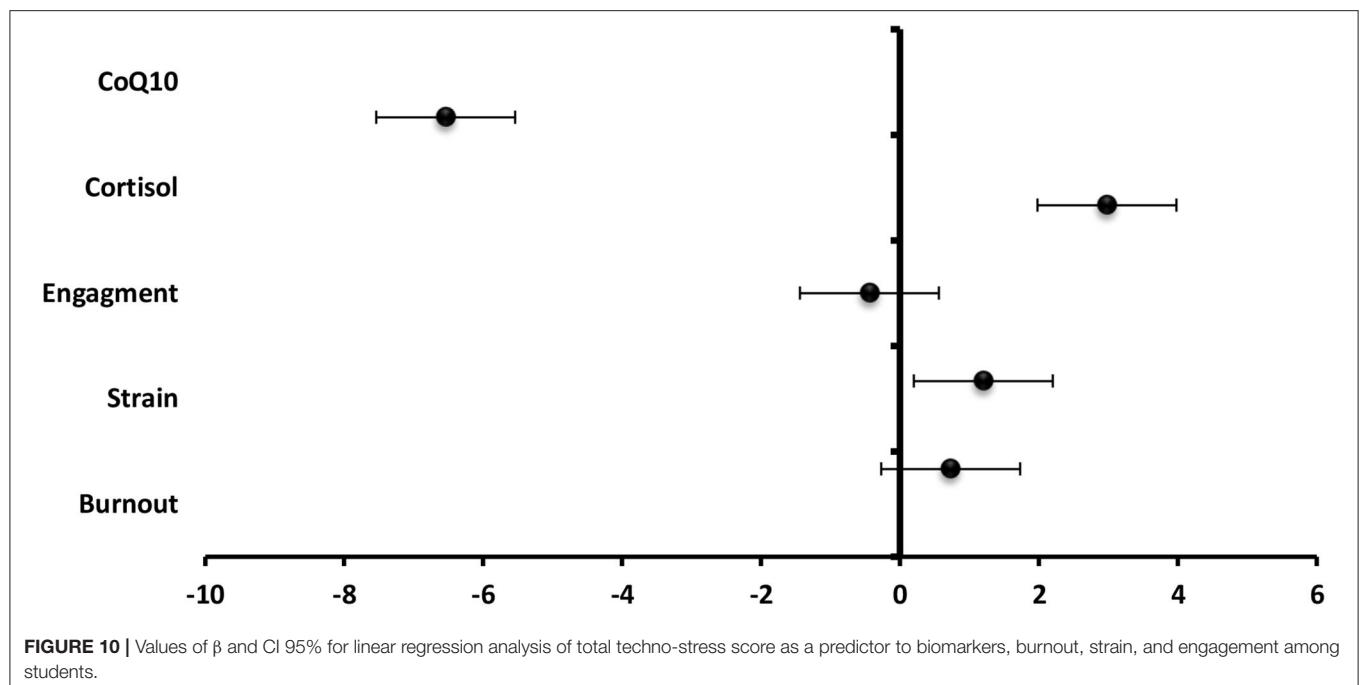
among healthcare faculty members at the Egyptian University and undergraduate medical students in different educational contexts.

The results revealed the prevalence of high-to-moderate technostress among medical staff members and students. These results were consistent with findings of another Egyptian study carried out among University staff members (20).

Healthcare professionals have reported that the technostress is significantly higher than that found among workers in other occupations, possibly due to higher job requirements, including

TABLE 3 | Risk factors for technostress among staff and students.

Staff	β	P value	95%CI	
			Lower bound	Upper bound
Residence (rural)	−0.133	<0.001*	−0.184	−0.082
Technical hours/week	0.006	<0.001*	0.005	0.007
IT complexity	0.075	<0.001*	0.051	0.100
Pace change	0.261	<0.001*	0.223	0.300
Job autonomy	−0.058	<0.001*	−0.088	−0.027
Task interdependence	−0.141	<0.001*	−0.179	−0.103
Presenteeism	−0.037	0.012	−0.066	−0.008
Experience years	−0.011	0.020	−0.020	−0.002
Gender (female)	0.053	0.035	0.004	0.103
Students				
Gender (female)	0.136	<0.001*	0.093	0.178
Residence (rural)	0.102	<0.001*	0.068	0.136
Grade (low grade)	0.058	<0.001*	0.027	0.090
Educational stage	−0.253	<0.001*	−0.311	−0.195
Technical hours/week	0.002	<0.001*	0.002	0.003
IT complexity	0.197	<0.001*	0.179	0.214
Pace change	0.096	<0.001*	0.075	0.117
Job autonomy	−0.140	<0.001*	−0.158	−0.121
Task interdependence	−0.047	<0.001*	−0.071	−0.023
Age	0.041	0.001*	0.018	0.065

*Significant.

teaching, research, and clinical practice (22). Outside of both Egypt and health care, about 80% of librarians at different African universities experience technostress (23, 24).

Differences in the prevalence and levels of technostress between this study and previous research can be attributed to differences in contexts. Librarians, especially now in sophisticated libraries in the 21st century, are more involved in computer technologies than in other fields.

This study, we found that staff members with less ICT experience but more technical h / week were more at risk for technicians and that being a student and living in a rural area were other technostress-related risk factors. These results are consistent with the vast majority of previous findings for more technostress among faculty members who were older, had more teaching experience, and were females living in rural areas (20). Conversely, other researchers found no significant differences in technostress incidence between males and females (25, 26). The inconsistent findings of this study could be the result of the different learning contexts and cultural concepts incorporated into other studies.

This study revealed that technology characteristics are remarkably positive predictors of technostress. The positive association between technology complexity and presenteeism and pace of change on the one hand and technostress on the other side agrees with many studies (26, 27).

Fortunately, Shu et al. considered technology complexity to be a modifiable risk factor for technostress and recommended updating computer self-efficacy and faculty competencies to overcome the resulting technostress (6).

The striking negative association between job characteristics (autonomy and task interdependence) and technostress in this study is noteworthy. Job autonomy describes the situation in which workers have the power to make decisions regarding their occupational tasks. In agreement with this study, autonomy has been reported to be negatively associated with technology (1).

During the COVID-19 pandemic, both staff and students are becoming more autonomous. Working from home emphasized job autonomy and required most staff members to coordinate, supervise, manage their tasks themselves, and make decisions more autonomously than ever before (5).

Mali Wong et al. not only the amount of interdependence that influences stress, but the clarity of interrelated tasks, worker roles, and the direction of interdependence, both extrinsic and intrinsic (28). Integrating alternative communication mechanisms to overcome social isolation and deficient collaborative work is expected to be promising.

Task interdependence is an integral part of today's organizations, and it describes the extent to which work teams interact to achieve a specific task (28). Turetken et al. and Tarafdar supported our study for the negative impact of task interdependence on the technostress and productivity during virtual work. They attributed this to the lack of interaction between the employee who works from home, which disturbs coordination, physical interaction, and subsequent achievement (29, 30). In Wong et al., it is not just the amount of interdependence that influences stress, but the clarity of interdependence tasks, the roles of workers, and the direction of interdependence, both external and internal (28). Integrating alternative communication mechanisms to overcome social isolation and deficient collaborative work is expected to be promising (28).

Burnout is defined as an inadequate response resulting from chronic work stress. It involves three components; depersonalization, emotional exhaustion, and low achievement (31).

Burnout was among the outcomes evaluated in this study. It was determined that techno-overload was the strongest contributor to fatigue among medical school faculty, while techno-uncertainty was the strongest contributor among medical students. With this study, we were the first to identify techno-overload as a contributor to technostress among faculty and the techno-uncertainty among medical students. Techno-overload is defined as the high demand for work that requires work faster and longer than usual to meet work obligations (26), and some researchers found that work overload was the primary contributor to technostress (21). Burnout occurs when the demands of a job exceed an individual's ability to adapt (32); it is a psychological behavioral disorder that appears by individuals under constant stress. Researchers have established a precise association between techno-overload (workload and work pressure) and burnout (23, 33). The results were more pronounced in medical fields because of the central nature of medical schools and the lower scope of innovation and creativity in the medical sciences compared to other fields. These factors contribute to problems such as burnout (33).

The techno-invasion scores in this study, 3.91 ± 0.93 for staff and 3.93 ± 0.87 for students, were lower than the averages reported in a previous Egyptian study in a similar educational setting (6.61 ± 2.76) (20). The inconsistency can be attributed to the different questionnaires used in evaluating technostress and the time periods in which the study in question was conducted. Gabr et al. (16) conducted their study in December 2020, before we conducted our study when learning was completely virtual due to the lockdown. Conversely, we conducted this study between January and May 2021, when learning was mainly mixed. This distinction could also explain the significant discrepancy between participants' ratings of ICT complexity in this study, which were 3.47 ± 0.87 for staff and 3.45 ± 0.85 for students, compared with the mean of 12.47 ± 4.20 reported by Gabr et al. (16). Participants in the latter study were fully engaged with ICTs and the online learning environment, whereas participants in this study reported more ICT training and modern device use.

Working strain is another important finding that this study addressed in detail. The strain is well-described based on the stress–strain model. When an individual suffers from certain psychological stresses (related to the work environment) that exceed his resources and capabilities, he suffers from a negative emotional feeling (strain) (34).

Techno-invasion, yet another of the dimensions of technostress, appeared in this study and it was associated with more burnout, strain, and less work engagement. The researchers describe technical invasion as the loss of privacy in one's personal life due to information and communication technology. When technology makes workers reachable at any time, with no boundaries between work and personal time, individuals report considerable work–family conflicts (20).

Similar to this study, Molyneux et al. (2020) accurately described the associations between techno-overload, techno-invasion, and stress, and found that conflict between family and work has significant direct correlations with technostress subscales. The authors blamed the work-at-home environment and at the same time expressed that universities are insisting on employees to continue working virtually, at least part-time, even after the lockdown is lifted, unsuitable for work (35). In contrast to this study, some research has reported positive effects of prolonged virtual work of more than a year on family and work conflict compared to actual work of <1 year (4). We consider it worth noting that most of the medical students in this study (1,562 of 2,526) and approximately half of the faculty members were living in the rural areas and might have been using ICTs for the first time.

Techno-uncertainty is another contributor to technostress, and it was identified as one of the strongest contributors to burnout and strain among the participants in this study. Techno-uncertainty refers to discomfort concerning the use of ICTs at work (33), and researchers identified its influence on worker strain (14) and fatigue (21). Apprehension, anxiety, and agitation are common behavioral strains attributable to technostress, and one marker of techno-uncertainty, in particular, is fear of losing information from clicking incorrect keys or generally making mistakes (36).

Engagement in work is a known term that refers to which extent the employees are committed to their work. However, the literature defined the engagement of students in a different way. It was described by the ability of students to behave, recognize, and feel in the expected way during the learning process (37).

Furthermore, we found that techno-insecurity positively correlated with burnout and strain and negatively with work engagement. Techno-insecurity is defined as the constant fear of losing one's job or being replaced with an employee with greater ICT capabilities (33); researchers associated it with emotional exhaustion, burnout, and strain; employees require specific coping mechanisms to reduce the harmful emotional stress owing to techno-insecurity (38).

Consistent with the findings of this study, previous researchers found negative correlations between techno-overload, techno-invasion, and techno-uncertainty on one side and work engagement on the other (33). They revealed that better faculty work performance was associated with these three technostress dimensions in particular, and suggested three strategies to counteract technostress: techno-support anticipation, facilitation of ICT literacy, and involvement (33). However, contrary to this study, scholars found positive correlations between job satisfaction and, in turn, engagement and virtual work and telecommunication; notably, though, the correlation was weak (r = 0.09, 95% CI: 0.07−0.11) (4). Previous researchers found a curvilinear relationship between workload and job satisfaction and subsequent engagement; working for more than 15.1 h/week was associated with a significant decline in job satisfaction and engagement compared with working fewer hours (39, 40). The fact that the workloads of the participants in this study were 35.5 ± 24.4 h/week for the faculty members and 40.1 ± 27.8 for the students could explain the discrepancies between the findings of this study and the previous ones (39, 40).

This study indicated that among the staff members, presenteeism was a positive predictor of burnout, strain, and a negative predictor of work engagement. Presenteeism describes the phenomenon of appearing at work without being productive, and burned-out employees who are indecisive show more presenteeism, absence, and turnover. Therefore, the researchers described presenteeism as a risk factor for burnout and highlighted its negative influence on work engagement and achievement (41). Researchers demonstrated that burnout can weaken "the gain cycle of daily job resources, daily work engagement, and daily job crafting" (41). Consistent with the findings here, other researchers found that technostress with resultant burnout negatively affected worker productivity (42), efficiency (43), job satisfaction, and ongoing commitment (44).

The findings of this study clearly contrast with other previous findings. For instance, virtual work was more efficient because it enabled completing tasks from anywhere and consequently lead to increased efficiency, employee satisfaction, and balance between work and family life (45). Moreover, researchers associated virtual work with better work performance and lower work-role stress (4) and found that ICTs can expedite task completion, thereby improving quality-of-life (21). Another researcher argued against any association between technostress and students' academic performance (46). The discrepancies

between our findings and these contrasting results might be attributable to the variations in the working contexts. The participants in the aforementioned studies mentioned were business users of ICTs, in contrast with our medical school faculty members and undergraduate students.

Barring the behavioral and psychological impacts of technostress, we here shed light on the influence of technostress on human biological systems. This study depicts that the total technostress score predicted blood cortisol level in both staff and students and found significant positive correlations with burnout, strain, and cortisol level. These results were consistent with previous findings of higher blood cortisol among study participants with higher technostress subscale scores, specifically, techno-overload and IT complexity (20). Moreover, Adam (2006) connected higher diurnal cortisol level and secretion in response to a stressor with increased self-reported pressure and negative mood (47).

Cortisol secretion is mediated by the hypothalamus-hypophyseal tract where the thalamus and the frontal cortex integrate sensory stimuli in response to different technostress creators. The brain sends this information to the limbic system, which mediates the emotional responses, and the hypothalamus releases a corticotrophin-releasing hormone (CRH). The CRH stimulates the pituitary gland to release an adrenocorticotropic hormone into the blood; subsequently, the adrenals secrete cortisol, which mediates the behavioral responses (48). Stress-induced cortisol secretions enable the human body to adapt perception, memory, cognition, and behavior to stressors (49). However, in the long run, cortisol precipitates burnout, depression, anxiety, hypertension, atherosclerosis, and immunological disorders (50–52).

This study, total technostress score was a significant predictor ofCoQ10 among studied staff, and researchers established a negative correlation betweenCoQ10 and certain working conditions. Co-enzyme Q10 is a vitamin-like antioxidant that is believed to exert protective effects on different body systems, notably, the cardiovascular system; it has a crucial role in producing cellular energy (53). The findings of negative correlation between technostress and CoQ10 are consistent with the recent study findings of a significant correlation between low CoQ10 and excessive working and burnout from a study on healthcare workers in Egypt (19).

Despite the ambiguity in study findings related to the exact role of CoQ10, researchers established a role of low CoQ10 in the path physiology of depression (54, 55). Consistent with this study, previous studies revealed that overwork was associated with burnout and that burnout significantly predicted the inflammatory cytokines TNF-a, IL6, and CoQ10 (23, 51, 52). Through their effects on the central nervous system, these cytokines precipitate behavioral manifestations, such as fatigue, diminished appetite, and inhibited libido (56).

Strength and Limitations

This study evaluates the prevalence and creators of technostress among medical staff and students as well as addresses the behavioral and biological consequences (fatigue, stress, engagement, cortisol, and CoQ10 levels) helping to better understand the underlying mechanisms and sequencing of technostress. Involving participants of different ranks from different universities increases the reliability of this study and allows generalization of the results obtained. Furthermore, as recall bias might be there, we attempted to offset this by looking at the assessment of cortisol and coenzyme Q10 levels in some of the participants. The main limitation of this study is limited to University healthcare workers (colleges and medical students) except healthcare workers outside the University. However, future research should be directed to other business sectors in healthcare, investigating potential adverse effects of technology and offering different adaptation strategies to deal with technology resulting from ICT due to the current pandemic. Another recommendation is to consider personality traits while suggesting coping strategies to overcome the technique.

CONCLUSION

Faculty and students at the Egyptian Colleges of Medicine and Health Care report that they encounter medium-to-high tech related to their use of ICT. In this study, higher stress was associated with extreme burnout, strain, and cortisol level on the one hand and lower engagement in work and CoQ10 on the other. The findings highlighted that it may be beneficial for medical school administrators to adopt programs to facilitate staff and students in the use of ICTs during the COVID-19 period of virtual work; such programs may include psychological support for individuals who are struggling. These facilitation programs should include training in creating good networks, use of smart devices, and IT support teams for staff and students as cornerstones to overcoming technology. Furthermore, healthcare and medical professionals must devote time and space to virtual work and not blur the boundaries between work and home, and policymakers must suggest different strategies for adapting to technostress.

DATA AVAILABILITY STATEMENT

The dataset analyzed during the current study are available from authors upon justified request.

ETHICS STATEMENT

The current study was carried out following the Declaration of Helsinki. Data collection was commenced after obtaining approval from Research Ethical Committee REC of Menoufia Faculty of Medicine, Menoufia University (ID: 06/2021FAM). An informed consent were taken in which each participant has been informed of all aspects of the study and have the right to give up as he/she wanted. The data were handled anonymously to maintain the confidentiality of the participants. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ZAK conceptualized the study, analyzed and interpreted the data, wrote the manuscript draft, proofread it and approved the final manuscript. AFS collected the data, wrote discussion, and revised methods and approved the final manuscript. AMB formulate the questionnaire and wrote the methods. AYS, NNH, and HMA conceptualized the study and collected the data, and approved the final manuscript. ASE and KAA conceptualized the idea and collected the data. SRA and NHH collected the data, wrote introduction, and approved the final manuscript. SMA collected the data, wrote discussion, and revised methods and approved the final manuscript.

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Occupational Burnout Symptoms and Its Relationship With Workload and Fear of the SARS-CoV-2 Pandemic Among Hospital Nurses

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Introduction: The pandemic has intensified physical and psychological work demands experienced by nurses in a hospital environment. The purpose of this study was to examine personal and work environmental risk factors associated with occupational burnout among hospital nurses.

Methods: We conducted a cross-sectional from April to November 2020. Data from 831 nurses who worked professionally in four educational hospitals were compiled through survey questionnaires to report the prevalence of burnout, occupational and individual factors. Independent t-test and Mann–Whitney test measured the link between the scopes of occupational burnout and risk factors.

Results: About half of the participants indicated moderate symptoms of burnout. The fear of the nurses correlated significantly with emotional exhaustion ($r = 0.71, p = 0.001$), depersonalization ($r = 0.67, p = 0.02$), and personal accomplishment ($r = 0.63, p = 0.05$). Mental demand ($r = 0.74, p = 0.01$) and effort at work ($r = 0.68, 0.001$) correlated significantly with emotional exhaustion ($r = 0.51, p = 0.03$).

Conclusion: The findings indicated a high prevalence of burnout symptoms, particularly emotional exhaustion, among hospital nursing professionals. Occupational health services should consider burnout as an occupational-related condition and provide interventions to reduce workplace chronic stressors and burnout in hospitals.

Keywords: occupational stress, risk factors, hospital nurse, burnout, mental health

INTRODUCTION

With the spread of the COVID-19 pandemic and cases and hospitalizations surging across the countries, the work environment and workload have highly influenced the well-being of hospital nursing professionals (1). Nurses are continuously observing the impacts of coronavirus in hospitals. The exposure of the nurses to daily acute airborne respiratory infections has led to high work-related physical and mental pressures during coronavirus outbreaks (2). According to the World Bank, Iran has 1.9 nurses per 1,000 people, far lower than 5.8 in Italy and 8.3 in the United Stated (3). In Iran, with the onset of coronavirus, many infected patients were admitted to hospitals, and each nurse had to manage, on average, double patients compared to the pre-pandemic situation (4).

The nursing professionals' concerns regarding the COVID-19 infection in the hospital, long hours of work, and physical and psychological stress affected their capacity to cope with their workplace stressors in the pandemic era. Moreover, hospital nurses had multiple tasks and responsibilities for patients during the COVID-19 pandemic, so they experienced fatigue, anxiety, and depression (5).

The World Health Organization has classified occupational burnout syndrome as a work-related phenomenon caused by chronic stress (6). The work demands model forms the theoretical concept of individual burnout in this study in which nurses experience burnout as a result of physical and psychological work demands that are higher than their abilities to manage them (7). In general, burnout is a state of physical and mental exhaustion resulting from chronic exposure to occupational stress or physically demanding work-related conditions (8).

Burnout among healthcare providers is a newly emerging challenge that affects healthcare systems and patient safety worldwide (9). Healthcare providers may experience anxiety, irritability, mood swings, insomnia, depression, a sense of failure, and as a result, burnout. Moreover, they may be at risk of severe fatigue in their duties because of alertness and prolonged attention to detail (10).

Previous studies have shown that occupational burnout is linked to stressful workplaces and leads to the poor health of nurses (11, 12). Factors such as job satisfaction, environmental factors in the workplace, workload, daily working hours, and perception of anxiety concerning working conditions can affect occupational burnout among nurses (13). The burnout in nurses can lead to exhaustion, lack of sense of affection for others (depersonalization), and lack of accomplishment and inefficiency. These effects can negatively impact the general health of nurses (14). Moreover, the unfavorable reaction to the clients may be associated with the experience of emotional exhaustion (15).

Increasing physical and mental work demands on the hospital nursing staff have made it crucial to identify the symptoms, and possible risk factors in the workplace, which lead to occupational burnout (16). A better understanding of the association between risk factors and burnout syndrome will help find ways to manage occupational stress, prevent occupational burnout, and thus provide higher quality services, work productivity, and promote community health.

AIM

The present study examined the associations between burnout symptoms, work-related and individual factors, workload, and fear of the SARS-CoV-2 pandemic among hospital nurses.

Hypotheses

The research hypothesized that 1—Burnout symptoms are frequent in hospital nurses during pandemic crises. 2—The fear due to COVID-19 in the hospital environment contributes to occupational burnout among nurses. 3—The perception of hospital nurses about workplace stressors has a link with burnout symptoms.

THE STUDY

Research Design and Participants

The present cross-sectional study was performed from April to November 2020. The statistical population comprised around 1,200 nursing professionals working in different wards of five teaching hospitals affiliated with the University of Medical Sciences in the province of Semnan in Iran. The participants were the hospital nursing staff, assistants, and technicians from the surgery, dialysis, intensive care, emergency care, cardiac care, internal medicine, gynecology, and pediatric wards. The inclusion criteria were having a nursing work experience of at least 2 years and signing an informed consent form. The nursing staff contracted with COVID-19 or identified with previous psychiatric or mental disorders were excluded. In this study, of all the copies of the questionnaire distributed among nurses in different wards, 831(69.2%) were returned. Also, 31% of the hospital nursing professionals were excluded because they were not eligible or unwilling to respond or failed to complete the questionnaires.

Data Collection and Instruments

We conducted a paper-based survey and briefed the participants in advance about the project, and sought informed consent for voluntary participation. Three students involved in the study distributed questionnaires and collected data. The questionnaires were in plain Persian language. The first part of the questionnaire was a demographic questionnaire on the nurses' gender, age, marital status, length of nursing work, shift work schedule, education level, and employment status. The second part applied the Iranian version of the Maslach Burnout Inventory- Human Services Survey translated into the Persian language for detecting and assessing the severity of burnout syndrome. It contains 22 items that evaluate burnout with relevant subscales, i.e., emotional exhaustion (EE) (a sense of fatigue and lack of energy), depersonalization (DP) (sense of a negative reaction to the clients and lack of personal accomplishment), and personal accomplishment (PA). The EE subscale has nine statements out of which eight items are related to personal accomplishment, and five items to depersonalization. The frequency of these emotions is measured from 0 (never), 1 (sometimes in a year), 2 (monthly), 3 (a few times a month), 4 (every week), 5 (occasionally in a week), and 6 (every day). Respondents marked their feelings based on the available options.

Higher scores in EE and DP subscales or lower scores in the PA subscale demonstrate a high level of occupational burnout. The following ranges of scores were used to determine the level of burnout as low, moderate, or high. Emotional exhaustion is considered low, moderate, or high if EE, respectively, scores ≤ 18, 19–26, or ≥ 27. DP scores of ≤ 5, 6–9, and ≥ 10 are considered low, moderate, and high for depersonalization, respectively. PA scores of ≥ 40, 34–39, and ≤ 33 demonstrate low, moderate, and high levels of personal accomplishment, respectively. A combination of high score levels for the three burnout domains

was attributed to a high level of overall burnout. The internal consistencies were estimated for each three burnout dimensions. The Cronbach's factors were 0.84 for emotional exhaustion, 0.76 for depersonalization, 0.79 for personal accomplishment, and 0.80 for the total scale. The reliability and validity of the burnout instrument in Iran were examined and confirmed by Moalemi et al. who reported a test-retest reliability constant of >0.7 for the three dimensions of burnout (17).

The third part of the questionnaire was used to assess perceived nursing workload by measuring four items of the NASA Task Load Index (TLX). While the original version of the NASA-TLX comprises 6 subscales, an earlier study performed a component analysis to determine the causal patterns between NASA-ionTLX and subscales of the Burnout Inventory. The analysis indicated that two subscales including frustration and performance are similar to emotional and depersonalization components along with measures of burnout, which proposed the four subscales including effort, physical, mental, and temporal demands may be a more direct determinant of task load (18). The items were as follows: How much thinking do you require to perform a task? How much is the intensity of physical activity at work? How much time pressure do you feel at work? How hard do you have to work? The instrument assessed workload on five 7-point scales. The overall workload scale ranging from 0 to 100 was obtained by combining the six scales. The workload scale was incremented as "low", "medium", and "high" estimates. The Cronbach's alpha was estimated at 0.71 for the nursing workload in this study.

The fourth part of the questionnaire assessed the scale of fear perceived by the nurses during the spread of SARS-CoV-2. The fear scale consisted of four items, which were adapted from the perceived threat of the COVID-19 scale (16): Fear of contracting coronavirus infection, spreading coronavirus to family (worry about taking it home to family), afraid for the future, and fear of death. The nurses were requested to answer a four-point Likert scale from "no" fear to "high" level of fear. The scores were from 4 to 16. The total score was classified as negligible (≤ 8), moderate (9–12), and high fear of the pandemic (13–16). The internal validity was assessed by three health professionals. In this study, Cronbach's alpha was 0.84.

Statistical Methods

After the participants completed the questionnaires, the collected data were first scored based on the instructions for the burnout symptom instrument and then analyzed in SPSS 22. This study used statistical tests of percentage, frequency, mean, SD, maximum, and minimum to describe personal and occupational factors, including age, sex, marital status, employment, work hours, and experience.

This study applied an independent t-test and Mann–Whitney U test to measure the link between the scopes of occupational burnout and personal factors such as sex and marital status. Kruskal–Wallis and one-way ANOVA examined the relationship between occupational burnout and independent risk factors. Spearman's test compared demographic variables with the scopes of occupational burnout. Pearson correlation test assessed the different dimensions and their relations to occupational

burnout and task load dimensions. The analysis used frequency percentages to compare occupational burnout in different hospital wards. The significance level was $p \leq 0.05$.

Ethical Considerations

We conducted this study according to the rules proposed by the Research Ethics Review Committee of the University Board. Following necessary coordination with the authorities of hospitals, the eligible nurses were enrolled. The nurses were briefed about the study and asked to answer all the questions in the questionnaires. The participation in the study was voluntary and with informed consent. Moreover, we ensured the nurses of data privacy and relevant ethical aspects. The research team coded hospitals, wards, and respondents in the questionnaire to protect their anonymity and confidentiality.

RESULTS

Individual and Occupational Characteristics of the Participants

Of the 831 nurses, 602 (72.5%) were women and 229 (27.5%) were men. The means and standard deviations of the nurses' age were 34.72 ± 0.7 (ranging 23–49 years), and work experience was 11.19 ± 0.6 (range: 2–29 years). Most of the nurses (93.1%) had a master's degree. Most nurses had received training for safe work procedures in the hospital environment. Over half of the hospital nurses believed that safety and health were acceptable in the work

TABLE 1 | Characteristics of the hospital nurses at studied teaching hospitals ($n = 831$).

Variables	Frequency (%)
Gender	
Female	602 (72.5)
Male	229 (27.5)
Marital status	
Single	190 (22.9)
Married	641 (77.1)
Employment status	
Permanent	545 (65.6)
Temporary	127 (15.3)
Informal	159 (19.1)
Working hours	
7 h	406 (48.9)
8 h	266 (32.1)
10 h	69 (8.4)
12 h	90 (10.7)
Training on safe work procedures	
Yes	699 (84.2)
No	132 (15.8)
Evaluation of safety and health at work environment	
Acceptable	346 (41.6)
Unacceptable	485 (58.4)

TABLE 2 | Burnout symptoms and task load items and fear felt by nurses during work under COVID-19 at studied teaching hospitals ($n = 831$).

Variables	N (%)	Mean (SD)
Emotional exhaustion		26.30 (11.02)
Low	456 (54.9)	
Moderate	326 (39.1)	
High	49 (6)	
Depersonalization		10.90 (4.31)
Low	615 (74.02)	
Moderate	143 (17.26)	
High	73 (8.70)	
Personal accomplishment		27.10 (9.28)
Low	115 (13.9)	
Moderate	309 (37.3)	
High	407 (49.05)	
Mental demand		81.30 (22.18)
Low	45 (5.41)	
Moderate	489 (58.84)	
High	297 (35.74)	
Physical demand		51.62 (24.30)
Low	96 (11.55)	
Moderate	523 (62.94)	
High	212 (25.51)	
Temporal demand		79.86 (26.14)
Low	34 (4.09)	
Moderate	462 (55.59)	
High	335 (40.31)	
Effort		84.35 (24.20)
Low	72 (8.66)	
Moderate	519 (62.45)	
High	240 (28.88)	
Fear of Covid-19		14.17 (3.57)
No or mild	32 (3.85)	
Moderate	102 (12.27)	
High	697 (83.87)	

environment. Data related to the characteristics of the hospital nurses who participated in this research are given in **Table 1**.

Occupational Burnout, Task Load, and Feeling of Fear in Hospital Nurses

Table 2 demonstrates the burnout symptoms, workload, and fear perceived by the nurses during the pandemic.

The hospital nurses reported high levels of emotion exhaustion (mean = 37.09, SD = ±0.8), depersonalization (mean = 24.9, SD = ± 0.3), and personal accomplishment (mean = 24.9, SD = ± 0.3). Overall, the nurses had a high task load during the pandemic. The analysis of our data showed that over half of the nurses felt moderate to high time pressure, physical and mental demands, and efforts because of their tasks. Most nurses perceived the fear of COVID-19 threat to their well-being at work (83.87%). The findings showed that 39.1% of the nurses experienced moderate emotional exhaustion, 8.7% had a high score of depersonalization, and 13.9% had a low score of personal accomplishment.

Table 3 shows the odds of having a high level of overall burnout in the nurses working in hospital wards. Working in different hospital department settings was not significantly associated with the high level of burnout symptoms.

Differences in Burnout, Task Load, and Fear Levels in Terms of Nurses' Characteristics and Occupational Factors

Table 4 presents the mean, standard deviation, and variances in the scores of burnout domains, task load, and fear of pandemic between independent variables of personal and occupational subgroups. The analysis of our data showed that the levels of overall burnout were not statistically different between subgroups of sex and marital status, and employment type. However, significant statistical differences in overall burnout were observed between subgroups of age ($p = 0.03$), hours of performing work ($p = 0.01$), and length of work experience ($p = 0.01$). Depersonalization levels were significant between female and male participants ($p = 0.01$). The degree of threat caused by the pandemic was statistically different between subgroups of variables of sex ($p = 0.001$), marital status ($p = 0.01$), age ($p = 0.02$), length of work experience ($p = 0.005$), type of employment ($p = 0.01$), and hours of performing work in a shift ($p = 0.01$).

Associations Among Burnout Dimensions, Task Load, and Fear of SARS-CoV-2

Table 5 gives the correlations between dimensions of burnout, task load, and feelings of fear perceived among hospital nurses during the SARS-CoV-2 pandemic. A considerable degree of correlation existed among the three main variables of emotional exhaustion, depersonalization, and personal achievement. Emotional exhaustion was directly correlated with personal achievement, as an increase in emotional exhaustion increased PA ($r = 0.19$, $p = 0.001$).

The analyses indicated that emotional exhaustion highly correlated with the nurses' effort ($r = 0.68$, $p = 0.001$). Depersonalization had higher correlation with mental demand ($r = 0.51$, $p = 0.03$), effort ($r = 0.51$). Personal achievement had higher correlation with mental demand ($r = 0.67$), effort (0.58). The fear of SARS-CoV-2 perceived by nurses associated significantly with emotional exhaustion ($r = 0.65$, $p = 0.03$), depersonalization ($r = 0.67$, $p = 0.02$), and personal accomplishment ($r = 0.63$, $p = 0.05$).

DISCUSSION

This work studied the prevalence of burnout and relationships between individual characteristics and occupational risk factors and burnout among Iranian hospital nurses during the SARS-CoV-2 pandemic. Our results showed a relatively high prevalence of emotional state of energy depletion and exhaustion, increased emotional distance from the nursing profession, and reduced professional efficacy in the nursing profession during the COVID-19 pandemic. We found that workload stressors perceived under the status of novel coronavirus contributed to burnout in hospital nurses. Our results revealed that years

TABLE 3 | Association of working in hospital wards with high level of burnout symptoms in studied hospitals.

Type of Wards	Burnout symptoms at high level %	Unadjusted odd ratio (95% confidence interval)	*Adjusted odd ratio (95% confidence interval)
Surgery	1.5	Reference	Reference
Dialysis	4.6	0.38(0.22–1.23)	0.54(0.3–1.30)
Intensive care	6.3	0.69(0.59–2.45)	1.07(1.05–2.60)
Cardiac care	7.1	1.23(0.37–8.02)	1.03(0.98–1.60)
Pediatric	7.6	1.09(1.03–4.56)	1.71(1.04–2.40)
Internal medicine	19.9	1.21(0.34–5.43)	1.70(1.44–3.34)
Gynecology	20.9	2.03(1.46–5.92)	1.52(1.06–3.91)
Emergency	32.3	2.18(1.03–7.48)	1.50(1.60–5.70)

Adjusted estimates are based on participants responded for all variables.

at work, age, and length of working hours were associated with burnout, but the type of employment had no significant association with burnout dimensions.

In our study, 54% of the nurses scored moderate level of emotional exhaustion, 8.7% scored high for depersonalization, and 13.9 % scored low on the accomplishment variable. Additionally, we found a higher frequency of burnout among hospital nurses in this study as compared to the studies before the coronavirus pandemic in Iran (19). The COVID-19 pandemic and workforce shortages that imposed extended hours of work for many nurses may explain the increased rate of burnout symptoms. Similar results reported high rates of burnout among health workers in the United Kingdom and Poland (20).

However, various studies reported different scores of burnout dimensions in the nursing profession (21, 22). In this study, the average scores of emotional fatigue were higher than other burnout dimensions. This result is in agreement with a Spanish research on burnout prevalence which reported emotional exhaustion among hospital nurses (16).

We found that all three dimensions of burnout were more frequent among nurses offering acute services in emergency wards. A previous study demonstrated a link between nurses' unpleasant relationships with coworkers and supervisors in emergency services and emotional exhaustion (23). Furthermore, our study found a link between a higher level of burnout symptoms and a higher level of work strains. Some studies have already suggested that nurses who care for severely ill patients with high job demands in terms of workload and work pressure had experienced more feelings of frustration, which may initiate burnout symptoms (3, 8, 24).

Our results showed that working in populated hospital settings and continuously wearing protective devices during the working period may have increased the risk of burnout. These findings are consistent with a previous study, which compared workloads across professions and reported high burnout incidence because of excessive workloads and high mental demands (25, 26).

We found a moderate level of depersonalization correlated with age, gender, work hours, and experience, which is similar to the results of prior studies (27, 28). Our study revealed a higher rate of work-related burnout among nurses in emergency units than nurses in other units. A previous study reported a higher

prevalence of burnout among emergency nurses might relate to work circumstances, particularly excessive extended working hours, psychological workload, and organizational factors (29–31).

This study found a link between years of work experience and individual accomplishment and depersonalization. We also found that nurses with older age may be related to higher personal accomplishment levels. Previous studies reported different results concerning the role of age in burnout symptoms. In a previous study on nurses, Elbarazi et al. (9) found that personal accomplishment improved with increasing age (9). Inversely, Lawn et al. (33) reported that older nurses had lower personal accomplishments but found no significant association between age and working years with emotional exhaustion or depersonalization (32). Furthermore, studies by Elbarazi et al. on emergency health care workers and medical doctors have not found a relationship between age and years of employment with burnout (9).

This study showed that gender and marital status have no statistical association with work-related burnout. These results are consistent with the findings of an earlier study on clinical nurses (33). However, some studies have claimed the association between age and gender with occupational burnout (34, 35).

In this study, our results pointed to no significant association between employment status in the forms of permanent, temporary, and informal work with burnout syndromes. However, a previous study before the onset of COVID-19 has reported an association between precarious employment and health (36). The probable explanation for our result that employment status was not a significant factor in burnout among nursing professionals would be the high work environment stress experienced under SARS-CoV-2.

In this study, extended working hours had a link to burnout. Nurses with longer hours of work were more likely to experience the depersonalization aspect of burnout, which is in line with a recent study that showed health care workers who worked continuously in an extended 12-h shift, experienced more burnout and human error during their tasks (37). Prior research on hospital nurses reported that extended working hours might increase job dissatisfaction and burnout compared to a standard 8-h shift work. Besides, nurses with extended working hours had lower work performance (7).

TABLE 4 | Differences in the dimensions of burnout, overall burnout, task load, and fear of COVID-19 in categorized subgroups in terms of individual and work characteristics in hospital nurses.

Variables	Emotional exhaustion		Depersonalization		Personal accomplishment		Overall burnout		Task load		Fear	
	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value
Sex												
Female	29.70 ± 12.01	0.4	11.5 ± 0.8	0.01	27.9 ± 0.7	0.2	88.06 ± 2.1	0.3	73.1 ± 18.2	0.1	15.3 ± 2.6	0.001
Male	28.05 ± 9.16		9.4 ± 0.4		27.3 ± 1.1		90.1 ± 1.7		77.6 ± 24.5		12.2 ± 4.9	
Marital Status												
Single	28.3 ± 1.7	0.3	12.2 ± 1.03	0.1	28.3 ± 1.3	0.5	89.8 ± 1.1	0.7	68.7 ± 16.8	0.1	12.4 ± 3.3	0.01
Married	26.7 ± 0.9		10.3 ± 0.3		27.5 ± 0.6		89.5 ± 0.6		72.1 ± 14.3		15.3 ± 2.9	
Age												
23–30	27.3 ± 7.3	0.1	13.8 ± 3.8	0.02	25.6 ± 6.2	*0.01	86.9 ± 13.02	0.03	65.1 ± 17.3	0.3	14.2 ± 2.5	0.02
31–40	27.9 ± 8.7		10.4 ± 3.9		27.9 ± 7.3		91.4 ± 17.2		70.3 ± 22.9		14.8 ± 2.2	
41–49	29.5 ± 4.8		8.1 ± 3.02		31.8 ± 6.8		93.9 ± 12.3		73.22 ± 25.7		15.1 ± 2.4	
Length of work Experience												
2–9	24.7 ± 7.9	0.1	14.7 ± 7.9	0.04	24.2 ± 5.9	0.02	70.8 ± 14.6	0.01	75.3 ± 20.7	0.4	14.3 ± 3.1	0.005
10–19	27.6 ± 9.6		17.6 ± 9.6		28.1 ± 3.9		85.6 ± 14.5		71.4 ± 16.2		15.1 ± 4.1	
20–29	24.7 ± 8.4		14.7 ± 8.4		30.7 ± 4.2		92.4 ± 8.5		71.9 ± 18.8		14.9 ± 3.1	
Employment Status												
Permanent	26.4 ± 1.07	0.5	16.4 ± 1.07	0.7	28.7 ± 0.7	0.3	90.5 ± 0.7	0.3	73.4 ± 15.1	0.3	14.8 ± 2.8	0.01
Temporary	39.0 ± 2.09		9 ± 2.09		27.1 ± 1.5		91.3 ± 1.4		74.1 ± 16.9		12.3 ± 3.2	
Informal	37.8 ± 1.7		11.8 ± 1.7		24.7 ± 1.4		85.3 ± 1.3		68.4 ± 20.7		13.1 ± 4.1	
Working hours												
7 h	28.03 ± 8.9	0.3	15.7 ± 4.09	0.04	28.5 ± 6.9	0.2	92.3 ± 14.9	0.01	70.4 ± 13.1	0.2	13.1 ± 3.6	0.01
8 h	25.4 11.08		13.4 ± 4.08		26.6 ± 7.5		85.4 ± 18.6		70.4 ± 16.3		13.9 ± 4.5	
10 h	27.2 ± 8.2		15 ± 3.7		29.4 ± 5		91.7 ± 10.8		72.9 ± 16.8		14.5 ± 3.7	
12 h	27.7 ± 9.2		17.7 ± 9.2		26.2 ± 6.8		89.4 ± 16.9		72.1 ± 15.7		14.4 ± 4.3	

TABLE 5 | Correlations (*p*-values) between emotional exhaustion, depersonalization, and personal accomplishment among studied hospital nurses.

Variables	1	2	3	4	5	6	7	8
1. Burnout: Emotional exhaustion	1							
2. Burnout: Depersonalization	0.12 (0.01)	1						
3. Burnout: Personal accomplishment	0.13 (0.06)	0.19(0.01)	1					
4. Mental demand	0.74 (0.01)	0.51(0.03)	0.67 (0.002)	1				
5. Physical demand	0.22 (0.01)	0.20(0.19)	0.27 (0.02)	0.29(0.002)	1			
6. Temporal demand	0. 28 (0.03)	0.22(0.06)	0.39 (0.04)	0.61(0.01)	0.32 (0.007)	1		
7. Effort	0.68 (0.001)	0.51(0.03)	0.58 (0.01)	0.49(0.04)	0.38 (0.02)	0.37(0.003)	1	
8. Fear of Covid-19	0.71 (0.001)	0.67(0.02)	0.63 (0.05)	0.26(0.07)	0.21 (0.01)	0.28(0.05)	0.24 (0.01)	1

This study shows that nurses are particularly susceptible to burnout because of the workload, environmental pressure, and chaos they confront. In our study, the mental demand for nursing tasks contributed to a higher level of depersonalization, which is similar to previous reports (10, 38). Furthermore, our study showed that the level of experienced depersonalization might explain individual accomplishment (13).

Study Limitations

This study had some limitations that might influence when inferring the findings. First, despite collecting data on individual and work-related characteristics, this study did not include other variables that might relate to burnout, work-family conflict, and organizational factors. Future studies may examine a broader range of variables inside and outside the work environment. Second, although our study included a representative sample of hospital nurses, we applied a cross-sectional design, and thus this study cannot conclude causal relationships. Finally, this study used a self-report to obtain data for describing workload, mental, and physical burnout, which resulted in possible responses nurses believed to be desirable for their well-being. However, we asked nurses to respond to the questionnaire anonymously to improve a more reliable response.

CONCLUSION

This study indicates that the work of nursing professionals under the high stress of COVID-19 could have a substantial impact on the prevalence of burnout dimensions. Increased work demands and patterns imposed on hospital nurses highlight links between risk factors and significant effects on nurses' health. Stress, fear, and overwork caused by the pandemic in the hospital environment pushed nurses beyond their capacity to cope with prolonged physical and mental strain. These factors may lead to more issues, such as anxiety, depression, and chronic fatigue. Workplace well-being units need to boost nurses' level of resilience by safely responding to stress.

Perceived high level of fear and extended working hours following the spread of COVID-19 contributed to increasing occupational burnout among nurses. Burnout, in turn, has affected their family life and their ability to provide services

to patients, which rationalized the workplace well-being units to take interventions. Interventions should focus on the emotional support of hospital nurses to enable them to manage their behavior and responses to work demand and hazardous environmental conditions. This study indicated the relatively high frequency of three dimensions of burnout, particularly symptoms of emotional exhaustion among hospital nurses. Workplace well-being units should provide occupational health services to reduce stressful work environment conditions in hospital settings. Future studies on workplace burnout should focus on actions that may prevent symptoms in nursing professions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study was performed in line with the principles of the Declaration of Helsinki. The research protocol was approved by the Research Ethics Committee of Medical Sciences University (IR.SEMUMS.REC.1400.176).

AUTHOR CONTRIBUTIONS

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Work Stress, Health Status and Presenteeism in Relation to Task Performance Among Chinese Medical Staff During COVID-19 Pandemic

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Objectives: This study aims to evaluate the direct effects of work stress, health status and presenteeism on task performance, and further explore the mediating effects of health status and presenteeism, hoping to provide theoretical basis for improving the performance of medical staff.

Methods: A cross-sectional study was conducted among medical staff in Jilin Province, Northeast China. The Challenge and Hindrance-Related Self-Reported Stress scale, Short Form-8 Health Survey scale, Stanford Presenteeism Scale and Task Performance Scale were adopted to assess the work stress, health status, presenteeism and task performance of medical staff.

Results: A total of 4,347 questionnaires were distributed among medical staff, and 4261 were valid, for an effective rate of 98.02%. The mean scores for work stress, health status, presenteeism and task performance were 2.05 ± 0.84, 4.18 ± 0.68, 2.15 ± 0.79 and 4.49 ± 0.64, respectively. The ANOVA results showed that there were significant differences in the task performance scores between different genders, ages, marital statuses, professional titles, departments and work years ($P < 0.05$). Work stress ($\beta = -0.136$, $P < 0.001$) and presenteeism ($\beta = -0.171$, $P < 0.001$) were negative predictors of task performance. Health status ($\beta = 0.10$; $P < 0.001$) was positive predictor of task performance. Health status ($\beta = -0.070$; $P < -0.001$) and presenteeism ($\beta = -0.064$; $P < 0.001$) mediated the relationship between work stress and task performance ($P < 0.001$). Presenteeism mediated the relationship between health status and task performance ($\beta = 0.07$; $P < 0.001$).

Conclusion: Work stress and presenteeism had significant negative impact on the task performance of medical staff; health status had a significant positive effect on task performance. Meanwhile, health status and presenteeism played a mediating role in the relationship between work stress and task performance, and presenteeism played a mediating role in the relationship between health status and task performance.

Reasonable assignment of tasks can reduce the work stress, but to improve the performance of medical staff, we should pay more attention on improving health, such as making health-related safeguard measures, raising awareness, building a platform, etc.

INTRODUCTION

Since the end of 2019, there have been outbreaks of infectious diseases caused by coronavirus disease 2019 (COVID-19) worldwide. COVID-19 was declared a pandemic by the World Health Organization in January 2020 and listed as a public health emergency and a matter of international concern (1, 2). Emerging and re-emerging pathogens are global challenges to public health (3). Medical staff, as the backbone of COVID-19 prevention and control, has been playing a leading role in controlling the epidemic through the unremitting struggle against the epidemic (4). According to a survey from Europe, the COVID-19 pandemic affects the work of employees on every continent (5). Numerous studies have found that the COVID-19 pandemic is placing increasing demands on health care workers, it caused the severe employment situation, long or irregular working hours and shifts, and excessive work stress which were putting the task performance of medical staff and its health, society, and economy in a dangerous environment (6–8). These problems have seriously affected the attention, perception and decision-making ability of medical staff, not only reducing enthusiasm and initiative but also lowering the overall quality of medical staff. These consequences hinder the struggle against the virus, and the development of society.

The evaluation of the performance of health professionals has been the focus of scientific research in recent decades, and the efficient work of health technicians was the basis for improving the quality of health services (9). There have been extensive studies of task performance around the world, and the research factors mainly included work stress, job satisfaction, conflict, attendance, leadership relationships, health and so on (10–13). Studies indicated that more stressors arose during pandemics, and that stress itself was associated with the development of various diseases (14, 15). At the same time, health problems have become more prominent during the epidemic. In addition, healthcare workers faced more severe challenges during the pandemic. The heavy workload forced them to stick to their posts, and their attendance significantly improved, so we speculated that presenteeism was also more serious. While saving the lives of others, medical staff were more likely to neglect their own health, and the presenteeism rate of medical staff was much higher than that of other professions. In the context of the pandemic and the growing demand for medical services, medical staff are facing increasing work pressure, with a series of physical and mental health problems, and the possibility of going to work sick is increasing. Therefore, in combination with literature and epidemiological background, we selected these variables related to performance: work stress, health status, and presenteeism, to explore their direct and indirect effects on performance in multipath. Task performance refers to the

employee's output in terms of goals and responsibilities related to the job. To some extent, it can more directly reflect an employee's work ability and performance. Task performance is considered to be one of the key indicators of organizational performance, contributing to an organization's productivity, competitiveness and social and psychological work environment (9). Therefore, this study adopted task performance as an indicator to measure the performance of medical staff.

The following subsections describe the hypotheses considered in this study.

HYPOTHESIS DEVELOPMENT

Work Stress

Work stress refers to the mismatch between work requirements and individuals under the interaction of work situations and individual characteristics, affecting individuals' physiology, psychology and behavior (16). COVID-19 has disrupted everyone's daily lives, making it challenging to maintain boundaries between work and non-work, and research by Kumar et al. (14) pointed to the many stressors that emerge during a pandemic that can disrupt people's work and affect their performance. Research by Bhagat (17) showed that people are more likely to experience distress due to stressful life events, which can lead to disruptions in work and thus affect their task performance. Medical staff faces high occupational pressure caused by heavy workloads, extended working hours and so on. Such high occupational pressure seriously affects the physical and mental health of medical staff, leads to an increase in the probability of work error, and seriously affects work efficiency (18).

Based on the above discussion, the following hypothesis was proposed.

Hypothesis 1 (H1): Work stress has a significant, negative effect on task performance.

Health Status

The World Health Organization defines health as a good state of physical, mental and social wellbeing (19). Health is the basic condition for the normal work and lives of professional people. Health problems not only people's own lives, but they also have a direct or indirect impact on the labor productivity of employers, increasing the economic burden of the workplace, namely the loss of productivity caused by health (20). Ford et al.'s study (21) showed a significant correlation between physical and mental health and task performance. Baldwin et al.'s study (22) showed that the health status of medical staff directly affects the quality of medical work. At the same time, researches have shown that negative emotions associated with work stress may worsen

employees' physical and mental health, and that work stress was a key factor in health care workers' physical and mental health during the pandemic (23, 24).

Based on the above discussion, the following research hypotheses were proposed:

Hypothesis 2 (H2): Health status has a significant positive effect on task performance.
Hypothesis 3 (H3): Health status mediates the relationship between work stress and task performance.

Presenteeism

Presenteeism refers to "the phenomenon of people who normally need rest and absence from work going to work despite poor health" (25). Studies have shown that presenteeism is important because of its negative impact on individual health and organizational productivity (26, 27). Health productivity loss includes sickness absence and presenteeism (28). Presenteeism leads to much higher productivity loss than sickness absenteeism and is the main mode of working inefficiency among professional people (29). Studies in the USA have shown that presenteeism results in more lost productivity than sick leave (30). Employees who are sick tend to make more mistakes and have lower levels of performance and productivity (31). The study also found that the incidence of presenteeism of medical staff was significantly higher than that of other professions: the presenteeism of medical staff was ~3–4 times higher than that of other occupational groups, and the occurrence of presenteeism of medical staff is common (25, 32). A literature review showed that health status is associated with presenteeism and lost productivity (27). Other studies have shown that work stress can lead to presenteeism (33). The Health and Safety Executive (2015) reported that stress-related illnesses accounted for 35% of all health-related illnesses and 43% of presenteeism in the UK (34).

Based on the above discussion, the following research hypotheses are proposed:

Hypothesis 4 (H4): Presenteeism has a significant negative effect on task performance.
Hypothesis 5 (H5): Presenteeism mediates the relationship between health status and task performance.
Hypothesis 6 (H6): Presenteeism mediates the relationship between work stress and task performance.

Based on the above discussion, a hypothetical path was proposed as shown in **Figure 1**.

METHODS

Study Design and Participants

To validate the hypotheses, a cross-sectional survey was conducted in January 2020 in Jilin Province, Northeast China. Medical staff members in public hospitals were selected by stratified random sampling as the subjects of the study. In this process, all areas of Jilin Province were divided into cities and counties, and hospitals were also divided into urban public hospitals and county-level public hospitals. Due to the high clustering of urban public hospitals, these hospitals were

stratified by region, type and level and randomly selected at a rate of 1/4. Because of the dispersion of different counties, city hospitals and traditional Chinese medicine hospitals were selected from each county as samples. Finally, a total of 109 hospitals, including 29 urban public hospitals and 80 county-level public hospitals, were selected as sample hospitals. Through quota sampling, 40 medical staff members, including doctors, nurses and medical technicians, were selected from each hospital to be investigated. The questionnaire was administered on site by trained investigators and was recovered on site. Finally, 4,347 questionnaires were distributed, and 4,261 valid questionnaires were collected. The valid response was 98.02%.

The study was approved by the Medical Ethics Committee of the author's institution (No. 2019-12-03). Participants were provided with a complete explanation of the purposes of the study. Participants were informed that the information collected would be used solely for the study and that they could withdraw at any time.

Measures

The measuring instrument was a questionnaire, which was developed by adapting previously validated scales to the context of the study. The questionnaire was divided into two parts. The first part collected demographic characteristics of the respondents, including gender, age, marriage status, education background, professional title, department and working years. The second part measured respondents' task performance, work stress, health status and presenteeism.

Challenge-and Hindrance-Related Self-Reported Stress Measures

Work stress was assessed using the Challenge-and Hindrance-Related Self-Reported Stress Measures (CHSS) developed by Cavanaugh et al. (35). It includes both challenging stress and hindrance stress. Challenge stressors were defined as work-related demands or circumstances that have associated potential gains for individuals despite potential stress. Hindrance stressors were defined as work-related demands or circumstances that tend to constrain or interfere with an individual's work achievements and that do not tend to be associated with the individual's potential gains. There are 11 items on the CHSS, including 6 challenging stressors and 5 hindrance stressors. The items are measured on a 5-point Likert scale ranging from 1 (no pressure) to 5 (extreme stress), and the higher that the score is, the greater that the work stress of the medical staff is. Cavanaugh's research (35) showed that the reliability coefficients of the two subscales were 0.87 and 0.75, and the correlation coefficient was 0.28, indicating that the two scales had good internal consistency and discriminant validity. The CHSS has been widely concerned and applied (36–41). In addition, Chinese scholars have translated it into Chinese and proved its applicability in Chinese professional groups (42). In this study, the Cronbach's alpha was 0.938 and 0.849 for the two subscales, respectively.

Short Form-8 Health Survey

The Short Form-36 (SF-36) Health Survey is the most popular instrument for investigating health-related quality of life
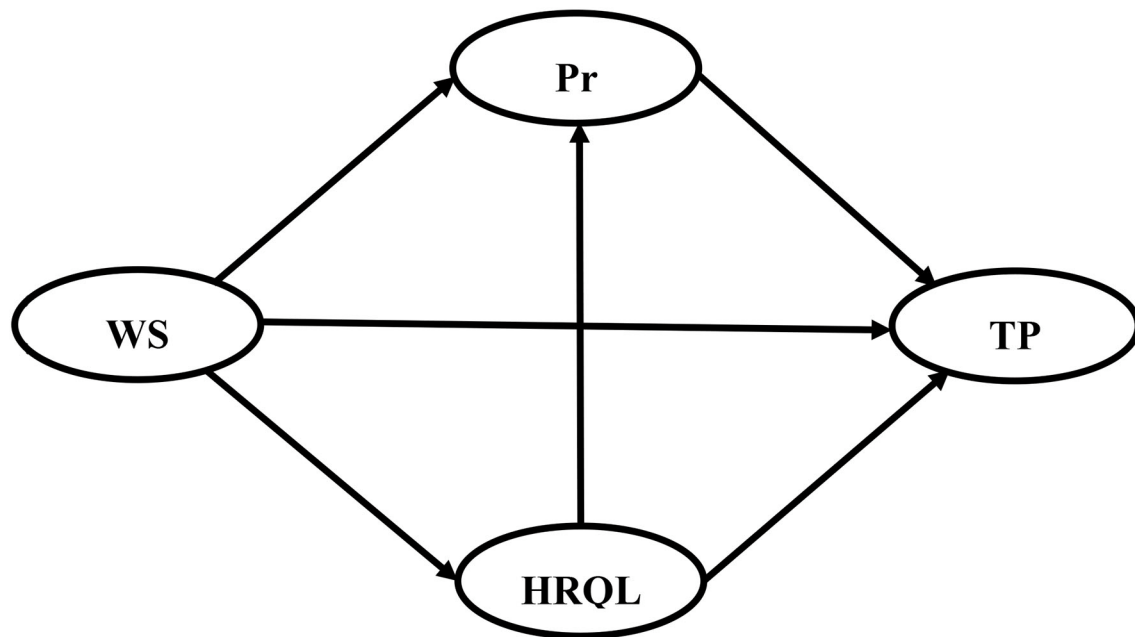
FIGURE 1 | The hypothetical structural equation model. TP, task performance; WS, work stress; HRQL, health-related quality of life; Pr, presenteeism.

(HRQOL) (43), and it contains 36 items in 8 subscales. However, despite its popularity, the length of SF-36 limits its use (43). The SF-8, a shortened version of the SF-36, was derived from the SF-36 and has been preferred by many scholars (44–46). The SF-8 has only 8 questions, including physical functioning, role limitations due to physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health; the scores range from 1 to 5, with higher scores indicating better performance. The SF-8 has demonstrated acceptable validity and reliability in previous studies (47). At the same time, the SF-8 was translated into Chinese by Lang et al. (43), and a survey of 10,885 individuals in 35 cities in China proved that the SF-8 had good internal consistency reliability and could be used in the Chinese population. The Cronbach's alpha for the SF-8 in this study was 0.916.

Stanford Presenteeism Scale

The Stanford Presenteeism Scale (SPS-6) was adapted to measure the effect of health status on task performance (48). The SPS-6 is not affected by occupation, disease type or characteristics and has been used in many fields (27, 49). Based on a survey of 14,195 people in 8 places, Jiang proved that the SPS-6 has high reliability and validity and can be applied to the study of the Chinese professional population (50). There are 6 items in the SPS-6, each with five options ranging from 1 to 5. On the scale, "*At work, I was able to focus on achieving my goals despite my health problem*" and "*Despite having my health problem, I was able to finish hard tasks in my work*" are scored in reverse order. The sum of the six items then produces a total attendance score, and the higher that the score is, the greater that the health impact on

work status is. In this study, the Cronbach's alpha for the SPS-6 was 0.756.

Task Performance

The measurement of task performance (TP) was adapted from Williams's (51) and Jessica's (52) performance measurement scales. TP consists of five items, which are measured on a 5-point Likert scale, rated on a scale from 1 (Strongly disagree) to 5 (Strongly agree). The higher that the score is, the better that the employee's performance is. In this study, TP was translated into Chinese through translation and back-translation. Two PhD students each translated the original items and then decided on a draft after discussion. Then, the items were translated back into English to ensure that the Chinese version had the same meaning as the English version. In this study, the Cronbach's alpha for TP was 0.917.

Data Analysis

Descriptive statistics were used to analyze the demographic characteristics of the respondents, as well as the scores for task performance, work stress, health status and presenteeism. In addition, age and working years were collected using continuous variables, whereas in order to reflect the task performance of different groups, we grouped them into groups with a distance of 10 based on previous studies (53, 54). The t tests and one-way analysis of variance (ANOVA) were performed to examine differences in the task performance scores among medical staff members of different genders, ages, marital statuses, educational levels, professional titles, departments, and working years. Pearson's correlation analysis was applied to analyze the correlations between the study variables. Structural equation

TABLE 1 | Demographic characteristics and task performance of 4,261 participants.

Variables	N (%)	TP	P
Gender			< 0.001
Male	1,323 (31.05)	4.41 ± 0.70	
Female	2,938 (68.95)	4.52 ± 0.60	
Age			
≤30	1,167 (27.39)	4.45 ± 0.64	0.015
31–40	1,554 (36.47)	4.48 ± 0.62	
41–50	1,182 (27.74)	4.53 ± 0.64	
≥51	358 (8.40)	4.47 ± 0.69	
Marital status			
Unmarried	769 (18.05)	4.41 ± 0.65	0.003
Married	3,360 (78.85)	4.5 ± 0.63	
Divorced	97 (2.28)	4.55 ± 0.66	
Other	35 (0.83)	4.38 ± 0.86	
Education			
High school and below	268 (6.29)	4.52 ± 0.64	0.202
Junior college	1,145 (26.87)	4.48 ± 0.66	
College	2,497 (58.60)	4.5 ± 0.63	
Master's degree and above	351 (8.23)	4.43 ± 0.63	
Professional title			
Senior	178 (4.18)	4.53 ± 0.59	0.001
Sub-senior	798 (18.73)	4.53 ± 0.62	
Middle	1,303 (30.58)	4.5 ± 0.64	
Junior	1,625 (38.14)	4.47 ± 0.64	
None	357 (8.38)	4.37 ± 0.67	
Department			
Internal medicine	1,159 (27.2)	4.46 ± 0.63	0.005
Surgery	666 (15.63)	4.44 ± 0.68	
Gynecology	192 (4.51)	4.61 ± 0.49	
Pediatrics	144 (3.38)	4.46 ± 0.70	
Traditional Chinese medicine	146 (3.43)	4.4 ± 0.69	
Preventive medicine	21 (0.49)	4.61 ± 0.44	
Other	1,933 (45.36)	4.51 ± 0.63	
Work years			
≤5	1,277 (29.97)	4.41 ± 0.64	< 0.001
6–15	1,525 (35.79)	4.5 ± 0.63	
16–25	863 (20.25)	4.52 ± 0.65	
≥26	596 (13.99)	4.56 ± 0.63	
Total	4,261 (100.00)		

TP, task performance.

TABLE 2 | Correlations among task performance, work stress, health-related quality of life and presenteeism.

Variables	Mean	SD	HRQL	WS	Pr	TP
HROL	4.18	0.68	1			
WS	2.05	0.84	−0.0606**	1		
Pr	2.15	0.79	−0.0503**	0.463**	1	
TP	4.49	0.64	0.279**	−0.266**	−0.161**	1

TP, task performance; WS, work stress; HRQL, health-related quality of life; Pr, presenteeism; **P < 0.01.

used to estimate the parameters. In addition, the bootstrapping technique was applied to explore the mediating role. The model was assessed by the following indexes (57, 58): (1) the standardized residual mean root (SRMR < 0.01); (2) the root mean square error of approximation (RMSEA ≤ 0.08); (3) the comparative fit index (CFI ≥ 0.90); (4) the Tucker–Lewis index (TLI ≥ 0.90); (5) the incremental fit index (IFI ≥ 0.90) and (6) the non-normed fit index (NFI ≥ 0.90). All of the statistical tests were two sided with the level of significance set at 0.05. SPSS software, version 25.0, and AMOS software, version 23.0 (IBM Corporation, Armonk, NY, USA), were used for the process.

RESULTS

Demographic Characteristics and Task Performance Scores

A total of 4,261 medical staff participated in the survey. In this sample, most of the respondents were female (68.95%) and married (78.85%), with college degrees (58.60%) and with middle or junior titles (68.72%). The medical staff members were aged 37.55 ± 9.11 years old, had worked for 13.73 ± 9.73 years and scored 4.49 ± 0.64 on task performance. Mean scores for task performance differed across the distributions of gender, age, marital status, professional titles, departments and working years. However, there were no differences in the scores among medical staff members with different marital statuses and educational levels. The demographic characteristics and task performance scores are shown in **Table 1**.

Correlations of Study Variables

Table 2 demonstrates the scores of the study variables. The health status score was 4.18 ± 0.68, and the presenteeism score was 2.15 ± 0.79. The work stress score was 2.05 ± 0.84, in which the challenging stress score was 2.22 ± 0.97 and the hindrance stress score was 1.85 ± 0.84. Health status was negatively correlated with work stress and presenteeism (r = −0.606, P < 0.01; r = −0.503, P < 0.01) and positively correlated with task performance (r = 0.279, P < 0.01). Work stress was positively correlated with presenteeism (r = 0.463, P < 0.01) and negatively correlated with task performance (r = −0.266, P < 0.01). Presenteeism was negatively correlated with task performance (r = −0.161, P < 0.01).

modeling (SEM) has the characteristics of Confirmatory factor analysis (CFA) and Path analysis (PA), and has incomparable advantages. PA tests the causal relationship between the observed variables, CFA tests the causal relationship between the observed variables and the latent construct, and SEM tests the causality between the observed variables and the latent construal as well as the interior of several latent construal (55). Some scholars proposed that SEM was the sum of CFA, PA and multiple regression analysis (56). Therefore, SEM was adopted to verify the effects of work stress, health status and presenteeism on task performance, and the Maximum Likelihood Estimation was

TABLE 3 | Results of the effects on task performance.

Path	Effect	Coefficient	Boot SE	Z	P	Bias-corrected 95%CI		Percentile 95%CI	
						Lower	Upper	Lower	Upper
WS→ TP	Direct	−0.136	0.031	−4.39	<0.001	−0.197	−0.075	−0.199	−0.076
	Indirect1	−0.070	0.020	−3.50	<0.001	−0.109	−0.029	−0.109	−0.030
	Indirect2	−0.064	0.011	−5.82	<0.001	−0.088	−0.044	−0.087	−0.043
	Total	−0.318	0.019	−16.74	<0.001	−0.354	−0.28	−0.355	−0.282
HRQL→ TP	Direct	0.100	0.029	3.45	<0.001	0.042	0.156	0.043	0.156
	Indirect	0.070	0.012	5.83	<0.001	0.048	0.094	0.047	0.093
	Total	0.170	0.028	6.07	<0.001	0.114	0.223	0.114	0.223
Pr → TP	Direct	−0.171	0.027	−6.33	<0.001	−0.227	−0.119	−0.225	−0.118

TP, task performance; WS, work stress; HRQL, health-related quality of life; Pr, presenteeism; Indirect1, WS→ HRQL→ TP; Indirect2, WS→ HRQL→ TP.

FIGURE 2 | The results of hypothesis testing. TP, task performance; WS, work stress; HRQL, health-related quality of life; Pr, presenteeism.
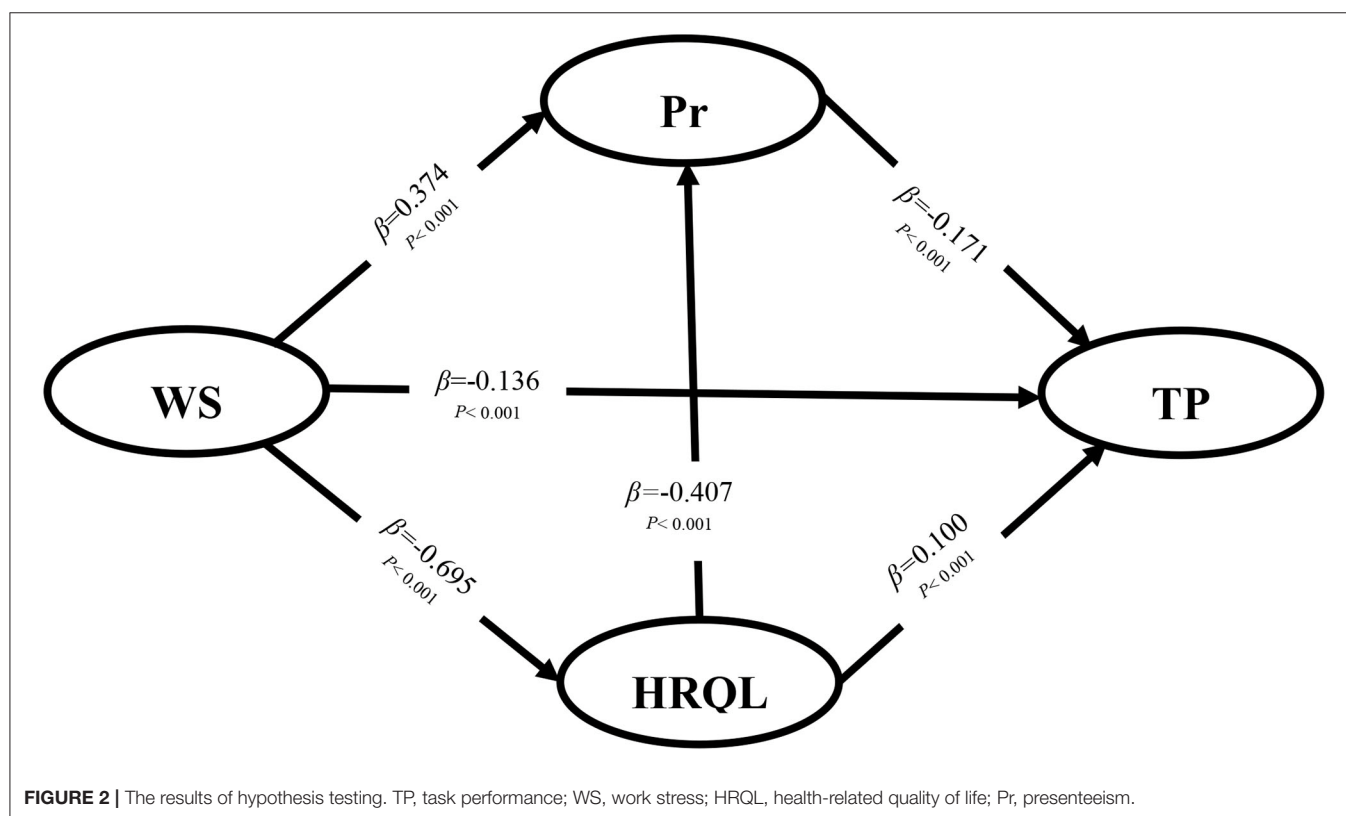
Hypothesis Testing

The t and P values for each path were calculated in AMOS to test the research hypothesis. The results of the structural equation model are presented in **Figure 2**.

The results showed that the higher that the work stress is, the more serious that presenteeism is, and the worse that the task performance is ($\beta = -0.136$; $P < 0.001$; $\beta = -0.171$; $P < 0.001$); moreover, the better that health status is, the better that task performance is ($\beta = 0.10$; $P < 0.001$), so H1, H2, and H4 were supported. At the same time, the bootstrapping technique in AMOS was used to explore the mediating roles of presenteeism and health status, and the

95% confidence intervals of the indirect effects were obtained with 5,000 bootstrap resamples. The results showed that work stress significantly affected the task performance of medical staff through presenteeism ($\beta = -0.064$; $P < 0.001$) or health status ($\beta = -0.070$; $P < 0.001$), and health status significantly affected the task performance of medical staff through presenteeism ($\beta = 0.070$; $P < 0.001$), so H3, H5 and H6 were supported as shown in **Table 3**. In addition, the total effect of work stress and health status on task performance was −0.318 ($P < 0.001$) and 0.170 ($P < 0.001$), respectively. **Table 4** shows the fit of the model, and the values represent an acceptably fitting model.

TABLE 4 | The fit of the structural equation model.

Model	SRMR	RMSEA	CFI	TLI	IFI	NFI
Reference	<0.1	<0.08	>0.9	>0.9	>0.9	>0.9
Model	0.038	0.046	0.975	0.970	0.975	0.972

DISCUSSION

This study explored the factors that influence the task performance of medical staff. A conceptual framework representing the direct and indirect relationships among four factors (task performance, work stress, health status, and presenteeism) was established and validated, and it was helpful for understanding the influence of physical and mental aspects on task performance. The data collection and processing in this study were strictly controlled, and the results could be considered a valuable reference for improving the task performance of medical staff. Based on the results of this study, it is now possible to revisit and reflect on the hypotheses established at the beginning of this study.

The survey results of this study showed that the mean score of task performance was 4.49, while the mean score of task performance of nurses in Malaysia was 3.85 as shown by Nasurdin et al. (59). This difference may be due to the fact that the research group includes different medical staff groups such as doctors and nurses, and nurses face more complicated work tasks, heavier work burden and greater occupational pressure than doctors (60). While reducing the burden of nurses, we should also strengthen the training of their comprehensive ability. The task performance score was relatively high, which may be due to the high sense of responsibility of medical staff in the context of the pandemic, which improves their work efficiency. It is very important to strengthen the guidance of medical ethics for medical staff. The mean score of challenging stress was 2.22, and that of obstructive stress was 1.85. Challenging stress includes workload, time pressure, job responsibilities, etc. Obstructive stress includes ambiguous roles, organizational politics, job insecurity, and blocked career development. This study found that the high score of challenging pressure indicates that the pressure of medical staff mainly comes from time pressure and workload, and also reflects the professional particularity of medical staff, which is more urgent than other industries. Therefore, hospitals and departments should make scientific and reasonable work arrangements to reduce the burden of medical staff. The average score of health status was 4.18, which was at a high level, indicating that the health status of medical staff in the investigated area was good, which may be affected by the local working and living environment and medical staff's own health management awareness. The average score for presenteeism was 2.05. In a study of nurses in Spain, Portugal and Brazil, the overall score for presenteeism was 3.36 (61). The reason for this difference may be, on the one hand, the medical staff group including doctors, nurses, medical skills, etc., whose tasks are not the same, on the other hand, it may be related to the better health status of medical staff in the surveyed areas. Local medical staff should continue to maintain good living and working habits and further strengthen health management.

Studies have shown that work stress, health status, and presenteeism were associated with task performance. Work stress and presenteeism had significant negative influence on medical staff's task performance, and health status had significant positive influence on it. The hypotheses proposed in this paper have been well verified in the structural equation model. The occupation of medical staff is special. Medical work is a high-risk occupation. The work of medical staff is characterized by high risk and urgency, especially during the epidemic period, facing with huge risks and long workloads, competing with time for patients' lives, research has shown that extreme work stress was a great challenge to the health status of medical staff, on the contrary, it would lead to anxiety, tension and other negative emotions, serious and even health problems, not conducive to work (62). Health problems, on the one hand, will increase long-term sick leave, on the other hand, medical staff is more likely to ignore its own health problems, resulting in higher presenteeism. Theoretically attendance will have a positive impact on performance, but sick attendance has a negative impact on performance. Sick attendance was strongly associated with burnout, and attendance due to presenteeism was considered to be working but poor performance, consistent with other study (63). As a result, medical institutions and relevant departments need to appropriately relieve the stress on medical staff through measures such as rational assignment of tasks and upgrading of professional skills, while paying close attention to the health of medical staff, through carrying out health lectures, regular medical check-up and other ways to improve their health literacy, reduce the possibility of carrying diseases to work, prevention or even avoidance of medical staff due to work stress, health status, presenteeism of work efficiency.

The study also found that health status and presenteeism played an mediating role between work stress and task performance, and presenteeism played an mediating role between health status and task performance. The hypotheses were verified in the structural equation model. Research has shown that work stress was linked to health status, when working in a high-pressure environment, health problems were more likely to occur, health was threatened, medical staff also insisted on working with diseases, not only would lead to work errors, work inefficiency, it also exacerbated the negative health effects of the disease, creating a vicious circle and even placing a physical or work burden on others, which was detrimental to the health and well-being of individuals and society as a whole (64, 65). Occupational characteristics lead to stress in the medical profession is inevitable, blindly reducing the work stress of medical staff may reduce the quality of service of medical staff. So when work stress is a factor that can be hard to control, we can focus on health and presenteeism. As hospital administrators, they should take effective measures, such as providing health-promoting places, adding more fitness facilities, enhancing their physical quality, carrying out psychological intervention and relevant training, and enhancing their awareness of health self-management, improve their health and productivity. The factors involved in this study were limited. Future researches may further

explore other factors related to performance, and suggest that we should continue to pay attention to the health status of medical staff.

Regarding advantages of this study, previous studies have not addressed the relationships among work stress, health status, presenteeism, and task performance. We established these associations and explored the direct and indirect roles among them. This study investigated a large population, carried out strict quality control, and was highly scientific and representative. Regarding disadvantages, although this study explored and verified the relationships among the four variables, it inevitably has limitations. First, this study was a cross-sectional study, so it is impossible to determine the causal relationships among the variables. In the future, longitudinal study design should be used to collect data as far as possible. Second, this is only one province of China, there may be differences between different provinces, which might have affected the generalizability of the results. When conditions permit, representative sample data can be selected from the whole country for analysis. Third, the method of quota sampling may produce research bias. However, after consulting with local health authorities and health experts, stratified random sampling was applied to capture hospitals and medical staff to minimize bias.

CONCLUSION

In conclusion, our results showed that work stress and presenteeism had a significant negative effect on task performance of medical staff; health status had a significant positive effect on task performance. At the same time, health status or presenteeism played a mediating role between medical staff's work stress and task performance, and presenteeism played a mediating role between medical staff's health status and task performance. To improve task performance, priority should be given to starting from ideological cognition, platform construction, safety assurance and other aspects, and continuously strengthen the health management of medical institutions and medical personnel.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Medical Ethics Committee of the School of Public Health Jilin University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HJ and PS: methodology and writing—original draft preparation. SG, JY, and PC: data curation and investigation. XY: funding acquisition, conceptualization, and supervision. All authors contributed to the article and approved the submitted version.

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The Influence of Emotional Intelligence on Job Burnout of Healthcare Workers and Mediating Role of Workplace Violence: A Cross Sectional Study

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Objective: Globally, reducing job burnout among healthcare workers is considered a basic healthcare policy goal. Emotional intelligence, as an essential protective factor against psychosocial risks and a measurable positive psychological resource, still receives less attention in the process of reducing job burnout among healthcare workers. This study aims to explore the level of job burnout among healthcare workers who are victims of workplace violence in China, to examine the influence of emotional intelligence on job burnout among healthcare workers, and to verify the mediating role of workplace violence; furthermore, providing a new perspective for health organizations and hospital administrators in order to relieve the level of job burnout and workplace violence among healthcare workers.

Methods: A cross-sectional study was used to collect data from six tertiary public hospitals in three provinces (cities) in Eastern (Shandong and Tianjin) and Western (Gansu) China in 2018, which are large healthcare sites providing care to patients upon referral from primary and secondary hospitals. A total of 2,450 questionnaires were distributed, with 2,061 valid questionnaires and a valid return rate of 88.95%. Of these, 825 healthcare workers had experienced workplace violence, accounting for 40.03% of the sample. A descriptive analysis, univariate analysis, Pearson correlation analysis, and mediated regression analysis were used to assess the level of job burnout among healthcare workers who are victims of violence, the effect of emotional intelligence on job burnout, and the mediating role of workplace violence.

Results: The mean job burnout score of the healthcare personnel who were victims of violence was 35.56, with 70% suffering from moderate and high burnout. The emotional intelligence of healthcare workers is significantly negatively correlated with the degree of job burnout (Emotional exhaustion: $r = 0.18$, $p < 0.01$, Depersonalization: $r = 0.24$, $p < 0.01$, Reduced personal achievement: $r = 0.24$, $p < 0.01$) and workplace violence frequency ($r = -0.22$, $p < 0.01$). Further, workplace violence has a partial mediating effect on emotional intelligence and the two dimensions of job burnout (emotional exhaustion and depersonalization).

Conclusions: This study is the first to combine emotional intelligence level, experiences of workplace violence, and job burnout levels of healthcare workers. We suggest that improving the emotional intelligence of healthcare staff has practical significance in reducing the level of job burnout directly and will reduce the incidence of burnout by reducing the frequency of violence (especially for emotional exhaustion and depersonalization). We provide specific and effective strategies for developing and guiding healthcare workers in the healthcare sector based on emotional intelligence.

Keywords: emotional intelligence, job burnout, workplace violence, healthcare workers, measure

INTRODUCTION

Job burnout is defined as a state of physical and emotional exhaustion caused by excessive and sustained levels of work-related stress (1). In general, job burnout has three key dimensions: feelings of over-extension and the depletion of resources (emotional exhaustion), negative or callous responses to job responsibilities (depersonalization), and feelings of incompetence and a lack of achievement (decreased personal accomplishment)(2). Researchers and administrators are increasingly recognizing the problem of job burnout as a major international concern in the field of occupational health (3, 4). In the medical field, the detrimental effects of job burnout are important not only for the psychological well-being of physicians but also for healthcare organizations because they increase absenteeism (5), job dissatisfaction (6), and willingness to leave (7). Reducing job burnout has been recognized as a fundamental healthcare policy goal across the globe. Scholars have found through bibliometrics that developing countries may neglect occupational stress in order to devote more energy to physical health issues, and that job burnout is one of the top three occupational stressors (8). Thus, continuous attention to the incidence of job burnout among health workers in China is of great significance in improving the quality of medical services and related reforms.

Most studies in the literature related to job burnout in healthcare professionals have used a disease-based mode (9) to analyze the harm or consequences of burnout. The prevailing negative bias is illustrated by the fact that the total number of publications on negative states exceeds that of positive states by a ratio of 14: 1 (10). However, psychologists have gradually discovered that by focusing on pain, people may experience more pain. At the same time, modern psychology also encourages scholars to conduct research from a more positive perspective (11). Particularly for healthcare workers who have been exposed to interpersonal pressure for a long time and have experienced dynamic changes between job burnout and mental health, it is particularly important to use positive psychology to study how to reduce their job burnout level. Meanwhile, the importance of non-technical skills is increasingly emphasized in current research on doctor-patient relationship (12). Therefore, emotional intelligence (EI), as a measurable positive psychological resource and a key non-technical skill, should receive attention in the process of mitigating burnout

levels in healthcare workers. Mayer and Salovey define emotional intelligence as the ability to recognize, understand, and regulate one's own and others' emotions, to differentiate between them, and to use this information to guide thoughts and actions (13). This concept of emotional intelligence contains the following four dimensions: (1) Self-emotion Appraisal, (2) Others Emotion Appraisal, (3) Regulation of Emotion, and (4) Uses of Emotion. Further, the concept aims to capture individual differences in the way people deal with emotions. As such, emotional intelligence is a prerequisite for key skills such as communication, self-confidence, empathy, creativity, sensitivity, self-awareness, and self-control (14). Studies have found that emotional intelligence is related to an individual's subjective well-being (15), way of dealing with problems (16), and intuition about stress (17). As research on emotional intelligence continues, it is also gradually being incorporated into the field of medical research in the form of empirical studies and has been shown to correlate with patient satisfaction, the occurrence of medical errors, communication skills, and the performance of medical staff (18, 19). Although emotional intelligence plays an important and profoundly promising role, it is surprising that few studies have examined the relationship between emotional intelligence and job burnout among healthcare workers in medical practice.

In addition, according to emotional intelligence theory, individuals with high emotional intelligence are able to identify their own emotions and the emotions of others, express emotions in a socially acceptable way, understand the causes and consequences of emotions, use them to enhance their thoughts, actions, and social relationships, and regulate them when they are inappropriate for their goals or situational contexts. Goleman (20) proposed that, by possessing EI, a person can manage painful emotions and control impulses in situations involving conflict, which in turn affects the management of interference behaviors and violent incidents. Thus, it is reasonable to speculate on the correlation between the frequency of exposure to violence in healthcare populations and the emotional intelligence of individuals. The World Health Organization (WHO) defines workplace violence as physical or psychological "incidents where staff are abused, threatened, or assaulted in circumstances related to their work, including commuting to and from work, and involves an explicit or implicit challenge to their safety, well-being, or health (21). Healthcare workers are 16 times more likely to experience workplace violence than workers in other occupations (22). Itzhaki et al. (23) found that almost 90% of

the healthcare worker population is exposed to violence. At the same time, scholars generally agree that WPV is still increasing in the health service sector (24) and some studies have confirmed that severe medical violence can even lead to post-traumatic stress disorder (PTSD) and induce severe job burnout in clinical health care workers (25). When the job burnout of healthcare workers injured by violent incidents increases, the quality of medical services is affected, and the relationship between doctors and patients becomes more tense, forming a vicious circle. This global, social phenomenon is no longer a simple doctor-patient relationship problem, but a serious social problem that needs urgent attention and effective management.

Thus, while a majority of previous studies have been based on the consequences and effects of job burnout and experiences of violence among medical personnel, it is clearly more relevant for a health system-building perspective to focus on the causes of burnout and violence in terms of the personality traits of healthcare personnel who are victims of violence. However, to the best of our knowledge, our study is the first to combine emotional intelligence level, experiences of workplace violence, and job burnout levels of healthcare workers fill the research gap of emotional intelligence of medical staff in medical practice. Importantly, China is a developing country with rapid economic and medical development, the number of physicians in China increased by 60% in the past two decades, yet the number of patient visits and the inpatient admissions increased by 276 and 355%, respectively in the mean (26). The surge in health care demand, the weakness of the primary health care system, and the increasing responsibilities demanded by health reform are considered to be the main drivers of the rise in job burnout among health care workers (27). Other countries are or will bear the consequences of healthcare workers' job burnout in the near future, so the findings are internationally representative, serve as a warning, and provide and can be utilized as an important example for other countries.

Hypothesis 1: Emotional intelligence is related to job burnout and workplace violence among healthcare workers.

Hypothesis 2: Workplace violence plays a mediating role in the relationship between emotional intelligence and job burnout levels of healthcare workers.

METHODS

Design, Samples, and Setting

Six tertiary public hospitals were selected in three provinces (cities) in Eastern (Shandong and Tianjin) and Western (Gansu) China. All study staff received uniform training and passed an assessment before the start of the survey. Permission for this study was obtained from relevant departments, hospital administrators, the medical dispute department, the human resources department, and the respondents. Based on feedback from hospital management experts and mental health professionals, the final questionnaire applied in this paper was validated. The inclusion criteria of this study were as follows: (1) physician, nurses, and medical technicians working in the hospital; (2) more than 1 year of experience; and (3) voluntary participation. The exclusion criteria were as follows:

(1) health care workers who were unwilling to participate in the investigation and (2) refresher health care workers and interns. A total of 2,450 questionnaires were distributed, with 2,061 valid questionnaires equaling a valid return rate of 88.95 %, of which 825 healthcare workers had experienced hospital violence, accounting for 40.03% of the sample. The healthcare workers who were victims of violence were used as the subjects of this paper (N=825). The study design has been self-checked through Strengthening the Reporting of Observational Studies in Epidemiology self-check list.

Emotional Intelligence Evaluation Scale

We used the Emotional Intelligence Scale (EIS) developed by Wong and Law in 2002 (28), which consists of 16 items and is a self-report assessment tool containing the following four dimensions: (1) Self-emotion Appraisal, (refers to a person's ability to understand and clearly express their emotions), (2) Others Emotion Appraisal (refers to a person's ability to recognize and understand the emotions of the people around him or her), (3) Regulation of Emotion (refers to a person's ability to control his/her emotions and quickly recover from psychological frustration), (4) Uses of Emotion (refers to a person's ability to engage in activities that are constructive to personal performance). Each dimension has four items each and seven levels of scoring are used. Several studies using this scale have reported good validity and reliability in this occupational group. The overall emotional intelligence construct produced a Cronbach's alpha of 0.96.

Workplace Violence Evaluation Scale

The study used the Workplace Violence Scale, which was jointly prepared by the International Labor Organization, the International Council of Nurses, the WHO, and the International Public Service Organization to assess healthcare workers' experiences with workplace violence (21). The scale contains three dimensions: verbal violence, physical violence, and sexual harassment. Verbal violence includes verbal attacks (insults or the use of other words that undermine human dignity—whether face-to-face encounters or telephone conversations, letters, networks, or leaflets, but no physical contact); physical violence includes physical contact or assault with objects (including punching, kicking, slapping, stabbing, pushing, biting, throwing, twisting arms, or pulling hair); and sexual harassment/violence (sexual assault, rape, or attempted rape). Each item was scored on a 4- point scale, reflecting the frequency of respondents' exposure to hospital violence (0=0 times, 1=1 time, 2=2 or 3 times, 3=more than 3 times). The lowest and highest scores were 0 and 27, respectively. The higher the total score, the higher the frequency of violence. The scale has good reliability and validity and has been widely used in China (29–31). The Cronbach's alpha for the entire questionnaire was 0.83.

Job Burnout Evaluation Scale

To assess job burnout, the most authoritative job burnout scale, the MBI-GS (Maslach Burnout inventorgeneral Survey) (32), was used. The original MBI-GS scale includes 16 items. When considering the internal consistency and validity, Li (33) deleted

one item when the scale was translated into Chinese in 2003. The 15-item MBIGS questionnaire included three dimensions: five emotional exhaustion items (EX), four items of depersonalization (DE), and six items of personal accomplishment (PA). These items were scored on a 7-point Likert scales,from 0 (never) to 6 (always), where personal accomplishment reduction was reverse-scored. In this experiment, a Cronbach's alpha scored a 0.94 in emotional exhaustion, a 0.92 in personal accomplish and a 0.94 in depersonalization.

Data Analysis

EpiData 3.1 was used for dual data entry to ensure data quality. Blank questionnaires, that is, questionnaires with a lot of missing or incorrect information, were removed. The normal distributions of the continuous variables were verified using Shapiro- Wilk test. Descriptive analysis, Univariate linear regression and Pearson correlation analyses were processed using the Statistical Package for the Social Sciences (version 20.0). Following this, the AMOS version 23.0 was used to estimate SEM, and robust maximum likelihood estimation structural equation models were used to estimate the direct and indirect relationships between emotional intelligence, workplace violence, and job burnout. Significant paths were estimated using standardized regression weights. Model fit metrics included $\chi^2/df < 5$, the root mean square error of approximation (RMSEA<0.08), a goodness-of-fit index (GFI>0.90), and a comparative fit index (CFI>0.90).

RESULTS

Demographic Characteristics

A common feature of the six tertiary hospitals participating in the survey was that they had more than 500 beds. These hospitals are preventive medical technology centers with comprehensive medical, teaching, and scientific research capabilities. Self-completed questionnaires were used to collect the demographic characteristics of the healthcare workers, including gender, age, education, marital status, profession, department, years of experience, and daily contact with patients. From the perspective of demographic characteristics, the respondents were mainly female (75.0%), and the majority of the workplace included healthcare workers in the ward (75.2%). Further details are provided in **Table 1**.

Differences Between Participant Characteristics and Scores on Variables

Univariate linear regression results show that there were significant differences in the effects of gender, work sector, and years of experience on the level of exposure to WPV. Among the subjects, emotional intelligence was significantly higher in women than in men. There were significant differences in the effects of gender, education level, marital status, profession, and years of experience on job burnout. Further details are provided in **Table 2**.

TABLE 1 | Demographic characteristics of the whole sample ($N = 825$).

Variables	Category	N	Percentage (%)
Gender	Men	206	25.0
	Women	619	75.0
Age group (years)	≤30	393	47.6
	31–50	379	45.9
	≥51	53	6.8
Education level	Junior college or below	257	31.2
	College	382	46.3
	Master or above	186	22.5
Marital status	Married	562	68.1
	Single	256	31.0
	Other	7	0.8
Profession	Physician	318	38.5
	Nurse	435	52.7
	Medical technician	72	8.7
Department	Emergency	82	9.9
	Surgery	123	14.9
	Ward	620	75.2
Years of experience	≤4	306	37.1
	5–10	272	33.0
	≥11	247	29.9
Daily contact with patients	≤4	62	7.5
	5–7	380	46.1
	≥8	383	46.4

Types of Violence for Victims of Violence

The percentage of violently victimized healthcare workers who had experienced verbal violence in the past 12 months was as high as 98.18%, the highest among all types of WPV in hospitals; physical violence and sexual harassment accounted for 33.82 and 13.21%, respectively.

Correlations Between Study Variables

As shown in **Table 3**, emotional intelligence was significantly negatively associated with all three dimensions of job burnout ($p < 0.01$) and exposure to workplace violence ($p < 0.01$). Workplace violence was significantly and positively associated with two sub-dimensions of job burnout (emotional exhaustion and depersonalization) ($p < 0.01$).

Mediation Regression Models of Study Variables

Based on Pearson correlation coefficients, two measurement models were developed for emotional intelligence, workplace burnout and emotional exhaustion, and depersonalization (incorporating meaningful demo-graphic characteristics in the single- factor test results: gender, education, marital status, profession, years of experience into the mode), and the models were tested using a likelihood estimation. Since

TABLE 2 | Univariate analysis and description of each scale.

Variables	Workplace violence	Emotional intelligence	Job burnout
Gender			
Male	5.35 ± 4.74	73.56 ± 19.51	37.24 ± 12.94
Female	3.93 ± 3.43	76.65 ± 16.87	34.91 ± 13.85
F/t [a]	4.64**	−2.05*	2.38*
Age group (years)			
≤30	4.14 ± 3.95	76.59 ± 16.24	35.70 ± 13.26
31–50	4.29 ± 3.49	75.38 ± 18.40	35.74 ± 13.81
≥51	5.32 ± 5.21	75.00 ± 21.28	33.51 ± 15.51
F/t [b]	2.21	0.53	0.64
Education level			
Junior college or below	4.20 ± 3.95	76.18 ± 17.15	34.01 ± 13.31
College	4.38 ± 3.90	75.95 ± 17.84	35.20 ± 14.05
Master or above	4.29 ± 3.85	75.53 ± 17.80	38.46 ± 12.96
F/t [b]	0.22	0.07	6.03**
Marital status			
Married	4.37 ± 3.77	75.66 ± 18.50	36.13 ± 13.76
Single	4.10 ± 4.03	76.62 ± 15.28	34.13 ± 13.13
Other	4.71 ± 3.73	75.93 ± 17.60	43.29 ± 20.70
F/t [b]	0.47	1.26	3.03*
Profession			
Physician	4.50 ± 3.97	75.35 ± 18.59	37.03 ± 14.12
Nurse	4.20 ± 3.75	75.99 ± 16.87	34.84 ± 13.09
Medical Technician	3.86 ± 3.85	78.07 ± 17.48	33.49 ± 14.55
F/t [b]	1.02	0.71	3.27*
Department			
Emergency	5.59 ± 3.90	72.06 ± 19.09	34.45 ± 12.59
Outpatient	4.63 ± 4.43	75.62 ± 20.08	34.80 ± 14.57
Ward	4.04 ± 3.68	76.50 ± 16.82	35.87 ± 13.62
F/t [b]	6.48**	2.33	0.61
Years of experience			
≤4	3.74 ± 3.30	76.82 ± 16.43	34.82 ± 13.26
5–10	4.87 ± 4.28	74.45 ± 17.56	37.74 ± 13.08
≥11	4.33 ± 3.89	76.45 ± 18.96	34.10 ± 14.53
F/t [b]	6.34**	1.47	5.40**
Daily contact with patients			
≤4	3.55 ± 3.04	77.50 ± 15.26	33.10 ± 12.89
5–7	4.44 ± 4.00	74.71 ± 17.78	36.12 ± 13.30
≥8	4.25 ± 3.80	76.88 ± 17.74	35.28 ± 14.11
F/t [b]	1.46	1.73	1.59

*$p < 0.05$; **$p < 0.01$.
[a] Statistics were estimated by t-test. [b] Statistics were estimated by ANOVA.

bootstrap methods have the most precise confidence intervals for indirect effects, we used the bootstrap estimation procedure (34) (using a specified bootstrap sample of 1000) to test the significance of the mediating effect of workplace violence on the relationship between emotional intelligence and job burnout.

In the model constructed for emotional intelligence, workplace violence, and emotional exhaustion, the final model fit was good after adding two correlated errors to improve the model fit: CMIN/df = 3.098, RMSEA = 0.050, GFI = 0.969, and CFI = 0.974. The final model plots, the standardized estimate critical ratio, standardizing effects, and mediating effect ratio for the route analysis are detailed in **Table 4** and **Figure 1**, with mediating effects accounting for 45.0% of the total effect.

In the models of emotional intelligence, workplace violence, and depersonalization, after adding two correlated errors to improve the model fit, the model fit was CMIN/df = 2.669, RMSEA = 0.045, GFI = 0.973, CFI = 0.980. The final path

TABLE 3 | The Pearson correlation analysis among research variables.

Variables	M ± SD	1	2	3	4	5
Emotional intelligence	75.93 ± 17.60	1				
Workplace violence	4.29 ± 3.85	−0.22**	1			
Emotional exhaustion	13.04 ± 6.34	−0.18**	0.31**	1		
Depersonalization	8.00 ± 5.09	−0.24**	0.33**	0.69**	1	
Reduced personal achievement	14.53 ± 8.71	−0.24**	0.03	−0.09*	0.11**	1

*$p < 0.05$; **$p < 0.01$.

TABLE 4 | Direct and indirect effects and 95% confidence intervals for the final model.

		95%CI	
	Estimated	Lower bound	Lower bound
Emotional intelligence→			
Workplace violence→			
Emotional exhaustion			
Total effect	−0.20**	−0.25	−0.10
Direct effect	−0.11**	−0.17	−0.02
Indirect effect	−0.09**	−0.12	−0.05
Emotional intelligence→			
Workplace violence→			
Depersonalization			
Total effect	−0.29**	−0.32	−0.18
Direct effect	−0.19**	−0.23	−0.10
Indirect effect	−0.10**	−0.13	−0.05

*$p < 0.05$; **$p < 0.01$.

coefficients and model plots are detailed in **Table 4** and **Figure 1**, with the mediating effect accounting for 34.48% of the total effect.

In these analyses, if the 95% CI did not include 0, the mediating effect was deemed to be statistically significant.

DISCUSSION

Variable Description and Differences

The mean job burnout score of the medical personnel subjected to violence (35.56 ± 13.66) in this study,which was higher than that of the medical personnel not subjected to violence (32.70 ± 12.90). Among the population subjected to workplace violence, 67% of them considered the burnout score to be above 30 and 3% considered the burnout score to be above 60. This shows that moderate burnout is common among healthcare workers subjected to violence, and some participants even experienced high levels of burnout. According to research results, while attaching importance to humanistic care for the physician community, it is especially important to pay more attention to men, highly educated individuals, medical and nursing staff, and healthcare workers with 5–10 years of practice in order to help them reasonably cope with the reality of high expectations and stressful dilemmas through appropriate means

such as psychological counseling, group counseling, and concern for specific difficulties in their work lives.

Our results show that women's EI is significantly higher than that of men, which is consistent with Brackett's research results (35). In the analysis of the results of our study it is believed that, compared to men, women's more delicate nature allows them to better perceive and pay attention to the emotions of others and react in a timely manner; thus, they demonstrated a higher level of emotional intelligence. While BarOn's study (36) showed that the difference in emotional intelligence between men and women may be due to the theoretical framework, the selection of measurement instruments at the time of the study, and the difference in the ratio of men to women, gender differences in emotional intelligence need to be further confirmed.

A cross-sectional study of the entire population of medical personnel found that the prevalence of WPV in the past year was 40.03%, which is similar to contemporaneous studies in China. At the same time, other studies have shown that severe WPV in China mainly occurs in tertiary hospitals (67.9%) (37). In our findings, men were more exposed to violence than women; the level of violence victimization was greater in emergency than outpatient clinics, with inpatient units experiencing the least. Regarding work experience, healthcare workers with 5–10 years of work experience had the highest level of violence. Verbal aggression predominated over other forms of violence, similar to other studies conducted in China (38). Our findings support the implementation of a "safe hospital" policy that demonstrates a zero tolerance for workplace violence against healthcare workers, including medical technologists. Specific measures have been described in detail in Vento's study (39).

Emotional Intelligence Affects Job Burnout

Through empirical research, this study found that emotional intelligence is significantly negatively correlated with the three dimensions of job burnout, verifying Hypothesis 1, which is consistent with previous research results (40, 41). According to Gross's model of emotion regulation, emotions are adaptive behavioral and psychological coping tendencies generated by situations (42). Its basic characteristics specifies that emotions can be regulated, controlled, and managed. Mayer and Salovey (43) proposed that, in theory, emotional intelligence includes the ability to recognize, understand, control, and regulate the emotions of oneself and others. This means that when people with high emotional intelligence encounter negative events, they can first accurately assess and express their emotional state by

being acutely aware of their own and the patient's emotional changes, reducing the likelihood of long-term negative emotions building up. On this basis, enhanced emotional management capabilities can better regulate the impact of emotional stimulation at work by strengthening, reducing, prolonging, or ignoring some emotions. This allows the individual to effectively and promptly cope with negative emotions (e.g., anxiety, depression, disappointment) using cognitive and behavioral strategies. Additionally, these individuals tends to spend less energy on emotional regulation and have less emotional stress at work. Therefore, good self-emotional use skills can help healthcare workers know how to recover from frustration, adopt a more positive way to cope with difficult situations, and maintain a stable emotional state to fundamentally maintain the motivation of healthcare workers to work, thus reducing the frequency and extent of job burnout. On the other hand, today's organizations generally draw results from organizational management experiences with high performers that are not necessarily those with outstanding skills or high IQ, but who are good at managing their own relationships with others (44); thus, emotional regulation is considered an important reference indicator of high performers. As a result, individuals with high emotional intelligence tend to be more likely to be promoted as they often build better interpersonal relationships, and thus experience less job burnout.

Soto-Rubiet al. (45) used nurses as research subjects to prove that emotional intelligence has a protective effect against the negative effects of psychological risks. In a 2-year longitudinal study, Gerits et al. found that female nurses with higher EI levels had fewer symptoms of burnout than female nurses with low EI characteristics (46). Karahan et al. confirmed in an experimental study that there is a causal relationship between trait EI and burnout levels; that is, when trait EI increases through training, burnout symptoms decrease (47). Supported by existing theories and research results, we have reason to believe that the emotional intelligence level of healthcare workers (including doctors, nurses, medical technicians) can be used as a protective factor in reducing job burnout.

The Mediating Role of Workplace Violence in Emotional Intelligence and Job Burnout

The results of this study show that workplace violence has a significant mediating effect on emotional intelligence and the two sub-dimensions of job burnout (emotional exhaustion and depersonalization), partially confirming the original hypothesis 2.

This study reports that the emotional intelligence of medical personnel significantly predicts workplace exposure. Goleman suggested that individuals who can assume a sense of emotional or self-control are able to handle conflicting circumstances more effectively, as a sense of emotional or self-control is very similar to the key components of the emotional intelligence model (48). Mavroveli et al. have shown that individuals with high emotional intelligence solve problems more positively (16). Morrison reports that "there is a negative relationship between the accommodating conflict-handling style and emotional

intelligence (49)." Weng et al. found that the higher the emotional intelligence of healthcare workers, the more harmonious their doctor-patient relationship is (50), and a better doctor-patient relationship inevitably leads to a decrease in the number of violent incidents. These findings support our speculation about the plausibility of the relationship between emotional intelligence levels and the frequency of exposure to violence. Başogul et al. (51) used Turkish psychiatric nurses as participants and showed that high emotional intelligence and autonomous personality characteristics reduced the rate of exposure to violence. To our knowledge, this is the first study to examine the relationship between emotional intelligence and workplace violence in the whole population of health care workers (including doctors, nurses, medical technicians).

Healthcare work is a special occupation that requires high emotional and communication skills because medical activity itself requires the full attention of the staff. Excessive concentration can also lead to neglect of workers' emotional output, which affects their attitude toward consultation, listening, patience, communication awareness, and emotional awareness. Studies have demonstrated that nurses' level of emotional intelligence influences the characteristics of the nurse-patient relationship and determines the rate of exposure to violence during conflict (52). In terms of the dimensions included in emotional intelligence, emotionally intelligent healthcare professionals have the ability to identify their own emotions and their patients' feelings and emotions during patient-physician communication, and to appropriately identify and differentiate between types of emotions to assess the potential for violence. By perceiving and understanding the patient's emotions, understanding the patient's suffering, and communicating well with the other party. Examples of this include discussing sensitive and heavy issues with acutely ill patients or their family members, understanding and controlling the emotions of others as much as possible, providing psychological support for the patients, and obtaining patients' cooperation and recognition. Through the perception of the patient's emotional changes, self-protection can be carried out in a timely manner, and methods to ease the patient's emotions are adopted to reduce conflicts with the patient, thereby obtaining the patient's cooperation and acceptance, and reducing the chance of conflict. By effectively regulating and changing their own emotional reactions, the patient's bad emotions can be induced and unblocked in a timely manner so that the patient can have the expected impression of himself. By using this emotional knowledge to guide his or her thinking and behavior, translating the concept of intrinsic humanism into practical action, and being able to manage painful emotions and control impulses in situations involving conflict (20, 52), social capital can be built in an emotionally stable manner, thus reducing the likelihood of violence.

Emotional intelligence at the individual, family, community, and societal levels has been proposed as a cognitive-behavioral strategy in order to overcome violence. Therefore, developing EI capabilities and understanding how to effectively handle conflicts is necessary for anyone, especially healthcare workers who are constantly dealing with stressors in the workplace. Littlejohn showed that the use of emotional intelligence to reduce workplace
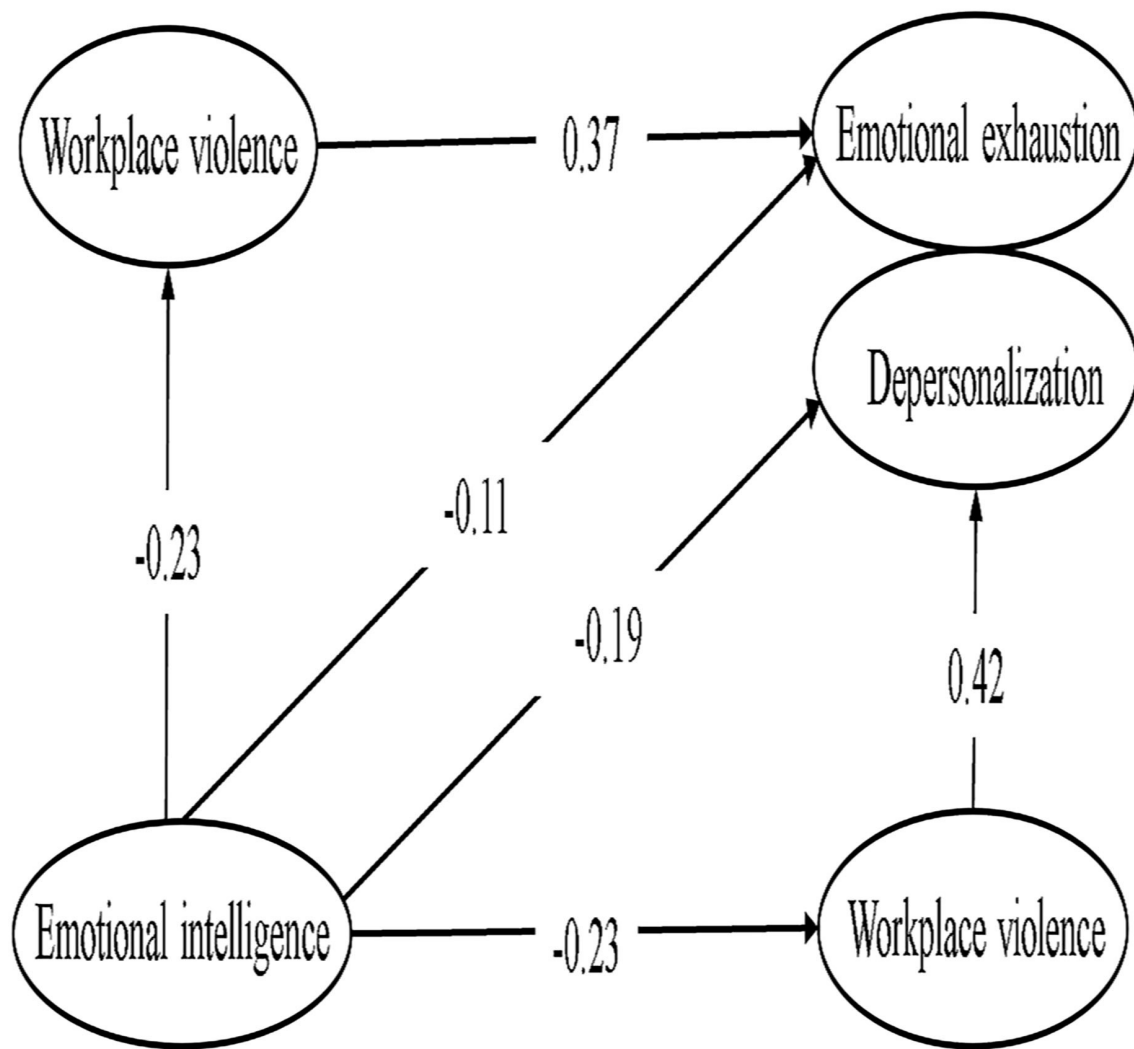
FIGURE 1 | Workplace violence play a mediating role between Emotional intelligence and Emotional exhaustion, Depersonalization.

stress and workplace violence has become the missing link in the nursing and healthcare industry, and emphasized that all healthcare professional leadership must coalesce and insert into all health care practice, education, and operations a focus on EI and WPV—lateral, vertical, or otherwise—and use awareness of EI and its inherent ability as a tool to reduce stress and thus WPV (53).

This study reported that workplace violence has a significant mediating effect on emotional intelligence, emotional exhaustion, and depersonalization dimensions. Similar to the results of this study, other studies have shown that physical and other forms of aggression are associated with higher levels of emotional exhaustion (54) and depersonalization (55). Job burnout is a continuous sequential conceptual model (56). In this process, one dimension promotes the development of the other. We analyze the impact of workplace violence based on the empirical stage model proposed by MBI. first, according to the theory

of resource preservation, individuals continue to suppress their inner negative emotions after experiencing workplace violence. This causes individuals to consume a lot of effective psychological resources, and continuous consumption will inevitably lead to exhaustion. Later, when healthcare professionals realize that they need to suppress their negative emotions, they try to keep themselves away from others (depersonalization) by defensive coping and reducing their emotional involvement in order to avoid continued conflict. Depersonalization is mainly an attitude and behavior. As the last part of the job burnout stage model, a reduced sense of achievement involves a negative evaluation of the self, which is caused by the lack of enthusiasm for work due to the long-term influence of the individual who finds that there is a large gap between his or her actual work status and the expected level, making it difficult to complete personal work tasks. After the experience of exposure to violence, there are still many other influences that affect the level of achievement, such as the

attributed perceptions of medical personnel and the occurrence of violence over the past year. It is reasonable to assume a non-significant correlation between the level of exposure to violence and a reduction in achievement, both in terms of time and the order of the theoretical model. Furthermore, according to the theoretical model of emotional intelligence, emotional intelligence can reduce job burnout levels by reducing violence. It is also possible to relieve painful emotions in a timely manner through a higher level of emotional intelligence after healthcare staff are subjected to violence and to return to a positive and stable mood in time, reducing the possibility of serious job burnout consequences.

Possible Measures to Develop the Emotional Intelligence of Healthcare Workers

Hartel et al. feel that the scope for future research in the field of emotions in workplace settings provides the potential to improve substantially our understanding of people and behavior as well as organizations (57). Knight et al. suggested the necessity and feasibility of improving emotional intelligence in public health (58). While their results provided inspiration for our research, they also made members of our research team aware of the importance of focusing on the emotional intelligence of healthcare workers who are more closely connected with patients. In the current context, when healthcare workers and patients are confronted, healthcare workers prefer to adopt a passive conflict-handling model in the process of conflict handling; the use of personal trait development to reduce the occurrence of negative events is undoubtedly beneficial.

Studies (59) that have adopted an ability-based model (28, 60) for EI suggest that EI is a facet of intelligence that is mildly correlated with general mental ability and that it develops mentally in nature. Further, EI increases with age and life experience (61). Research has proven that emotional intelligence is an ability that can be improved through training. Therefore, developing emotional intelligence to help healthcare workers reduce job burnout levels is an urgent issue that every healthcare organization and system needs to address.

For medical institution managers, they should pay attention to the "emotional intelligence" training of the health care worker. A series of measurement tools based on emotional intelligence can be incorporated into the organizational system and can be used as an important indicator in the entire process of career planning for the selection, deployment, training, and promotion of healthcare workers.

Healthcare staff should carry out continuous emotional intelligence training throughout their careers. Utilizing an emotional intelligence improvement course, the specific profile and dimensions of emotional intelligence are developed, such as Reshetnikov et al. proposed "Health Leadership Factory" for public health professional development (62), to help individuals master good expression skills and doctor-patient emotional communication. Additionally, the course helps to reduce the indifference, numbness, and other negative emotions and dehumanization experiences in the interaction with patients

under heavy work pressure, This will bring healthcare workers a pleasant emotional state and establish a good self-perception, and it is also helpful in improving the sense of accomplishment at work. Overall, it will help individuals to obtain rich social support in time when they encounter difficulties at work, to improve their adaptability to work and life through the establishment of satisfactory interpersonal relationships, thus increasing their enthusiasm for work and patient satisfaction, and reducing the incidence of work burnout and violence.

Experiential interpersonal interaction training through the use of feedback and manipulative methods such as the Balint Group Method to improve emotional intelligence (63). Healthcare personnel personally experience negative communication events by role swapping and role playing. This allows them to analyze and experience the reasons for the occurrence of various cases and the emotional change states of the patients; thus, discovering the deficiencies in the communication process in terms of cognitive self-emotional regulation. Overall, healthcare workers attempt to better understand, respect, and accept patients' emotions and behaviors; to enhance their own emotional intelligence and communication skills in practice; to reduce the generation of non-technical conflicts; and to help physicians cope with increasingly important professional emotional intelligence needs.

In short, targeted cultivation of the emotional intelligence of healthcare workers is necessary and feasible for the improvement of the doctor-patient relationship, the physical and mental health of healthcare workers, and the construction of health organizations.

CONCLUSIONS

Our study is the first to combine emotional intelligence level, experiences of workplace violence, and job burnout levels of healthcare workers. The structural equation model verified our prediction that emotional intelligence is related to job burnout and workplace violence among healthcare workers, workplace violence mediates between emotional intelligence and job burnout. In light of these results, we believe that the government should pay special attention to preventive measures and strengthen the training of healthcare workers on emotional intelligence; hospital administrators should also pay attention to this issue, and healthcare workers themselves should pay attention to the application and practice of "emotional intelligence".

LIMITATIONS

(1) This research is a horizontal study that reveals the state of the research object at a certain moment in time. Although the predictive effect of emotional intelligence on the level of burnout and violence is discussed through theories, the presentation of weak correlations between emotional intelligence and other variables ($r < 0.3$) (64), more empirical research is needed in order to use positive and reliable methods to provide evidence to further verify the actual mechanism of action. EI may benefit

job burnout and violence reduction, as evidenced by follow-up surveys. (2) Additionally, we collected data on whether the healthcare workers experienced WPV in the past 12 months. Therefore, there may be a recall bias in the results, yet the reliability and validity of the scale has been verified by other scholars in this study. (3) Although the Workplace Violence Scale reported good reliability and validity in this study, this scale uses the frequency of violence as a measurement index, and the severity of violence cannot be measured. The development of more reliable research tools will also be our future research field.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the School of Public Health of Harbin Medical University (Project Identify Code:

HMUIRB20180305). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

YC and LG responsible for research design, data analysis, and wrote the manuscript. LF provided help with the investigation and data collection. MJ and YL provided guidance in article structure and result interpretation. YM provided assistance in reviewing the manuscript. All authors contributed to the article and approved the submitted version.

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Emotional Intelligence and Burnout Among Otorhinolaryngology–Head and Neck Surgery Residents

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Background: Burnout syndrome is common among surgical residents, negatively affecting their mental health, physical wellbeing, and work performance. We investigated the relationship between emotional intelligence (EI) and burnout among Otorhinolaryngology–Head and Neck surgery residents.

Methods: This cross-sectional study examined 51 residents across different Otorhinolaryngology-Head and Neck surgery programs at various hospitals in Saudi Arabia using a survey conducted between January 2021 and March 2021. The questionnaire had different validated measurements of burnout and included the Trait EI Questionnaire–Short Form, Maslach Burnout Inventory–Human Services survey, and questions regarding demographics and job satisfaction.

Results: Of all the residents, 17.6% had a high risk of burnout, 39.2% had emotional exhaustion (EE), 29.4% had depersonalization (DP), and 43.1% had a low sense of personal accomplishment (PA). A statistically significant negative association was observed between the total EI score and EE ($r = -0.577$, $p < 0.001$) and DP ($r = -0.765$, $p < 0.001$), indicating that higher total EI scores were associated with lower EE levels.

Conclusions: Positive associations existed between high levels of EI, PA, and satisfaction with both surgical skills and specialty choice. Therefore, residency programs should use EI modifiers as tools to reduce the risk of burnout.

Keywords: burnout, emotional intelligence, residents, Otorhinolaryngology-Head and Neck surgery, ENT

INTRODUCTION

Burnout syndrome is defined as a physiological state characterized by emotional exhaustion (EE), depersonalization (DP), and a low sense of personal accomplishment (PA) (1, 2). Burnout can affect anyone regardless of their profession, but it mostly affects those with high-demand jobs, including healthcare providers (3). The Maslach Burnout Inventory (MBI) is a validated tool for the evaluation of burnout, and can be used to develop self-awareness about this issue (1).

The main causes of burnout are related to the nature of hospital work, since residents and physicians are expected to work long hours, can suffer from a lack of sleep, and are often on call. Healthcare providers can be affected by daily work requirements, such as discussing unfortunate

events to patients or dealing with difficult patients (4). In 2015, a study conducted in Saudi Arabia found a higher incidence of burnout among Otorhinolaryngology-Head and Neck surgery (ORL-HNS) residents in the Saudi Board Training Program than in other board training programs (5). An additional study in 2011 found that ∼41% of Otorhinolaryngology–Head and Neck surgeons presented with features of burnout (6).

Emotional intelligence (EI) is defined as "the awareness, control, and expression of one's emotions and the ability to handle interpersonal relationships judiciously and empathetically" (7, 8). In 1995, Goleman conceptualized EI as a set of competencies that can be trained and learned (9). Recently, the medical field has established the potential benefits of EI for the healthcare system, and there is growing interest in the importance of EI in medical training (10, 11). Moreover, higher EI in medical residents and internists is associated with a decreased incidence of burnout and a higher degree of job satisfaction (12). Few studies have examined the association between EI and burnout among surgical residents. A cohort study conducted in the Northeastern United States showed that high EI and positive work experiences were associated with a low incidence of burnout among general surgery residents (13). Other studies have suggested that EI may have a significant impact on a resident's ability to control the stress associated with medical training, and be useful for optimizing their wellness (14, 15). In this context, the present study aimed to investigate the relationship between EI and the individual components of burnout among ORL–HNS residents in Saudi Arabia.

MATERIALS AND METHODS

Ethics Approval and Study Design

This study was conducted in accordance with the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board/ethics committee of Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi Arabia (No. 83-2021). Written informed consent was obtained from the participants to publish this paper. A cross-sectional study was conducted in a sample of ORL–HNS residents registered in different ORL–HNS programs across different hospitals, including university, military, national guard, security forces, and the Ministry of Health hospitals. The survey was conducted between January and March 2021, and data collectors distributed the survey questionnaires to the residents through social media as well as AirDrop (Apple Inc., Cupertino, California, USA). The participants are those residents from the second year to the fifth year in the ORL–HNS residency program and were informed of the purpose of the study before providing written informed consent.

Assessment Measures

The questionnaire used in this study included three main parts: demographics, the Trait EI Questionnaire–Short Form (TEIQue-SF), and the MBI–Human Services (MBI-HS) survey. Demographic information, such as sex and age, was assessed in Part A of the survey. Additional questions were included to assess job satisfaction, operating room role, and job salary, since these variables may affect EI. EI was assessed using the TEIQue-SF,

an abbreviated version of the TEIQue. The TEIQue-SF includes 30 questions that assess four EI domains: wellbeing, self-control, sociability, and emotionality. All questions are graded on a scale from 1 ("completely disagree") to 7 ("completely agree"). The overall global EI score is calculated by averaging the scores of all 30 items. The survey is scored using an online key (London Psychometric Laboratory). The TEIQue-SF provides a global trait EI score ranging from 1 to 7, and is calculated using the mean of the individual question scores. Factor scores also range from 1 to 7. The MBI-HS was used to assess the prevalence of various burnout domains among respondents. The MBI-HS targets healthcare services and includes 22 questions. The questions assess three domains of burnout: EE (nine questions), a sense of PA (eight questions), and DP (five questions). High scores on the DP and EE domains, and low scores on the PA domain, are associated with a higher risk of burnout. High EE is identified if the EE score is >26, while high DP is identified if the DP score is >12. A cut-off value of 32 is used to define the PA level. Thus, students with a PA score of <32 were classified as having a low sense of PA.

Statistical Analyses

Statistical analyses were performed using R software version 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria). Continuous numerical variables, EI, and burnout dimensions were described as the mean ± standard deviation, and categorical data were summarized as numbers and percentages. Spearman correlations were used to assess the strength and magnitude of the linear association among the various EI dimensions and burnout. Multiple linear regression was used to model the multivariate effects of different variables as predictors of high EE, low PA, high DP, and EI as the main outcomes. Statistical significance was set at $p < 0.05$.

RESULTS

Descriptive Statistics

The descriptive statistics of the study sample are provided in **Table 1**. The questionnaire was completed by Otorhinolaryngology residents ($n = 51$), the majority of whom were male (64.7%). The average age of the included residents was 27.9 ± 2.1 years. Approximately half (45.1%) of the respondents were married. Regarding residency year, 50% of the respondents were in their second, 15.7% were in their third, 17.6% were in their fourth, and 17.6% were in their fifth residency year. The average weight of the included residents was 71.9 ± 15.2 kg, with an average height of 169 ± 8.18 cm. The majority of study participants (68.6%) were non-smokers. A third (33.3%) of the residents reported not exercising at all, 25% reported exercising 2 days per week, and 23.5% reported exercising 3 days per week. The mean working period at the hospital was 13.8 ± 15.4 h per day, while the mean number of clinics attended per week was 3.12 ± 1.24. The average number of on-call events per month was 5.54 ± 1.92, while the average number of patients under daily care was 3 ± 2.5. A total of 10 (38.5%) students considered their families supportive, and a similar number thought their families were very supportive.

TABLE 1 | Descriptive statistics of the study sample.

Characteristics (*n* = 51)	Value
Sex, *n* (%)	
Female	18 (35.3%)
Male	33 (64.7%)
Age (years), mean (SD)	27.9 (2.14)
Current level of residency program, *n* (%)	
R2	25 (49.0%)
R3	8 (15.7%)
R4	9 (17.6%)
R5	9 (17.6%)
Marital status, *n* (%)	
Married	23 (45.1%)
Not married	28 (54.9%)
Weight (kg), mean (SD)	71.9 (15.2)
Height (cm), mean (SD)	169 (8.18)
Smoker, *n* (%)	
No	35 (68.6%)
Yes	16 (31.4%)
Average number of days of exercise per week, *n* (%)	
0 days	17 (33.3%)
1 day	7 (13.7%)
2 days	12 (23.5%)
3 days	12 (23.5%)
4 days	2 (3.92%)
>4 days	1 (1.96%)
Hours of sleep per day, mean (SD)	6.29 (0.95)
Number of on-call events per month, mean (SD)	5.54 (1.92)
Hours per day of working in the hospital, mean (SD)	13.8 (15.4)
Number of clinics attended per week, mean (SD)	3.12 (1.24)
Number of surgeries performed per week, mean (SD)	2.81 (1.75)
Number of patients under daily care, mean (SD)	3.21 (2.50)
Spousal support, mean (SD)	
Not supportive	1 (3.85%)
Neutral	5 (19.2%)
Supportive	10 (38.5%)
Very supportive	10 (38.5%)

SD, standard deviation.

Assessments of Burnout

Figure 1 shows the responses to the MBI-HS items. In total, 82% of the residents were satisfied with their specialty choice, while 8% were dissatisfied (**Figure 2**). Furthermore, 67% of the respondents were satisfied with their surgical skills, and 61% with their roles in the operating room. Less than half of the residents were satisfied with their job salaries. A high prevalence of EE among Otorhinolaryngology residents which was 39.2% (*n* = 20), while the prevalence of DP was 29.4% (*n* = 15). A low sense of PA was observed in 22 (43.1%) residents. Overall, nine (17.6%) participants had a high risk of burnout (**Table 2**).

Correlations Between Burnout and Emotional Intelligence

Statistically significant negative associations were observed between total EI score and EE (r = −0.577, *p* < 0.001) and DP

(r = −0.765, *p* < 0.001), indicating that a higher total EI score was associated with a lower EE. A higher PA score was significantly associated with a higher total EI score (r = 0.68, *p* < 0.001) (**Table 3**). A statistically significant negative correlation was observed between all EI and MBI-HS domains, except for the association between EE and emotionality (r = −0.23, *p* > 0.05). The positive correlation between EE and DP was statistically significant (r = 0.59, *p* < 0.001). Higher PA scores were significantly associated with lower DP scores (r = −0.637, *p* < 0.001) and lower EE (r = −0.613, *p* < 0.001). Statistically significant positive correlations were observed among all four EI domains, with values ranging from r = 0.446–0.824.

The correlations between burnout and EI domains were all statistically significant (**Table 2**). Greater skill satisfaction was significantly associated with a higher total EI score (r = 0.40, *p* < 0.05). A statistically significant positive association was observed between satisfaction with specialty and the total EI score (r = 0.31, *p* < 0.05). Satisfaction with salary was not significantly associated with the total EI score (r = 0.26, *p* > 0.05). No statistically significant association was observed between satisfaction with the role in the operating room and total EI score (r = 0.21, *p* > 0.05). The number of patients under daily care and that of clinics attended per week were not significantly correlated with EI, EE, DP, or PA (all *p* > 0.05), as summarized in **Table 3**. The number of surgeries performed per week was significantly associated with the PA score (r = 0.401, *p* < 0.01). The average number of days of exercise per week showed a statistically significant positive correlation with the total EI score (r = 0.447, *p* < 0.001), whereas the average number of sleeping hours per day showed a statistically significant negative correlation with DP (r = −0.277, *p* < 0.05). EE showed statistically significant positive associations with the average number of on-call events per month (r = 0.356, *p* < 0.05) and average working hours at the hospital (r = 0.324, *p* < 0.05).

A statistically significant negative correlation was observed between satisfaction with salary and EE (r = −0.329, *p* < 0.05) (**Table 3**), suggesting that an increase in satisfaction with salary was associated with a decrease in EE score. Salary satisfaction was significantly positively correlated with the PA score (r = 0.37, *p* = 0.016), while there were statistically significant negative associations between satisfaction with specialty and EE (r = −0.463, *p* < 0.001), specialty and DP (r = −0.317, *p* < 0.05), and role in the operating room and EE (r = −0.414, *p* < 0.01). A statistically significant negative correlation was observed between satisfaction with skills and EE (r = −0.365, *p* < 0.01), as well as between satisfaction with salary and DP (r = −0.29, *p* < 0.05). Two important factors showed a positive association with PA: satisfaction with salary (r = 0.37, *p* < 0.01) and satisfaction with specialty choice (r = 0.305, *p* < 0.05).

Linear Regression Analysis

Age, sex, and residency level were not significant predictors of the total EI score, and marital status was not a significant predictor of burnout. The average daily sleeping hours showed a statistically significant association with the total EI score (B = 0.026, *p* < 0.05), indicating that one extra sleeping hour is associated with a 0.44-unit increase in the average
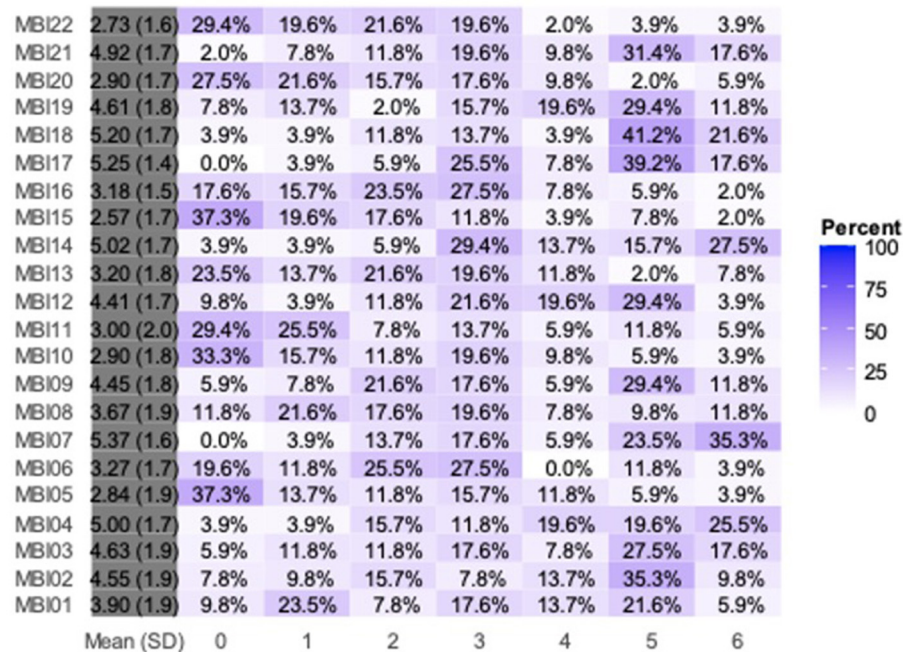
FIGURE 1 | Responses to the Maslach Burnout Inventory–Human Services survey items. MBI, Maslach Burnout Inventory; SD, standard deviation.
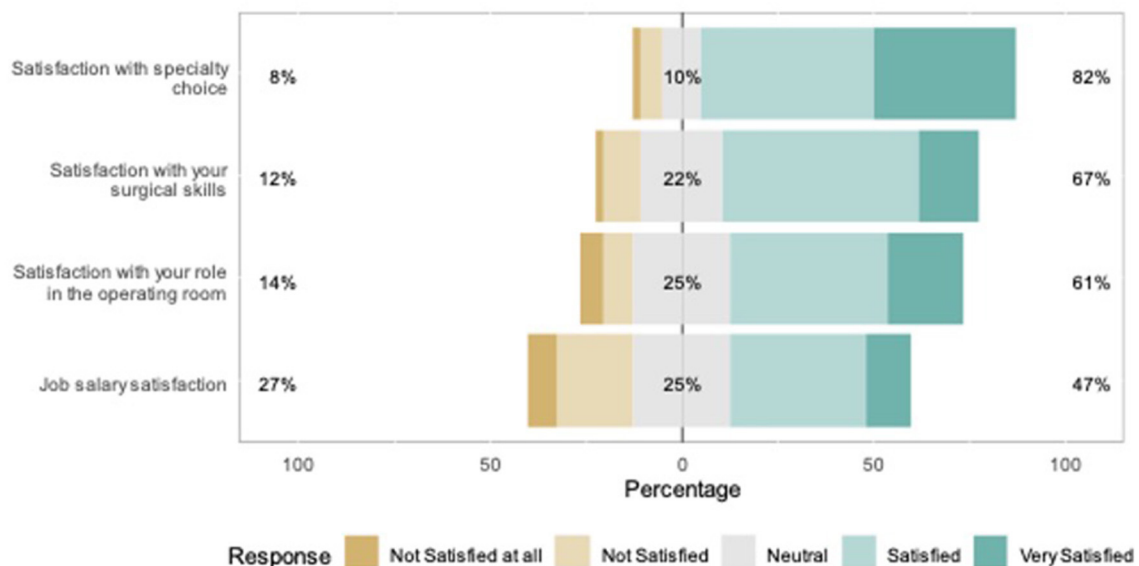
FIGURE 2 | Satisfaction with various aspects of work.

EI score. Exercise level also showed a statistically significant association with the EI score (B = 0.52, $p < 0.05$), indicating that the average EI score was 0.52 units higher in residents who exercised than in those who did not. None of the remaining sociodemographic characteristics were significant predictors of the EI score.

More regular physical exercise was a significant predictor of higher PA scores (B = 5.72, $p < 0.05$) (**Tables 4**, **5**). Thus, the average PA score increased by 5.72 points in respondents who exercised at least once per week compared to those who did not exercise. None of the remaining sociodemographic factors were significant predictors of the EE, DP, or PA scores.

TABLE 2 | Correlations among emotional intelligence and burnout components.

	TEI	Wellbeing	Self-control	Emotionality	Sociability	EE	DP	PA
TEI		0.814‡	0.742‡	0.786‡	0.824‡	−0.577‡	−0.765‡	0.680‡
Wellbeing	0.814‡		0.508‡	0.446†	0.578‡	−0.567‡	−0.570‡	0.723‡
Self-control	0.742‡	0.508‡		0.472‡	0.507‡	−0.419†	−0.555‡	0.400†
Emotionality	0.786‡	0.446†	0.472‡		0.584‡	−0.230	−0.604‡	0.369†
Sociability	0.824‡	0.578‡	0.507‡	0.584‡		−0.577‡	−0.688‡	0.596‡
EE	−0.577‡	−0.567‡	−0.419†	−0.230	−0.577‡		0.590‡	−0.613‡
DP	−0.765‡	−0.570‡	−0.555‡	−0.604‡	−0.688‡	0.590‡		−0.637‡
PA	0.680‡	0.723‡	0.400†	0.369†	0.596‡	−0.613‡	−0.637‡	

*Computed correlation used the Pearson method with listwise deletion. *$p<0.05$, †$p<0.01$, ‡$p < 0.001$.*
DP, depersonalization; EE, emotional exhaustion; PA, personal accomplishment; TEI, total emotional intelligence.

TABLE 3 | Correlations among the various factors in the present study.

Variable	EE	DP	PA	TEI
Average number of days of exercise per week	−0.192	−0.157	0.216	0.447†
Average hours of sleep per day	−0.118	−0.277*	0.072	0.232
Average number of on-call events per month	0.356*	0.128	−0.125	−0.053
Average hours of working at the hospital per day	0.324*	0.002	−0.084	0.015
Average number of clinics attended per week	−0.188	−0.265	0.206	0.158
Average number of surgeries performed per week	−0.008	−0.141	0.401†	0.207
Average number of patients under daily care	0.237	0.142	−0.166	−0.109

*Computed correlation used Pearson method with listwise deletion. *$p < 0.05$, †$p < 0.01$, ‡$p < 0.001$.*
DP, depersonalization; EE, emotional exhaustion; PA, personal accomplishment; TEI, total emotional intelligence.

TABLE 4 | Factors associated with the total emotional intelligence score.

Predictors	Estimates	95% CI	p
Sex: Male vs. Female	−0.21	−0.59–0.16	0.261
Age (1-year increase)	0.00	−0.11–0.12	0.931
Exercise: 1 day or more vs. Never	0.52	0.15–0.90	**0.007***
Residency: R4 to R6 vs. R1 to R3	0.38	−0.12–0.87	0.131
Average daily sleeping hours: >6 vs. <6	0.44	0.05–0.82	**0.026***
Smoker: Yes vs. No	0.00	−0.37–0.37	0.986
Marital status: Not married vs. Married	−0.24	−0.60–0.12	0.189

*Statistical analysis was performed using linear regression. *$p \leq 0.05$. CI, confidence interval; DP, depersonalization; EE, emotional exhaustion; PA, personal accomplishment.*

DISCUSSION

In a study examining 684 Otorhinolaryngology residents in the United States, 76% had moderate burnout, and 10% had a high burnout rate. In our study, 17.6% of residents were at a high risk of burnout, despite an overall small sample size ($n = 51$). Residency training is arguably the most important and difficult period of a student's medical career. Physicians are required to improve their character and hone their skills as they become more knowledgeable in their fields, while carrying out a daily workload considered to be heavier than that of other higher level careers. These years of training can have a physical and psychological effect on residents. The high prevalence of burnout among residents in general, and surgical residency training in particular, is especially alarming [16]. Despite a plethora of recent research on the magnitude of burnout and its consequences, research on the individual factors which predict burnout and how to deal with them is still lacking.

There are many causes of burnout that cannot be controlled or avoided, which makes those that can be controlled or improved more valuable. Studies on the significance of personality traits in predicting burnout have shown contradictory results. Therefore, personality traits may not have a consistently reliable predictive relationship with burnout [6, 13]. EI, comprising wellbeing, self-control, sociability, and emotionality, was found to have a significant relationship with the propensity toward burnout

Predictors	EE		DP		PA	
	Estimates (95% CI)	p	Estimates (95% CI)	p	Estimates (95% CI)	p
(Intercept)	38.37 (−26.22–102.97)	0.237	9.06 (−24.02–42.15)	0.584	3.76 (−37.40–44.92)	0.855
Sex: Male vs. Female	−4.73 (−12.38–2.92)	0.219	2.58 (−1.34–6.50)	0.191	−3.04 (−7.91–1.84)	0.216
Age (1-year increase)	−0.07 (−2.41–2.27)	0.950	0.05 (−1.14–1.25)	0.928	0.88 (−0.61–2.37)	0.241
Exercise: 1 day or more vs. Never	−6.10 (−13.74–1.54)	0.115	−0.74 (−4.65–3.18)	0.706	5.72 (0.85–10.59)	**0.022***
Residency: R4 to R6 vs. R1 to R3	−8.34 (−18.38–1.70)	0.101	−4.60 (−9.74–0.54)	0.078	0.40 (−5.99–6.80)	0.899
Average daily sleeping hours: >6 vs. <6	−0.03 (−7.85–7.79)	0.993	−3.59 (−7.59–0.42)	0.078	2.76 (−2.23–7.74)	0.271
Smoker: Yes vs. No	2.14 (−5.43–9.71)	0.572	−0.29 (−4.17–3.59)	0.880	3.60 (−1.23–8.42)	0.140
Marital status: Not married vs. Married	−2.92 (−10.37–4.53)	0.434	3.05 (−0.76–6.87)	0.114	−4.03 (−8.78–0.71)	0.094

Statistical analysis was performed using linear regression. *p ≤ 0.05. CI, confidence interval; DP, depersonalization; EE, emotional exhaustion; PA, personal accomplishment.

among physicians previous studies (17). Therefore, EI assessment can be employed as a tool to better understand the individual experiences of residents regarding burnout, factors that make them more vulnerable, and protective factors against burnout. EI assessment might be a better strategic tool for lowering the risk of burnout than advising residents to seek mental health counseling, especially since the constituents of EI are modifiable (13).

In a meta-analysis of studies that measured burnout prevalence using the MBI, the international prevalence rate of burnout among surgical residents was calculated at 51%. In the United States, the prevalence rate of burnout among residents was 27–75%, depending on the specialty (18). When applying the strict scales of EE, DP, and PA of burnout syndrome, a study focused on surgical specialties found that 3% of the participants had burnout syndrome. Furthermore, when individually evaluating the subscales of burnout, the number of affected participants increased to 50%, with high EE or DP in one out of every three surgeons (19).

In our study, high EI scores were associated with lower EE scores, indicating that residents with high EI were better equipped to avoid EE. This represents the stress dimension of burnout syndrome that could lead to residents distancing themselves from work both cognitively and emotionally (20). High EE scores were positively associated with a higher average number of on-call events per month, and average working hours, but negatively associated with satisfaction in both salary and role in the operating theater. Thus, it is plausible that EE corresponds to the workload and decreases with improvement in efficacy and rewards. Similarly, DP, which represents the cynical aspect of burnout, was strongly associated with EE, and therefore is negatively correlated with EI. These findings confirm the importance of ensuring tolerable working hours for residents, since physical and mental exhaustion translates to EE. The need for integration of operating theater roles from the start of the residency program should be examined, as this also reflects lower EE levels.

The EI score was significantly positively correlated with a sense of PA, and satisfaction with both surgical skills and specialty choice. This could be explained by high EI increasing the ability to manage stress, while at the same time decreasing the

chances of experiencing EE (20). A satisfactory job experience, sense of accomplishment, and satisfaction with their own skills may be easier to achieve for residents with higher EI traits. Some key findings from this study highlighted the importance of residents' lifestyles, suggesting that lifestyle modifications could help increase EI levels. This could further assist residents in dealing with different domains of burnout syndrome and reducing its associated risk. Average daily sleeping hours and the extent of physical exercise were both positively correlated with the total EI scores, and in the burnout domains, higher PA scores were significantly positively correlated with physical exercise.

Tolerable working hours, fair pay, and safe assignment of operating theater roles to residents have been shown to decrease EE, thereby enhancing EI. Physical exercise increases the sense of PA, which, combined with sufficient sleeping hours, reflects higher EI levels. All these aspects can be targeted to enhance EI and reduce the risk for burnout. Further research on EI factors and their relationship with burnout needs to be conducted across various specialties, and a detailed plan to protect residents against burnout is needed. Our study assessed the subjective perspectives of the residents. However, their work performance was not evaluated to confirm the effects of EI levels, making it a possible limitation. Moreover, the relatively small sample size might have contributed to a non-response bias.

CONCLUSIONS

This study showed that surgical specialty residents with higher EI levels had a lower risk of burnout. Factors such as lifestyle modification can promote EI. Residency programs can benefit from EI measurements to estimate the risk of burnout and develop methods to prevent it.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Imam Mohammad Ibn Saud Islamic University (IMSIU). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AS, IA, AMA, ANA, OA, ZA, and FM: conceptualization. AS, FA, IA, and ANA: methodology. ZA: software. AS and FA: formal analysis. FA and ZA: resources. AS: data curation. AS, IA, AMA, and ANA: writing–original draft preparation. AS, IA, AMA, ANA, and FA: writing–review and editing. FA: supervision. AS, AMA, and FA: project administration. All authors have read and agreed to the published version of the manuscript.

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The Mediating Role of Emotion Regulation Strategies in the Relationship Between Big Five Personality Traits and Anxiety and Depression Among Chinese Firefighters

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Identification of protective factors to prevent firefighters' anxiety and depression is meaningful. We explored whether emotion-regulation strategies mediate the relationship between personality traits and anxiety and depression among Chinese firefighters. Approximately, 716 Chinese firefighters were recruited and completed the Emotion Regulation Questionnaire (ERQ), Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), and Big Five Inventory−2 (BFI-2) Scale. Results ($N = 622$) indicated that only negative emotionality traits could predict anxiety symptoms. Meanwhile, the multilevel mediation effect analyses showed that conscientiousness through cognitive reappraisal could reduce anxiety and depression symptoms in Chinese firefighters. Our findings clarify Chinese firefighters' underlying emotion-regulation process between personality traits and anxiety and depression. Implications, limitations, and future directions are discussed.

Keywords: firefighters, emotion-regulation strategies, personality traits, anxiety, depression

INTRODUCTION

Numerous studies have shown that firefighters are frequently exposed to traumatic events and stressful situations, increasing their vulnerability to developing psychiatric problems, such as anxiety (1, 2) and depression (3, 4). Anxiety symptoms refer to excessive nervousness-related emotional and behavioral responses (e.g., avoidance) and related cognitive patterns (5). Depression is characterized by widespread negative emotions, greatly impacting cognitive, emotional, social, and occupational functions (5). A study on the mental health of the firefighters in China revealed that the overall mental health of the firefighters was at an intermediate level, and 5% of them were terrible (6). Similarly, another study also found that at least 4% of Chinese firefighters had psychological problems, including anxiety, depression, and low self-esteem, especially young firefighters (7). As emergent workers, effective interventions to avoid firefighters' depression and anxiety symptoms are meaningful. Notably, early interventions may help shun potential morbidity (8, 9). Hence, it is essential to identify protective factors to prevent anxiety and depression for firefighters and improve their wellbeing.

Personality Traits and Anxiety and Depression Symptoms

The Five-Factor Model (FFM) of personality seems to be the most prominent and influential in contemporary psychology (10–12), which could define individual differences in thoughts, feelings, and actions patterns at different dimensions (13). The FFM assesses five traits: neuroticism (i.e., negative emotionality), extraversion (i.e., positive emotionality), openness to experience (open-mindedness), agreeableness, and conscientiousness (14, 15).

Previous studies have revealed that negative emotionality is a general contributor to anxiety disorders (16–18), and persons with depressive disorders tend to be highly neuroticism (19). Besides, extraversion is uniquely related to social anxiety (17), with agreeableness (20) showing consistent negative associations with anxiety (21, 22) and depression symptoms (16). Pointedly, less is known about the role of conscientiousness and openness in anxiety and depression symptoms. Although several studies have focused on the relationships between personality traits and anxiety and depression (23), not all personality traits are associated with anxiety and depression (18, 19). Moreover, information about this linkage in Chinese firefighters has been sparsely documented and, whether there are personality traits associated with anxiety and depression, is still unknown from previous studies. We hypothesized that variations in personality traits would affect their relationship with firefighters' anxiety and depression symptoms (H1).

Mediating Role of Emotional Regulation

Emotion regulation is defined as the process through which people can adjust or express their emotions and experience using cognitive or behavioral strategies (24, 25). As an effective coping strategy, emotional regulation has been widely used in improving individual mental health (26). There are many emotion regulation strategies (27), such as expressive suppression, cognitive reappraisal, acceptance (28), distraction (29), and rumination (30). The most commonly researched emotion regulation strategies are cognitive reappraisal and expressive suppression. Cognitive reappraisal reflects tendencies to think about the situation differently to modify emotional impact (31). Expressive suppression refers to the attempts to suppress thoughts and emotions associated with the situation and emotional expression (32).

Cognitive reappraisal yields effective benefits by increasing positive emotions and crumbling negative ones (33). Higher cognitive reappraisal frequencies are specifically associated with higher life satisfaction (34, 35), self-esteem (36), and wellbeing (37). Expressive suppression belongs to the process of model's response modulation category, which happens after the emotion has been generated (38). Compared to cognitive reappraisal, expressive suppression aims to deal with external or behavioral emotional responses with little effect on controlling internal emotional responses. From previous research, the use of expressive suppression to manage negative emotions, such

as sadness or anxiety, has been proved to intensify negative emotions, while the use of expressive suppression to manage positive emotions, such as happiness, has been shown to inhibit positive emotions experience (39, 40).

Individual differences reflected in variations of personality dimensions contribute to emotional reactivity and regulation (41). For instance, individuals with high scores of extraversion, agreeableness, openness to experience, and conscientiousness use more communication to enhance positive emotions and regulate negative emotions. While people with high neuroticism are more likely to depend on other persons for social modeling and mollification (42). Besides, it has been found that low extraversion is a possible precursor of using emotional suppression to adjust emotions, while neuroticism has a moderate negative correlation with cognitive reappraisal (43). Overall, people with different personality traits would take different emotional regulation strategies. Thus, we hypothesized that the relationship between five personality traits and cognitive reappraisal and expressive suppression differed from each other (H2).

According to Barlow (44), mental disorders are emotional ailments. Hence, numerous research have also established a link between emotion regulation and psychiatric symptoms (45, 46). Specifically, a link has been established between emotional dysregulation and depressive symptoms (47). Another study discovered that emotional regulation deficiencies were associated with suicidal ideation (48). On the other side, however, studies show that using emotional suppression may entice internal attack, and, thus, people applying emotional suppression are more prone to experience negative effects or even depressive symptoms (43). In other words, different emotion regulation strategies may prevent or even elicit mental problems. Because firefighters are trained people with competencies and abilities in managing dangerous situations, they may have stronger control over their emotions, especially negative ones (49). Thus, we hypothesized that both emotional regulation strategies could negatively predict firefighters' anxiety and depression symptoms (H3).

Moreover, in the light of the biopsychosocial model in health psychology (50), coping strategies can mediate the relationship between dispositional characteristics, such as personality traits and health-related outcomes. Thus, it is vital to elucidate the factors that might mediate the association between personality traits and anxiety and depression symptoms. Taken all together, we hypothesized that cognitive reappraisal and expressive suppression could play a mediating role in the relationship of personality traits – anxiety and depression symptoms (H4).

In summary, the present study first examined the relationship between different personality traits and anxiety and depression symptoms in Chinese firefighters. Second, we examined the extent to which emotion-regulation strategies might mediate the influence of different personality traits on anxiety and depression symptoms and expected a negative correlation between personality traits and anxiety and depression symptoms except for negative emotionality.

MATERIALS AND METHODS

Participants

The current study recruited 716 full-time male professional firefighters in China voluntarily. After eliminating multivariate variables' outliers, the final participant sample was 622 ($Mean_{age}$ = 26.25, SD_{age} = 3.12). The mean working experience was 29.36 months. The ethical committees of all the authors' universities approved this study. The informed consent was obtained from the participants before they took part in either assessment.

Measures

Emotion Regulation Questionnaire

The ERQ (51) is a 10-item self-report and ranges from 1 to 7 (1 = *strongly disagree*; 7 = *strongly agree*), which measures an individual's habitual use of expressive suppression and cognitive reappraisal to regulate emotion. The expressive suppression subscale comprises 4 items, and the cognitive reappraisal subscale includes 6 items. Subscales were calculated based on mean values, with higher scores indicating higher frequencies of usage. The Chinese version of ERQ was validated for both adults and adolescents, and it demonstrated a good Cronbach's alpha value (0.73 for reappraisal and 0.71 for suppression) (52). In the current study, Cronbach's alpha of cognitive reappraisal and suppression subscales were 0.85 and 0.70, respectively. The questionnaire had good validity [χ^2/df = 3.98, CFI = 0.97, NFI = 0.96, TLI = 0.95, RMSEA (90% CI) = 0.07 (0.06–0.08)] in the current study.

Big Five Inventory−2

The BFI-2 is a 60-item self-report measure of personality traits (53) and comprises five subscales: extraversion, agreeableness, conscientiousness, negative emotionality, and open-mindedness, and each subscale has 12 items, respectively. Each item is rated on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*). Subscales were calculated by mean value, with higher scores indicating more inclined toward the specific personality.

The present study used a Chinese version of the BFI-2 questionnaire to evaluate personality traits (15). The current study showed good internal consistency, Cronbach's alpha value = 0.74,0.84,0.85,0.82, and 0.76 for extraversion, agreeableness, conscientiousness, negative emotionality, and open-mindedness, respectively. The questionnaire had good validity [χ^2/df = 4.11, CFI = 0.71, NFI = 0.65, TLI = 0.69, RMSEA (90% CI) = 0.07 (0.06 −0.07)] in the current study.

Self-Reported Anxiety and Depression Symptoms

Anxiety and depression symptoms were assessed using the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS), respectively, which were designed by Zung (54, 55) to quantify the degree of anxiety and depression symptoms. Although SAS and SDS cannot be used to diagnose anxiety and depression clinically, they are good tools for evaluating and screening anxiety and depression symptoms and determining the cohort of high-risk patients with anxiety and depression. SAS and SDS scales are both 20-item self-report assessment instruments. All subscales were calculated by mean value, with higher scores indicating more inclination toward anxiety or depression.

The Chinese versions have been validated in epidemiological surveys (56, 57). The current study showed good internal consistency, Cronbach's alpha = 0.93, and 0.92 for anxiety and depression, respectively. The questionnaire had good validity for anxiety [χ^2/df = 3.90, CFI = 0.94, NFI = 0.92, TLI = 0.93, RMSEA (90% CI) = 0.07 (0.06 −0.07)] and depression [χ^2/df = 4.89, CFI = 0.92, NFI = 0.90, TLI = 0.90, RMSEA (90% CI) = 0.08 (0.07–0.09)], respectively.

Data Analysis

In the present study, all analyses were calculated in R4.1.1 (58). Initially, we performed data cleaning and deleted outliers using the *boxplot.stats* function (58). Then, a common method deviation test, description analyses, and normal distribution were done using the *psych* package (59). The correlation matrix table was made by *apaTables* (60). Finally, we conducted the multiple level mediation analysis by *lavaan* (61).

RESULTS

Common Method Deviation Test

The Harman single factor test showed that the eigenvalues of eighteen-eight factors were more outstanding than one without rotation, and the explanatory variation of the first factor was 21.784%, which was lower than the critical value of 40% (62). Therefore, there was no obvious common methodological bias in this study.

Descriptive Statistics and Correlations Among Main Measures

The means, standard deviations (SD), and spearman correlations between main variables are shown in **Table 1**. Results indicated that cognitive reappraisal and expressive suppression were significantly and negatively correlated with anxiety and depression (p < 0.01). Conversely, cognitive reappraisal and expressive suppression were significantly and positively correlated with negative emotionality (p < 0.01). Similarly, both anxiety and depression were significantly and negatively correlated with extraversion, agreeableness, conscientiousness, and open-mindedness (p < 0.01). Furthermore, both anxiety and depression were significantly and positively correlated with negative emotionality (p <0.01).

Multiple Mediation Analysis

We used the package of *lavaan* to test multiple level mediations (see **Figure 1**). The result indicated that the model fitted the data well [χ^2/df = 3.364, CFI =0.997, NFI = 0.996, TLI = 0.929, RMSEA (90% CI) = 0.062 (0.000–0.139)]. Path analysis revealed that conscientiousness significantly and positively predicted cognitive reappraisal (β = 0.31, p < 0.01) and expressive suppression (β = 0.42, p < 0.001). By contrast, other personality traits could not significantly predict cognitive reappraisal and expressive suppression (p > 0.05). Furthermore, path analysis revealed that only negative emotionality could significantly predict anxiety symptoms (β = 0.14, p < 0.001). As the mediator variable, only cognitive reappraisal could significantly and negatively predict anxiety (β = −0.06, p < 0.001) and

TABLE 1 | Means, standard deviations, and pearson correlations.

	M	SD	1	2	3	4	5	6	7	8	9
1. Cognitive reappraisal	4.03	0.95	1								
2. Expressive Suppression	4.72	1.08	0.71**	1							
3. Depression	2.28	0.32	−0.21**	−0.15**	1						
4. Anxiety	1.87	0.34	−0.35**	−0.27**	0.41**	1					
5. Extraversion	3.39	0.55	0.32**	0.23**	−0.12**	−0.40**	1				
6. Agreeableness	4.07	0.62	0.32**	0.29**	−0.11**	−0.41**	0.59**	1			
7. Conscientiousness	3.97	0.66	0.37**	0.32**	−0.16**	−0.45**	0.67**	0.79**	1		
8. Negative Emotionality	2.33	0.66	−0.31**	−0.25**	0.13**	0.49**	−0.68**	−0.73**	−0.76**	1	
9. Open-Mindedness	3.55	0.59	0.33**	0.26**	−0.18**	−0.36**	0.66**	0.61**	0.68**	−0.60**	1

M and SD are used to represent mean and standard deviation, respectively. ** indicates p < 0.01.

FIGURE 1 | The model of mediating role of emotion regulation strategies between personality traits and anxiety and depression symptoms. The red line indicates the positive regression coefficient. The blue line indicates the positive regression coefficient. The solid line indicates that the regression coefficient is significant ($p < 0.05$). The dashed line indicates that the regression coefficient is insignificant ($p > 0.05$). ** indicates $p < 0.01$. *** indicates $p < 0.001$.

depression symptoms ($\beta = -0.09$, $p < 0.001$), conversely; expressive suppression was not ($p > 0.05$).

We conducted bias-corrected bootstrap tests (Created 5,000 bootstrap samples, 95% confidence interval) to evaluate the significance of the direct effects shown in **Table 2**. As the bias-corrected bootstrap tests mentioned, if the 95% confidence interval of the direct path coefficient does not include 0, it is suggested that the direct path is significant. **Table 2** shows the bias-corrected bootstrap test results. Results confirmed that indirect pathways from conscientiousness to anxiety and depression symptoms at cognitive reappraisal strategies were significant. In sum, cognitive reappraisal strategies fully mediated the relation between conscientiousness, anxiety, and depression among Chinese firefighters.

DISCUSSION

To sum up, the present study applied a large sample of firefighters to reveal the machine of emotion regulation strategies between personality traits and anxiety and depression symptoms. Several findings are worth discussing.

As an essential psychological state, negative emotionality is a general contributor to anxiety disorders (16–18), which could positively predict anxiety (17), and the present study also demonstrated it (A part of Hypothesis 1 was supported). As we know, firefighters are always in a readiness state, and the long term of dealing with uncertainties may make firefighters worried and afraid of the terrible events. It is precise because of the adverse effects of constant uncertainties and confrontation that firefighters with neurotic traits are prone to anxiety. Hence,

TABLE 2 | Bias-corrected bootstrap test of mediating effects.

Paths	Standardized β (SE)	Standardized 95% CI	
		Low	High
Direct paths			
Extraversion–Anxiety	−0.040 (0.031)	−0.102	0.021
Agreeableness–Anxiety	−0.032 (0.034)	−0.100	0.033
Conscientiousness–Anxiety	−0.059 (0.035)	−0.128	0.009
Negative Emotionality–Anxiety	0.141*** (0.031)	0.076	0.201
Open-Mindedness–Anxiety	0.024 (0.031)	−0.034	0.086
Extraversion–Depression	0.040 (0.035)	−0.027	0.110
Agreeableness–Depression	−0.006 (0.032)	−0.071	0.055
Conscientiousness–Depression	−0.040 (0.037)	−0.110	0.034
Negative Emotionality–Depression	0.009 (0.030)	−0.051	0.066
Open-Mindedness–Depression	−0.048 (0.035)	−0.116	0.021
Indirect paths			
Extraversion–Cognitive Reappraisal–Anxiety	−0.010 (0.007)	−0.028	0.002
Agreeableness–Cognitive Reappraisal–Anxiety	−0.005 (0.006)	−0.019	0.007
Conscientiousness–Cognitive Reappraisal–Anxiety	−0.019* (0.008)	−0.039	−0.006
Negative Emotionality–Cognitive Reappraisal–Anxiety	0.001 (0.006)	−0.010	0.013
Open-Mindedness–Cognitive Reappraisal–Anxiety	−0.006 (0.007)	−0.021	0.005
Extraversion–Cognitive Reappraisal–Depression	−0.014 (0.011)	−0.039	0.003
Agreeableness–Cognitive Reappraisal–Depression	−0.007 (0.010)	−0.028	0.010
Conscientiousness–Cognitive Reappraisal–Depression	−0.027* (0.012)	−0.056	−0.009
Negative Emotionality–Cognitive Reappraisal–Depression	0.002 (0.008)	−0.014	0.019
Open-Mindedness–Cognitive Reappraisal–Depression	−0.009 (0.009)	−0.031	0.007
Extraversion–Expressive Suppression–Anxiety	0.000 (0.002)	−0.004	0.005
Agreeableness–Expressive Suppression–Anxiety	−0.001 (0.003)	−0.011	0.002
Conscientiousness–Expressive Suppression–Anxiety	−0.003 (0.006)	−0.017	0.007
Negative Emotionality–Expressive Suppression–Anxiety	0.000 (0.002)	−0.006	0.002
Open-Mindedness–Expressive Suppression–Anxiety	−0.001 (0.002)	−0.008	0.002
Extraversion–Expressive Suppression–Depression	0.000 (0.003)	−0.008	0.006
Agreeableness–Expressive Suppression–Depression	0.002 (0.004)	−0.002	0.016
Conscientiousness–Expressive Suppression–Depression	0.007 (0.009)	−0.008	0.028
Negative Emotionality–Expressive Suppression–Depression	0.001 (0.003)	−0.003	0.009
Open-Mindedness–Expressive Suppression–Depression	0.001 (0.004)	−0.002	0.015

*Indicates p < 0.05. ***Indicates p < 0.001.*

correctly evaluating and handling negative emotions is essential for firefighters. In contrast to previous research (63), a high level of negative emotionality could not predict depressive symptoms in the present study, even if patients who undergo negative emotional states could significantly predict depressive symptoms (64). The particularity of firefighters' occupations shows them a more stable and rational mental state and better self-psychological adjustments when dealing with negative events.

Another general trait, extraversion or positive emotionality, has shown negative associations with a generalized anxiety disorder (65), which was not confirmed in the present study (A part of Hypothesis 1 was not supported). When confronted with unfavorable events or emotional arousal, extroverted personality groups are more likely to engage in conservative decision-making, which cannot improve decision-making (66). While those with an extroverted personality are more likely to be

satisfied and wellbeing (67), it should not be overlooked that, for the firefighters, the inability to deal with negative events calmly and comfortably frequently results in psychological problems, such as anxiety. Moreover, the present study found that positive emotionality could not be a valid predictor factor for depression, which is relevant to firefighters' occupations. On the other hand, with the organization's support (68) and frequent internal communication (69), the study found that the depression scores of the firefighters surveyed were low.

Conscientious firefighters were more likely to be disciplined, organized, and persistent about events in their daily lives. Indeed, in this study, we found that firefighters' conscientiousness was a significantly positive predictor for cognitive reappraisal (A part of Hypothesis 2 was supported), suggesting that firefighters with high level of conscientiousness tend to initiate reflection, summary and render emotional adjustment methods

automatically (70). The analysis of mediating effects showed that firefighters' conscientiousness could influence anxiety and depression through cognitive reappraisal strategies instead of expressive suppression strategies (A part of Hypothesis 4 was supported). Previous research indicated that newly recruited firefighters showed significantly less depression than experienced firefighters (71), indicating that the experience of participating in fire rescues was also a vital predictor. We recruited firefighters with an average of 29.36 months of experience in fire rescue work for this study, implying that prolonged experience alters firefighters' emotional expression strategies.

It is beneficial for individuals to use more cognitive reappraisal strategies to change their attitudes and opinions about negative events (72), especially those who easily experience negative emotions. Cognitive reappraisal plays a positive role in predicting anxiety and depression in our current study, which is consistent with the previous study (73). Firefighters face many acute negative events and failures that can induce anxiety, depression (74), PTSD (75), and even suicide (76). In addition, firefighters with lower anxiety and depression are adept at using appropriate cognitive reappraisal strategies. As an essential risk factor, cognitive bias significantly influences firefighters' psychological resilience, which is substantially related to self-encouragement (72). It also provides us with an idea of correct and timely cognitive intervention that we should consider for firefighters in the future, especially for conscientious firefighters. Hence, good cognitive intervention is essential to predict the mental health status of firefighters (A part of Hypothesis 3 was supported).

However, expressive suppression strategies did not predict anxiety and depressive symptoms (A part of Assumption 3 is not verified). Specifically, expressive suppression strategies can moderate events that have occurred, while cognitive reappraisal can moderate events that have not occurred. A cross-cultural comparison study between European Americans and Hong Kong Chinese revealed that expressive suppression was associated with adverse psychological functioning for European Americans but not for Chinese participants (77), which implies that cultural context should be considered in understanding the emotional consequences of suppression strategies (78, 79). In China, the community has great respect for firefighters and communicates with firefighters frequently. Despite regular exposure to catastrophic and traumatic events, a high level of organizational and social support for the firefighting group has resulted in fewer dependencies on expression suppression strategies to regulate emotions and decreased depressive mood (80).

Several limitations should be considered in the current study. First, as a cross-sectional and correlational research design, our results are inadequate, prohibiting determining causality and whether the impact is stable over time. Future research should examine these constructs' temporal and reciprocal associations using a long-term cross-lag design, experimental methods, or network analysis. Secondly, more emotion regulation strategies (e.g., acceptance, distraction, rumination) should be included in future research work because individuals often adopt more emotion regulation strategies simultaneously in their daily lives.

CONCLUSION

First, the current study extended the research on the relationship between different personality trait dimensions and anxiety and depression symptoms in firefighters. Additionally, the significant direct effect suggests that researchers must pay attention to firefighters with negative emotional traits. Second, cognitive reappraisal fully mediated the association between the conscientiousness trait and anxiety and depression symptoms. These results provide preliminary evidence supporting that conscientiousness is associated with low levels of anxiety and depression by using more cognitive reappraisal strategies. For firefighters, managers should guide them through utilizing effective cognitive reappraisal in their daily working lives.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Northeast Agricultural University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

XL: study design. LZ and DB: data collection. YT: analysis, interpretation, and drafting of the manuscript. ZM, WH, HN, and SW: critical revision of the manuscript. All authors contributed to the article and approved the submitted version.

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Study on Instant Delivery Service Riders' Safety and Health by the Effects of Labour Intensity in China: A Mediation Analysis

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The Instant Delivery Service (IDS) riders' overwork by "self-pressurisation" will not only reduce the level of their physical and mental health but also lose their lives in safety accidents caused by their fatigue riding. The purpose of this article is to examine whether there is overwork among IDS riders in big and medium cities in China? What's going on with them? Based on the Cobb-Douglas production function in the input-output theory, this study characterised the factors on IDS riders' safety and health associated with labour intensity. A mediating model with moderating effect was adopted to describe the mediation path for the 2,742 IDS riders who were surveyed. The results of moderating regression demonstrated that (1) 0.4655 is the total effect of labour intensity on the safety and health of IDS riders. (2) 0.3124 is the moderating effect that working hours make a greater impact on labour intensity. (3) The mediating effect of work pressure is the principal means of mediation both upstream and downstream.

Keywords: IDS riders, labour intensity, safety and health, instrumental variables, mediating effect, moderating effect

INTRODUCTION

The Instant Delivery Service (IDS) riders have been linked to the city's capillaries. The outbreak of COVID-19 prompted the number of IDS riders to increase in early 2020. The IDS riders delivered food, vegetables, and medicines to the inhabitants ignoring the dangers to themselves both day and night during the epidemic period. 20.8% of IDS riders are serviced by riding more than 50 kilometres per day [1]. The number of workers has increased significantly in new employment forms such as online appointment distributors, online appointment drivers, and Taxi drivers employed on the Internet platform. IDS workers have bounded to the "human component" [2] of IDS which set up the game mechanism depending on the AI system, especially the IDS riders.

Most of the work of couriers takes place outdoors, where they are exposed to various environmental conditions such as weather, pollution, and the risk of accidents [3]. The demand for fast deliveries and payment per delivery in some modes of employment put extra stress on couriers that increase the risk of unsafe behaviours and involvement in accidents [4–6]. Statistics for Great Britain show that motorcyclists are more at risk of being killed or injured in a road traffic crash than any other type of vehicle user [7].

There was a definite relation between hours of work, fatigue, and involvement in a road accident [8]. A number of studies have demonstrated that the risk of a motorcyclist having a crash increases

with exposure and falls with age and riding experience [e.g., (7, 9–11)], increase crash risk include riding too fast e.g. (12–14).

Gig's work led some couriers to experience impairment caused by fatigue and pressure to violate speed limits and to use their phones whilst driving (15). Descriptive analysis for the assessed mobile phone use while driving (MPUWD) behaviours showed that 96.3% ($N = 315$) of food deliverymen undertook the MPUWD behaviours, food deliverymen, interact with mobile phones while on work-related travels mostly for business rather than entertainment (16). One notable exception was intersections, where the risk of being involved in a conflict was twice as high for e-bikes as for conventional bicycles. The speed immediately preceding a conflict was higher for riders of e-bikes compared to conventional bicycles, a pattern that was also found for mean speed (17). Motorists tend to accept smaller gaps in crossing situations in front of an oncoming e-bike compared to a bicycle approaching at the same speed (17). This effect was hypothesised to be the result of an apparent mismatch between the cyclist's actual speed and the speed perceived by the motorist. Given that the motorised component eases acceleration for the e-bike rider, it could be expected that mis-judgements of e-bike speed are especially prevalent at intersections, resulting in an increased number of conflicts (17). Safety attitudes had a significant negative effect on aberrant riding behaviours. E-bike riders reporting more errors and aggressive behaviours were more prone to at-fault accidents involving. E-bike riders who had stronger positive attitudes towards safety and showed more worry and concern about their traffic risks tended to be less likely to engage in aberrant riding behaviours (18). The emergence of the gig driver could give rise to a perfect storm of risk factors affecting the health and safety not just of the people who work in the economy but of other road users (15). Higher traffic violations of laws, more and more frequent traffic accidents and casualties, it cannot be underestimated for IDS riders' safety.

Today, anyone who can prove their right to work in the UK can put themselves to work via on-demand platforms such as Deliveroo (19), which has successfully drawn in full-time and part-time riders, including students, migrant workers, and those looking to supplement their incomes with gig work (20). Were any of these individuals to suffer a crash, however, they would not qualify for employee compensation. Deliver riders are classified as "self-employed contractors rather than as employees of the company" (21).

IDS companies control the employees by carrying out "over the horizon management" and flat management by Internet technology (22). It is naturally and constantly weakened for the formal employment contract of IDS workers. IDS workers with informal employment relations cannot be protected by China's industrial injury insurance. The amount of compensation is very limited even if parts of workers insure themselves commercially.

The properties of the hegemonic factory regime make the employees working on the IDS platform be no sense of commitment and identity to their profession (23). IDS riders' work is instrumental and transitional. "No life, but work," (24, 25) The poor living conditions are only for the reproduction of physical strength and recovery of labour tools. IDS rider's concept

of labour time and space runs counter to the presupposition of labour law, and their injury to occupational health and physical and mental health deviates from the labour legal standard.

Reportedly, delivery riders are temporarily employed, poorly paid, and often paid "by the job," e.g., paid by the hour or the number of delivery goods (26). This tends to induce an intense work pace for long hours, without breaks but also higher work stress, work fatigue, and unsafe driving behaviours, e.g., running a red light or a stop sign (27, 28). Since the motorcyclists could be forced by employers to shorten the delivery time (29), they could be forced to commit traffic violations inevitably (27). Many restaurants in Korea maintain quick-delivery service programs to satisfy customers. This service allows delivery workers limited time to deliver, which frequently puts them in danger (30). Stress and work overload were associated with reduced safety behaviour and increased risk of involvement in accidents (31).

The workers' fatigue savings formed by their high intensity of labour and pressure of life seriously affect their safety and health. It is seen often enough that overwork and sudden death of IDS riders.

Papakostopoulos and Nathanael (32) reported that the delivery industry lacks a safety culture, thus making risk-taking acceptable for a delivery rider in Greece. At least in this particular socio-cultural context, the estimated compliance of food delivery companies to safety and health rules suggesting to do so. This is supported by the vast majority of respondents (83%) reporting an intensive work pace (more than 3.5 deliveries per hour) suggesting that employers vastly promote fast delivery over self-protection (32). The fatigue savings of IDS riders mainly arise from the work game design of the platform and the cognitive psychology at work (33–35). To study the association factors and mechanism why IDS riders will be overworked, we should consider the factor of labour intensity. This paper analyzes the mediation path of the impact of labour intensity on safety and health in physical and mental, based on the hypothesis that labour intensity has a direct impact on IDS riders' safety and health.

It is the scholars abroad who first began their research of IDS riders. However, most of the research results focused on the safety guarantee of riding. With the development of China's platform economy, domestic scholars began to study IDS riders. However, most of the research results are related to their life and work on rights (36). In terms of research methods, qualitative research is generally carried out from the perspective of law and management. In these qualitative studies, there are few results on IDS rider health issues. From the literature search, there are few empirical studies on IDS riders by Chinese scholars (37, 38). Of course, little empirical research is on the health issues of IDS riders.

This research mainly makes breakthroughs from two aspects: (1) In discussing the economic problem of IDS riders' income, their safety and health are also considered, and high-quality employment is promoted from the employment problems. (2) An empirical method is used to describe the intermediary path of IDS riders' safety and health.

METHODS

Participants and Procedure

From June 2020 to June 2021, A total of 3,000 questionnaires were distributed in 16 districts and 2 counties in Beijing and 13 administrative regions in Wuhan (no survey was conducted in 6 functional areas).

The participants of IDS riders are from 12 IDS companies including Meituan, ELM, SF Express, EMS, JD, YTO, STO, ZTO, Rhyme Express, TTK Express, Best Express, and Homestead Express. These 12 companies have the largest scale in China's express industry and absorb a large number of IDS riders. They are also the most standardised enterprises which carry out the labour law standards. For IDS riders, these companies with formal management should be able to better protect their health and avoid overworking. If the employees of these companies are in a state of overwork, it shows that the sample is more persuasive.

According to the "Code of Occupational Classification of the People's Republic of China" (2015 Edition), the "National Occupational Standard for Express Operators" (Draught), IDS riders were identified as our research object. They mainly focus on food and beverage distributors and express delivery. The research in the express industry is usually conducted when they pick up and pick up goods from 9 to 11 a.m. Because their personnel is relatively concentrated at this time. IDS riders in food and beverage distributors usually concentrate from 8:30 to 10:30 am. Before and after the morning meeting of the company, they can communicate freely or inquire about orders online for a while. Because there are few orders during this period, it is more convenient to investigate IDS riders in food and beverage distributors during this period.

In this study, if IDS riders are directly probability sampled, they would refuse to investigate because of their busy work. The sample selection process is judgmental sampling. We get the cooperation of enterprise management through the intervention of the administrative organisation. Judgment sampling, a non-probability sampling procedure, has low operation cost and is also suitable for the objective situation of tight funds in this study. Although there are disadvantages of tendentious influence, IDS riders have a high coincidence of working properties, so the non-probability sampling results can be inferred as a whole.

Among the questionnaires, 2,000 were distributed in Beijing, 1,000 were distributed in Wuhan, 2,848 were recovered, 107 invalids were excluded, and the rate of recovery was 94.9%, and the rate of effectiveness was 91.4%. Of the 106 invalid questionnaires, 95 were incomplete (the IDS riders did not complete the questionnaire). Because the answer results should be analysed together with the working conditions of the respondents, it is necessary to avoid mutual consultation when filling in together in the workplace. Six questionnaires cannot be counted due to the lack of data or inconsistencies between filling in and out. Five questionnaires were filled in by others instead, so we eliminate them. Therefore, we get 2,742 observations.

We take Beijing and Wuhan as the research areas, mainly because Beijing is a megacity and Wuhan is a megacity[1].

These two cities are very developed and representative cities in express delivery. One is the capital, whose industrial development plays the role of a wind vane. Another reason is that Beijing has a simple terrain of the traffic route map, which can be used as a concise sample representative of urban planning. Wuhan is located in the central region, and its development level is equivalent to the national average standard. Wuhan has complex terrain, intricate, and intersecting rivers, lakes, and a vast area, which can be used as a sample representative of complex urban planning.

Data Analyses

The questions about safety and health in Part 1 of the questionnaire are mainly based on the Cumulative Fatigue Symptoms Index (CFSI) (39, 40), Fatigue Scale-14 (FS-14) developed by Japan (41), and Fatigue Assessment Instrument (FAI) (42).

Japan's Fatigue Assessment Instrument has many design items, including not only physical but also spiritual. In addition to working conditions, it also analyzes the main causes of damage to health in working life from the aspects of living time and living conditions (43).

The results of factor analysis are classified and a new item classification is obtained[2]. CFSI includes five major causes, including sleepiness (Group V), restlessness (Group V), unhappiness (Group III), fatigue (Group V), and vertigo (Group V). It is composed of 25 subjective fatigue descriptions.

Fatigue Scale-14 was jointly compiled by Trudie Chalder (41) of King's College Hospital's psychological medical research laboratory and G. Berelowitz of Queen Mary's University Hospital in 1992. The scale consists of 14 items, including two dimensions: first, physical fatigue, which mainly evaluates physical strength, muscle strength, and rest, with a total of 8 items; The second is mental fatigue, which mainly evaluates memory, attention, and quick thinking, with a total of 6 items. FS-14 requires respondents to answer "yes" or "no" according to their actual situation, in which "yes" is 1 and "no" is 0. The higher the score, the more serious the fatigue is.

Fatigue Assessment Instrument was formulated by Joseph E, Schwartz of the American Psychiatric and behavioural sciences research laboratory, and Lina Jandorf of the neurology research laboratory in 1993 (44). Workers can make self-assessments

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[1]In 2014, the State Council issued the criteria for the division of city size, which divides cities into categories based on the permanent resident population in urban areas.

Cities with a permanent resident population of more than 5 million and less than 10 million are megacities, and cities with a permanent resident population of more than 10 million are megacities.

According to the data of the seventh national census, the total population of Beijing in 2021 is 21893095. By the end of 2021, Wuhan had a permanent resident population of 13.6489 million, which is less than the threshold of 50000 super cities.

[2]Two factor analyses were conducted, and six characteristic factors were extracted for the first time in 1970. The second analysis was attempted in 1985. The second analysis was a factor analysis of 81 items. The data used in factor analysis are the data of 11897 employees in the motor equipment manufacturing industry, including 8888 men in 91 workplaces and 3009 women in 32 workplaces.

based on this scale, which includes four dimensions: first, the severity of fatigue, which has 11 items; Second, the environmental specificity of fatigue, including 6 items; The third is the result of fatigue, including three items; fourth, the response of fatigue to rest and sleep, including 2 items. Each item in FAI shall be graded from 1 to 7.

The scale consists of 14 items, including two dimensions (45): first, physical fatigue, which mainly evaluates physical strength, muscle strength, and rest, with a total of 8 items; The second is mental fatigue, which mainly evaluates memory, attention, and quick thinking, with a total of 6 items. Fs-14 requires subjects to answer "yes" or "no" according to their actual situation, in which "yes" is 1 and "no" is 0. The higher the score, the more serious the fatigue is.

In the questionnaire of IDS riders, we designed options such as irritability, unable to control emotions, sleepy at work, lack of motivation, feeling weak limbs, and so on. According to the data in the survey, 50.4% of IDS riders sometimes felt impatient, irritable, and unable to control their emotions by themselves. They sometimes want to drop express items on the ground. 20.2% of them even often did that too. In the options about health, 27.2% of them have frequent physical issues (headache/dizziness/heart discomfort/tinnitus/dizziness, etc.). Comparing their stress of mental with physical, 56.3% chose "mental stress is greater than physical stress." Regarding work status, 30.6% were in the range of 9–20 (II). 42.5% were in the range of 21∼27(III). More than 20.4% were above 28 (IV) in the statistic. Making statistics on work Burden Indices, we found that 26% were in the early warning zone, 35.1% were in the danger zone, 23.3% were in the danger zone, and 6.2% were in the high-risk zone.

From the analysis above, according to the statistical data, we would conclude that most IDS riders were in an overworked state.

Variables

Dependent Variable

The dependent variable is the Work Burden Index reflects the degree of overwork in the zone of health risk, which is to measure the status of IDS riders' safety and health. The variables are in order. A higher value indicates lower health. The Work Burden Indexes representing safety and health are classified by I, II, III, and IV levels based on the 2 scales of self-conscious symptoms and working conditions.

The 7 points in a matrix[3]. form different zones of safety and health. The safety zone, early warning zone, dangerous zone, and high-risk zone can be seen in **Table 1**.

In the zone of 0–1 point, IDS riders' job is easy and the hours are good; In the range of 2–3 points, IDS riders have a work burden, and their safety and health in the early warning zone; In the range of 4–5 points, IDS riders have a higher work burden and be in the danger zone; In the range of 6–7 points, IDS riders are in the high—risk zone.

According to the Work Burden Index matrix, safety and health are mainly completed in three steps.

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[3]The standard is generally accepted by Chinese scholars. Such as Huang et al. (46–48).

Step 1: Divide the fatigue symptoms into health grades according to the Self-Diagnosis Scale of Fatigue Accumulation of Workers issued by the Ministry of Health, Labour, and Welfare in Japan, Safe Production Law of the People's Republic of China, and Guiding Opinions on Safeguarding Workers' Rights and Interests of Labour Security in New Forms of Employment issued by eight departments in China[4]. Construct an evaluation system to measure IDS riders' work burden. This system combined with the Fatigue Assessment Instrument, FS-14, Fatigue Scale-14, and the ten early warning signals of "overwork death" issued by the Japan Overwork Death Prevention Association. Then a scale is established to measure IDS riders' subjective feelings of fatigue, including 14 items: such as "impatient, irritable, unable to control their emotions, sometimes want to drop the delivery items on the ground," "frequent physical issues (headache/dizziness/heart discomfort/tinnitus/dizziness, etc.)." The scores and grades are as follows: 0–8 is for I, 9–20 is for II, 21–27 is for III, and 28 or more is for IV.

Step 2: Classify the grade of work level. Eight items are in the work condition evaluation form, such as "sudden increase in the number of receiving and sending, the need to work overtime" and "mental pressure caused by work." The standard of score and level are: 0 ∼ 8 points are Grade A, 9–15 points are Grade B, 16–23 points are grade C, and more than 24 points are grade D.

"Five score rating scale" was drawn according to IDS riders' work. They are "never so (0), rarely so (1), sometimes so (2), often so (3), and always so (4)."

Step 3: Build a conscious symptom and work condition matrix to determine the safety and health zone of IDS riders.

Independent Variables

According to National Standard GB3869-83, physical labour intensity was divided into four levels: I (light labour), II (medium labour), III (heavy labour), and IV (extremely heavy labour). The measurement indicators are average energy consumption and net labour time[5]. However, it is difficult to measure the energy consumption in the survey. IDS riders' work is mainly determined by working hours and riding distance. (In the structural survey, we found that many riders are not only interested in the number of orders, but also concerned about their daily odometer). In this paper, the "average daily distance" is instead of the "energy metabolism rate" in National Standard GB3869-83. We keep the calculation formula and calculation coefficient unchanged. A calculated six-level labour intensity index is used as the independent variable.

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[4]8 departments: Ministry of Human Resources and Social Security, National Development and Reform Commission, Ministry of Transport, Emergency Management Department, General Administration of Market Supervision, State Medical Insurance Bureau, Supreme People's Court and All China Federation of Trade Unions.

[5]The calculation formula of labor intensity index is as follows: $I = 3T + 7M$. Where: I - labor intensity index; T - labor time rate = net labor time in working days (minutes) / total working hours in working days (minutes) (%); M-8 hour working daily energy metabolism rate (kJ / min · m2); 3 - calculation coefficient of labor time rate; 7 - calculation coefficient of energy metabolic rate.

Self-conscious symptoms	Working status			
	A	**B**	**C**	**D**
I	0 (safety zone)	0 (safety zone)	2 (early warning zone)	4 (dangerous zone)
II	0 (safety zone)	1 (safety zone)	3 (early warning zone)	5 (dangerous zone)
III	0 (safety zone)	2 (early warning zone)	4 (danger zone)	6 (high-risk zone)
IV	1 (safety zone)	3 (early warning zone)	5 (danger zone)	7 (high-risk zone)

Source: Based on the comprehensive judgment of "CFSI, FS-14, FAI."

Instrumental Variable

As the needs of the instrumental variable are correlated with the independent variables, the frequency of traffic offences and orders are tailored to the instrumental variables. The correlation is that IDS riders are easily distracted while driving in the mood of high work intensity and pressure. It is easy for IDS riders to cause traffic violations facing plenty of orders. Labour intensity increases with the increase in the number of orders. There is a correlation between the number of orders and labour intensity.

The instrumental variable also needs to meet the condition that it is not correlated to the disturbance item. We find that the number of orders is qualified as an instrumental variable that has no correlation to the random disturbance term. However, being the new economic form, IDS riders obtain tasks randomly on the platform through "online order-grabbing." Random orders are knocked out without limited time and placed by different millions of customers on the platform. Since the random orders do not correlate with the error term, the instrumental variable is credible.

Another instrumental variable of traffic violation frequency has random too. Complex and changeable traffic full of the constant flow of vehicles and people randomly happens on traffic violations or accidents. Similarly, traffic violation frequency meets the requirements of an instrumental variable.

Theory Model

An increasing number of employees of IDS workers sign up for the IDS platform. It is a rational choice for flexible employees under the development situation of the new economics. U_{ij} is for the utility of the IDS riders in the state of reasonable working hours and pleasant mood, and U_{ik} is for the utility while they are in physical and mental fatigue state. When $U_{ij} \geq U_{ik}$, IDS riders have higher physical health. IDS riders' utility is determined by career and restricted by the status of their family economy and the way to get income. As it is known to all, those characteristics of IDS riders have a low employment threshold, which makes them limited space for career to transform and less income to improve. An Intertemporal Utility Model for IDS riders can be constructed using the C-D Function:

$$U = L_1^\theta L_2^{1-\theta}$$

Where U is for the utility of IDS riders, L1 and L2 are for IDS occupation and leisure consumption while quitting IDS, $\theta \in [0, 1]$.

Suppose that labour intensity is $\alpha \in [0,6]^6$. In this paper, the average daily distance is used to replace the energy metabolic rate in the National Standard GB3-83. We keep the calculation formula and the coefficient of the labour intensity index. The "Daily Distance" is divided into 6 levels as the labour intensity index.

A rise α indicates an increase in labour intensity. The budget constraints for the two periods are

$$L_1 + C + S + B_1\alpha \leq \omega(\alpha)t(\alpha) + E$$
$$L_2 + B_2\alpha = Y + \lambda S - \ln f$$

Among them, L_1 is the labour supply during the working period, and C is the total consumption expenditure for IDS riders' daily living; S is the savings during the working period, is the health cost during the working period, is the salary, $t(\alpha)$ is the working hours, and E is the non-labour income. The labour intensity α will affect by health costs, wages and working hours, etc. L_2 is the consumption of physical or leisure while quitting IDS, refers to the health cost after quitting IDS occupation, Y refers to the IDS riders' old-age pension, λS refers to the savings and transferred interest after quitting IDS occupation, and $\ln f$ is the legacy and death gratuity left to their family. Consumption capacity after they quit IDS depends on their all pension, savings, and the property left to their family.

Construct the Lagrange Function and take a derivative of labour intensity to solve IDS' Intertemporal Utility Function:

$$\frac{\partial U}{\partial \alpha} = [\lambda(1-\theta)]^{1-\theta}\theta^\theta \left[\frac{\partial \omega(\alpha)}{\partial \alpha}t(\alpha) + \frac{\partial t(\alpha)}{\partial \alpha}\omega(\alpha) - \left(\frac{\partial B_1(\alpha)}{\partial \alpha} + \frac{1}{\lambda}\frac{\partial B_2(\alpha)}{\partial \alpha} \right) \right]$$

It can be seen from the above formula that the impact direction of labour intensity on the occupational utility of IDS riders is related not only to wage and working hours $t(\alpha)$, but also to the impact of labour intensity on wages and working hours $\frac{\partial t(\alpha)}{\partial \alpha}$, and so does the impact on intertemporal health costs and .

Measurement Model

The average age of IDS, riders is 26.4 years old. The employees are mainly male youth. This paper assumes that IDS riders are

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[6]0-6 represents the labor intensity of different "Daily Distance" (6 levels is divided in this paper).

homogeneous, $[\lambda(1-\theta)]^{1-\theta}$ and θ^{θ} are constants[7] and >0; More labour supply will result in increases in working hours and salary. Both $\frac{\partial \omega(\alpha)}{\partial \alpha} t(\alpha)$ and $\frac{\partial t(\alpha)}{\partial \alpha} \omega(\alpha)$ will be >0. IDS riders will ignore or overdraft the health cost (current and future) to work which is likely an economic rational choice under the constraint of the platform. and will be also >0. According to these theories, we can deduce Hypothesis 1.

H1: The increase in riders' labour intensity makes the Work Burden Index rise, which eventually leads IDS riders to overwork and is in the zone of health risk.

Due to the order-grabbing system in the IDS industry, the substitution effect of labour supply caused by salary is greater than the income effect. To increase working hours, the result is to improve labour intensity. From this, we can get Hypothesis 2.

H2: Salary and working hours play a moderating role.

The effect of increasing work intensity on health is not direct, where job stress and job satisfaction have a mediating role. Therefore, we can propose Hypothesis 3.

H3: Job stress and job satisfaction play a mediation role between labour intensity and safety and health.

Labour intensity is ordered by multiple categorical variables, and its value has only ordered significance and lacks an interval scale. Therefore, this study selects the Ordered Multinomial Logistic Regression Model:

$$H_{ij} = \alpha + \beta LI_{ij} + \gamma X_{ij} + \varepsilon_{ij}$$

Where, H is the health degree of IDS rider i in an urban area j, and LI (Labour Intensity) is the labour intensity of IDS rider i in an urban area j; X_{ij} is the control variable group; α, β and γ are the parameters to be estimated.

However, there are many factors affecting the health level of IDS riders. In addition to the physical health level characteristics of IDS riders, there are also external complex factors such as urban discrimination against migrant workers, riders' living conditions, and living environment. It is difficult to completely control in the model, and other unobservable factors may be omitted, which would result in the endogenous problem. On the other hand, there can be a reverse causality between labour intensity and safety and health. Different knowledge about familiarity with urban rods will make IDS riders safer and healthier. The safety and health of IDS users will also be exacerbated by the degree of congestion in various sections of urban traffic and psychological discouragement after poor evaluation. Due to the endogenous problem, this document selects an identification strategy by the instrumental variable analysis. We adopt IV-Logit Two-stage Estimation Method after adjusting the Logit Model above.

RESULTS

Estimated Results

The regression results in **Table 2**, Model 1 only includes the core independent variable, and the significance of the regression

results is not too strong. The age control variable was added to Model 2, and the test results were slightly improved. Three control variables of age, education, and gender were added to Model 3, and the significance was greatly enhanced. Model 4 adopts the IV-Logit Two-stage Method, the regression coefficient is more statistically significant, and the result is more reliable.

In model 4 (IV), the regression coefficient is significantly positive and the intensity is high. H1 is verified and supported. The increase in labour intensity will greatly increase the work burden, so it is a negative impact on safety and health.

Extreme Working Environment Analysis

We did not do a heterogeneity test for IDS riders of the model. The safety issues, more dangerous than health, are caused by the extreme working environment. Structure investigation is adopted to analyse the problem of safety.

Instant Delivery Service riders are exposed to outdoor work most of the time. The external factors harm their safety and health, such as hot sun, high temperature, fierce wind, rain and snow, and daily breathing exposure. Daily breathing exposure is mainly due to the excessive PM2.5 in haze air. The little difference in daily breathing exposure for the whole urban residents, so IDS riders are afraid of the hot sun, high temperature, wind, rain, and snow. Poor working environment, especially the extreme weather has the greatest impact on IDS riders. However, in the survey, it is believed that the impact of wind, rain, snow and high temperature, and hot sun on safety are, respectively, 78, 88, 94, and 23%. According to the structural interview survey, IDS riders generally don't care about the high temperature and hot sun. What is the reason that they take the first three items seriously, but the high temperature? It may be that the high temperature cannot prevent them from delivering. Another reason may be that they know little about the probability of heatstroke which leads to death. They have no medical understanding that high-temperature thermal fatigue may potentially induce safety and health issues, such as heart disease and coronary heart disease.

Mediating Path Analysis

The transmission path between labour intensity and safety and health is as follows: the stronger become the labour intensity, the greater cost the of safety and health. Labour intensity is not beneficial to physical safety and health.

A high income formed by labour utility may make IDS riders satisfied with their work. High satisfaction work makes workers be in good health, physical and mental. The impact is positive. While the work pressure of long working hours does harm workers physically and mentally. Then, that impact is negative. Therefore, in this study, we take income and working hours as moderating variables.

Salary has a substitution effect and an income effect. The income effect makes fewer working hours, while the substitution effect makes workers work more. The total effect is uncertain. But for IDS riders, being a game of orders-grabbing, the substitution effect of salary is greater than the income effect.

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[7]It is a constant greater than 0 because IDS riders are homogeneous, and the parameters have no difference in different IDS riders.

	Model 1	Model 2	Model 3	Model 4(IV)
LI (labour intensity)	0.0054* (0.0645)	0.0263* (0.0232)	0.3723** (0.0406)	0.4655*** (0.0308)
Age	-	0.5766** (0.1433)	0.4725* (0.4407)	0.6724*** (0.3423)
Academic	-	-	0.2724* (0.1425)	0.2215** (0.3087)
Gender	-	-	-	0.1212 (0.5013)
Instrumental variable	-	-	-	0.3016** (0.4371)
R^2	0.432	0.397	0.365	0.412
Adjusted R-square	0.7378	0.6162	0.5164	0.7188
F	23.56***	25.77***	28.32***	22.66***

*** $P \leq 0.001$, ** $P \leq 0.01$, * $P \leq 0.05$; Robust standard error in brackets.

Source: authors' own.

Our study explores the variable's role and the mediation path by applying Muller's Chain Mediating Effect Model with moderating variables.

$$H_{ij} = \alpha_1 + \beta_1 LI_{ij} + \varphi_1 G_{ij} + \vartheta_1 LI_{ij}*G_{ij} + \gamma_1 X_{ij} + \varepsilon_1$$
$$M_p = \alpha_2 + \beta_2 LI_{ij} + \varphi_2 G_{ij} + \vartheta_2 LI_{ij}*G_{ij} + \gamma_2 X_{ij} + \varepsilon_2$$
$$H_{ij} = \alpha_3 + \beta_3 LI_{ij} + \varphi_3 G_{ij} + \vartheta_3 LI_{ij}*G_{ij} + \phi_3 M_p + \tau_3 M_p*G_{ij} + \gamma_3 X_{ij} + \varepsilon_3$$

H_{ij} represents safety and health, and G_{ij} represents the moderating variables of salary and working hours[8] The data on salary comes from the 7-income range of monthly income in the questionnaire, and the data on working hours come from 4-time ranges in the questionnaire.

M_p(p =1-3)is the mediating variable: work stress M_1 includes 5 dimensions, Calculate the mean value of 5 dimensions as the variable: "24 h rest/month, labour contract, social security, perception of competitive stress, and poor comments," which is answered in four grades. Job satisfaction M_2 is investigated from six dimensions. The mean value is calculated in the same way. Six dimensions are "organisation satisfaction, management satisfaction, job reward satisfaction, working atmosphere satisfaction, the job itself satisfaction, and human resource management satisfaction," which are answered in five levels of satisfaction. The chain mediating variable M_3 is expressed by "job stress * job satisfaction."

Mediating Effects Test

To analyze the mediating effect neatly, the moderating effect is not considered.

According to the mediating effect results in **Table 3**, the front-end effect of Road 1 is significant, and the back-end effect of the Road 1 mediation path is also very significant. It is not difficult to find that job pressure is the leading mediating variable leading to safety and health. Hypothesis 3 is verified job pressure has a mediating effect.

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[8] As the moderating variable of salary and working hours, G_{ij} will be carried out hierarchically during regression.

Moderating Effect Test

Data is centralised before the two variables G_{ij} are used in moderation. Hierarchical Regression is carried out for the two generated interactive variables. The linear regression estimation results of the model with moderating variables are shown in **Table 4**.

According to the estimation results of the moderating effect in **Table 4**, the impact of salary on labour intensity is not significant, and the extension of working hours has a positive effect on labour intensity. The significance test of multiplication of salary and labour intensity is passed at 10%. Though the moderating effect of salary on labour intensity is determined by the income effect and the substitution effect, the total effect is positive. Facing the temptation of salary, IDS riders will take the initiative to grab more orders to earn more money. In reality, platform work has only changed mechanisms through which companies can exercise control over labour and evade their employer obligations. The freedom of food delivery platform workers is essentially an "illusory freedom" (49).

As a result of an increase in labour intensity, they will be overworked, which is no benefit to their health. The multiplication of working hours and the labour intensity is tested at the significance of 1%. It shows that the IDS riders' labour intensity increases with the extension of working hours, and the resulting job pressure will affect their health, and even their safety. We verified that both salary and working hours have a moderating effect on labour intensity, and the effect of working hours is greater, so Hypothesis 2 is tested.

DISCUSSION

We can see the health mediating effect of IDS riders in **Figure 1**. Overall, in the mediating effect, job pressure has not only a strong impact on the front-end effect but also a strong mediation path in the back-end effect. Job satisfaction is a weak mediation path in both the front-end effect and the back-end effect. The mediating effect of job pressure is 0.1562 (β_1-β_3 = 0.4655–0.3093). The change in salary causes the change in working hours, which leads to the change in labour intensity and job pressure. The moderating effect of salary is 0.1537 and the moderating effect of working hours is 0.3124. Working hours increase labour intensity

TABLE 3 | Estimation results of chain mediating effect.

Mediation path	Total effect β_1	β_2	ϕ_3	Direct effect β_3	Mediating effects β_1-β_3
Road1	0.4655*** (0.0308)	0.0076*** (01352)	0.0063** (0.5643)	0.3093** (0.1338)	0.1562*** (0.5437)
Road2	0.4655*** (0.0308)	−0.0021 (0.2322)	−0.034*** (0.9321)	0.4668 (0.7985)	−0.0013* (0.3428)
Road3	0.4655*** (0.0308)	0.0016 (0.5323)	−0.027 (0.1421)	0.4913* (0.5363)	−0.0258** (0.5712)
LLCI	0.2763	0.1242	0.0322	−0.1426	0.2152
ULCI	0.5734	0.3216	0.0453	−0.1043	0.4026
R^2	0.348	0.235	0.350	0.359	0.294
Adjusted R-square	0.4823	0.5326	0.5035	0.6011	0.6202

***P ≤ 0.001, **P ≤ 0.01, *P ≤ 0.05; Robust standard error in brackets.
CI, confidence interval. Source: authors' own.

TABLE 4 | Estimation results of moderating effect.

Variables	Model 1	Model 2	Model 3
Salary level	0.0246 (0.6456)	0.3524 (0.1432)	0.2636* (0.4365)
Labour intensity * salary level	0.0124 (0.4328)	0.0324** (0.6834)	0.1537* (0.7156)
Working hours	0.5265 (0.9342)	0.4278 (0.8326)	0.5023*** (0.2475)
Labour intensity * working hours	0.2146** (0.3215)	0.3547*** (0.5452)	0.3124*** (0.3486)
Age	-	0.5375 (0.7246)	0.4328*** (0.6143)
Academic	-	-	0.2321 (0.4122)
Gender	-	-	0.1326* (0.5129)
R^2	0.4023	0.2011	0.3212
Adjusted R-square	0.6782	0.5163	0.6166
VIF	3.135	2.242	3.026

***P ≤ 0.001, **P ≤ 0.01, *P ≤ 0.05; Robust standard error in brackets.
VIF, variance inflation factor.
Source: authors' own.

and then affect safety and health through job pressure. Labour intensity has a positive impact on safety and health. The total effect of labour intensity on safety and health is 0.4655.

The index of job pressure mainly includes five dimensions: "complete rest days per week, signing of the labour contract, social security participation, perception of competitive pressure, and perception of dealing with bad comments." Take the mean value as the working pressure variable and evaluate it with 4 grades of "very small, small, general, large, or very large."

The index of job satisfaction is formed by a six-factor analysis of "organisation satisfaction, management satisfaction, job reward satisfaction, working atmosphere satisfaction, the job itself satisfaction, and human resource management satisfaction." Five grades are formed by Likert five subscale methods: "very dissatisfied, relatively dissatisfied, average, relatively satisfied, and very satisfied."

The regression coefficient of labour intensity is 0.0076, which can cause work pressure. Labour intensity can directly lead to the decline of physical health and make IDS riders enter a state of overwork. For other job characteristics, it appears that workers in the app-enabled gigs are ordinarily doing standardised tasks repeatedly over a period of time, the structured algorithmic management techniques offer workers a high level of autonomy (50). Unstable employment tends to negatively affect health status. As it causes psychological and physical health risks, such as low mental health, dissatisfaction with physical health, anxiety, or high blood pressure. Platforms have added "digital reputation mechanisms" or "evaluating and rewarding mechanisms." Their real motivation is to let IDS riders grab orders and compete to increase labour intensity.

The regression coefficient of working hours is 0.3124, which has the greatest impact on labour intensity. The survey found that 14.2% of IDS riders worked more than 12 h. In European countries, around 80% of platform workers declare platform work to be a secondary or tertiary source of income (51, 52). Even when platform work is the main source of income, the number of working hours is often low. Platform workers typically work low numbers of hours per week in European countries. A positive association with the number of hours worked per week was found for traffic penalties (or fines) (53). Working for a long time not only affects the health of IDS riders but also endangers their life safety.

The influence of salary is two-way, with both income effect and substitution effect. This study found that the income effect of IDS riders is still dominant in China. Although some studies have used evidence to show that piecework wage in a casual economy increases health (54). But at the same time, some studies have shown that performance-based pay is harmful to health. Vietnamese garment factories and American shoe factories that implement performance-based pay have had poor physical conditions and emotional health (55). The present study corroborates the UK findings for US workers, with poorer health outcomes reported for piece-rate workers than for salaried workers (56). Giggers often earn below minimum wage without any entitlements to social benefits (57–62), and prices are being raised or decreased by an algorithm depending on demand (63). Poor health outcomes linked to performance and piece-rate might further erode a company's bottom line.

Under current law, it is impossible for all the IDS riders to pay workers' compensation insurance for platform workers. Therefore, it is difficult for platform workers to manage chronic
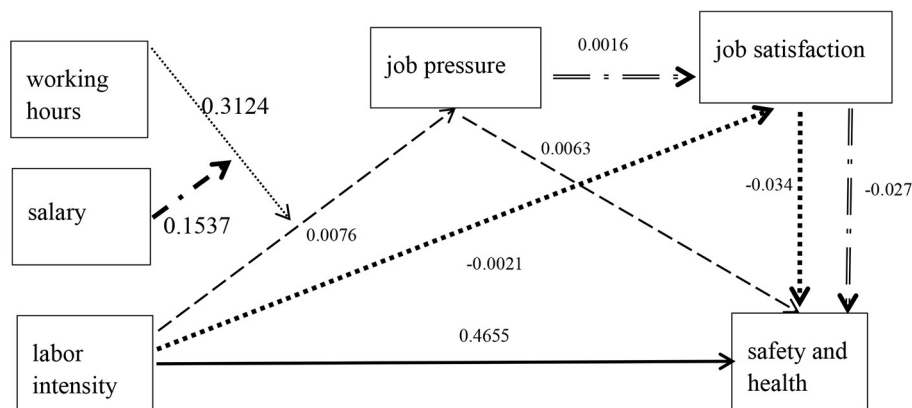
FIGURE 1 | Impact path of the labour intensity on safety and health.

diseases, work-related diseases, and occupational diseases due to difficulties in health examination and health care.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

First, our study results are limited to a sample of IDS employees currently working in two big cities in China, which has a more formal employment setting as reflected by the large proportion of IDS workers in the country. China has a vast territory and IDS business is generally developing, IDS in smaller and medium-sized cities should have more characteristic problems to be resolved. As such, our results should be generalised with caution to broader contexts.

Second, there is no heterogeneity analysis for IDS riders in this paper. After all, few IDS riders are female. Only 2.5% of the female respondents in our questionnaire, the analysis of the difference between male and female groups can not reflect the truth. Another reason is that women may be slightly poorer than men in security and cycling technology. They are not as fast as men in grabbing orders, and their orders are less than men. So, their labour intensity may be weaker than that of men, and the security of female IDS riders is relatively higher.

Third, the research deficiency is that the variation is not examined when an order was completed in unit time. The algorithm of time compression has become a trick to improve labour intensity in the AI system. After comparing the labour intensity between a normal speed and a limited speed, we may portray the mechanism of labour intensity to improve. Future research will collect the average speed in an order to make up for this deficiency.

THEORETICAL CONTRIBUTIONS

This study makes two key contributions to the knowledge base around the IDS riders. First, based on the life cycle theory of labour supply decision-making, a two-stage decision-making

analysis is carried out on the consciousness of labour intensity. Work and safety and health are in two periods for decision-making, so this decision-making view should contribute to the progress of the traditional employment theory which is the basis of stable employment and high-quality employment.

Second, this study represents a pioneering attempt to analyse the theoretical explanation of labour control. The work of IDS is seemingly free, while it is actually a non-free labour process controlled by the platform. This study explains the deep reason why IDS appears seemingly free, but actually has no freedom from the comparison of substitution effect and income effect. The work caused by the substitution effect will make IDS riders lose their freedom as long as they start to work. IDS riders only have the freedom to choose to work or not, and never to work.

PRACTICAL IMPLICATIONS

This study found that the job pressure comes from the labour intensity. Different from the traditional method, labour intensity comes from the work overweight by the management in traditional employment. While IDS riders increase their labour intensity without much prompting. They extend their working hours just for the temptation of salary, resulting in overwork. They lose their freedom to work in the game in order-grabbing which is seemingly free. Under the pressure of assessment, IDS riders deliver an order in a shorter and shorter time. Though IDS riders want to earn quick money under the order reward mechanism, the company should rely on the obligation specification following the labour law to cultivate employees' professional commitment, rather than only on the monetary benefits.

More and more orders to deliver, less and fewer rights to choose. The delivery sequence and riding route are locked and monitored by the platform. They even have no autonomy to deal with physical discomfort, accidents, rainstorms, and other special work environments. The labour intensity of IDS riders is increasing with their overwork, and so does the job pressure

which is caused by the assessment. Both of them are not beneficial to IDS riders. To reduce the negative economic losses caused by IDS riders' safety and health issues, the company should formulate a working algorithm within a reasonable labour intensity.

In terms of their behaviour, it is very dangerous to watch their mobile phones while their riding. In particular, keep safety riding in an extreme work environment. In addition to providing a "health bag" and other necessary equipment, we should pay more attention to the IDS riders' rights. They should also be given the right to keep safe and healthy.

CONCLUSION

In this paper, an intertemporal utility model is established to measure the labour intensity of IDS riders. An IV-Logit Model is used to investigate the impact of the change in labour intensity on IDS riders' safety and health combined with the survey data. Then the mediation path of job pressure is analysed and explored. The following conclusions and understandings are obtained:

(1) Hypothesis 1 is supported clearly by regression. The labour intensity has a positive impact on safety and health. The labour intensity increases, and the risk index of IDS riders' safety and health increases.

(2) Salary level and working hours have a moderating effect on labour intensity, so Hypothesis 2 is tested to be true. To the two moderating variables, the moderating effect of working hours is greater, and the moderating effect of salary is mainly determined by the total effect between the income effect and the substitution effect. As for IDS riders, their substitution effect is greater than their income effect.

(3) Predicted paths are not completely supported in Hypothesis 3. Job satisfaction is not effectively supported, while job pressure is the dominant mediation in the mediation paths. The increase in job pressure has a significant positive impact on the level of overwork in safety and health.

Piece rate pay designed to promote efficiency may have important negative implications for worker health, especially for the most vulnerable members of the US workforce (64), such as women, minorities, and low-income workers. Given the growing popularity of performance-based pay in the gig economy, more research is needed to determine if the practise is justified from a public health perspective (65). McDowell et al. suggested that vulnerable jobs include job-related insecurity, lack of legal rights and labour rights, lower salary levels, and higher occupational health risks (66). The work design in the IDS platform company is from the algorithms (67). Undeniably, the algorithms could not provide high-quality employment for IDS riders. IDS riders are more vulnerable.

The IDS riders should be put in a reasonable salary and working hours system to keep healthy. As no basic salary guarantee and appropriate working hours were designed in the IDS platform economy, it would be unrealistic that IDS riders reduced labour intensity.

It is never the normal way to improve the salary depends on grabbing more, riding faster. Undoubtedly, active overwork under the high pressure of work and life should damage their health. In particular, it is very dangerous for IDS riders being busy watching or grabbing orders while they are riding, especially in the mood of fatigue. The platform economy is recommodifying labour. We need to democratise it (68).

The findings above have obvious reference value for promoting the development of high-quality employment in China. Firstly, nearly 3 million workers are employed, and the employment group of IDS riders is expanding. Only IDS riders are safe and healthy, and the structure of whole social employment will be healthy. Secondly, IDS riders are controlled by the impersonal platform algorithm systems. In the current new economic policies, we should be more vigilant about labour intensity to be improved by the economic effects of algorithms and artificial intelligence technology. Finally, to study the safety and health of IDS riders in economic theory, an Intertemporal Utility Model was constructed using C-D Function. With the introduction of the intertemporal concept, we overcome the shortcomings of previous research on IDS riders in economic theory. The intertemporal concept can prevent us from studying the shortsighted behaviour of IDS riders.

Key evidence has surfaced since Adam Smith's early conjecture to support his theory of the negative health impacts. Taylorism has been largely criticised for turning workers into an automaton or machines who fail to find meaning in their work.

To cope with the new occupational health and safety issues, we need to establish new concepts of "decent work" and standardise regulations, which are responsible for health and safety (69). With the vigorous development of the platform economy, the country should pay more attention to vulnerable employees, as well as high-quality employment.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the animal study because IDS riders' employment qualification meets the constraints of labor law. In line with the legal age of 18, there are no inhumane moral problems such as employing child labor.

AUTHOR CONTRIBUTIONS

TC is responsible for research ideas and overall research work. DT conducts the investigation for data. PD corrects the grammatical errors in the article. EZ and JH sort out the data and materials. All authors contributed to the article and approved the submitted version.

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Job demands, resources, and task performance in Chinese social workers: Roles of burnout and work engagement

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Social work is a rapidly developing occupation in China. In the early 2000s, there were merely a few hundred thousand social workers, but by 2020 there were over 1.5 million social workers in the field. However, research has indicated these social workers are also experiencing record high burnout and turnover rates. Thus, researchers have started to question the work engagement and task performance factors that could be contributing to these increasing rates. This study uses the Job Demands and Resources (JD-R) Theory to understand how 537 social workers from Guangzhou, China are impacted by burnout and how it influences work engagement and task performance. The results show JD-R directly affect task performance through burnout and work engagement *via* a dual process. First, job demands were associated with high burnout and low work engagement, which both were found to lead to low task performance. Second, job resources were related to low burnout rates and high work engagement, both of which were associated with high task performance. These findings call for healthcare interventions to reduce burnout and workplace policy changes to promote work engagement to support task performance in social workers in China. These factors can each have a crucial impact on the public health of both the affected social workers and the vulnerable clients these social workers serve.

KEYWORDS

burnout, job demands, job resources, task performance, social workers, work engagement

Introduction

Throughout the last century, the Chinese social work industry has grown exponentially in tandem with China's increasing economy (1, 2). However, the past decade has brought about the most change yet. In 2010, there were an estimated 0.2 million social workers, but by 2020 there were an estimated 1.5 million workers within the field (1, 3, 4). This rapid but massive influx of social workers highlights the quick expansion of the social work field, and of the increasing impact social workers have had on public health, given social work agencies began serving largely disadvantaged communities with poor healthcare access and services (5, 6).

However, it is important to note social work has faces several challenges in development. First, it has not progressed evenly throughout the various regions of China. For example, in more urban cities such as Shenzhen, the social work industry has blossomed due to the greater access to resources. Comparatively, rural regions in western China such as Guizhou have not witnessed these same types of social work changes (7). Second, the professional identity has not yet been fully established and often the public mistakenly perceives social workers to be volunteers. Without nationwide recognition, social workers are continuously deprived of professional respect, which influences their capacity to implement professional, helping work (8, 9).

Third, there is a knowledge gap between what social work education programs teach and how social workers practice in the real world. For example, within Chinese culture certain healthcare concepts, such as mental health, are stigmatized and thus widely underreported, underassessed, and undereducated in professional education programs (10). Social workers based in China frequently work with vulnerable populations who suffer from mental health disorders, but often social workers underdiagnose or misdiagnose clients because of a lack of formal education on mental health and cultural stigma (10). This disconnect often leaves social workers feeling unprepared and frustrated when entering into the professional work setting (11–13). Moreover, these gaps perpetuate a major mental health crisis.

Additionally, the tasks of frontline social workers in China are incredibly comprehensive. Social workers are generally required to perform administrative work, client visits and contacts, case work and management, group work, program planning and implementation, community networking, evaluation, supervision, and training (14, 15). Because many social work tasks are related to health and social inequity, social workers and public health practitioners share the collective goals of delivering quality services to various vulnerable populations in need (5, 16). Like many public health practitioners, social workers often work overtime and during weekends because of the extensive clients' needs. Moreover, many social workers are using this weekend time to fulfill heavy, government-required administrative tasks that stem from social work service purchasing agreements (11, 17, 18). Finally, social workers in China are often underpaid [on average salaries range from 3,000 to 5,000 Yuan ($500–800 USD) per month] (9, 14) and have few promotional opportunities (9, 11).

Moreover, these increasing professional challenges have drastically increased high burnout and turnover amongst social workers in China (2, 8, 9, 19–21). For instance, 25% of social workers based in Guangzhou quit social work in 2014 (22). Similarly, by 2013 Shenzhen social workers were experiencing a turnover rate well over 22% and by 2015 18.08% of social workers based in Shenzhen had quit their jobs (23). These numbers were well over 10% of what they had been a decade earlier. Additionally, research also suggests burnout and

turnover rates have become so popular that 90% of Chinese social work students did not intend to enter the social work industry after graduation (24).

Cross-cultural research has shown a strong association between burnout and turnover rates (18, 25, 26), especially amongst social workers in China (19, 20, 27). Given this strong relationship, it is imperative to acknowledge high rates of burnout and turnover can impose negative consequences for social work practitioners and subsequent client populations. For example, social workers who are experiencing burnout may struggle to provide quality client services. This then creates a system of unethical practices and imposes risks of harming vulnerable clients. Moreover, large turnover rates may mean agencies are understaffed so social workers are forced to take on additional job demands and workloads. These extra work pressures and stressors can lead to more burnout, which perpetuates the cycle of high turnover within the industry.

In addition, studies have shown that burnout significantly affects workers' physical health (28–30) and mental health (31–35). Social workers specifically who experience high rates of burnout and work stress are at significantly higher risk for morbidity (24). For example, von Känel et al. (30) found significant associations between burnout and physical health such as high blood pressure, chronic somatic symptom disorder, and lung disease amongst 5,671 respondents in Switzerland. Additionally, Capone and Petrillo (31) found job burnout was significantly linked to depression ($r = 0.42$) amongst a sample of 285 high school teachers. Likewise, Xie et al. (35) found burnout significantly increased psychological distress (Beta = 0.46) amongst a sample of 897 social workers based in Chengdu, China. Thus, burnout is an important factor of health outcomes for social workers, as well as other professionals in China and beyond (28, 30, 32, 34, 35).

Research gaps and highlights

As burnout and turnover rates continue to rise amongst social workers, there have been concerns and research gaps on whether social workers are able to maintain work engagement, complete task performance, and sustain quality services within social work agencies, community centers, healthcare centers, and alternative social welfare agencies (3, 9). First, this research paper seeks to utilize the Job Demands and Resources (JD-R) Theory to fill this research gap by examining how job demands (JD) and job resources (JR) affect task performance of Chinese social workers and to understand if burnout and work engagement mediate this relationship. Highlights of this study include an effort to: (1) help spread awareness of the type of work conditions Chinese social workers experience, (2) shed light on the effects burnout and work engagement have on task performance amongst social workers in China, and (3) expand

information on how the JD-R theory applies to social workers within China.

Second, this paper seeks to raise awareness of the ethical and public health concerns of this rising social work burnout problem. Social workers, especially those based in China, typically work with vulnerable populations who require significant hands-on services. However, if social workers are experiencing burnout and are disengaged with their work, social workers may be unable to fulfill their ethical duties to zealously serve the clients (36). Thus, clients may have become at-risk for experiencing harm, malpractice, or a lack of resources/support that is available. Given these rising harms to both social workers and clients, this paper seeks to investigate factors of burnout and work engagement that effect social workers to limit this growing healthcare crisis (6, 16).

The job demands-resources theory

The JD-R Theory posits JD and JR each effect the job performance, health, and overall wellbeing of working employees (37, 38). JD are the physical, social, or organizational job features that require an employee to exert prolonged physical or mental efforts. Additionally, JD typically impose physiological costs, such as fatigue and debilitation. JR are the job features that help facilitate work achievements, mitigate any psychological costs of JD, and encourage personal development (39).

Together, JD and JR affect burnout, work engagement, and health outcomes through two different processes: (1) the health-impairment process (also known as the energy-driven process) and (2) the motivation-driven process. In the health-impairment process, JD are physical and emotional stressors that gradually deplete social workers energy. Subsequently this depletion can lead to high burnout, low work engagement and performance, and poor health outcomes such as chronic somatic symptom disorder and depression (30, 31, 38, 40). In contrast, in the motivation-driven process, JR encourage and support employees in their efforts to meet work responsibilities, which increases work engagement, reduces burnout, and improves various job and health outcomes (33, 35, 38, 41, 42).

> Hypothesis 1: JD are positively associated with burnout
> Hypothesis 2: JD are negatively associated with work engagement
> Hypothesis 3: JR are negatively associated with burnout
> Hypothesis 4: JR are positively associated with work engagement

Burnout and work engagement

Burnout is a psychological condition that can create emotional exhaustion, a feeling of being outside one's body, and a reduced sense of personal accomplishment, especially during challenging work situations (43). Thus, burnout is considered an occupational threat to professionals in various human service industries (44, 45) such as social workers (35, 46). In contrast, work engagement is a positive, fulfilling, work-related state of mind that is characterized by vigor and dedication (42, 47). Burnout is an important predictor of physical and mental health outcomes, (28, 30, 31, 33, 35) while work engagement is a crucial factor of motivational outcomes (38, 40).

Task performance

Task performance can be understood as the efficiency with which an employee performs assignments that contribute to core job responsibilities. Additionally, task performance measures the employee's success at delivering specific work outcomes, as well as quality and quantity work (48, 49). It is critical to examine burnout, work engagement, and task performance through the lens of JD-R Theory (11, 21, 39) as numerous researchers have discovered JD and JR have direct effects on task performance, as well as indirect effects through burnout and work engagement (18, 21, 35, 38). Task performance is negatively affected by JD and burnout (50–53). For example, one study by Bakker and Heuven (50) found that of 108 nurses and 101 police officers, burnout negatively affected both sample's task performance (beta $= -0.32$ in nurse sample and -0.35 in police sample). Likewise, Dyrbye et al. (51) found that amongst a national sample of U.S. nurses, those who were experiencing burnout were also more likely to have poor task performance ($n = 3,098$).

In contrast, task performance is positively affected by JR and work engagement (52, 53). One study by Halbesleben and Wheeler (52) found that of 587 employees from various industries and occupations, work engagement was associated with high task performance amongst self-reported, supervisor-rated, and coworker-rated performance. Additionally, Song et al. (53) also found that amongst a sample of 481 Korean teachers, work engagement was positively correlated with task performance (beta $= 0.23$).

> Hypothesis 5: JD are negatively associated with task performance
> Hypothesis 6: JR are positively associated with task performance
> Hypothesis 7: Burnout is negatively associated with task performance
> Hypothesis 8: Work engagement is positively associated with task performance

In addition to the extensive research conducted on task performance, the JD-R Theory has also been widely utilized to understand how burnout, stress, work engagement, health, and task performance affect work outcomes (29–31, 35, 45, 50,

51, 54). Studies have shown JD can substantially influence the health-impairment process which in turn can cause burnout, low work engagement, and poor health outcomes. Meanwhile, JR, through a motivation process, can be a significant protective factor against burnout and can even increase work engagement.

Despite the volume of JD-R research in this area, few studies have focused on whether burnout and work engagement mediate the effects of JD-R on task performance of social workers in China. This is an important gap, especially considering the serious and negative health outcomes stemming from social worker burnout and how these effects spill-over onto the clients they serve. Thus, this study fills the research void. We use the JD-R Theory to examine the effects of JD-R on task performance and seek to understand if there are any relationships mediated by burnout and work engagement amongst a sample of social workers in China.

Hypothesis 9: Burnout and work engagement mediate the effects between JD-R and task performance

Methods

Data and sample

Our study consisted of an online anonymous survey which was administered to working social workers in Guangzhou, China. Guangzhou is the capital of Guangdong province and has undergone rapid social work developments within the last decade (55). In 2017, Guangzhou policymakers created street level social work service stations to expand social services offered within the local communities. Each of these stations are operated by 20 social workers and 14 of them are front-line social workers, whom offer immediate services/referrals for housing, healthcare, education, and employment. For example, the healthcare services include health management at elderly daycare centers and working with local community health service centers to provide education on disease prevention.

We randomly selected 54 of the 180 Guangzhou service stations to sample, and emailed survey participation links to the front-line social workers at each site on September 15, 2021. We then sent follow-up notices 7 and 14 days later to remind participants to complete the initial survey. Out of 756 social workers we initially emailed (54 * 14), 537 social workers answered the online survey by October 10, 2021. Thus, the response rate was 71%. Each participant was notified of their right to informed consent prior to their participation in the survey. Each participant was also informed their participation was voluntary and of their ability to stop the survey at any time. The research protocol was also approved by the research review committee at one of the co-authors' university in China. The demographics show a majority of our sample identified as female (84.5%) and were never married (54.2%). The average age of the sample was 29.3 (SD = 6.3). Over half of the sample had

at least a college degree (54.2%). Additionally, the mean income and work experience of social workers were 4,355 yuan (~$647 USD) monthly and 3.7 years, respectively.

Measures

First, we measured task performance using Goodman and Svyantek's (56) 9-item task performance scale. Numerous studies have verified this scale's validity, psychometric soundness, and reliability (56–58). The scale assessed task performance through a series of questions that assess whether the worker feels he/she is able to "achieve the objectives of the job" and "plan and organize to achieve objectives and meet deadlines" for example. Each item was rated on a seven-point Likert scale, ranging from 0 to 6. High scores meant the item was completely characteristic of the employee, while a low score meant it was not characteristic of the employee. We averaged a mean score of all 9 items as the task performance score. The Cronbach's alpha of task performance was 0.94 in this study.

Second, we assessed for work engagement using a short form of the Utrecht Work Engagement Scale (UWES-9) (59). The short form version of this scale has been verified by numerous studies for its validity, reliability, and soundness (59–61). The UWES-9 includes nine items to gauge the three dimensions of work engagement: vigor, dedication, and absorption. Each has three items. Initially, participants were tasked with answering opinion questions about their jobs. Exampled questions were: "At my work, I feel bursting with energy" (vigor), "I am enthusiastic about my job" (dedication), and "I am immersed in my work" (absorption). Each item was assessed along a 7-point Likert scale ranging from 0 ("never") to 6 ("always"). The overall work engagement score was an average mean score of all 9 items. The Cronbach's alpha of work engagement was 0.95 in this study.

Third, we measured burnout using the Oldenburg Burnout Inventory (OBI) (62) which has been utilized frequently to study burnout amongst working professionals on an international scale (39, 63, 64). The OBI survey consisted of 16 items which assessed for exhaustion (8 items) and disengagement from work (8 items) through questions such as: "It happens more and more often that I talk about my work in a negative way". Questions geared toward studying exhaustion sought to understand the intense physical, emotional, and mental pressures each employee experiences at work, while questions geared toward disengagement examined how the employee distanced himself from his work generally, work object, and/or work content (62). Each item was measured in 4 categories (1 = strongly disagree to 4 = strongly agree). We reversed positively worded items so that high scores represented high burnout. We averaged mean score of all 16 items as the burnout score. The Cronbach's alpha of the scale was 0.85 in our study.

Finally, we measured JD-R using a multidimensional scale from Lequeurre et al.'s (65) Questionnaire sur les Ressources et Contraintes Professionnelles (QRCP). This scale focused

FIGURE 1
Conceptual model.
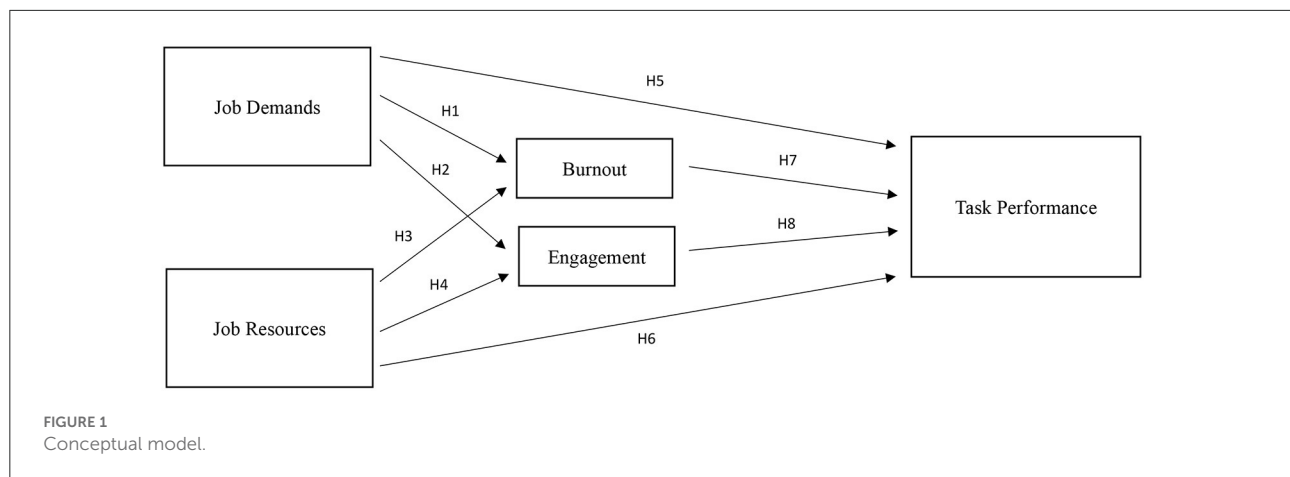
on three dimensions of JD– workload, emotional workload, changes in the tasks, –and three areas of JR– relationships with colleagues, relationships with supervisor, and information. Workload refers to the sense of having an extensive quantity of work to complete in minimal time, while emotional workload refers to the JD that require participants to expend emotional energy. Changes in the tasks refers to the participants difficulty within their job functioning when there are changes in agency job roles and responsibilities. Relationships with colleagues concerns the team atmosphere, including whether a respondent can rely on co-workers for help and social support. Relationships with supervisors describes the rapport between a participant and their superior. Lastly, information refers to the participant's access to feedback on his/her work performance from supervisors or co-workers. Lequeurre et al. (65) used four items to measure each dimension. The Cronbach's alpha was high, above 0.80 for each dimension. Each item was also rated according to a 7-point Likert scale with scores ranging from 1 ("never") to 7 ("always"). The higher the score per item, the higher the level of JD or JR was present. The Cronbach's alpha was 0.85 for all 24 items and were 0.83 and 0.93 for JD and JR in this study. Finally, we calculated JD and JR scores by averaging the item responses under each scale. Appendix 1 lists all scale items used in this study.

Analytical approach

Based on the JD-R Theory, we developed a conceptual model, as shown in Figure 1. The figure posits JD and JR directly and indirectly affect task performance because of their effects on burnout and work engagement. In addition, burnout and work engagement also have their own, separate direct effects on task performance.

We conducted analytical analyses using STATA software 16.0. Initially we sought to examine the participants'

TABLE 1 Descriptive statistics and correlations of key variables.

	Mean (SD)	1	2	3	4	5
1. Task performance (0–6)	4.0 (0.9)	–				
2. Work engagement (0–6)	3.5 (1.3)	0.58***	–			
3. Burnout (1–4)	2.5 (0.4)	−0.37***	−0.60***	–		
4. Job demands (1–7)	5.0 (0.8)	0.00	−0.19***	0.51***	–	
5. Job resources (1–7)	5.2 (0.7)	0.45***	0.45***	−0.30***	0.06	–

$N = 537$; *** $p < 0.001$.

demographics to determine if there were correlations amongst all the variables. Second, we generated a structural equation modeling (SEM) analysis, to understand the direct and indirect effects of JD-R (the independent variable) on task performance through the hypothesized mediators, burnout, and work engagement using a maximum likelihood method of estimation. We also conducted regression analyses with extensive covariates, including personal characteristics. The results from the regression analyses are similar to those reported here. Results of regression analyses are not provided within this study but can be provided upon request. The common method variance analysis was performed, and the results showed that only 27% of the variance shared by JD-R, work engagement, burnout, and task performance items, suggesting common method variance was not an issue in the data.

Results

Although the scales used in this study were all from published scales that show verified reliability and validity in literature, it is not clear the extent of the reliability and validity of these scales for Chinese social workers in this study. We conducted confirmatory factor analysis for all scales and the results were presented in Appendix 2. Overall, all scales show acceptable reliability, however, the factor loadings of certain

items in burnout and job demands, particularly in emotional workload and changes in tasks dimensions, were low. We removed items with factor loadings <0.50 (66, 67). As a results, burnout items reduced from 16 to 15, and job demand items reduced from 12 to 9. We used the new burnout and job demand scales to conduct the analysis. The results based on original scales, available upon requested, were not significantly different from the ones using new scales.

Table 1 presents the descriptive statistics and correlation of key variables. The sample had an average task performance score of 4.0, which ranged from 0.6 to 6.0. The average work engagement score was 3.5, which ranged from 0.0 to 6.0, while the average score for burnout was 2.5, from a range of 1.1–3.9. Overall, the sample reported moderate task performance with above means work engagement and burnout. The sample also reported an average 5.0 for JD, but answers ranged from 2.0 to 7.0. Additionally, the sample reported an average 5.2 for JR, but answers ranged from 2.2 to 7.0. These results suggest the participants experienced relatively high JD at work but simultaneously received high assistance at work.

The Pearson's correlation analysis results were largely compatible with our hypotheses. As displayed in Table 1, JD were positively correlated with burnout ($r = 0.51$, $p < 0.001$) and negatively correlated with work engagement ($r = -0.19$, $p < 0.001$). Concurrently, JR were negative corelated with burnout ($r = -0.30$, $p < 0.001$) and positively corelated with work engagement ($r = 0.45$, $p < 0.001$). JR were also positively correlated with task performance ($r = 0.45$, $p < 0.001$). Work engagement was also positively correlated with task performance ($r = 0.58$, $p < 0.001$), while burnout was negatively correlated with the task performance ($r = -0.37$, $p < 0.001$).

In Figure 2, we present the standardized coefficients of the SEM model. The results show JD had positive effects on burnout ($\beta = 0.53$, $p < 0.001$) and negative effects on work engagement ($\beta = -0.22$, $p < 0.001$). These findings confirm Hypothesis 1 and 2. Meanwhile, JR were positively associated with work engagement ($\beta = 0.47$, $p < 0.001$) and negatively associated with burnout ($\beta = -0.33$, $p < 0.001$). These findings support Hypothesis 3 and 4. Conflicted with Hypothesis 5, we found JD had a positive and direct effect on task performance, though the estimate was small ($\beta = 0.13$, $p < 0.01$). JR had a medium effect on task performance ($\beta = 0.21$, $p < 0.001$) which is consistent with Hypothesis 6. Finally, burnout ($\beta = -0.12$, $p < 0.05$) and work engagement ($\beta = 0.43$, $p < 0.001$) significantly affect task performance. These findings confirm Hypothesis 7 and 8.

Finally, JD had significant and indirect effects on task performance through its effects on burnout and work engagement ($\beta = -0.16$, $p < 0.001$). Likewise, the indirect effect of JR on task performance through burnout and work engagement was also significant ($\beta = 0.24$, $p < 0.001$). These findings support Hypothesis 9 and confirm that burnout and work engagement partially mediate the associations between JD-R and task performance.
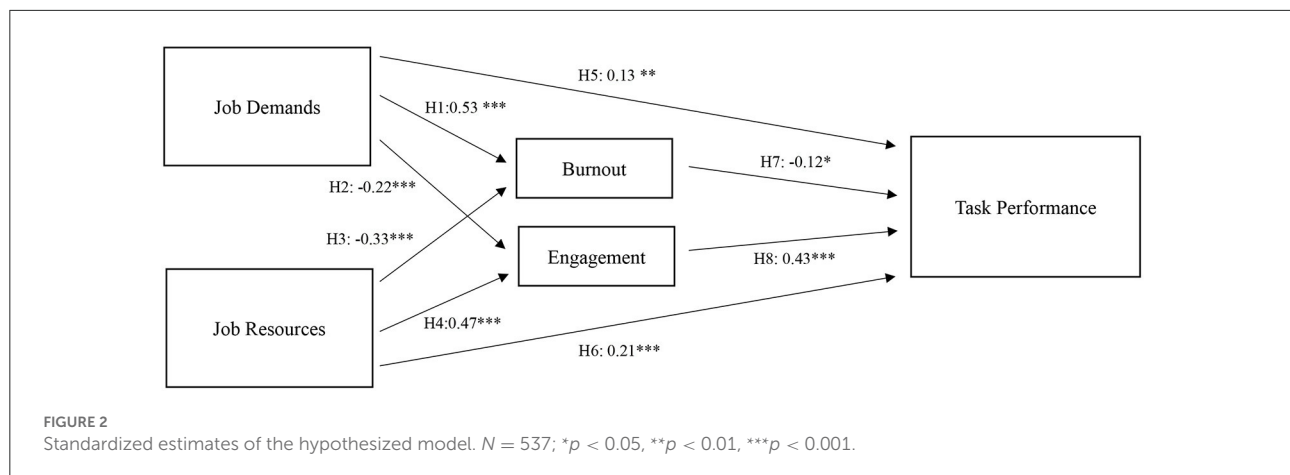
Discussion

The sampled social workers reported high JD and JR. As shown in previous research (38, 40), JD had a strong and positive effect on burnout but a medium and negative effect on work engagement. Both of these results ordinarily lead to low task performance. However, contradicted with the JD-R Theory, we also found high JD in social workers were directly associated with positive task performance, although the size of the estimate was small ($\beta = 0.13$). It may be that social workers are more likely to increase their job performance when facing high job demands because the demands are related to helping vulnerable populations, which make the work meaningful (68). In short, though high JD may cause social workers to achieve high task performance, its effects on burnout and work engagement actually lowered task performance. Accordingly, the sum effect of JD on task performance was small and insignificant, but it considerably increased burnout and lowered work engagement amongst Chinese social workers.

In contrast, JR had a medium and negative effect on burnout plus a strong and positive effect on work engagement. Both of its effects on burnout and work engagement led to high task performances. Additionally, JR also had a medium and positive effect on task performance directly, which means it both directly and indirectly effects task performance. The findings of the SEM analysis also revealed approximately half of the effects JD-R imposed on task performance, were intervened by burnout and work engagement. This finding indicates JD and JR could be used to design new interventions that improve task performance. Such interventions could seek to reduce burnout and improve work engagement of social workers (38).

Overall, the findings of this study offer policy, managerial practice, and research implications. First, the study illuminates the prevalence of high JD amongst Chinese social workers. Given high JD pose a significant risk of burnout, which has significant impacts on public health outcomes and health service delivery for their clients (5, 6, 16), Chinese social work agencies should initiate policies such as work-life balance policy to alleviate high workloads and provide support to make emotional workloads more manageable (69–71). These policies will not only reduce social worker burnout, but they also have the potential to increase public health outcomes and health service delivery of the clients.

Second, social work agencies could impose managerial practice such as heightened supervision to encourage safer, more positive work environments (72–74). Supervision provides social workers the opportunity to engage in reflection of the emotional challenges of their jobs with someone who can provide support and help problem solve. Moreover, reflection with a supervisor can act as a JR which helps reduce the physiological costs of high emotional workloads. Currently, even though supervision has been shown to have significant effects on job-related issues, it is not widely practiced, especially in smaller cities or rural areas (75, 76).

FIGURE 2
Standardized estimates of the hypothesized model. $N = 537$; $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Third, as the findings of the study demonstrate, JR have a strong effect on task performance. As such, social work agencies should consider implementing policies and managerial practices that promote collegial environments and also provide employees direct job performance feedback. Encouraging these types of positive work environments could help reduce burnout, increase engagement, and improve task performance amongst employees (35). Given social workers play a vital role in improving health care services and reducing inequities for their clients, promoting work environments of social workers would have profound effects for promoting health service delivery and public health outcomes for the vulnerable Chinese clients' social workers serve (5, 6, 16).

Fourth, given the negative effects burnout can impose on employees' mental and physical health, Chinese social work agencies should consider providing burnout-reduction services and public health interventions. For example, empirical studies have shown mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), and mindfulness-based interventions (MBI) all can successfully decrease burnout, while improving mental health and wellbeing (77–79). Alternatively, emotional intelligence training has been shown to reduce job burnout (80–82). Essentially emotional intelligence training encourages individuals to understand, perceive, and utilize emotions to increase relationships and positive thinking (80, 82). Moreover, Cao et al.'s (82) recent study found individuals with higher emotional intelligence, tend to have lower rates of burnout because of their ability to better regulate inner emotions. Social work agencies in China should also consider adopting emotional intelligence training for their workers to improve emotional intelligence amongst employees to not only reduce burnout, but also improve their service delivery (81, 82). Thus, agencies should consider implementing these types of programs to reduce the extent of burnout and to improve wellbeing of their workers.

Fifth, given JD were positively associated with job performance amongst social workers in China, future studies

may want to examine how the effects of JD on job performance are varied by type of employment: public, private and non-profit. It may be that social workers at non-profit organizations are more likely to increase their job performance when job demands are high than other workers due to the nature and meaningfulness of their work (68, 83–85).

Sixth, with respect to research implications, given the main tasks of social workers are centered around public health and resolving social inequities, further research should examine how the effects of social worker job burnout and work engagement effect public health service delivery and outcomes of their clients (5, 16). Understanding the mechanisms between job burnout, work engagement, task performance, and public health outcomes is crucial for an ethical and successful social work practice to adequately serve vulnerable populations in need of services and support. This knowledge has profound implications for promoting public health service delivery and outcomes.

Finally, uneven social work development across China can also hinder various agencies, especially smaller ones, from properly employing JD reduction or JR improvement practices (1, 3). Resource constraints severely limit the degree to which these agencies can improve the work conditions of their employees. Increasing governmental policies that provide supportive funds for small or rural social work agencies may have the potential to improve the labor force amongst social worker and to promote health service delivery and public health outcomes for various vulnerable clients (5, 6, 16).

In addition, this study has theoretical implications. This study further extends the theoretical development and application of JD-R model in Chinese social workers. The study enhances the knowledge of JR as a vital intercultural construct by providing support for the relationships between JR, work engagement, and task performance in Chinese social workers. However, the validity tests in Appendix 2 suggest certain items in burnout and job demands, particularly in emotional workload and changes in tasks dimensions, may not fit Chinese social workers well. The relative average variance extracted

(AVE) for these scales was between 0.40 and 0.42, suggesting low convergence validity and discriminatory validity (square root of AVE lower than inter-construct correlation) of the scales. It is important to design scales capture underline constructs while have empirically convergence and discriminatory validity (66). Future studies are warranted to develop burnout and job demands scales that better fit Chinese social workers theoretically and empirically.

Our study also had several limitations. First, our analyses were based on a cross-sectional dataset, thus the results do not consider causal relationships amongst JD-R, burnout, work engagement, and task performance. Future research may utilize longitudinal data to properly account for temporality and to test for bidirectionality. Moreover, our dataset was compiled using the participants' self-reports. Self-reporting can riddle the data with intentional and unintentional reporting errors because the participants may have underreported JD or overreported JR within their work experiences. Future studies should consider using data triangulation to overcome this type of bias.

In addition to JD and JR, there are also many factors that affect job burnout such as personal demographics, psychological characteristics, and even environmental factors such as social media and social support (86–90) that can affect participants' answers. Our study did not test for any of these variables, so this absence may have affected the reported estimates. Additionally, our data was collected from social workers concentrated solely in Guangzhou, China. Thus, these findings may not be generalizable to all social workers throughout China. A future study could expand upon our findings by exploring whether employment in rural or urban regions of China affect the mediational pathway between JD-R, burnout, work engagement, and task performance.

Conclusion

This study analyzed data collected from 537 social workers in Guangzhou, China, to examine how JD-R affects task performance, and whether a relationship existed between burnout and work engagement amongst Chinese social workers. The study's results support previous cross-cultural research, which have shown JD-R significantly influences burnout and work engagement and that JD-R affects task performance through burnout and work engagement. Given the strong effects of JD on burnout, this study calls for public health interventions on JD of social workers in China from both government and social work agencies. Burnout out is a serious problem that not only affects the work performance of social workers but also on the health and overall wellbeing of social workers. Implementing measures to reduce JD will reduce burnout which in turn can even reduce the morbidity rates of social workers (24). Moreover, these recommended healthcare interventions will not only affect the social work labor force for the better, but they will also promote heath service delivery and public health outcomes for the vulnerable populations social workers serve.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Review Committee, School of Public Administration Guangdong University of Foreign Studies. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

BT, XL, SS, and CH: conceptualization, validation, formal analysis, and writing—original draft preparation. BT and CH: methodology and software, resources, and investigation and data curation. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh. 2022.908921/full#supplementary-material

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