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Alleviating Health Impairment Impact of Job Demands – Leader-Member Exchange as a Moderator in Job-Demands Resources Model: Evidence from Chinese Public Hospitals

MA Xiaofeng

Doctor of Management

Supervisor:
PhD MA Shaozhuang, Associate Professor with Habilitation,
ISCTE University Institute of Lisbon

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Abstract

In the context of Chinese public hospitals, doctors generally have to face high job demands in medical practice. Based on the Job Demands-Resources Model and the Conservation of Resources Theory, this study explored the relationship between job demands and burnout of doctors in Chinese public hospitals through the doctor-patient relationship and work engagement, as well as the moderation effect of leader-member exchange therein.

Using a cross-sectional design, this research conducted a survey of 708 doctors from 18 public hospitals of different levels and categories in 14 regions of Jiangsu Province, China. For data analysis, we used Process Macro to test the research hypothesis model.

The results showed that: (1) Job demands had an energy depletion effect on doctors; they were negatively associated with the doctor-patient relationship and work engagement but positively related to burnout; moreover, they were positively associated with burnout through the doctor-patient relationship and work engagement sequentially. (2) As a challenge job demand, the doctor-patient relationship was positively associated with work engagement but negatively related to burnout; it also mediated the relationship between job demands and work engagement, as well as the relationship between job demands and burnout. (3) Leader-member exchange mitigated the detrimental impacts of job demands on the doctor-patient relationship and produced a moderated mediation effect in the path between job demands and burnout.

Based on these findings, implications and strategies were discussed for health policy-makers, public hospital managers, and doctors in public hospitals.

Keywords: Doctors in Chinese public hospitals, doctor-patient relationship, work engagement, burnout, leader-member exchange, Job Demands-Resources Model

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Resumo

No contexto dos hospitais públicos chineses, os médicos enfrentam geralmente exigências laborais elevadas na prática médica. Com base no Modelo Exigências-Recursos Laborais e na Teoria da Conservação de Recursos, este estudo explorou a relação entre as exigências laborais e o esgotamento dos médicos em hospitais públicos chineses, considerando o papel mediador da relação médico-doente e do compromisso com o trabalho, bem como o efeito moderador da troca líder-membro.

Com um desenho transversal, esta investigação realizou um inquérito a 708 médicos de 18 hospitais públicos de diferentes níveis e categorias, localizados em 14 regiões da Província de Jiangsu, China. Para a análise dos dados, foi utilizado o Process Macro para testar o modelo de hipóteses da investigação.

Os resultados revelaram que: (1) As exigências laborais tiveram um efeito de exaustão energética nos médicos; estavam negativamente associadas à relação médico-doente e ao compromisso com o trabalho, mas positivamente relacionadas com o esgotamento dos médicos; além disso, a sua relação positiva com o esgotamento era mediada pela relação médico-doente e pelo compromisso com o trabalho, de forma sequencial. (2) A relação médico-doente, enquanto exigência laboral desafiante, estava positivamente associada ao compromisso com o trabalho, mas negativamente ao esgotamento dos médicos; também mediou a relação entre as exigências laborais e o compromisso com o trabalho, bem como a relação entre as exigências laborais e o esgotamento dos médicos. (3) A troca líder-membro atenuou o impacto negativo das exigências laborais sobre a relação médico-doente e produziu um efeito de mediação moderada no caminho entre as exigências laborais e o esgotamento.

Com base nestes resultados, são discutidas implicações e estratégias para os decisores de políticas de saúde, gestores de hospitais públicos e os médicos nesses hospitais.

Palavras-chave: Médicos em hospitais públicos chineses, relação médico-doente, compromisso com o trabalho, esgotamento, troca líder-membro, Modelo Exigências-Recursos Laborais

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摘　要

在中国公立医院医疗情境下，医生群体在医疗实践中普遍需要面对高强度的工作需求。本研究基于工作需求-资源模型和资源保存理论，探讨中国公立医院医生的工作需求通过医患关系和工作投入与职业倦怠之间的路径关系以及领导部属关系在这一路径中的调节作用。

本研究以中国江苏省14个区域共18家不同级别与类别公立医院的708名医生为样本进行了横断面调查，使用Process宏对研究假设模型进行验证分析。

研究结果表明：（1）工作需求对医生工作存在能量损耗效应，与医患关系和工作投入负相关而与职业倦怠正相关，并先后通过医患关系和工作投入与职业倦怠正相关；（2）医患关系作为挑战性工作需求，与工作投入正相关而与职业倦怠负相关，并在工作需求与工作投入之间、工作需求与职业倦怠之间起中介作用；（3）领导部属关系缓解了工作需求对医患关系的消极影响并在工作需求与职业倦怠的路径关系中形成了有调节的中介效应。

基于这些发现，论文讨论了研究启示并从医疗卫生的政策制定者、公立医院管理者、公立医院医生视角提出了具有针对性的策略。

关键词：中国公立医院医生；医患关系；工作投入；职业倦怠；领导部属关系；工作需求-资源模型

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在我接近完成这篇论文时，我想对我的导师马绍壮教授表达最诚挚的感谢。作为一名公立医院的管理者，工作实践在助力本人学术研究的同时也带来了较大的工作负荷，尤其是本研究周期经历了严重的新冠肺炎疫情，个人在学习与工作过程中承担了较大的身心压力。如果不是马教授在这个过程中始终给予我坚定的鼓励与耐心的指导，我可能无法达到今天的成绩。这其中最让我印象深刻的是马教授对学术标准的严谨与坚持，让我在脚踏实地的努力中收获了超越研究项目本身的学术素养，对我来说这将是受益终身的财富。

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List of Abbreviations

COR = Conservation of resources

DPR = Doctor-patient relationship

BO = Burnout

JD = Job demands

JDI = Job Demand Indices

JD-R = Job demands-resources

LMX = Leader-member exchange

MBI = Maslach Burnout Inventory

UWES = Utrecht Work Engagement Scale

WE = Work engagement

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Chapter 1: Introduction

This chapter first introduces the practical background of China's healthcare system and the impact of the three-year COVID-19 on healthcare services, as well as the theoretical background focusing on job demands-resources and burnout. Following that, the research objectives and problems are put forward. Finally, the structure of this thesis is introduced.

1.1 Research background

With the Chinese government vigorously advancing healthcare reform, China's healthcare system has witnessed remarkable development and progress in recent years. Public hospitals of all categories at all levels hold a dominant position in the current healthcare system of China, playing a leading role in the entire system, and assuming significant social security functions (R. Li, 2024).

The *Opinions of the General Office of the State Council on Promoting the High-quality Development of Public Hospitals* explicitly emphasized the dominant position of public hospitals in the healthcare system and put forward specific measures to promote the high-quality development of public hospitals (General Office of the State Council of China (GOSCC), 2021). The General Office of the State Council issued the *Notice on the Key Tasks of Deepening the Reform of the Healthcare System in 2022*, clearly pointing out that in the process of healthcare system reform, it is necessary to promote the comprehensive reform and high-quality development of public hospitals, especially giving play to the demonstration and leading role of high-level public hospitals therein (GOSCC, 2022). At present, Chinese public hospitals are showing a notable upward trend in terms of number and scale, structure and level, and reform and development, striving to meet people's growing healthcare needs in the background of economic and social development and the aging population. According to the *Statistical Bulletin of China's Health Development in 2022* (B. Fang, 2023), as of the end of 2022, there were a total of 1,032,918 medical institutions (i.e., hospitals, primary healthcare institutions, and specialized public health institutions) in China, including 36,976 hospitals (11,746 were public hospitals). In terms of the structure and level of hospitals, there were 3523 tertiary hospitals (including 1716 Grade A tertiary hospitals), 11,145 secondary hospitals, 12815 primary hospitals, and 9493 non-graded hospitals. There was a total of 7.663 million hospital

beds, among which, 5.364 million were in public hospitals, accounting for 70% of the total. There were a total of 11.658 million health care workers (i.e., licensed doctors, registered nurses, pharmacists, technicians, health supervisors, and other healthcare personnel). Among them, 4.435 million were licensed doctors (including assistant doctors), and on average, there were 3.15 licensed (assistant) doctors per 1000 people. The annual total number of patients diagnosed and treated in hospitals nationwide was 3.82 billion, with a decrease of 60 million over the previous year due to COVID-19.

In addition, reviewing the evolution of China's healthcare system reform over the years, which is closely related to people's livelihood, we can see that it has gone through the initial stage of "overall contracting" and the stage of "excessive marketization", which triggered some social disputes during the "old healthcare reform" following China's reform and opening-up; in the current "new healthcare reform", there may be a certain degree of "excessive publicization" (Y. Zhou, 2015). Through either the healthcare system reform or the continuous improvement of the hospital management system, the ultimate goal is to enhance hospitals' healthcare service ability and improve the satisfaction of health care workers and patients. In the medical practice toward these goals, whether health care workers have a healthy psychological state and maintain professional stability is an important premise and guarantee for public hospitals providing high-quality healthcare services to patients and achieving sustainable development. However, at present, doctors in public hospitals are faced with some realistic challenges, such as high job demands and workload, as well as tense doctor-patient relationships resulting from insufficient trust. If doctors stay in such a work environment over a long period of time, they will face a high risk of burnout (X. Zhang, 2023).

Since 2020, the three-year COVID-19 has swept the world, having a long-term impact on all walks of life, among which the healthcare system suffered the most direct impact. During the fight against COVID-19, public hospitals of all categories at all levels in China undertook the most urgent, challenging, and important tasks. It shows that a national healthcare system with public hospitals as the main actor is currently the most cost-efficient healthcare system that ensures public welfare and optimizes the doctor-patient relationship while controlling medical expenses (L. Li, 2021). However, since the outbreak of COVID-19, due to the high job demands brought about by normalized COVID-19 prevention and control measures, health care workers have experienced notable work stress, resulting in different degrees of anxiety, depression, panic, and other adverse emotional problems (Dong et al., 2023). They continue to face challenges such as heavy workload, normalized overtime work, insufficient sleep, and the continuous adjustment and change of COVID-19 prevention and control policies and measures.

The long-term demand for COVID-19 prevention and control while ensuring regular healthcare services has led to burnout among health care workers (L. Liu, 2023).

1.1.1 Practical problem

In China, at present, healthcare resources are unevenly distributed, and problems such as high demands for health care workers, heavy workload, and overcrowding in large hospitals are still prominent (Y. Zhu et al., 2015). At the national policy level, in 2020, the National Health Commission, the Ministry of Human Resources and Social Security, and the Ministry of Finance of China jointly issued *Several Measures on Improving the Working Conditions of Front-line Medical Personnel and Caring About Their Physical and Mental Health* (C. Xu, 2020). This official document pointed out that with the ongoing COVID-19, health care workers were generally faced with critical practical problems such as high psychological pressure and heavy workload in medical services, and that all relevant authorities and medical institutions should ensure health care workers' mental health and protect their legitimate rights and interests (C. Xu, 2020). In China's public hospitals of all categories at all levels, doctors are the main force in medical services and are facing the realistic problem of unprecedented excessive workload (X. Zhang, 2023), which, in turn, has brought higher job demands and work stress to them (L. Li, 2021). It is of great practical value and urgency to carry out research on burnout of doctors, a highly important group for public hospitals and even the healthcare system.

With the continuous advancement of healthcare system reform, doctors in China's public hospitals are generally facing high job demands such as high workload and high risk (Qin et al., 2015). According to the statistics in the *Statistical Bulletin of China's Health Development in 2022*, doctors in China's medical institutions, especially public hospitals, have long been experiencing high job demands and workloads (B. Fang, 2023). Dong et al. (2023) pointed out that currently, there are high job demands in public hospitals, bringing significant work stress to the health care workers, resulting in anxiety, depression, panic, and other adverse emotional problems. S. Tao and Shen (2024) pointed out that at present, the problems of unbalanced allocation of medical resources, excessive pursuit of economic benefits, low input-output benefits, and low work enthusiasm are still prominent in public hospitals. The Fourth National Health Service Survey in 2008 was an extensive survey on the working status of health care workers in China. The survey results showed that only 25.7% of the respondents agreed with "If you were provided the chance to choose your career again, you would still choose medicine". The Fourth Survey on the Status of Doctors' Practice in China, conducted by the Chinese Medical Doctor Association in 2011, revealed that only 6.83% of doctors clearly expressed their

wish for "their children to study medicine", which shows that Chinese doctors' professional identification is not optimistic (Qin et al., 2015). As mentioned above, high job demands can cause significant physical or psychological costs, resulting in corresponding physical or psychological impair, such as fatigue and irritability, thereby leading to burnout (Du, 2020). Of course, the practice of doctors in public hospitals is no exception.

Research has shown that doctors in China's public hospitals are continuously confronted with high job demands in their medical practice. As they undertake a large number of diagnoses, treatments, and surgical operations, doctors are continuously in a high-intensity and high-pressure state, which can easily cause physical and mental fatigue and eventually affect the quality of medical treatment (J. Li et al., 2023; Niu, 2020). The shortage of medical resources resulted in an unmet demand for medical services and increased medical disputes, making doctors in public hospitals often have to face tense doctor-patient relationships (He, 2021). That not only brings work pressure to doctors but also affects the medical experience of patients. At the same time, the salary of doctors in public hospitals is relatively low, which is out of proportion to doctors' professional skills and efforts, which may lead to doctors' violating behaviors under economic temptations, such as accepting kickbacks and conducting excessive medical examinations and treatment (Niu, 2020). In addition, besides the high job demands, in terms of job resources, doctors in public hospitals lack career promotion channels and academic exchange opportunities, which may lead to un-updated professional skills, limited opportunities for career development, and increased risk of doctors' burnout (L. Huang, 2023).

The interactions between doctors and patients in medical services form a specific interpersonal relationship with both sides as the main actors, which is the so-called doctor-patient relationship (Q. Li & Li, 2021). Research has shown that this specific interpersonal relationship can have a direct impact on doctors' job performance and can also indirectly affect doctors' job performance through other variables (X. Zhang et al., 2020). In 2018, the Chinese Medical Doctor Association released the *White Paper on the Practice of Doctors in China*, and the statistics showed that only 34% of doctors had never encountered violence from patients or their families at work, while 62% of doctors considered their hospitals' work environment poor, had experienced doctor-patient conflicts of varying degrees, and perceived low job satisfaction (J. Wu, 2018). From the perspective of the Job Demands-Resources (JD-R) model, the job demand of excessive workload may negatively affect the doctor-patient relationship and lead to violence toward health care workers. For doctors in public hospitals, on the one hand, they need to meet the demands of heavy workload and high stress, which require physical or psychological efforts; on the other hand, they need to build a harmonious doctor-patient

relationship through better communication and interactions. The health impairs caused by such job demands may increase the risk of doctors' burnout (X. Zhang, 2023).

Research has shown that Chinese health care workers are facing excessive workloads, and the incidence of burnout among them is generally higher than that of their counterparts in European and American countries. Relevant statistics show that 75.7% of Chinese doctors may suffer mild or higher burnout, and therefore, it is extremely urgent to pay attention to the job characteristics and the related problems of this population (H. Wang & Zhang, 2008a). In 2008, the Statistical Information Center of the Ministry of Health of China released a survey report, showing that the overall incidence of burnout among Chinese health care workers reached 52.4%, calling for more attention to this problem; moreover, among these health care workers, 3.1% met the criteria of severe burnout (X. Sun, 2009). Through a survey on burnout among 933 health care workers in public hospitals, D. Li et al. (2010) found that nearly 50% of doctors showed varying degrees of turnover intention. At the same time, burnout of varying degrees has been found among Chinese doctors in hospitals of different categories, at different levels, in different regions, and in different specialties. F. Wang and Xu et al. (2013) found that the overall level of burnout of doctors in the central and western regions of China was significantly lower than that in the eastern regions, doctors' burnout in rural areas was significantly lower than that in urban areas, and the burnout level in primary medical institutions was significantly lower than that in large general hospitals. Cui et al. (2013) pointed out that over 80% of doctors exhibited at least one dimension of burnout, and the level of burnout of doctors in secondary hospitals was lower than that in tertiary hospitals. Regarding burnout differences, several Chinese scholars have reached similar conclusions through systematic surveys and research (Gan et al., 2020). Taking a hospital in Nanjing as the sample, L. Zhou (2014) found that 42.07% of doctors showed mild burnout, 27.41% showed moderate burnout, and 5.33% showed severe burnout, which should be paid special attention to. S. Tao et al. (2020) found that 53.6% of doctors had the intention to leave the clinical front line or leave their current jobs. H. Dai et al. (2020) found that in a general hospital, as the sample, the overall incidence rate of perceived burnout among health care workers reached 46.6%. It can be seen that doctors' burnout has become an important topic for research on China's public hospital operation and management.

Since 2020, COVID-19 has swept the world, long affecting all walks of life, among which, the healthcare system and the health care workers experienced the most direct impact. During this period, COVID-19 strains continued to mutate, and new strains continued to emerge. According to the statistics of Hopkins University in the United States, by January 2023, the number of COVID-19 infections in the world had reached 660 million, including 6.7 million

deaths (L. Liu, 2023). During the fight against COVID-19 in China, public hospitals undertook the most urgent, challenging, and significant task, which shows that the national healthcare system with public hospitals as the main actors is a healthcare system that ensures public welfare while exhibiting cost-efficiency, which is conducive to controlling medical expenses and optimizing the doctor-patient relationship (L. Li, 2021). However, in the face of high job demands brought about by the normalized COVID-19 control, health care workers have experienced significant work stress, resulting in anxiety, depression, panic, and other adverse emotional problems (Dong et al., 2023). In addition, health care workers have been faced with challenges such as heavy workloads, normalized overtime work, insufficient sleep, and constantly changing policies for COVID-19 prevention and control. The continuous pressure brought by COVID-19 prevention and control further increased the risk of burnout among health care workers (L. Liu, 2023).

Therefore, under the background of China's healthcare undertakings, especially the development of the public healthcare system, the global outbreak of COVID-19, and the healthcare system's three-year fight against COVID-19, it is of great time relevance, theoretical significance, and practical value to carry out empirical research on burnout of doctors in public hospitals in the Chinese context based on the JD-R model.

1.1.2 Theoretical background

In view of the job demands and burnout risk faced by health care workers, both Chinese and international scholars have applied the JD-R model proposed by Demerouti et al. (2001) to explore the relevant influence paths between the two. According to the JD-R model, the work environment faced by employees in the organization can be basically classified into two types: job demands and job resources. Specifically, individuals face role conflict, work intensity, and physical load at work, which are job demands; at the same time, individuals also face team spirit, a sense of ownership, job security, job satisfaction, and a degree of respect from patients at work, which are job resources. Demerouti et al. (2001) pointed out that the imbalance or mismatch between job demands and job resources is the main reason for employees' psychological stress and even burnout. Therefore, to make employees more engaged in their current work, it may be necessary to appropriately reduce or optimize the job demands they face and simultaneously increase the corresponding job resources to achieve balance and match between job demands and resources.

In addition, there are two influence paths corresponding to job demands and job resources, namely, the energy depletion (or health impairment) process and the motivational process,

respectively (Pan, 2016). In terms of job demands, employees need to make continuous efforts physically or psychologically to acquire relevant skills to meet job demands, which may bring additional physical or psychological costs to them. When employees cannot address high job demands, these demands may turn into stress (Meijman & Mulder, 1998). For employees, job resources refer to the physical, psychological, social, and organizational resources at work, including internal and external resources. These resources can help them achieve their work goals in the organization and reduce the physical or psychological burden caused by job demands. Usually, employees are motivated by job resources, which can further improve their work engagement and thus have a positive impact on work results (Bakker, Demerouti, & Boer et al., 2003). Hakanen et al. (2006) and Alarcon et al. (2009) verified the applicability of the JD-R model in the context of different occupations and cultural backgrounds. It has been found that, regardless of the occupation and cultural background, job demands and resources are important factors affecting employees' physical and mental health and job performance. Therefore, continuous high job demands may result in the depletion of employees' physical and mental resources, whereas the continuous lack of job resources may lead to employees' inability to effectively complete the work. These two directly lead to the depletion process, which further leads to a continuous decline in employees' work motivation and may even cause burnout or turnover intention (Bakker et al., 2004; Hakanen et al., 2006; Xanthopoulou et al., 2007).

The JD-R model is a theoretical model that can be applied to explore the impact of job characteristics on outcome variables such as burnout and work engagement. According to this model, for any occupation, employees have access to a variety of resources to meet the demands of the job. These resources can effectively help employees to complete and improve their work, enhance work efficiency, and develop professional skills, thus further increasing their work engagement (Demerouti et al., 2001). Y. Dai et al. (2018) analyzed the factors influencing nurses' work engagement based on the JD-R model and categorized them into personal resources, organizational resources, and job demands. Galanakis and Tsitouri (2022) suggested that increasing external resources is an effective way to relieve employees' work stress and improve their work engagement. In public hospitals, the most common external job resource is organizational support: when health care workers have to face challenges such as doctor-patient conflicts in their work, organizational support can help them effectively deal with the negative effects. Research on doctors' burnout and related factors in public hospitals can draw on this theoretical perspective.

The particularity of medicine determines that medical services are characterized by high risk, high workload, and high demands. As the main force of medical services and front-line

workers in hospitals, clinicians generally face practical problems such as high job demands, heavy workload, and high stress. Doctors are likely to encounter conflicts between their roles at work and in family (Wei, 2012). Such role conflict can reduce doctors' job satisfaction, result in burnout, and hinder their work engagement (D. Huang et al., 2009). Research has shown that at present, doctors in public hospitals have a certain degree of role conflict due to the unmatched personal time, energy, and resources (L. Wang, 2017). In 2019, the Medscape website conducted a survey on burnout among more than 15000 doctors from different countries, and the results showed that burnout greatly affected the physical and mental health of individuals, reduced their work efficiency, and increased their absenteeism and turnover rate (Ahola et al., 2008). H. Wang and Zhang (2008) suggested that compared with Europe and the United States, the incidence of burnout among health care workers in China is significantly higher, mainly due to the chronically overloaded working state.

In summary, the JD-R model has been widely used in research on the relationships and the related influence paths between job demands, job resources, and burnout of employees in the organization (Yin et al., 2015). Under the background of the current healthcare system reform in China, the reform of public hospitals' operation and management mechanisms, and the long-term impact of COVID-19, it is of great time relevance and practical significance to study the job characteristics of doctors in public hospitals and the relevant influence paths that may lead to doctors' burnout based on the JD-R model. Exploring the working status and influencing factors of doctors' medical practice in public hospitals can help to build harmonious doctor-patient relationships, improve the quality, safety, and efficiency of medical services, and enhance doctors' work engagement and professional loyalty.

Moreover, in previous research on healthcare, the research samples mainly targeted the whole population of health care workers or nursing staff. In recent years, more and more Chinese and international scholars have been applying the JD-R model to carry out research on the job characteristics of health care workers or doctors of a particular specialty. However, few studies have been dedicated to examining the relationship between job demands, job resources, and burnout of doctors in public hospitals (S. Wang et al., 2017). In particular, there is still a research gap in using this theory to carry out empirical research on doctors in various positions in Chinese public hospitals of all categories at all levels across different regions. Specifically, Chinese public hospitals may differ in terms of development level, management capacity, and medical service ability due to different levels of economic and social development and different health literacy levels of residents across regions, which will influence the job characteristics of doctors. Moreover, different job positions may also lead to doctors' different job characteristics.

In medical practice, these doctors may exhibit some common characteristics associated with China's medical and health system, the context, service mode, and operation mechanism of public hospitals, and the human resource management mechanism of doctors. For doctors in various positions in public hospitals, the theory remains unclear regarding the role of the doctor-patient relationship in the influence paths between job demands and burnout, whether the doctor-patient relationship mediates job demands and work engagement, what is the influence path between work engagement and burnout, whether there are other influencing factors in the Chinese context, such as the leader-member exchange (LMX) as a moderator in the above-mentioned relationships, and whether sociodemographic characteristics play a role therein. Therefore, it is necessary to fill the research gaps through this study on the burnout of doctors in public hospitals so as to further enrich the research based on the JD-R model.

In addition, when the JD-R model is applied to research on the job demands and burnout of doctors in public hospitals, other factors should also be taken into account, such as the particularity of job demands in this field, the limitation of job resources, the context of Chinese healthcare, the necessity of cross-regional analysis, LMX, and organizational support, as well as the evaluation of the long-term effects. In particular, the LMX theory has been rarely applied to systematic research on the influence path of doctors' burnout in public hospitals. In order to improve the applicability and explanatory power of the JD-R model, it is necessary to further develop and improve the model and consider combining it with other theories and research methods to ensure that the research findings are applicable to a wider range of contexts.

1.2 Research objectives

The purpose of this study is to explore the relationship between the job demands of doctors in public hospitals, the doctor-patient relationship, work engagement, and burnout, as well as the moderation effect of LMX between job demands and the doctor-patient relationship. This study will extend the JD-R model's application to research on the job characteristics of doctors in public hospitals and provide valuable policy suggestions for optimizing job demand management, improving the doctor-patient relationship, enhancing work engagement, and reducing burnout in public hospitals.

1.2.1 Theoretical significance

This study's theoretical significance is mainly manifested in the following aspects:

First, it contributes to the development and application of theoretical frameworks such as

the JD-R model. Previous Chinese and international researchers have provided significant theoretical references for the study of the paths and relationships between job demands and burnout of health care workers based on the JD-R model. By improving and developing these theoretical frameworks, this study can further explore the job characteristics of doctors in public hospitals, enriching the research of the JD-R model.

Secondly, it further enriches the theoretical research on burnout of health care workers in public hospitals. Previous Chinese and international studies on the burnout of health care workers mainly focused on health care workers as a whole or nursing staff in a particular hospital. The research on doctors mainly targeted those in a particular category, such as stomatologists and emergency doctors, and there is a lack of systematic research on doctors across regions, across positions, and across professional categories. This study, which is on the burnout of doctors in public hospitals of all categories at all levels in different cities, helps to fill this research gap, enriching the theoretical research on burnout.

In addition, it enriches the research on the influencing factors of doctors' burnout in public hospitals in the Chinese context. In addition to job demands, the doctor-patient relationship, and other factors that Chinese and international scholars have explored in previous research, this study also considers LMX, which is a hot research topic in management and psychology research in the West but has received limited attention in empirical research in the medical field in China. Based on the Chinese context, this study attempts to explore the paths and relationships between job demands, the doctor-patient relationship, work engagement, and burnout, as well as the moderation effect of LMX, which will help to fill the relevant research gap.

1.2.2 Practical significance

This study aims to improve the current theories and guide public hospitals to improve the quality of medical services, build a harmonious doctor-patient relationship, and improve the doctors' professional loyalty and patient satisfaction by optimizing medical work allocation and doctors' human resource management. Its practical significance is mainly reflected in the following aspects:

First, it can guide public hospitals to better manage doctors' job demands and actively improve the doctor-patient relationship. By studying the influence paths of doctors' job demands, work engagement, the doctor-patient relationship, and burnout in public hospitals, we can have a deeper understanding of doctors' work status and psychological needs, so as to guide

hospitals to provide doctors with a better work environment, welfare and benefits, and career development opportunities. That will help to improve doctors' job satisfaction and professional loyalty, so as to improve the quality of medical services. At the same time, targeted measures are put forward from aspects such as job demands and LMX to improve the quality of communication and interaction between doctors and patients, establish a more harmonious doctor-patient relationship, reduce medical disputes and accidents, and improve patient satisfaction.

Secondly, it serves as a reference for public hospital managers to strengthen LMX, improve the doctor-patient relationship, enhance doctors' work engagement, and reduce burnout. By studying the moderation effect of LMX on the relationship between job demands and the doctor-patient relationship, as well as its impact on doctors' work engagement and burnout, we can suggest more targeted management strategies and working modes for hospital managers. From the perspective of resource replenishment, in the context of medical practice in public hospitals, this study serves as a reference for hospitals to improve their overall operation efficiency and management by enhancing LMX, improving doctors' work environment and incentive mechanism, and optimizing the work process and management system for doctors. At the same time, hospitals should provide more targeted guidance and support for doctors' career development and establish a comprehensive incentive mechanism and promotion channels, so as to improve their job satisfaction and professional accomplishment and reduce the risk of burnout.

In addition, this study can guide relevant government authorities and policy-makers to improve the scientificity and precision of healthcare policy-making. By studying the paths and relationships between doctors' job demands, the doctor-patient relationship, work engagement, and burnout in public hospitals, as well as the moderation effect of LMX on the relationship between job demands and the doctor-patient relationship in the context of medical services in public hospitals, we can provide a scientific basis for policy-makers to evaluate doctors' work status in public hospitals and the reform of public hospital operation. Competent government authorities can formulate relevant policies, increase the financial investment and resource guarantee for public hospitals, improve doctors' work environment and welfare, and enhance doctors' and patients' satisfaction, so as to reduce the risk of burnout among doctors and provide policy support for the sustainable development of public hospitals and healthcare undertakings.

1.3 Research questions

Based on the above discussion, our research questions (RQ) on doctors' burnout in public hospitals in China are as follows:

RQ1: What are the characteristics and current status of doctors' job demands, the doctor-patient relationship, work engagement, burnout, and LMX?

RQ2: What are the relationships between job demands, the doctor-patient relationship, work engagement, and burnout of doctors in public hospitals?

RQ3: Does LMX moderate the relationship between job demands and the doctor-patient relationship?

1.4 Thesis structure

This thesis consists of six chapters, including the introduction. The overview is as follows:

Chapter 1: Introduction

This chapter introduces the research background, research problems, research objectives, and research problems.

Chapter 2: Literature review

This chapter systematically reviews the relevant theories, studies, and measurement methods for job demands, the doctor-patient relationship, work engagement, burnout, and LMX. In particular, the JD-R model and the Conservation of Resources (COR) Theory are described in detail as the theoretical foundation for this study. The research hypotheses are put forward, and based on the relationships between the variables, the corresponding research model is established.

Chapter 3: Research methods

This chapter introduces the methods of questionnaire design, data collection, and statistical analysis in detail. The collected sample data were systematically analyzed. Exploratory and confirmatory factor analyses were performed on the data to test the reliability and validity of the questionnaire. Two independent samples t-tests and one-way analysis of variance (ANOVA) were carried out to find out the differences in the mean values of variables across different sociodemographic groups, and Process Macro was used to test the moderated mediation effect.

Chapter 4: Results

This chapter reports the results of descriptive analysis of the data, the results of correlation analysis and one-way ANOVA, and the results of hypothesis testing by using Process Macro on the theoretical model.

Chapter 5: Discussion and conclusions

This chapter analyzes and discusses the results of our empirical research in comparison with the findings of previous studies and conducts a systematic summary accordingly. In addition, this study's theoretical contributions and implications for management practice are presented. Finally, the limitations of this study are pointed out, based on which, future research directions are prospected.

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Chapter 2: Literature Review

This chapter describes the related literature and basic propositions of the Job Demands-Resources (JD-R) model and the Conservation of Resources (COR) Theory. It reviews the basic concepts, related theoretical research, and measurement methods of job demands, doctor-patient relationship, work engagement, burnout, and leader-member exchange (LMX), based on which the research hypotheses and research models are put forward.

2.1 Job Demands-Resources (JD-R) model and Conservation of Resources (COR) Theory

2.1.1 JD-R model and its core propositions

The Job Demands-Resources model (the JD-R model) was formally proposed by Demerouti et al. (2001). As an important theoretical framework in the field of organizational behavior and occupational health psychology, the JD-R model focuses on how job characteristics and work environments affect employees' physical and mental health and job performance. The JD-R theory is a kind of job design theory in nature. It theoretically explains how the relevant physical and social aspects of the work environment, including job demands and resources, affect employees' job performance. At the same time, it describes how employees affect job demands and resources through active or passive behavior at work to protect their own interests in the work process, so as to affect work outcomes (Bakker & Demerouti, 2017).

The theoretical basis of the JD-R model stems from the Conversation of Resources Theory (the COR theory) (Hobfoll, 1989). The COR theory holds that in order to achieve a balance of resources, human beings attempt to obtain valuable resources; at the same time, they will consume a few resources to meet their needs (Hobfoll, 2001). Following this theory, relevant theoretical research continued to expand. In view of the relationship between job resources and job demands, Bakker (2024) explored the application of the JD-R theory at a broader level, further enriching its theoretical system.

The JD-R model suggests that the work environment faced by employees in the organization falls into two categories: job demands and job resources; the imbalance between job demands and job resources is the main reason for individuals' psychological stress and

burnout (Demerouti et al., 2001). This model involves two main influence processes: the energy depletion process and the motivational process. As burnout and work engagement are the outcome variables of the energy depletion process and the motivational process, respectively, the integration of these two has become an important theoretical basis for relevant research (Demerouti, 2014). With the continuous expansion of research on work engagement, the model has been widely applied around the world (H. Zhang, 2013).

In the JD-R model, job demands mainly include dimensions such as workload, duration of work, complexity of work, and working environment, while job resources mainly include dimensions such as salary and benefits, work control, work participation, work security, and support from superiors (Demerouti et al., 2001). Research has shown that job demands require employees' continuous efforts at the physical and psychological levels and relevant skills, which may lead to employees' energy loss at the physical or psychological level. When employees cannot meet the high job demands, it may lead to work stress (Meijman & Mulder, 1998). On the other hand, job resources can stimulate employees' work motivation, which will further develop into work engagement; meanwhile, they can also reduce employees' physical or psychological burden brought by job demands and lead to positive results, thus enabling employees to achieve the established work goals more effectively (Bakker, Demerouti, & Boer et al., 2003).

Demerouti et al. (2001) found that the balance between job demands and job resources could greatly impact employees' well-being. With high job demands and insufficient job resources, employees are prone to burnout; on the other hand, when job resources are sufficient, employees can better respond to job demands and thus obtain higher well-being. Bakker and Demerouti (2007) showed that job resources could meet the psychological needs of employees and enhance their enthusiasm and commitment to work, which is conducive to enhancing their work engagement. By revising the JD-R model, Bakker et al. (2004) further enriched the theoretical explanations of positive coping states (e.g., work engagement) and negative psychological states (e.g., burnout). The research of Hakanen et al. (2008) further suggested that job demands have a strong predictability for the level of burnout and depression among employees, while job resources have a strong predictability for employees' level of work engagement and organizational commitment. Researchers such as Alarcon et al. (2009) and Hakanen et al. (2006) examined the applicability of the JD-R model in different occupations and different cultural backgrounds. The results showed that regardless of employees' occupations and cultural backgrounds, job demands and resources are both significant factors affecting employees' physical and mental well-being and job performance.

The core propositions of the JD-R model are as follows. The factors affecting individuals' work status and physical and mental well-being fall into two categories: job demands and job resources. Job demands and resources can be found in all occupations, and any relevant factor can be classified as either job demand or resource accordingly. Job demands are related to physical and mental impairment at work, while job resources are related to reducing job demands and physical and mental impairment. The more job resources an individual can access at work, the more it is likely for them to meet job demands and achieve corresponding work goals (Demerouti et al., 2001). On the whole, job demands and resources have a comprehensive impact on employees' work engagement and burnout (Bakker et al., 2023; Bakker et al., 2014).

Building on the core propositions, the JD-R model was further developed into three basic theoretical hypotheses, including the "dual processes" hypothesis, the "buffer" hypothesis, and the "boost" hypothesis (Bakker and Demorouti, 2024; Hobfoll et al., 2018; Q. Yang & Li, 2022). Among them, the "dual processes" hypothesis states that the impact of job demands and resources on employees can be divided into two processes, namely, the energy depletion process and the motivational process, also known as the health impairment path and gain path. The energy depletion process is triggered by excessive job demands, which lead to burnout and other negative outcomes. The main predictor of the energy depletion process is job demands. The motivational process is based on relatively abundant job resources, which can stimulate employees to actively engage in work, leading to positive work outcomes and helping them to achieve work goals. The main predictor of the motivational process is job resources (Bakker & Demerouti, 2007).

The "buffer" hypothesis states that when excessive job demands at work negatively affect individuals' physical or psychological well-being and cause energy depletion, abundant job resources can buffer this negative impact (Bakker, 2024; Bakker et al., 2005; Bakker & Demerouti, 2007). In particular, when the job demands and job resources are homogeneous in nature or are on similar dimensions, they are most likely to create synergy (Heidinger et al., 2011).

The "boost" hypothesis states that in a highly demanding or challenging work environment, the positive impact of abundant job resources becomes more salient, helping employees effectively cope with the physical or psychological challenges brought by such a demanding environment, which will further translate into high job performance (Bakker, 2024; Bakker et al., 2010; Bakker & Demerouti, 2007). This study is mainly based on the theoretical framework of the "dual processes" hypothesis and the "buffer" hypothesis to explore the relationship and influence paths between job demands and burnout of doctors in public hospitals.

In summary, the JD-R model includes a positive motivational process and a negative health impairment process, which cover a wide range of personal characteristics, job characteristics, and work-related variables. Such a theoretical system, which is based on resource balance, enables the model's wide application in various types of enterprises and organizations in society. In this study, using the JD-R model, we intend to explore the facilitators and inhibitors of the healthcare practice of doctors in public hospitals by considering various dimensions of job demands and job resources. After putting forward relevant theoretical hypotheses and research models, we examine the relationships and influence paths between these factors using Process Macro (Hayes, 2018), based on which the research findings are obtained and discussed.

2.1.2 Job demands in the JD-R model

Based on the JD-R model, job demands (JD) refer to organizational, social, physical, psychological, and other demands confronted by employees at work. Employees need to make continuous physical or psychological efforts and be equipped with corresponding professional skills to meet these demands. At the same time, these job demands may lead to employees' physical or psychological impairment such as emotional demands and work stress (Bakker & Demerouti, 2007; Lorist et al., 2000).

In the theoretical research of the JD-R model, job demands are defined as work-related efforts that individuals need to make and thus are related to the physical and psychological costs of individuals. According to the "dual processes" hypothesis of the model, job demands play a key role in the energy depletion process, but not in the motivational process (Bakker & Demerouti, 2017). In addition, although job demands positively influence employees' burnout, it does not mean that every demand will inevitably lead to burnout among employees at work; in particular, some job demands may even enhance employees' engagement at work (Anja et al., 2010). According to some scholars, job demands may play a motivational role in certain cases.

In a conceptual expansion of the JD-R model, some scholars proposed that job demands include challenge demands and hindrance demands (Anja et al., 2010; Crawford et al., 2010). According to McCauley et al. (1994), some examples of challenge job demands are high-level workload, time pressure, and responsibility. Based on the research on stressors and according to stressors' different natures, some authors categorized job stressors into hindrance stressors and challenge stressors (Lepine et al., 2005; Nathan et al., 2007). Hindrance job demands refer to the factors that impose excessive restrictions on the job demands or work environment, interfering with or hindering individuals' realization of values and goals, such as role conflict

and role load (Cavanaugh et al., 2000). Challenge job demands refer to the job demands that require effort costs but may contribute to personal growth and accomplishment, such as high work complexity, time pressure, and responsibility (Nathan et al., 2007). Bakker and Demerouti (2017) pointed out that although challenge job demands may make individuals feel uncomfortable at work, they can still be regarded as beneficial and worthwhile work experience for them. Zeng et al. (2022) pointed out that the doctor-patient relationship is a challenge job demand in the Chinese context. In view of that, this study includes the doctor-patient relationship as a variable in the JD-R model.

Research on the classification of job demands further clarified the conceptual framework and action mechanism of job demands in the JD-R model, laying a foundation for the exploration of the influence paths of different types of job demands on work engagement and burnout (Qi & Wu, 2018).

The JD-R model is a framework applicable for studying healthcare professionals (Demerouti et al., 2001), as it explains the influence mechanism of the physical and social work environment (as job demands and resources) on employees' work behavior and job performance (Bakker & Demerouti, 2017). As far as this study's research object is concerned, with regard to the job demands faced by doctors in medical practice, previous studies have shown that continuous high job demands and work stress will have negative effects on doctors' physical and mental well-being and social evaluation. Thomas and Valli (2006) pointed out that compared with the general working population, doctors tend to show a higher level of occupational stress. Xanthopoulou et al. (2013) pointed out that in order to improve the satisfaction of patients and their families with medical services, the front-line health care workers need to cope with interpersonal situations that impose emotion-involving job demands, such as doctor-patient communication and interaction. Cui et al. (2014) pointed out that the coordination demand and intensity demand of doctors' work were significantly positively related to the depersonalization dimension of burnout, while the intensity demand and knowledge/skills demand of doctors' work were significantly positively related to the low accomplishment dimension of burnout. A. Wang et al. (2016) conducted a study on the work stress of health care workers and found that they were bearing great work stress, which would not only lead to doctors' poor job performance, but also cause doctor-patient disputes in escalated cases. T. Yang et al. (2017) pointed out that when doctors' work stress could not be relieved, it would lead to a decline in their job satisfaction, further leading to burnout. According to J. Xu (2023), intensive care unit (ICU) nurses, due to their distinctive job demands in clinical nursing, face relatively high work intensity and work stress, which may lead to exhaustion and

health problems. In view of the above analysis, this study, which explores doctors' job demands and their impact in public hospitals based on the JD-R model, has great theoretical value and practical significance.

The measurement of job demands is a systematic process, which involves the use of qualitative and quantitative methods to evaluate the necessary conditions for employees to meet the specific job demands. At present, the job demand measurement tools applied by scholars mainly include the following categories:

Regarding job demands, a main and commonly used occupational stress model is the Job Demand-Control(-Support) model (the JDC(S) model) (Van der Doef & Maes, 1999). The JDC(S) model is a legitimate and simple model that has been applied to a large number of empirical studies (De Jonge & Kompier, 1997; Mikkelsen et al., 2005). The model involves the conceptualization and measurement of different job demand dimensions (De Jonge et al., 1999; Mikkelsen et al., 2005). In the Swedish version of the JDC(S) questionnaire, the psychological job demand dimension is mainly measured quantitatively (Theorell, 1996), and the measurement items involve work efforts, fast work, excessive work, insufficient time to complete tasks, and conflicting demands (Eacute & Gunnel, 1999). However, the job demands in the field of healthcare go beyond those. The multifaceted nature of job demands is not only manifested in the psychological demand dimensions in the JDC(S) model, but also in other types of job demands (De Jonge et al., 1999; Peeters & Le Blanc, 2001).

Sundin et al. (2008) developed the Job Demand Indices (JDI) and carried out research on specific job demands in healthcare. The authors explored the relationship between the JDI and the dimensions of the JDC(S) model in two occupational groups: registered and assistant nurses. A total of 795 registered nurses and 527 assistant nurses from three hospitals and two primary healthcare centers in Stockholm, Sweden, voluntarily participated in the study. For both occupational groups, questionnaires were used to collect information on demographics, job demands, job control, and social support. The JDI contains 28 items measured on a four-point Likert scale. The scores indicate the extent to which respondents encountered the factors related to job demands. The test results indicated that the JDI showed satisfactory internal consistency. In subgroup analysis, independent sample t-tests showed that the mean difference between each demand index was statistically significant. Thus, the scale can be used to obtain information concerning various job demands as a supplement to the generic psychological demand dimension specified in the JDC(S) model.

S. Wang et al. (2017) developed a JD-R scale for clinicians to study the impact of job demands and resources on work-family conflict. The scale contains 14 items on the dimensions

of job demands and job resources, including factors such as workload, time pressure, professional skills, job control, performance feedback, and physical and psychological costs. The five-point Likert scale was used for scoring. Results of the reliability test and exploratory factor analysis showed that the scale had good reliability and validity.

Kaiser et al. (2020) used the JD-R model to evaluate the work-related outcomes of 489 healthcare workers engaged in public healthcare services for children and their families in Norway. The scale they used is a well-established scale that has been applied in related studies in Norway for many years. In the scale, job demands include the dimensions of workload, work conflict, and work-family conflict. The scale contains 12 items in total, including eight items for workload, two items for work conflict, and two items for work-family conflict, all measured on a seven-point Likert scale. Through reliability and validity tests, the scale was proven to show good internal reliability.

Considering the purpose of the study and the job characteristics of the research object, this study focuses on the emotional demands and workload of doctors when selecting measurement tools for job demands. The reason is that Chinese doctors are confronted with not only the powerlessness perceived by patients in the face of pain and death, but also the tense doctor-patient relationship, which even includes the threat of violence from patients and their families (e.g., Ma et al. 2017; Zeng et al. 2022). In addition, as mentioned in the research background, Chinese doctors are faced with a great workload. Therefore, in terms of job demands, this study focuses on the emotional demands and workload of Chinese doctors in exploring the relationship between job demands, the doctor-patient relationship, work engagement, and burnout.

2.1.3 Conservation of Resources Theory

The Conservation of Resources Theory (the COR theory), proposed by Hobfoll (1989), is essentially a motivation and stress theory. The COR theory is mainly used to describe the interaction process of resources between the social environment and individuals. The theory states that individuals will make their best efforts to avoid resource loss and to obtain, retain, foster, and protect the resources they consider valuable. The COR theory and the JD-R model are closely related in their theoretical framework. According to the COR theory, factors related to job demands are the main reasons for individuals' negative emotions (e.g., emotional exhaustion and depersonalization) and burnout at work. Therefore, both job demands and job resources are regarded as the dimensions for predicting individuals' work attitudes and behavior (Lee & Ashforth, 1996; Leiter & Maslach, 1998). The research of Bakker et al. (2023) suggested

that job resources played a role in achieving work goals, buffering the impact of job demands, and fostering learning and personal development.

Initially, the COR theory was mainly applied to stress research (Benight et al., 1999); later, its application extended to burnout research (Brotheridge & Lee, 2002; Buchwald & Hobfoll, 2004). The COR theory has great significance in guiding the exploration of individuals' motivation and stress response to the environment and the formulation of relevant coping strategies, and for that reason, it has been widely applied in research since it was first proposed (Westman et al., 2004).

Lee and Ashworth (1996) explored the relationships between job demands and resources, behavior and attitude, and three dimensions of burnout. The study found that job demands and resources were more strongly associated with emotional exhaustion than with either depersonalization or personal accomplishment; emotional exhaustion was more strongly associated with job demands than with job resources; the three dimensions of burnout were differentially related to turnover intentions, organizational commitment, and control coping. Complex or high-load job demands cause employees' health impairment by depleting their physical, emotional, and cognitive resources (Y. Li et al., 2023).

Hobfoll and Shirom (2001) classified resources into four types: object resources, conditions, personal characteristics, and energies, including time, energy, skills, opportunities, and various social resources. These authors believe that resources can be valuable things or a way to obtain valuable things (Hobfoll & Shirom, 2001). The COR theory's explanations on the generation mechanism of burnout, work stress, and job performance are mainly from the perspective of the imbalance between resource investment and return (Hobfoll & Shirom, 2001).

Demerouti et al. (2001) pointed out that resources play a crucial role in improving organizational performance and promoting organizational development. When higher job demands are coupled with insufficient job resources, individuals may make defensive responses such as non-adaptive physiological responses or negative work behavior, which will have a negative impact on work outcomes. Using the COR theory, Brotheridge and Lee (2002) studied the relationship between burnout and emotional labor and showed that employees attempted to cope with role demands by performing surface or deep acting, and the impact of such resource expenditure on employees' burnout depends on the immediate rewards and the application of resources specific to needs at hand. Buchwald and Hobfoll (2004) suggested that in an environment with limited opportunities for resource renewal or replenishment, continuous work stress will lead to burnout among individuals. According to the COR theory, burnout is usually caused by sustained and low-level resource loss. It is a continuous and progressive process,

where the resource loss shows a spiral growth. Due to energy or emotional exhaustion at work, individuals develop burnout syndrome simply because they realize that their resources are threatened to be depleted, or they fail to sufficiently and continuously gain new resources, or the resources have been depleted in fact. Kessler et al. (2010) pointed out that if employees show emotional exhaustion, low job performance, burnout, or turnover intention at work, it is likely that their chronic workplace stress would lead to mental health problems such as somatization, anxiety, or depression, resulting in further strain of personal resources.

At present, the COR theory is one of the most frequently cited theories in the literature on organizational behavior. Through a large number of empirical studies, the theoretical model and influence path from "stressors" to "work behaviors" and "work outcomes" via "resource conservation mechanism" have been verified and this theoretical view has been enriched (Hobfoll et al., 2018).

In recent years, the COR theory has been gradually introduced to medical and health fields such as occupational well-being, which has enriched the theories and perspectives of medical management research. In particular, the COR theory has been increasingly applied in research on nursing management in medical institutions (X. Han et al., 2024). Egozi et al. (2022) pointed out that the COR theory emphasizes that resource conservation can reduce the threat of resource loss, while resource loss will challenge individuals' ability to cope with trauma. Personal resilience, leadership support, and working atmosphere can help nurses recover from psychological trauma and maintain mental health at work. The theoretical basis of this mechanism is that factors such as personal resilience, leadership support, and working atmosphere play a role as nurses' psychological resources in nursing practice. Chinese scholars Y. Li et al. (2017) and X. Tao et al. (2022) pointed out that due to factors such as young age and little experience, newly onboarded nurses are more likely to be affected by work setbacks, which will consume psychological resources, leading to reduced professional identification and causing burnout. Therefore, nursing managers should strengthen external guidance and timely carry out effective psychological counseling for nurses with negative emotions. According to Duan et al. (2020), more in-depth theoretical research on the COR theory is needed, and in particular, the research and application of this theory is insufficient in China. It is necessary to further explore the mechanism of resource dynamics influencing work behavior and to further study the effect of resources' circular flow between individuals and the environment from a dynamic perspective.

The COR theory involves four basic principles in terms of resource gain and conservation. Principle 1: Primacy of loss principle. The impact of resource loss is disproportionately more

salient than that of resource gain on individuals. Principle 2: Resource investment principle. Individuals must continue to invest resources through direct replacement or indirect investment of resources to protect against the continuous loss of resources and to recover from resource losses. Principle 3: Gain paradox principle. In the context of resource loss, resource gains will become more important – they gain in value. Principle 4: Desperation principle. When individuals' resources are outstretched or exhausted, they may enter a defensive mode, showing defensive, aggressive, or irrational behaviors at work. That may be due to the self-protection mechanism generated when individuals' resources are exhausted at work (Hobfoll, 2011; Hobfoll et al., 2018).

Based on the above principles, Hobfoll proposed three corollaries that are interrelated. Corollary 1: Resource loss cycles. As resource loss is more salient than resource gain, and stress occurs when resources are lost, the momentum of resource loss continues to increase in the iteration of the stress spiral, resulting in further loss of resources. Corollary 2: Resource gain spirals. Individuals with more initial resources are more capable of gaining new resources and have more resource investment opportunities, making the resource gain increase in a spiral manner. Based on the primacy of loss principle, the resource gain is both of less magnitude and slower compared to the resource loss, and thus, resource gain spirals tend to be weak and develop slowly. Corollary 3: Individuals with more initial resources are relatively more capable of resource gain and less vulnerable to resource loss, and thus are more active or risk-tolerant in resource investment (Hobfoll et al., 2018).

Based on the four basic principles and three corollaries of the COR theory, individuals will have the following perception in their work: valuable resources can not only meet their needs, but are also conducive to their self-identification and social positioning (Lee & Ashforth, 1996). Therefore, two hypotheses can be put forward accordingly: Hypothesis 1: Based on the principle of benefiting oneself, individuals are likely to actively protect existing resources and strive to obtain new resources. Hypothesis 2: individuals will strengthen the continuous investment of resources to protect against the threat of resource loss or potential adverse events they perceive.

According to the COR theory, the root cause of burnout of individuals may come from the decisive impact of the depletion of psychological resources on individuals' motivation and behavior, which will lead to reduced self-efficacy and depersonalization (Bakker, Demerouti, & Taris et al., 2003). Based on the COR theory and the JD-R model, this study holds that job demands, the doctor-patient relationship, and burnout of doctors in public hospitals are related to individuals' resource loss. The chronically high job demands, or the frequent encounters of

patients' distrust or even doctor-patient conflict can easily cause the depletion of doctors' psychological resources, which will further lead to doctors' burnout. Therefore, from the perspective of resource conservation and resource investment, it is necessary to explore the moderation effect of leader-member exchange (LMX) on the relationship between job demands and the doctor-patient relationship, that is, LMX can provide necessary resource replenishment in the process of job demands' straining effect, so as to make up for individuals' resource loss at work.

In summary, the COR theory, as the theoretical basis of the JD-R model, explains the intrinsic motivation of individuals' conservation, acquisition, and utilization of resources, and describes the influence mechanism of burnout from the perspective of resource investment and resource loss, making it an important theoretical basis for research on burnout. In addition, the COR theory provides significant theoretical support for this study that considers LMX as a job resource that moderates and mitigates the impact of job demands on burnout.

2.2 Doctor-patient relationship

2.2.1 Definition of the doctor-patient relationship

The doctor-patient relationship (DPR), as the name suggests, refers to the relationship between "doctors" and "patients". With the development of society and the update of medical technology, the connotation of the "doctor-patient relationship" has gradually expanded from the traditional definition that specifically refers to the interaction between health care workers and patients in the context of disease-centered biomedical model to the interaction between the medical side (e.g., medical institutions, health care workers) and patient side (e.g., patients, their families, patients' caregivers) in the context of patient-centered biological-psychological-social medical model (L. Sun & Wang, 2019). Therefore, the doctor-patient relationship is a specific interpersonal relationship formed in the process of medical services, with both doctors and patients as the main actors (Q. Li & Li, 2021).

The doctor-patient relationship can be divided into two dimensions: a broad sense and a narrow sense. The doctor-patient relationship, in a broad sense, is established between health care workers, patients, and their families, while the narrow sense is between doctors and patients (Fu et al., 2010). In this study, the doctor-patient relationship faced by the research object falls into the narrow-sense of doctor-patient relationship, namely, the relationship established between doctors and patients in medical practice. According to Hakanen et al.

(2008), the doctor-patient relationship refers to a series of interactions between doctors and patients in the context of doctors providing relevant medical services for patients.

As a special two-way interpersonal relationship established in medical practice, the doctor-patient relationship is a specific treatment-based relationship between health care workers and patients based on medical technology and disease characteristics. This relationship is essentially a "community of interests" between doctors and patients with the shared goal of disease recovery. That is because both parties share the goal of overcoming diseases, whose realization requires not only the doctors' exquisite medical techniques, but also the patients' confidence in recovery and active cooperation in diagnosis and treatment. A tense doctor-patient relationship generally involves distrust between doctors and patients and will have a negative impact on health care worker's work (Y. Wang & Du, 2023). A positive doctor-patient relationship is usually established through effective communication and mutual trust between doctors and patients, and it is essential to improve the doctor-patient relationship in public hospitals accordingly (Han et al., 2022).

2.2.2 Review on doctor-patient relationship

Since the 1920s, academic circles in the West have carried out research on relevant indicators of the quality of doctor-patient relationships and the elements involved in doctor-patient interactions, including the overall characteristics of doctor-patient relationships, patient satisfaction, trust between doctors and patients, compliance with treatment, and the effectiveness of doctor-patient communication (L. Sun & Wang, 2019). Since then, scholars have developed evaluation tools for the doctor-patient relationship to assess these indicators, mainly including three aspects: global evaluation of the doctor-patient relationship, evaluation of doctor-patient trust, and evaluation of doctor-patient communication quality.

Horvath et al. (1993) suggested that the doctor-patient relationship includes five dimensions: cooperation, helpfulness, trust, empathy, and open mind. Hahn et al. (1994) proposed that the doctor-patient relationship includes three dimensions: doctors' subjective reaction, patients' objective behavior, and the combination of the doctors' subjective reaction and patients' objective behavior. Van der Feltz-Cornelis et al. (2004) believe that the doctor-patient relationship can be divided into two dimensions, including doctors' affective behavior toward patients and patients' attitudes toward medical behavior. Various studies have shown that the doctor-patient relationship is closely related to patient satisfaction with medical treatment and treatment outcomes (Eveleigh et al., 2012; Mohseni & Lindstrom, 2007) and has a great impact on the medical work status and career development prospects of health care workers (Baker et

al., 2003).

At present, research on the status quo of the doctor-patient relationship in China mainly focuses on the formation and influencing factors. The research methods mainly include observation, experiments, and the development of doctor-patient relationship measurement scales (S. Liu, 2019). Research has shown that psychological factors are the main antecedents of doctor-patient contradictions and conflicts, and therefore, attention should be paid to the importance of doctors' and patients' psychological adjustment (L. Fang et al., 2013). In addition, there are many other factors that affect the doctor-patient relationship, including the attitude of health care workers in medical practice, the effectiveness of doctor-patient communication and interaction, the salaries and benefits of doctors, the workload of the position, the hospital's management system, medical risks, and public opinions (Y. Han & Zhong, 2017; Hao et al., 2017). Shi et al. (2017) pointed out that if doctors are continuously in a state of high pressure and high intensity, their work enthusiasm will be reduced, leading to increased risk of burnout and a negative attitude in dealing with doctor-patient relationships. X. Zhao et al. (2019) found that doctors' overall evaluation of the doctor-patient relationship was not optimistic; doctors were suffering serious emotional exhaustion; burnout negatively affected doctor-patient relationships; and comparatively, doctors with higher education levels evaluated the doctor-patient relationship more optimistically. According to Zeng et al. (2022), the doctor-patient relationship is the core feature of all medical service institutions and faces uncertainties in many scenarios; the doctor-patient relationship based on pragmatism cognition will continue to increase the mutual distrust between doctors and patients.

With the rapid development of medical science and technology and information technology, China's medical industry has developed rapidly through reform and innovation, and the quality and efficiency of medical services have continued to improve. However, at present, the tense doctor-patient relationship, doctor-patient conflicts, and doctor-patient disputes remain the prominent industrial and social contradictions in the medical field (X. Zhou et al., 2020). As patients' expectations of the medical process and medical outcomes may not be aligned with medical rules or doctors' judgment, the interaction between doctors and patients may develop into a crisis of trust. However, the reasons for the tense doctor-patient relationship are very complex. At present, the continuous heavy workload of doctors in public hospitals may easily lead to physical and mental fatigue and emotional exhaustion, making doctors a high-risk group prone to burnout, which will further negatively impact the doctor-patient relationship to a certain extent (X. Zhao et al., 2019). Ma et al. (2017) pointed out that the tense doctor-patient relationship is a hot topic in the field of public health in China. Due to the marketization trend

in China's medical reform and the government's insufficient investment and safeguard for public hospitals, public hospitals may turn into "for-profit" business organizations that treat patients as customers. Based on the JD-R model, Zeng et al. (2022) suggested that currently, the doctor-patient relationship is a challenge demand in China's medical service environment. While bringing physical and psychological pressure to doctors, it also leads to economic and professional returns.

In summary, the formation and influencing factors of the doctor-patient relationship are multifaceted, involving the joint actions of factors such as the alignment of the goals of both sides, the asymmetry of information, and the medical and health management capabilities. These intertwined and interacting factors jointly contribute to the particularity and complexity of the doctor-patient relationship. Based on the JD-R model, this study will explore the role of the doctor-patient relationship as a challenge job demand in the context of Chinese public hospitals..

2.2.3 Measurement of the doctor-patient relationship

Internationally, scholars have developed scales for measuring the doctor-patient relationship from different measurement perspectives with varied evaluation focuses. Eveleigh et al. (2012) classified 19 doctor-patient relationship scales according to the measurement perspective and conducted a comprehensive analysis. Among the 19 scales, two scales measured the doctor-patient relationship from the observer's perspective, 16 scales measured from the patient's perspective, and only one scale measured from the doctor's perspective, that is, the Difficult Doctor-Patient Relationship Questionnaire-10 (DDPRQ-10) developed by Hahn et al. (1996).

At present, the relatively well-established doctor-patient relationship scales include the Difficult Doctor-Patient Relationship Questionnaire-10 (DDPRQ-10) developed by Hahn et al. (1996), the Patient-Practitioner Orientation Scale (PPOS) developed by Krupat et al. (2000), and the Patient-Doctor Relationship Questionnaire-9 (PDRQ-9) developed by Van der Feltz-Cornelis et al. (2004).

The DDPRQ-10 scale, developed by American scholar Hahn and others, is a simplified and adapted version of the Difficult Doctor-Patient Relationship Questionnaire-30 (DDPRQ-30). The scale measures the doctor-patient relationship from the doctors' perspective, mainly scored by doctors in medical institutions. The scale has three measurement dimensions, including the doctor's subjective reactions, the patient's objective behavior, and the combination of the patient's objective behavior and the doctor's subjective reaction. It includes ten items, which are scored on a six-point Likert scale. The score represents the level of goodness of the doctor-

patient relationship (Hahn et al., 1996).

The PPOS scale, developed by Krupat et al. (2000), is mainly based on the modern medical model. It measures the doctor-patient relationship according to the doctors' and patients' perceptions of the doctor-patient relationship. The scale has two measurement dimensions: power-sharing and physicians' supportiveness. The scale includes 18 items, which are measured on a six-point Likert scale.

The PDRQ-9 scale, developed by Dutch scholar Van der Feltz-Cornelis and others, is a simplified and adapted version of the Patient-Doctor Relationship Questionnaire-15 (PDRQ-15). It measures the doctor-patient relationship from the perspective of patients (Chen et al., 2018; Van der Feltz-Cornelis et al., 2004). The PDRQ-9 scale has three measurement dimensions, including patients' attitudes toward medical symptoms, patients' satisfaction with doctors, and doctors' approachability. The scale includes nine items, which are measured on a five-point Likert scale. A higher total score indicates a better doctor-patient relationship, and vice versa (Van der Feltz-Cornelis et al., 2004).

According to the comprehensive analysis of doctor-patient relationship scales by Eveleigh et al. (2012), the scales from the perspective of patients had the highest percentage – there were 16 in total. The Patient-Doctor Depth-of-Relationship Scale (PDDRS) (L. Sun & Wang, 2019) is a representative scale measuring doctor-patient relationships from the perspective of patients. It evaluates the continuity of the doctor-patient relationship from four dimensions (knowledge, trust, regard, and loyalty) through nine items, providing a systematic measurement and comprehensive evaluation of the doctor-patient relationship (Ridd et al., 2011).

For the measurement of the doctor-patient relationship, Chinese scholars have mainly adopted qualitative research methods or independently designed questionnaires from different measurement perspectives (H. Sun et al., 2016), or translated and localized international scales such as DDPRQ and PDRQ to adapt to local context (L. Sun & Wang, 2019). For example, H. Yang and Wang (2011) designed their scale by translating and adapting the DDPRQ-10 scale developed by Hahn et al. (1996) to the Chinese cultural context. However, due to the limited application of the scale, its reliability and validity still need to be verified (Zeng et al., 2018). Ma et al. (2017) pointed out that it is necessary to develop a doctor-patient relationship scale suitable for China's medical context to more accurately measure and evaluate the doctor-patient relationship in Chinese medical institutions.

According to the specific national conditions of China's medical and health development and the reality of China's medical institutions, Zeng et al. (2018) developed the scale named Doctor-Patient Relationship in China (DPR-C) for the Chinese medical context. The scale

measures the doctor-patient relationship from the perspective of doctors, including two dimensions, namely, patient-centered treatment and mutual trust between the patient and doctor. The scale consists of ten items, which are scored on a six-point Likert scale, from 1 "completely disagree" to 6 "completely agree". A higher score indicates a better quality of the doctor-patient relationship. Testing results showed that the overall internal consistency indicators and Cronbach's α of the ten items were 0.90, 0.88, and 0.90, respectively, and the factor loadings of all items were greater than 0.7, indicating that the scale had good reliability and validity.

In summary, Chinese and international scholars have measured the doctor-patient relationship from various perspectives with varied evaluation focuses. The measurement of the doctor-patient relationship is a complex process, involving many influencing factors. It is necessary to consider multiple dimensions, including doctor-patient communication, trust, and satisfaction. Different scales may focus on different aspects of the doctor-patient relationship, and the measurement methods and criteria may vary across different countries and medical contexts. The DPR-C scale developed by Zeng et al. (2018), as an addition to current research on the doctor-patient relationship in the Chinese context, provides a reliable localized scale for the quantitative research on the doctor-patient relationship in China.

2.3 Work engagement

2.3.1 Definition of work engagement

The term "engagement" generally refers to devoting oneself to a situation and doing something dedicatedly. "Work engagement" (WE) refers to individuals identifying with their work or even occupation at the psychological level and aligning their job performance and personal values with specific work goals.

The concept of work engagement was first put forward by Kahn (1990), who defined it as organization members' self-employment during work role performances to harness their personal selves to their work roles. From the physical, cognitive, and emotional perspectives, Kahn divided work engagement into three dimensions, namely, physical engagement, cognitive engagement, and emotional engagement. Organization members' overall work engagement depends on their engagement level in each dimension. In Kahn's view, organization members' personal roles and work roles are always involved in a dynamic process of reciprocal transformation, which is related to their level of work engagement. With a low level of work engagement, the alignment of the two will decrease, leading to employees' burnout or even

turnover intention.

Based on Kahn's theories, Schaufeli et al. (2006) defined work engagement as individuals being in a positive and fulfilling work-related state of mind. This state is lasting and fulfilling, characterized by vigor, absorption, and dedication, as well as pervasiveness and persistence. A high level of work engagement means that individuals have a strong sense of professional identification at work, which is a positive experience for them.

More than a decade after Kahn proposed the concept of work engagement, researchers defined the concept of work engagement as the opposite of burnout, mainly inspired by the existing research on burnout at that time and the increasing popularity of positive psychology (Seligman & Csikszentmihalyi, 2000). H. Zhang (2013) stated that Schaufeli and others' definition of work engagement is relatively more comprehensive, as it was established based on an in-depth study of work engagement from multiple perspectives.

In summary, work engagement conceptually involves the linkage between individuals and their work and the integration of individuals' personal and work roles, emphasizing individuals' self-expression in their work roles, as well as the positive, fulfilling, and persistent motivational emotional states.

2.3.2 Review on work engagement

Based on the three-dimensional model of responsibility proposed by Schlenker et al. (1994), through in-depth research on the relationship between personality hardness, the meaningfulness of work, and deriving long-term benefits from a stressful event, Britt et al. (2001) defined work engagement as the sense of responsibility and work commitment generated by individuals as they fully recognize the importance of job performance to themselves. The authors suggested that work engagement can be divided into three dimensions: perceived influence of job performance, responsibility, and commitment.

Work engagement, as a new perspective of individuals' occupational health with positive psychology as the theoretical basis, has become an emerging topic for theoretical research (H. Zhang, 2013). Schaufeli et al. (2006) defined work engagement as a positive work-related state of fulfillment and developed a questionnaire for its measurement. The results confirmed that work engagement could be considered as the positive antipode of burnout.

May et al. (2004) showed that individuals' psychological conditions might have a direct impact on their work engagement. There are three related psychological conditions, including psychological meaningfulness, psychological safety, and psychological availability, among which the psychological condition of meaningfulness has the greatest influence.

To measure burnout and work engagement, Schaufeli et al. (1996) revised and improved the Maslach Burnout Inventory (MBI), where work engagement is measured by reverse scoring on the three dimensions of burnout (Schaufeli et al., 1996; H. Zhang, 2013). According to Maslach and Leiter (1997), work engagement is a positive emotion that individuals show at work, reflecting their physical and psychological well-being. In this way, work engagement is defined as the opposite of burnout. Maslach et al. (2001) indicated that the prominent characteristics of work engagement include energy, involvement, and efficacy; on the contrary, the prominent characteristics of burnout include exhaustion, cynicism, and inefficacy. The characteristics of these two may mutually transform under certain conditions.

Chinese scholars' research on work engagement in the early stage mainly centered on enterprises and education (Jelena et al., 2018; G. Chen & Hu, 2019; Y. Li et al., 2015). Y. Cheng & Song (2024) screened 459 Chinese research articles on work engagement in the CNKI database from 2011 to 2022 and visually analyzed them using CiteSpace. Through the analysis of publication years, core authors, cooperating institutions, keyword clusters, and keyword emergence, it was found that Chinese scholars' research topics on work engagement mainly centered on three dimensions: job redesign, job performance, and psychological capital.

With the continuous advancement of China's medical and health system reform, the topic of improving the enthusiasm of doctors in public hospitals has received increasing attention from scholars, but previous studies mainly focused on the reform of doctors' salaries and benefits (L. Zhang et al., 2021). In the early stages, Chinese scholars' research on the work engagement of medical and health practitioners mainly centered on nurses, while less attention was paid to doctors (J. Liu et al., 2019; Y. Zhang & Li, 2015). In recent years, scholars have expanded the research on doctors' work engagement. For instance, based on the career construction theory and self-determination theory, using 403 valid samples of doctors in public hospitals, Y. Wang and Zhang (2020) showed that doctors' work engagement was significantly positively associated with occupational responsibility, and that professional identification had a partial mediation effect therein. Through an investigation of 638 doctors in public hospitals using the work engagement scale, L. Zhang et al. (2021) suggested that public hospital managers should take proactive measures to stimulate doctors' work engagement and pay special attention to the doctors who are greatly affected by factors such as identification, knowledge level, and career development in work.

Research has shown that work engagement is negatively associated with turnover intention (Bakker, Demerouti, & Schaufeli, 2003), but positively associated with the quality of the doctor-patient relationship (Zeng et al., 2022). Based on the JD-R model, Zeng et al. (2022)

pointed out that the doctor-patient relationship, as a challenge job demand, can stimulate employees' positive work behavior and improve their work engagement, thus fostering the achievement of work goals.

In summary, employees' work engagement is related to many factors, such as individual motivation, psychological characteristics, and working conditions. A high level of work engagement may be developed through the coordination and interaction of these factors. In public hospitals, the work engagement of doctors is affected by personal, organizational, and social factors, as well as the characteristics of medical work.

2.3.3 Measurement of work engagement

May et al. (2004) developed a work engagement scale based on Kahn's theory. The scale measures work engagement from three dimensions, including physical, emotional, and cognitive engagement, and contains a total of 13 items. Rich (2006) developed the Job Engagement Scale (JES), which measures work engagement from the dimensions of intrinsic motivation, job involvement, and job satisfaction through 18 items. The author conducted both exploratory and confirmatory factor analysis on the data.

The Gallup Organization developed the Gallup Workplace Audit (GWA) scale and measured the work engagement of millions of employees from 36 companies through interviews (Harter et al., 2002). The GWA scale includes a total of 12 items, covering two dimensions: one is attitudinal outcomes (loyalty, pride, satisfaction, customer service intent, and intent to stay with the company), and the other is the issues that are antecedents to the attitudinal outcomes and are within a managers' control. Further, Colbert et al. (2004) revised the GWA scale and found that work engagement was significantly negatively associated with workplace deviance.

Schaufeli et al. (2002) developed the Utrecht Work Engagement Scale (UWES), which can independently measure the work engagement of organization members from three dimensions: vigor, dedication, and absorption. Through continuous research and testing, the UWES scale has gradually developed from the initial 24-item scale to a 17-item scale (UWES-17). UWES-17 is currently a widely applied scale in work engagement research. Through tests, it has proven to have good reliability and validity across different occupations and cultures.

Subsequently, Schaufeli et al. (2006) further simplified the scale without compromising the scale's internal consistency, reliability, and validity, developing it into UWES-9, in which the number of items was reduced from 17 to nine. A six-point Likert scale was used for scoring, facilitating the measurement. Research has shown that UWES-9 can replace UWES-17 in

research on work engagement as it can well evaluate work engagement.

In all, when measuring work engagement, it is necessary to first select the appropriate measurement tool by considering the reliability, validity, and applicable population of the scale. In addition, the understanding of work engagement may be significantly different across different cultural backgrounds. Therefore, attention should be paid to the cross-cultural applicability when selecting internationally established scales for local use. At present, there is a small number of studies on the measurement of work engagement of doctors in public hospitals, either in China or internationally. Therefore, this study's exploration can contribute to this field by filling the research gap.

2.4 Burnout

2.4.1 Definition of burnout

The concept of burnout was first proposed by the American scholar Freudenberger in 1974. By describing the characteristics of emotional exhaustion and motivation loss of volunteers working in clinics, Freudenberger suggested that burnout is a state of physical and mental fatigue and exhaustion of individuals at work, which comes from great work stress (Freudenberger, 2008).

In organizational behavior and human resource management research, the theory of burnout has gradually gained popularity among scholars since the 1980s (Bianchi et al., 2014). At present, Maslach's definition of burnout has been widely accepted by academic circles. According to Maslach and Jackson (1981), burnout is a syndrome of emotional exhaustion, depersonalization, or reduced sense of accomplishment. In the field of human services, this syndrome comes from employees' physical or psychological response to work.

In 1994, the International Labor Organization pointed out that "the world is becoming a tense world". Excessive job demands or work stress can lead to individuals' significant fatigue, anxiety, or depression, which will further result in reduced work ability or even physical and mental exhaustion. This phenomenon has been called "burnout" in academic circles (Freudenberger, 2008; X. Wu, 2005).

"Burnout" was formally included in the International Classification of Diseases 11th revision (ICD-11) at the World Health Assembly in 2019. According to the World Health Organization (WHO), the characteristics of burnout include the dimensions of a) energy depletion or exhaustion perceived by individuals at work, b) mental distance from one's job or

feeling of negativism or cynicism related to one's job, and c) a sense of ineffectiveness and lack of accomplishment. The WHO also states that this syndrome results from the lack of successful management of the chronic workplace stress faced by individuals (Y. Liu et al., 2021).

Burnout mainly results from chronic high work stress, which will lead to emotional, psychological, and physical exhaustion. Effective intervention measures need to be taken to help individuals proactively respond to related demands and stressors at work, so as to reduce their risk of burnout.

2.4.2 Review on burnout

Since Maslach and Jackson (1981) put forward the three-dimensional concept of burnout, both Chinese and international scholars have carried out relevant research on burnout in many occupations, such as civil servants, teachers, health care workers, and athletes, among others, and the research scope and theoretical system have been continuously expanded and improved (Y. Liu et al., 2021).

In theoretical research, scholars have explored burnout from both dynamic and static perspectives (West et al., 2016). The dynamic perspective regards burnout as a continuous and progressive development process: at a critical point, individuals suddenly perceive energy exhaustion, which will further develop into burnout, resulting in negative attitudes toward work and other individuals. The static perspective holds that the state of physical or psychological exhaustion results from the work environment with chronically excessive demands for emotional resources, which will further lead to burnout. However, as the current theoretical research has not yet reached a general consensus regarding the connotation and concept extension of burnout, scholars generally follow the three-dimensional definition of burnout proposed by Maslach and Jackson (1981) in their research (de Pablo González & González, 1998).

The COR theory, proposed by Hobfoll et al. (1989), explained burnout by combining the JD-R theory. Subsequently, through relevant research, the COR theory was further developed by Shirom (2003). The theory holds that job demands include multiple dimensions, including employees' role cognition at work, stress events, workload, and tense working atmosphere; job resources also include multiple dimensions, including employees' time, energy, and ability to engage in work, the available opportunities, and organizational and social support. According to the COR theory, a work environment with high job demands but insufficient job resources may lead to burnout among employees (Hobfoll et al., 1989; Shirom, 2003).

From the perspective of social exchange theory, Siegrist (1996) classified the influencing

factors of burnout according to two dimensions, namely, work effort and work reward, and proposed the model of effort-reward imbalance (ERI) at work accordingly. In the ERI model, the work effort dimension mainly includes the physical, time, and emotional investment of individuals during work, as well as other related intangible losses. The effort dimension includes individuals' physical and psychological efforts, while the reward dimension mainly includes salaries and benefits, the recognition of leaders and colleagues, and some other intrinsic rewards obtained by individuals by engaging in work (Maslach et al., 2001; Siegrist, 1996). The research based on the ERI model has shown that when employees' work rewards are insufficient to make up for their work efforts, it will result in stress; when employees are unable to effectively manage this imbalance between efforts and rewards, they will chronically stay in a physical or psychological state of tension or anxiety, which will lead to burnout (Harden, 1999; Feng, 2012).

Maslach et al. (2001) proposed the Job-Person Fit (JPF) theory, which states that burnout is rooted in the degree of fit between individuals and occupations, rather than caused by occupational or individual reasons unilaterally. According to the JPF theory, the engagement level of individuals in professional activities depends on the fit degree between personal expectations and the work environment. The greater the fit, the lower the risk of burnout, and vice versa. The JPF theory put forward six dimensions for evaluating the degree of fit between individuals and the work environment, including workload, reward, control, community, values, and fairness.

Previous research on burnout has established the complex "three-dimensional" structure of burnout and looked at individuals' stress experience in the wider organizational context and work environment – that is, individuals' relationship with work. With the international expansion of research on burnout and the emergence of new conceptual models, attention has been paid to work engagement as the positive opposite of burnout, bringing a new perspective for putting forward intervention measures to alleviate burnout (Maslach et al., 2001). Lien et al. (2016) showed that burnout would negatively impact employees' physical or psychological status, work process and outcomes, and their organizations, which may lead to employees' anxiety, absenteeism, negative work attitude, reduced work efficiency, and increased turnover intention.

Research has shown that due to medical services' characteristics of chronically high demands and heavy workload, health care workers are a high-risk occupational group prone to burnout (Gashmard et al., 2015). The high incidence of burnout has a significant negative impact on the medical work, family life, and physical or mental health of health care workers

(Cordes & Dougherty, 1993). In medical institutions, doctors' burnout can directly affect the quality and safety of medical services and seriously undermine doctor-patient relationships (Dewa et al., 2017; Moradi et al., 2015).

The British Medical Association (BMA) conducted a study on burnout among nearly 24,000 physicians. The survey results showed that 21% of the physicians perceived great stress and found it difficult to cope with, and those who explicitly expressed that they could not manage the negative impact of work stress on their personal lives accounted for 55%, which is obviously a high percentage (Gundersen, 2001). Primack et al. (2010) conducted a survey on the burnout of early career clinical investigators – research trainees in a medical institution. According to the survey results, 16% of the clinicians suffered burnout, and a higher incidence was reported among female doctors above 35 years old. Focusing on specific medical positions, Goldberg et al. (2014) conducted a survey on burnout among 1272 emergency physicians. According to the survey results, 60% of the emergency physicians suffered moderate or higher level of burnout. Similarly, Kluger et al. (2015) conducted a survey on burnout among 422 specialist anesthetists, and the results showed that in terms of gender differences, a higher incidence of burnout was reported among women. In addition, the percentage of anesthetists reporting high emotional exhaustion, high levels of depersonalization, and low levels of personal accomplishment reached 20%, 20%, and 36%, respectively. In 2019, Medscape surveyed more than 15,000 physicians across 29 specialties about burnout, depression, suicidal thoughts, and how they attain happiness. The results showed that 44% of the physicians suffered syndrome of burnout, 11% suffered syndrome of depression, and 4% were clinically diagnosed with depression. These results indicate that burnout is a critical problem among doctors in reality (Lo et al., 2018).

Chinese scholars' research has shown that there is a serious problem of burnout among Chinese health care workers, and the incidence of burnout syndrome ranged between 45.4% and 76.9%, which is significantly higher than that in Europe and North America (H. Wang & Zhang, 2008b). F. Wang and Xie et al. (2013) pointed out that the burnout of health care workers is not only related to their physical or mental health, but also related to the quality of medical services and patient safety, or even social harmony and stability. Given the age structure and health status of the Chinese population, chronic diseases have become the primary threat to health and the major cause of death for Chinese residents (M. Zhou et al., 2016). With the rapid development of China's economy and society and the increasingly prominent trend of an aging population, Chinese residents' demand for health safety and medical services is continuously growing. Solving the problem of "insufficient access and high costs of medical treatment" has

long been guiding health authorities' policy-making. As public hospitals are the main medical service providers in China, many health care workers in public hospitals encounter problems such as excessive workload (Q. Xu et al., 2018), low job satisfaction (Goldberg et al., 2014), and chronic physical and mental fatigue (Shen et al., 2018), which can lead to burnout and turnover intention of health care workers, negatively affecting their medical service ability (H. Yang et al., 2007). That will result in reduced quality and efficiency of medical work, further negatively impacting patients' satisfaction with medical treatment and even social harmony (C. Li, Shi, Luo, Yang et al., 2003).

Therefore, burnout not only affects health care worker's physical/mental health, job performance, and personal/family life quality, but can also greatly impact the doctor-patient relationship and the quality of medical services. At present, scholars' research on burnout of medical practitioners is mainly centered on the health care workers in large hospitals, especially the nurse population, while less research has been dedicated to doctors in public hospitals. Thus, through this study, we attempt to fill the gap and enrich the related research.

2.4.3 Measurement of burnout

Burnout is usually measured by using standardized and well-established questionnaires or scales. Internationally, scholars have conducted extensive research on burnout of health care workers. Based on theories and models such as the COR theory, the ERI model, and the JPF theory, they have developed a series of burnout scales applicable to various fields (Shao et al., 2019).

The Maslach Burnout Inventory (MBI) developed by Maslach et al. (2001) is currently the most commonly applied scale in burnout research. MBI measures burnout from three core dimensions: exhaustion, depersonalization, and inefficacy (reduced personal accomplishment). It includes 22 items, measured on a seven-point Likert scale. Test results showed that Cronbach's α of the three subscales of MBI were 0.90, 0.79, and 0.71, respectively, indicating that the scale has good reliability and validity (Maslach et al., 1997). In addition, the MBI scale has been developed into multiple versions with a wide range of applications. The scale in different language versions has been applied to many occupational fields, including nursing (Bria et al., 2014; Laranjeira, 2014; Pisanti et al., 2013).

Shirom and Melamed (2005) developed the Shirom-Melamed Burnout Measure (SMBM), which focuses on the dimensions of physical fatigue, emotional exhaustion, and cognitive weariness, providing a relatively comprehensive assessment framework for burnout. The Oldenburg Burnout Inventory (OBI) is also a widely applied measurement tool, which focuses

on the dimension of emotional exhaustion and involves work-related factors and personal factors (Shirom, 2003).

Kristensen et al. (2005) developed the Copenhagen Burnout Inventory (CBI), which contains 19 items from the dimensions of personal burnout, work-related burnout, and client-related burnout, measured on a five-point Likert scale. The scale focuses on the measurement of individuals' exhaustion and fatigue. The internal consistency coefficients of CBI and its three subscales were 0920, 0902, 0.765, and 0.927, respectively. The scale was found to have good reliability and validity (Jordan et al., 2013).

The Spanish Burnout Inventory (SBI) was designed by Gil-Monte et al. (2013) mainly to measure organization members' negative emotional responses due to chronic work stress and interpersonal difficulties at work, from four core dimensions: enthusiasm toward the job, psychological exhaustion, indolence, and guilt. The SBI scale includes 20 items, measured on a five-point Likert scale. Compared with MBI, the SBI scale contains a broader range of dimensions of burnout. Its four subscales were found to have good internal consistency, showing a high level of reliability and validity. Some studies have shown that the four-dimensional model of the SBI scale provides an adequate measurement for psychological characteristics and can be used to study burnout in the context of Portuguese culture (Figueiredo-Ferraz et al., 2013).

At present, Chinese scholars have mainly used internationally established scales as reference to measure burnout, such as the translated and localized version of MBI. For instance, C. Li, Shi, Luo, Li et al. (2003) were the first to translate and adapt the Maslach Burnout Inventory – Human Services Survey (MBI-HSS) to the Chinese healthcare context. They conducted a survey on burnout among a sample of health care workers from three hospitals. The results showed that 42.1% of the health care workers suffered emotional exhaustion, 22.7% reported depersonalization, and 48.6% lacked a sense of personal accomplishment. H. Xu (2013) developed a burnout scale for doctors based on six dimensions, including work ability, work control, work engagement, work prospects, emotional management, and fatigue, and the test results showed that the scale had high levels of reliability and validity. By applying the localized version of MBI in the field of healthcare, Chinese scholars' studies have been able to reveal the current status of burnout among medical practitioners in China to a certain extent, but due to the limited breadth and depth of research, current studies failed to accurately provide a comprehensive view of the burnout status of this population (Liang et al., 2017). In addition, there has been relatively little application of this scale to clinicians, and currently, there is no established burnout scale specifically for clinicians (Yi et al., 2017).

In summary, burnout is a very relevant but yet complex issue in the field of human resource management and organizational behavior, and MBI is one of the most commonly used measurement tools for it. Scholars have continued to explore and develop the theory and measurement methods of burnout, but currently, Chinese scholars' research on burnout in the context of medical institutions is mainly centered on the whole health care workers population or nurses, and the research focusing on the burnout of doctors in public hospitals is rather limited. In view of that, this study will attempt to further explore this topic and enrich the research.

2.5 Leader-member exchange

2.5.1 Definition of leader-member exchange

Scholars believe that the relationship between leaders and subordinates is essentially the leader-member exchange (LMX), which refers to an exchange relationship with specific economic and social attributes based on the working relationship between leaders and subordinates (Cashman et al., 1976). Due to the limitation of time and energy, leaders tend to distinguish their subordinates and adopt differentiated management styles at work, which will lead to differentiated working relationships. Accordingly, the interaction between subordinates and leaders also shows differentiation (Graen & Uhlbien, 1995). The LMX theory emphasizes the establishment of a one-to-one relationship between the leader and different subordinates, which is based on the theory of role play, social exchange, and reciprocity (Deluga, 1994). Drawing on the LMX theory, some scholars proposed the concept of relationship circles. According to the proximity of the relationship between subordinates and leaders at the physical and psychological levels, subordinates are categorized into "in-group" and "out-group" members. According to Carsten et al. (2010), leaders usually distinguish their subordinates in work and carry out differentiated management and resource allocation according to the quality of the relationship, which will further affect subordinates' behaviors as followers. After more than 40 years of exploration and development, the LMX theory remains a relevant and frontier topic in the field of management psychology (Schriesheim et al., 2011).

China is a typical relationship-oriented society (Y. Li & Tu, 2011), where "relationship" and "power" are the most relevant and noteworthy issues in Chinese society. These characteristics will result in different types of social exchange in individuals' daily work and life (Zhai, 2011). From the working relationship perspective, LMX refers to a hierarchical

relationship that is established between leaders and subordinates in an organization to serve specific job demands and is formally implemented in the workplace (Ren et al., 2014).

The essence of the relationship between leaders and subordinates lies in the exchange of economic or emotional resources between leaders and subordinates in the same organization. Under the premise of limited resources, the purpose of this exchange is to find the best combination that can maximize the interests of individuals and organizations, so as to achieve personal and organizational goals.

2.5.2 Review on leader-member exchange

In the 1970s, the leader-member exchange (LMX) theory was developed by multiple scholars, including Dansereau et al. (1975) and Cashman et al. (1976). Over the past 40 years, LMX has developed into a popular and frontier topic in the field of management psychology. The literature on LMX encompasses various research perspectives, including concept definition, dimensionality, relationship quality, and relationship analysis, forming a multi-dimensional framework for the theoretical research on LMX (Ren et al., 2014). For instance, from the perspective of relationship quality, Graen and Uhl-Bien (1995) developed a new classification method for leadership and elaborated on the theoretical perspective of LMX as a relationship-based leadership, providing references for future related research.

For the operational concept of LMX, scholars generally agree that it is represented by “the quality of exchange” (Schriesheim et al., 1999). Schriesheim et al. (1999) conducted a review of the relevant theoretical research since the first study of LMX structure in the 1970s, including the theoretical system and measurement methods of LMX. They showed that the definition and dimensions of LMX evolved over time, and the measurement tools varied greatly, which may result in researchers’ insufficient understanding of the communication between leaders and subordinates.

Scholars such as Bernerth et al. (2006) and Law et al. (2000) focused on defining the concept of leader-member exchange. Law et al. (2000) pointed out that with China’s rapid economic growth, China has become an important global market, where the establishment and maintenance of good interpersonal relationships between leaders and subordinates is one of the key factors for foreign enterprises’ effective investment and management in China. From the perspective of dimensionality, Liden and Maslyn (1998) as well as S. Peng and Yang (1999) developed and validated multidimensional measurement tools for LMX.

In recent years, there has emerged a prominent question in the theoretical research on LMX: Is the core of the LMX theory “the quality of exchange” or “the quality of relationship”? It has

been pointed out that the LMX-7 scale (Graen & Uhl-Bien, 1995) and LMX-MDM scale (Liden & Maslyn, 1998), which are widely used to evaluate the relationship between leaders and subordinates, focus on evaluating the quality of the relationship, rather than the real social exchange (Bernerth et al., 2006). X. Huang et al. (2008) conducted research from the perspective of differences in behavior, cognition, and traits and found that leaders and members tend to form different relational schemas of their partners. While leaders developed LMX schemas that focus on work-related issues, members tend to focus more on interpersonal concerns. The different relational schemas employed by the two parties will affect how they store, retrieve, and (mis)evaluate their LMX experiences with each other.

In China, there is a tradition of hierarchical relationships between leaders and subordinates in organizations, but systematic research on this type of relationship is still in its early stage, and there is only a small number of empirical studies of LMX in the context of Chinese culture (Ren et al., 2010). Among the localized research on LMX, B. S. Cheng et al. (2006), from the perspective of relationship types, pointed out that the relationship between leaders and subordinates was related to their role obligations; interpersonal behaviors depend on individuals' identification of the relationship with the other party and the communication rules selected accordingly; and an individual's identification of the relationship will affect the subsequent interpersonal interaction behavior. Scholars have suggested that in localized research on LMX, it is also necessary to consider the "differential pattern theory" related to the cultural background and interpersonal communication in the Chinese context (Fei, 2020) Traditionally, people may adopt different standards when treating people depending on the relationships with them, and that stems from the "differential pattern" cognition in Chinese social relationships (B. S. Cheng, 2006). On the whole, although Chinese scholars' research on LMX involves multiple dimensions, there is still a lack of systematic and in-depth research regarding this theory's localized connotation and structure (Ren et al., 2010).

From the perspective of the LMX theory's application in different cultural contexts, Berry (1989) studied cross-cultural strategies and proposed "derived etic" strategy and "imposed etic" strategy, between which, the "derived etic" strategy is considered superior. Chinese scholars such as D. Wang and Cui (2003) conducted comparative research on Chinese and Western personality structure and further verified this conclusion. Wong and Cheng (2020) suggested that encouraging leaders to improve their communication with employees and establish group preferences could help reduce employees' burnout and its negative impact. From the perspective of job resources, Zeng et al. (2022) showed that LMX could positively affect the doctor-patient relationship, thus further improving doctors' work engagement.

With the development of the social network theory and the wide application of the multilevel analysis model, the LMX theory increasingly emphasizes the role of "relationship" in LMX's operational concept. Some scholars started referring to the concept of LMX as "LMX relationship" (Goodwin et al., 2009; Schriesheim et al., 2011). From this theoretical perspective, "the quality of relationship" seems to outweigh "the quality of exchange" in the concept of LMX.

The construct of LMX is mainly used to measure and evaluate the quality of the relationship established between leaders and subordinates in the organization based on organizational goals and job demands. It mainly focuses on work relationships but also includes related non-work relationships. In management, leaders should pay attention to improving the work enthusiasm of employees and the operation efficiency of the organization. At present, the LMX theory has not been applied much to the medical service industry in China, and there is limited research focusing on doctors in public hospitals. This study will explore this topic to fill the research gap.

2.5.3 Measurement of leader-member exchange

The measurement dimensions of LMX are based on the research dimensions of "relationship". Research from the perspective of "relationship" dimensionality focuses on the content dimensions or component composition of the "relationship", and therefore, it is also called the "component view" (Ren et al., 2010). The measurement of LMX includes single-dimensional measurement and multi-dimensional measurement.

The single-dimensional view of LMX considers LMX is a continuum from low quality to high quality and emphasizes the overall quality of the exchange relationship between leaders and subordinates in the workplace. A representative scale is LMX-7, which was developed by Graen and others and contains one dimension and seven measurement items. Operationally, LMX is represented by the overall quality of the working relationship, focusing on work-related content and emphasizing an overall measurement. The scale is relatively simple and practical in operation (Graen & Uhl-Bien, 1995; Graen et al., 1982). Law et al. (2000) developed a LMX scale that contains one dimension and six measurement items, with LMX operationally represented by the relationship quality outside of work, serving as a supplement to LMX-7. Bernerth et al. (2006) developed the leader-member social exchange (LMSX) scale, which is considered superior to LMX-7 in criterion validity. The scale contains one dimension and eight measurement items, and LMX is operationally represented by the quality of leader-member social exchange at work.

The multidimensional view of LMX holds that LMX involves multiple dimensions, such as affect, loyalty, contribution, and professional respect. A representative scale is the LMX-MDM scale developed by Liden and Maslyn, where LMX is operationally represented by a relationship measurement based on multiple dimensions beyond work. The scale includes four dimensions and 12 items and emphasizes the diversity of roles (Liden & Maslyn, 1998).

However, Schriesheim et al. (1999) hold a different view. They pointed out that the initial design and subsequent modification of various LMX scales were too arbitrary. In terms of scientificity, the theoretical logic of the scales is not clear. Moreover, the items failed to provide a global and comprehensive measurement, and the scales need to be further tested for structural validity and content validity.

M. Huang et al. (2006) designed a formal scale for LMX, which includes three dimensions and 15 items. For the first time, they measured three types of components of the relationship in the Chinese context: the established components, the instrumental components, and the affective components. The authors found that the instrumental components showed a negative effect, and the LMX directly impacted subordinates' loyalty to their leaders. This scale is the first localized LMX scale in the Chinese context, but its content lacks precision, and some findings are quite different from the general views in other studies (Goodwin et al., 2009). X. Huang et al. (2008) defined the cognition of role expectations through relational schemas, based on which they developed a scale for measuring LMX schemas. Through measurement and analysis, it was found that individuals' evaluation of LMX experiences showed variation, which had a particular effect on their role cognition. As for the localized measurement of LMX, Ren et al. (2010) pointed out that a localized LMX scale should be developed by taking into account standardized psychological measurement, cultural fit, and validation criteria, ensuring that the LMX measurement conforms to psychological measurement standards, fits Chinese cultural tradition, and conforms to validation criteria.

In summary, LMX measurement is generally based on the dimensionality of "relationship", using either single or multi-dimensional scales to assess the trust, interaction quality, cooperation level, and satisfaction between leaders and subordinates in work.

This study, based on the JD-R theory and COR theory, considers LMX as a job resource of employees. In other words, a doctor with a high-quality LMX tends to have access to more job resources, such as support and care from their leaders. We posit that these resources can compensate for doctors' resource depletion caused by job demands, thereby mitigating the health impairment effect of those demands..

2.6 Research hypotheses

2.6.1 Job demands and the doctor-patient relationship

According to the JD-R theory, job demands can lead to individuals' work stress. Medical work is an occupation characterized by high intensity, high stress, and high risk (L. Fang & Yang, 2018). Thomas and Valli (2006) pointed out that compared with the general working population, clinicians tend show a higher level of work stress. Excessive job demands and occupational stress can lead to high error rate, low job satisfaction, emotional exhaustion, increased burnout, and increased turnover intention, and may induce negative behaviors such as smoking, alcoholism, and suicide (Song et al., 2017). Moreover, the burnout of doctors will directly affect the medical quality and safety and can greatly undermine the doctor-patient relationship (Dewa et al., 2017; Moradi et al., 2015).

In terms of job demands, Xanthopoulou et al. (2013) pointed out that in order to improve the satisfaction of patients and their families with medical services, the health care workers at the front line need to cope with interpersonal situations involving emotions through effective doctor-patient communication and interaction. A. Wang et al. (2016) conducted a study on the work stress of health care workers and found that they were bearing a high level of work stress, which would not only lead to the poor working status of doctors, but also cause doctor-patient disputes in escalated cases. Continuous exposure to a work environment with high job demands will lead to energy depletion among doctors, which will further lead to their emotional exhaustion and health impairment, as well as reduced medical quality and job performance, thus affecting the doctor-patient relationship. Shi et al. (2017) suggested that if doctors stay in an environment where they are continuously confronted with high job demands, they are likely to show reduced work enthusiasm, develop burnout, and grow negative thoughts, perceiving that the doctor-patient relationship would not be improved despite their efforts.

Based on the JD-R model and the COR theory, the interaction mechanism between doctors' job demands and the doctor-patient relationship in China's public hospitals can be explored from the following perspectives:

First, doctors' workload may be negatively related to the quality of the doctor-patient relationship. When doctors are confronted with a high workload in medical practice, in other words, when they need to receive and treat a large number of patients in a short time, they will not be able to allocate sufficient time to every single patient, which may lead to insufficient doctor-patient communication and interaction, thus reducing medical quality. In this case,

patients may feel ignored by doctors, while doctors may feel not being understood by patients. Such a reduced mutual trust will affect the quality of the doctor-patient relationship.

In addition, the emotional labor caused by doctors' work stress may directly affect the quality of the doctor-patient relationship. Research has shown that there is a significant relationship between individuals' emotional labor and work stress: the higher the stress, the greater the emotional labor. Chronic emotional labor will result in accumulated negative emotions on individuals, which in turn will lead to even greater work stress, thus forming a vicious circle (Khalid et al., 2020). If doctors feel emotionally exhausted or are unable to effectively manage their emotions over a long period of time, they may show an indifferent attitude during the communication and interaction with patients, which may affect patients' trust in them, thus negatively impacting the doctor-patient relationship.

Therefore, we put forward the following hypothesis:

Hypothesis 1 (H1): *Job demands (JD) are negatively associated with the doctor-patient relationship (DPR).*

2.6.2 Job demands and work engagement

According to the definition of work engagement, a high level of work engagement means that an individual is in a positive experience, showing strong professional identification and a high level of energy at work (Schaufeli et al., 2006). Work engagement is related to professional identification since individuals' intrinsic work motivation will decrease with the decline of professional identification (Hua et al., 2020). Individual doctors' identification with their role as medical workers will affect their work engagement in medical work. Health care worker's professional identification is manifested by their positive perception and evaluation of the medical practice and related aspects on the psychological level (Y. Zhu, 2020).

Research has shown that when job resources are insufficient to meet job demands, it will lead to a decline in employees' work engagement; an environment with high job demands and insufficient job resources is likely to lead to burnout or turnover intention among employees (Demerouti et al., 2001). In public hospitals, doctors are chronically confronted with high work stress. According to the JD-R theory, such a high work stress, as a job demand, will lead to energy depletion among individual doctors, which will result in doctors' poor job performance or even cause doctor-patient disputes (A. Wang et al., 2016). When the stress cannot be well managed, it will lead to a decline in doctors' job satisfaction, which further leads to burnout, greatly affecting the level of work engagement (T. Yang et al., 2017). Previous studies have also shown that with high job demands, the motivating effect of job resources on individuals' work

engagement becomes more prominent (Bakker et al., 2007, 2010).

Based on the JD-R model and the COR theory, the interaction mechanism between doctors' job demands and work engagement in the context of China's public hospitals can be discussed from the following perspectives. Excessive job demands may lead to a decrease in doctors' work engagement. Although appropriate job demands can stimulate individuals' work engagement, when faced with excessive job demands, doctors may be physically and mentally exhausted due to excessive work stress and workload, which will affect their work engagement. In this case, doctors may grow resistance to the current work, thus reducing the level of work engagement or even leading to burnout or turnover intention.

Therefore, the following hypotheses is put forward:

Hypothesis 2 (H2): *Job demands (JD) are negatively associated with work engagement (WE)*.

2.6.3 Job demands and burnout

According to the JD-R model, when an organization has excessive job demands and insufficient job resources, it is likely to lead to burnout among employees (Hobfoll et al., 1989; Shirom, 2003). Research has shown that if employees cannot cope with the high job demands, it may result in work stress (Meijman & Mulder, 1998). Moreover, according to the JPF theory, burnout is rooted in the fit degree between individuals and occupations and is related to workload, reward, control, community, values, and fairness (Maslach et al., 2001).

The energy depletion path, one of the JD-R model's "dual paths", states that excessive job demands and insufficient job resources may lead to individuals' energy depletion, resulting in burnout and negative outcomes at work (Q. Yang & Li, 2022). Due to medical services' characteristics of chronic high job demands and heavy workload, health care workers are considered a high-risk occupational group prone to burnout (Gashmard et al., 2015). The high incidence of burnout has been found to show a significant negative impact on health care worker's work, family life, and physical/mental health (Cordes & Dougherty, 1993). Employees with burnout may even show self-destructive behaviors, resulting in an increase in job demands due to the vicious circle, which will further lead to an escalated level of burnout (Bakker & Demerouti, 2024).

Based on the JD-R model and the COR theory, the interaction mechanism between job demands and burnout of doctors in China's public hospitals can be explored from the following perspectives.

First, high job demands may increase the risk of burnout among doctors. Their medical

work is usually characterized by high work stress, long working hours, and high intensity. When doctors need to deal with job demands and work stress beyond their physical and psychological endurance in a limited time, they are likely to develop emotional exhaustion and physical and mental fatigue, resulting in a loss of enthusiasm and confidence in medical work, as well as a decrease in mutual distrust and proximity when communicating with patients, which will further lead to burnout syndrome or even turnover intention.

Moreover, in addition to the high job demands, doctors may also face the reality of insufficient resources in medical practice, such as the shortage of professionals, urgency of tasks, and inadequate logistical support. The shortage of such job resources may increase doctors' work stress, further increasing the risk of burnout. At the same time, the lack of a supportive work environment and insufficient team and leadership support may lead to doctors' doubt about their career prospects, which will further lead to burnout.

Therefore, the following hypothesis is put forward:

Hypothesis 3 (H3): *Job demands (JD) are positively associated with burnout (BO).*

2.6.4 Doctor-patient relationships and work engagement

The doctor-patient relationship is not only closely related to patient satisfaction and treatment effect (Eveleigh et al., 2012; Mohseni & Lindstrom, 2007), but also has a great impact on health care worker's work status and career development prospects (Baker et al., 2003). The chronically intensive and stressful work environment is likely to reduce employees' work enthusiasm, thus leading to burnout (Shi et al., 2017). The chronic high workload of doctors in public hospitals can easily cause physical and mental fatigue and emotional exhaustion, making doctors a high-risk group prone to burnout, which can negatively impact the doctor-patient relationship (X. Zhao et al., 2019).

Ma et al. (2017) pointed out that the increasingly tense doctor-patient relationship is a highly concerning issue in the field of public health in China and suggested that the deteriorating doctor-patient relationship can be improved by addressing clinicians' needs such as autonomy in work, use of expertise, and empowerment, as well as by providing competitive and fair compensation and benefits. Based on the JD-R model, Zeng et al. (2022) argued that the doctor-patient relationship, as a challenge demand in the current Chinese medical service environment, may also bring financial and professional rewards to doctors, despite of its physically and psychologically stressful characteristics.

We argue that a good doctor-patient relationship, as a challenge job demand, has the potential to promote personal growth or financial gains, which will motivate doctors to better

carry out medical services (Crawford et al., 2010; Zeng et al., 2023). Previous research has indicated that challenge job demands have a significant positive impact on individuals' work engagement (Crawford et al., 2010). If doctors perceive a high level of doctor-patient relationship in medical practice, it may enhance their psychological meaningfulness in medical work, which will further stimulate their work enthusiasm.

Based on the JD-R model and the COR theory, the interaction mechanism between the doctor-patient relationship and doctors' work engagement in China's public hospitals can be explored from the following perspectives.

First, a good doctor-patient relationship may motivate doctors to show a higher level of work engagement. When doctors and patients establish a good interactive relationship in medical practice, it can reduce communication barriers and misunderstandings between the two, enhance patients' trust and cooperation with doctors, and create a more supportive work environment for doctors, making it more likely for doctors to perceive the meaningfulness of their medical work, thereby enhancing individuals' professional identification, stimulating their work motivation, and increasing their work engagement.

In addition, a tense doctor-patient relationship may lead to a decrease in the work engagement of doctors. When doctors are faced with tense doctor-patient relationships in medical practice, they may sense the non-understanding and threat of the patients and their families and may even feel being unfairly judged and treated, which can stimulate doctors' psychological defensiveness, work stress, and emotional exhaustion, leading to negative emotions and attitudes toward medical work, thereby reducing work engagement, forming a vicious circle.

Therefore, the following hypothesis is put forward:

Hypothesis 4 (H4): *The doctor-patient relationship (DPR) is positively associated with work engagement (WE).*

Combining H1 (negative relationship between job demands and the doctor-patient relationship) with H4, we put forward the following hypothesis:

Hypothesis 5 (H5): *The doctor-patient relationship (DPR) mediates the relationship between job demands (JD) and work engagement (WE).*

2.6.5 Doctor-patient relationship and burnout

The doctor-patient relationship is a specific interpersonal relationship established in the process of medical services, with both doctors and patients as the main actors (Q. Li & Li, 2021). It is one aspect of the work environment that doctors are confronted with in medical practice. The

doctor-patient relationship with low quality, tension, and lack of trust will result in more stress and energy depletion among doctors in medical work.

As medical work has the characteristics of high workload, stress, and fatigue, doctors are a high-risk population prone to burnout (Gashmard et al., 2015). In medical institutions, doctors' burnout will directly affect medical quality and safety, which may seriously undermine the doctor-patient relationship (Dewa et al., 2017; Moradi et al., 2015). Research has shown that with the rapid development of China's economy and society and the increasingly prominent trend of population aging, residents' demand for medical services continues to grow. Doctors in most public hospitals face problems such as a high level of workload, low job satisfaction, and physical and mental fatigue, which may lead to the reduction of work quality and efficiency and undermine doctor-patient relationships, further leading to burnout or turnover intention (C. Li, Shi, Luo, Yang, et al., 2003). At present, in China, doctors' overall evaluation on the doctor-patient relationship is not optimistic, as it brings serious emotional exhaustion and leads to burnout, which, in turn, will further negatively impact the doctor-patient relationship (X. Zhao et al., 2019).

Based on the JD-R model and the COR theory, the interaction mechanism between the doctor-patient relationship and doctors' burnout in China's public hospitals can be discussed from the following perspectives.

A harmonious doctor-patient relationship may reduce the risk of burnout among doctors. When doctors and patients have established good communication and interactions in medical services, doctors' perceived work stress and negative emotions may be reduced. This positive work environment helps to improve doctors' mental well-being and may enable them to directly perceive a sense of accomplishment and the meaningfulness of work, thereby increasing their work motivation and reducing the risk of burnout.

Hence, the following hypothesis is put forward:

Hypothesis 6 (H6): *The doctor-patient relationship (DPR) is negatively associated with burnout (BO).*

Combining H1 (negative relationship between job demands and the doctor-patient relationship) and H6, we put forward the following hypothesis:

Hypothesis 7 (H7): The *doctor-patient relationship (DPR) mediates the relationship between job demands (JD) and burnout (BO)*.

2.6.6 Work engagement and burnout

A high level of work engagement means that the individual has a strong professional

identification at work, which is a positive experience for them (Schaufeli et al., 2006). According to Maslach and Leiter (1997), work engagement is a sustained positive state of individuals at work, and therefore, it is regarded as the opposite of burnout. The research of Schaufeli et al. (2006) confirmed that work engagement could be regarded as the positive antipode of burnout.

Based on the COR theory, if employees invest a lot of inherent resources, such as time, energy, and opportunities, but the reward is insignificant or obviously unbalanced compared with the investment, it will reduce the motivation for work engagement, further leading to burnout (Hobfoll & Shirom, 2001). However, in medical practice, if doctors invest a lot of expertise, time, and energy in diagnosis and treatment, they will bring a friendly and professional medical experience to patients in most cases, making it more likely for patients to understand, support, and cooperate with doctors' medical work. Such positive feedback can further motivate doctors to invest more physical or psychological resources, thereby reducing the risk of burnout.

Based on the JD-R model and the COR theory, the interaction mechanism between doctors' work engagement and burnout in the context of China's public hospitals can be discussed from the following perspectives.

First, higher work engagement may reduce the risk of burnout. When doctors are full of enthusiasm for medical work in their practice, possess a strong sense of responsibility, and are more focused when communicating and interacting with patients, they are more likely to intuitively enjoy the sense of accomplishment brought by medical work, which can continuously stimulate their intrinsic motivation to be engaged in work, making them more patient in dealing with work stress and challenges, thus reducing emotional exhaustion and physical and mental fatigue, thereby reducing the risk of burnout.

Moreover, low work engagement may increase the risk of burnout. In medical practice, if doctors' investment in medical work and doctor-patient communication is insufficient and they show a lack of responsibility and indifferent attitude to patients' diseases, they are more likely to perceive the stress and tediousness of the work, which may result in patients' negative feedback on the quality of the medical service or even cause doctor-patient conflicts, further leading to doctors' negative emotions for work and increased emotional exhaustion, thus increasing the risk of burnout.

In addition, burnout may affect doctors' work engagement. Doctors with burnout may show a negative attitude toward medical work or unwillingness to cope with challenges and lose enthusiasm or become tired of the job of saving people's lives. Such emotional exhaustion may

lead to a continuous decrease in their engagement in medical work, resulting in a vicious circle, which further increases doctors' burnout. This study is mainly based on the theoretical framework of the JD-R model and the COR theory to explore the generation mechanism of burnout among doctors in public hospitals and the path of job demands and resources influencing burnout. Therefore, in this study's research design, we pay attention to the path of work engagement influencing burnout.

Hence, the following hypothesis is put forward:

Hypothesis 8 (H8): *Work engagement (WE) is negatively associated with burnout (BO).*

Combining H1 (negative relationship between job demands and the doctor-patient relationship), H4 (positive relationship between the doctor-patient relationship and work engagement), and H8, we propose the sequential mediation hypothesis as follows:

Hypothesis 9 (H9): *Job demands (JD) are positively associated with burnout (BO) through the doctor-patient relationship (DPR) and work engagement (WE)*.

2.6.7 Leader-member exchange between job demands and the doctor-patient relationship

The essence of the relationship between leaders and subordinates is the leader-member exchange (LMX), which refers to a work-based exchange relationship with specific economic and social attributes established between leaders and subordinates (Cashman et al., 1976). According to the concept of relationship circles in the LMX theory, leaders usually distinguish different subordinates in work and carry out differentiated management and resource allocation according to the quality of the relationship, which will result in subordinates' different behaviors as followers (Carsten et al., 2010). In public hospitals, the quality of the work-based relationship established between leaders and doctors can affect doctors' perception of this relationship, resulting in their different interaction and behavior styles, which may affect the process and outcomes of medical practice.

The LMX in this study mainly refers to the work-based relationship established between doctors and their leaders in public hospitals. In operation, it focuses on the working relationship between doctors and their direct leaders and the quality of this relationship. According to the JD-R model and the COR theory, in medical practice, doctors tend to obtain resources they consider valuable for themselves and for their work. A good LMX serves as a resource gain for doctors in medical work, as it can make up for the resource loss in the "energy depletion path" caused by job demands in the JD-R model. In medical practice, when doctors are faced with high job demands, they have to make more physical and psychological efforts, which may lead to the depletion and loss of doctors' job resources, causing stress responses in individuals. In

this case, if job resources such as leadership support are available to address such needs, doctors will be able to access additional resources as replenishment, mitigating the decline in the quality of the doctor-patient relationship caused by job demands.

Therefore, based on the JD-R model and the COR theory, LMX can influence the relationship between job demands and the doctor-patient relationship in the context of China's public hospitals. This influence mechanism can be discussed from the following perspectives.

First, based on the COR theory, good LMX, as a job resource, can moderate and buffer the negative impact of job demands on the doctor-patient relationship. When positive interactions and a mutually supportive working relationship are established between doctors and leaders, leaders are more likely to provide these doctors with necessary resources and support in medical work. Such resource investment and leadership support can help doctors better respond to high job demands and reduce work stress and negative emotions, enabling them to actively improve the quality of interaction and communication with patients in medical work, thereby improving the quality of the doctor-patient relationship.

On the contrary, tense LMX may accentuate the negative impact of job demands on the doctor-patient relationship. If the working relationship between doctors and their leaders (e.g., department directors) is tense or shows contradictions and conflicts, the leaders may not understand doctors' status and do not actively provide support for doctors to address the job demands and stress. In certain circumstances, the leaders may even impose additional pressure or restrictions on doctors' medical work. In this case, doctors may feel more depressed, helpless, and dissatisfied. Such negative emotions may aggravate their energy depletion in medical work and reduce their enthusiasm for medical services, which will negatively impact the quality of communication and interaction with patients. Due to the lack of mutual trust between doctors and patients, the doctor-patient relationship will be further undermined.

LMX not only has a direct effect on the quality of the doctor-patient relationship, but also indirectly affects the doctor-patient relationship by influencing doctors' job demands. For example, leaders can improve doctors' working conditions and reduce doctors' work stress by imposing more reasonable job demands, providing necessary emotional and resource support, and creating a friendly working atmosphere, which will enable doctors to establish better communication and interaction with patients in medical work. Therefore, LMX may play a moderating (buffering) role in the relationship between doctors' job demands and the quality of the doctor-patient relationship.

Therefore, the following hypothesis is put forward:

Hypothesis 10 (H10): *The leader-member exchange (LMX) mitigates the relationship*

between job demands (JD) and the doctor-patient relationship (DPR), such that the better the LMX, the weaker the negative relationship between JD and the DPR.

Combining that with H5 (the doctor-patient relationship mediates the relationship between job demands and work engagement), we put forward the following hypothesis:

Hypothesis 11 (H11): *The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) in the negative relationship between job demands (JD) and work engagement (WE), such that the higher the LMX quality, the weaker the negative relationship between JD and WE through DPR*.

Similarly, combining with H7 (the doctor-patient relationship mediates the relationship between job demands and burnout), we put forward the following hypothesis:

Hypothesis 12 (H12): *The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) in the positive relationship between job demands (JD) and burnout (BO), such that the higher the LMX quality, the weaker the positive relationship between JD and BO through DPR.*

Combining with H9 (job demands are positively associated with burnout through the doctor-patient relationship and work engagement), we put forward the following hypothesis:

Hypothesis 13 (H13): *The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) and work engagement (WE) in the positive relationship between job demands (JD) and burnout (BO), such that the higher the LMX quality, the weaker the positive relationship between JD and BO through DPR and WE*.

In summary, based on the proposition of the JD-R model that job demands lead to energy depletion, this study deduced the path relationship between job demands and the doctor-patient relationship and between work engagement and burnout. In addition, based on the COR theory and the "buffer" hypothesis of the JD-R model (i.e., when excessive job demands bring negative physical or psychological effects and energy depletion to individuals, sufficient job resources can play a role in buffering such negative effects), this study hypothesized the moderation effect of LMX in the main paths between job demands and other variables.

According to the above-proposed 13 research hypotheses, the theoretical hypothesis model of this study is constructed, as shown in Figure 2.1.

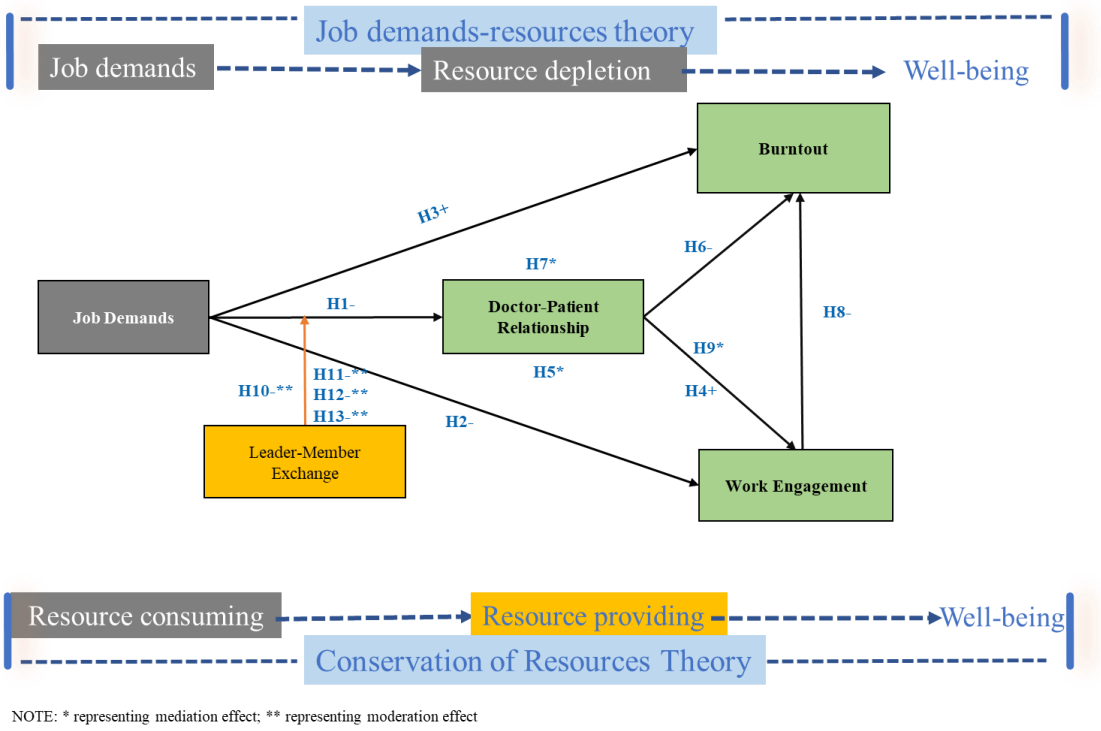

Figure 2.1 Theoretical hypothesis model

Note: (+) indicates that the effect coefficient is positive; (-) indicates that the effect coefficient is negative.

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Chapter 3: Research Methods

Using convenience sampling and following the principle of ensuring representativeness, this study employed the cross-sectional design and collected data of sociodemographic information and relevant measurement indicators from 708 doctors in 18 public hospitals in 14 cities of Jiangsu Province, China through a questionnaire survey on the "Sojump" platform. The content of the questionnaire includes the sample's sociodemographic information and the measurement of job demands (JD), doctor-patient relationship (DPR), work engagement (WE), burnout, and leader-member exchange (LMX). In this study, SPSS 26.0 and AMOS 24.0 were used for statistical analysis. Confirmatory factor analysis, exploratory factor analysis, and Cronbach's α were employed to test the reliability and validity of each scale; descriptive statistical analysis was performed to find out the current status of doctors' job demands, doctor-patient relationship, work engagement, and burnout in public hospitals; independent sample t-tests and one-way analysis of variance (ANOVA) were performed to find out the differences between groups in the scores of measurement variables; the Process Macro (Hayes, 2018) was used to test the hypothesis model.

3.1 Research process and sampling

This study employed a cross-sectional design. From November to December 2023, based on convenience sampling and the principle of ensuring representativeness, we conducted a questionnaire survey via the "Sojump" platform on doctors from 18 public general or specialized hospitals in 14 cities at different administrative levels in different regions of Jiangsu Province. During sample selection, prior to determining the sample hospitals, we solicited opinions from the directors and vice directors of eight Grade A tertiary (Grade III A) hospitals with rich management experience in Jiangsu Province, and two industry management experts from the Jiangsu Province Hospital Association. We organized a group exchange session and conducted ten individual interviews (seven face-to-face interviews and three telephone interviews) to consult on the design of the questionnaire.

The convenience sampling used in this study refers to reasonably selecting the sample organizations based on convenience. This study selected public hospitals of all categories at all levels in Jiangsu Province as the survey sample. Jiangsu Province is at the forefront of China's

reform and opening-up and is the leading province in economic and social development. The medical service capacity of its medical institutions of all categories at all levels is relatively strong, and the relevant policy and theoretical research is at a relatively mature stage compared to other regions in China. Moreover, as the researcher of this study has been engaged in management and academic research in medical institutions, medical associations, hospital associations, and public hospitals in the province, he has a significant advantage in the convenience of transportation, coordination, and communication required for this study.

In this study, ensuring the representativeness of samples means ensuring the diversity and balance of the selected of sample organizations. In terms of the administrative level of the city where the sample hospital is located, the sample selected in this study includes the provincial capital city, prefecture level city, county-level city, and county-level district; in terms of the level of economic and social development of the cities where the sample hospitals are located, this study included new first-tier cities, second-tier cities, and third-tier cities; in terms of the medical service capacity of the sample hospitals, this study included grade A tertiary (Grade III A) hospitals, grade B tertiary (Grade III B) hospitals, grade A secondary (Grade II A) hospitals, and other levels of hospitals; in terms of the category of sample hospitals, this study included both general hospitals and specialized hospitals. Overall, in selecting the sample hospitals, we fully considered the current basic structure and functional classification of hospitals in China's healthcare system, according to the purpose and objectives of this study. The selected samples exhibited strong representativeness and feasibility.

The 18 sample hospitals selected in this study exhibit their respective regional characteristics, development characteristics, and research values. JSRY is a provincial-level Grade III A general hospital located in the capital city of the province, SDFY is a Grade III A general hospital located in an economically developed non-capital prefecture-level city, JDFY is a Grade III A general hospital located in a prefecture-level city with medium economic development level, JYRY is a Grade III A general hospital located in an economically developed county-level city, JTYY is a Grade III B general hospital located in an economically developed municipal district, XHRY is a Grade III B general hospital located in a county-level city with medium economic development level, JYSY is a Grade II A general hospital located in an economically developed county-level city, and KSFY is a Grade II A specialized hospital located in an economically developed county-level city. From the above description of the basic information of the eight public hospitals, we can see that the samples include provincial-, municipal-, county-, and district-level hospitals from cities in different regions, of different administrative levels, with different economic development levels in Jiangsu Province,

covering hospitals of different grades and categories, exhibiting great representativeness. The other ten sample hospitals are also from Jiangsu Province, showing diversification in terms of regions, levels, and categories, and the information will not be detailed here.

For the research object, “doctors in public hospitals”, the inclusion and exclusion criteria are as follows:

Inclusion criteria: 1) Registered in public general or specialized secondary hospitals or above certified by the government; 2) holding a medical practitioner certificate and a relevant junior/intermediate/senior professional or technical title; 3) having worked in the certified hospital for at least one year; 4) informed consent to this study.

Exclusion criteria: 1) not on the job during the research period or not on the job for more than three months in the same year due to study reasons; 2) with incomplete qualifications; 3) having been subject to administrative punishment by competent government authorities or been suspended from his practice due to violation of relevant industrial laws and regulations; 4) the questionnaire did not pass the attention test.

Before the formal distribution of the questionnaire, we carried out a pilot test in October 2023 on two hospitals, JYSRMYY and JYSDSRMYY, which were intended to be the survey samples. For the pilot test, we randomly selected 20 doctors (ten from each hospital) who met the above-mentioned inclusion criteria. A total of 20 paper-and-pencil questionnaires were distributed, and 20 effective questionnaires were recovered, with a recovery rate of 100%. The questionnaire was revised according to the feedback of 20 respondents.

Through the “Sojump” platform, we distributed the questionnaire to doctors who met the inclusion criteria in 18 sample hospitals and recovered a total of 721 questionnaires. In order to ensure the quality of this questionnaire survey, in the formal questionnaire design, we added a total of three attention test items, one in every 15 items. After verification, 13 of the recovered questionnaires were eliminated due to obvious errors in the attention test items. Eventually, we obtained 708 effective questionnaires, with an effective rate of 98.2% (708/721).

The research roadmap of this study is shown in Figure 3.1.

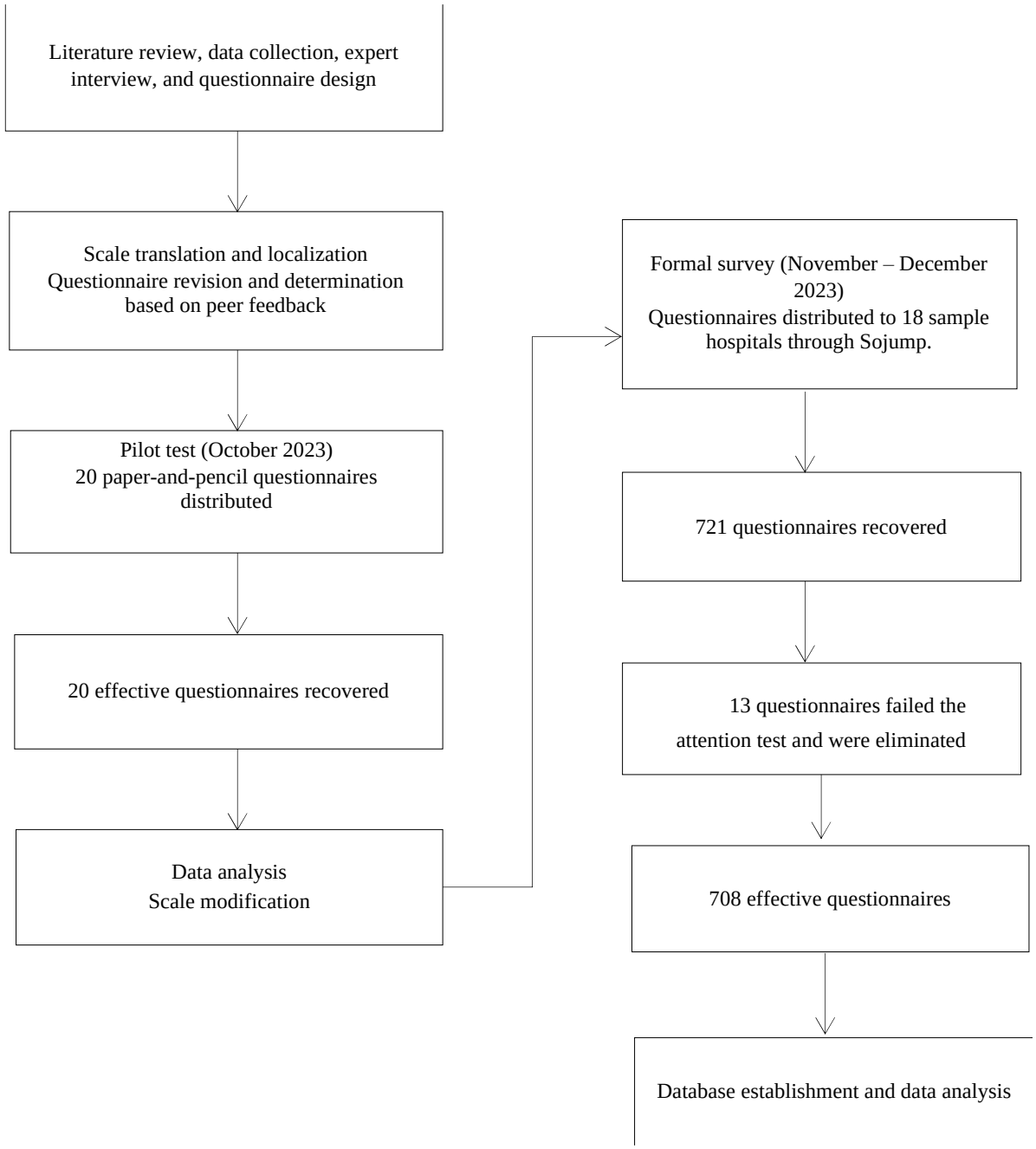

Figure 3.1 Research roadmap

3.2 Measurements

In this study, we conducted a questionnaire survey to measure job demands (JD), doctor-patient relationship (DPR), burnout, work engagement (WE), and leader-member exchange (LMX).

3.2.1 Measurement of job demands (JD)

This study drew on the Job Demand Indices (JDI) developed by Sundin et al. (2008), which exhibited satisfactory internal consistency. In subgroup analysis, independent sample t-tests showed that the mean difference between the four demand indicators was statistically significant. This scale can be used to obtain information about different job demands as a supplement to the psychological dimensions in the Job-Demand-Control-Support model. In this study, we translated and localized the scale into Chinese, and then selected 15 public hospital doctors in different professional positions for peer review and suggestions for revision. The feedback rate was 100%, and according to the feedback, we revised the scale. The scale included 12 items, measured on a six-point Likert scale, from 1 = "Never" to 6 = "Always". A higher score indicates that the respondent is facing higher job demands, and vice versa.

After reliability and validity testing, the following seven items were included in the actual data analysis:

(1) I face difficulties in giving/obtaining pain relief.

(2) I have experienced threats from patients.

(3) I have been exposed to violence from patients.

(4) I have to care for aggressive and threatening patients.

(5) I have to work very intensively.

(6) My work demands too much effort.

(7) I have to work very fast.

The first four items pertain to emotional demands, while the latter three items relate to workload.

3.2.2 Measurement of doctor-patient relationship (DPR)

This study used the Scale of Doctor-Patient Relationship in China (DPR-C) developed by Zeng et al. (2018). The scale contains two dimensions, namely "doctor-patient trust" and "patient-centered diagnosis and treatment", including ten items. A six-point Likert scale was used for scoring, from 1 = "Completely disagree" to 6 = "Completely agree". The higher the score, the better the doctor-patient relationship, and vice versa.

After reliability and validity testing, the following seven items were included in the actual data analysis:

(1) My patient trusts that I will put his/her medical need in the first place.

(2) My patient trusts the treatment plan I made for him/her.

(3) My patient is willing to follow the treatment plan I suggested.

(4) My patient believes that the examinations I requested are reasonable.

(5) I often patiently communicate with my patient and his/her family over and over.

(6) I always carefully help my patient and his/her family.

(7) I often provide the best treatment plan to my patient by comparing different schemes.

3.2.3 Measurement of work engagement (WE)

This study drew on the Utrecht Work Engagement Scale (UWES) developed by Schaufeli et al. (2006). The scale includes nine items, measured on a six-point Likert scale, from 1 = "Completely disagree" to 6 = "Completely agree". A higher score indicates a higher level of work engagement, and vice versa.

After reliability and validity testing, the following five items were included in the actual data analysis:

(1) I am enthusiastic about my job.

(2) My job inspires me.

(3) When I get up in the morning, I feel like going to work.

(4) I am proud on the work that I do.

(5) When I am working, I forget everything else around me.

3.2.4 Measurement of burnout (BO)

Drawing on the Work-Family Conflict Scale (C. Li et al., 2003) and the Maslach Burnout Inventory (Maslach & Jackson, 1981), the burnout scale in this study focuses on the relationship between work-family conflict and burnout among health care workers. After peer review, the final scale contains five items, measured on a six-point Likert scale, from 1= "Completely disagree" to 6 = "Completely agree". A higher score indicates a higher level of burnout of the respondent, and vice versa.

After reliability and validity testing, the following four items were included in the actual data analysis:

(1) I feel burned out from my work.

(2) I feel fatigued when I get up in the morning and have to face another day on the job.

(3) Working with people all day is really a strain for me.

(4) I feel like I'm at the end of my rope.

3.2.5 Measurement of leader-member exchange (LMX)

This study used the Leader-Member Exchange 7 Questionnaire (LMX-7) (Graen & Uhl-Bien,

1995; Graen et al., 1982), which is the most widely used scale for measuring leader-member exchange (LMX). It measures the overall quality of the relationship at work, focusing on work-related content and emphasizing holistic measurement. It includes seven items, measured on a six-point Likert scale, ranging from 1 = "Completely disagree" to 6 = "Completely agree". The higher the score, the better the perceived LMX, and vice versa.

After reliability and validity testing, the following four items were included in the actual data analysis:

(1) I usually know how satisfied my leader is with what I do.

(2) I think my leader understands my job problems and needs to a great deal.

(3) I think my leader fully recognizes my potential.

(4) My working relationship with my leader is effective.

3.2.6 Sociodemographic information

This study used a self-designed questionnaire. According to the research objectives and scope, considering the basic information of public hospitals in various regions of Jiangsu Province, we collected data on 11 sociodemographic characteristics of the sample doctors, including gender, age, tenure, education level, professional title, marital status, after-tax monthly income, hospital grade, number of beds in the hospital, the department where they work, and employment type.

Among them, age and tenure are continuous variables (in years), while other variables are categorical variables. Among the categorical variables, gender is a binary variable, while the rest are polytomous variables. According to the conventional educational system, the education level was divided into four categories, namely, college or below, bachelor, master, and doctorate. According to the current professional and technical titles of doctors in China, this study categorized professional titles into four groups: junior, intermediate, deputy senior, and senior. Marital status was divided into three categories: single, married, and others (e.g., divorced). According to the average income of doctors in public hospitals at various levels in Jiangsu Province, the after-tax monthly income was categorized into four groups: 10000 RMB or below, 10001-15000 RMB, 15001-20000 RMB, 20000 RMB or above. According to the classification of public hospitals in China and the scope of this study, hospital grade was categorized into four groups: Grade III A, Grade III B, Grade II A, and others. According to the status of public hospitals at various levels in different regions of Jiangsu Province, we categorized the number of beds in the hospital into four groups: 500 or below, 501-1000, 1001-1500, and above 1500. According to the norms of clinical specialty classification in public hospitals and for convenience in categorization, the departments of the respondents were divided into eight

categories: internal medicine, surgery, obstetrics and gynecology, pediatrics, intensive care, anesthesia, medical examination, and others. According to the requirements and current status of human resource management in public hospitals in Jiangsu Province, we categorized the employment type into three groups, namely, permanent contract, long-term contract with reference to permanent contract, and temporary contract based on workload.

3.3 Data collection and processing

Before formally distributing the questionnaire, we conducted a pilot test, for which we randomly selected a total of 20 doctors from two hospitals (ten from each) who met the inclusion criteria mentioned above to participate. A total of 20 paper-and-pencil questionnaires were distributed. The pilot test lasted two days, one day for each hospital. Each time, two uniformly trained investigators went on-site and distributed the questionnaires one by one after verifying the name and code of the respondents, who were pre-selected according to the inclusion criteria. Through our training, the investigators were familiar with the specific contents of the questionnaire and knew the detailed requirements for questionnaire distribution and filling in. During the survey, the informed consent of the participants was first obtained, followed by scripted instructions to all the doctor participants, explaining the purpose and content of the study and the questionnaire filling requirements. It was explicitly emphasized that the collected data would only be used for research purposes and would be kept absolutely confidential. Participants were asked to read and answer the questionnaire independently in their personal work area without interference or influence from others. A total of 20 effective questionnaires were collected in the pilot test, and the recovery rate was 100%. The average completion time was 7-8 minutes, and according to the feedback of the participants, if the online questionnaire via “Sojump” is adopted, it is estimated that it will take about 10 minutes to complete the questionnaire, which is within the acceptable range. After collecting the pilot test questionnaires, we revised the questionnaire according to the feedback of the 20 respondents.

In order to ensure the questionnaire survey quality during the formal survey, an attention test was added to the final version, with an attention test item added between every 15 items. The whole questionnaire has three attention test items, including “COVID-19 is an infectious disease that can be transmitted from person to person”, “This year is 2023”, and “Please choose ‘Completely agree’ from the following options”, all provided with six options, from “Completely disagree” to “Completely agree”.

In the formal survey stage, according to experts’ suggestions during interviews and based

on convenience sampling and the principles of representativeness, we selected 18 sample hospitals. For each sample hospital, we contacted the management of the hospital in advance to obtain the consent and cooperation of the hospital. Each hospital appointed a dedicated coordinator (mostly heads of the medical department or the science and education department of the hospital; in two hospitals, the role was assigned to the head of the hospital director's office and the director of the nursing department, respectively). After we contacted them directly and agreed on a date, we assigned one of the two investigators who had received our training to have a visit and face-to-face communication, to elaborate on the purpose and methods of the study, the specific requirements for filling in the questionnaire, and the scope of respondents according to the inclusion criteria. After determining the scope of the respondents, the investigator used the scripted instructions to explain the purpose, content, and questionnaire-filling requirements of the study to the surveyed departments, and fully obtained the informed consent of the respondents, emphasizing that the data would only be used for research purpose, and all information would be kept absolutely confidential. Following that, the "Sojump" survey link was sent to the respondents. Considering the fact that doctors usually have busy agendas, we asked the respondents to fill in the questionnaire within three days. Before the specified deadline, the respondents could log in to the "Sojump" platform to read the questionnaire and answer independently, without interference or influence between each other.

Upon the deadline of the formal survey, 721 questionnaires had been collected on the "Sojump" platform. After the follow-up verification of the answers, we found that 13 of the questionnaires contained obvious errors in the attention test items, and therefore, they were eliminated. Eventually, 708 effective questionnaires were obtained, with an effective rate of 98.2% (708/721). For the effective questionnaires, after verification, the data were exported as an Excel file and then imported into SPSS 26.0 for subsequent data analysis.

3.4 Statistical analyses

In this study, SPSS 26.0 and AMOS 24.0 were used for confirmatory factor analysis (CFA) of each scale, as well as descriptive statistical analysis, correlation analysis, and one-way ANOVA on relevant data. This research is committed to ensuring the authenticity of the results from a variety of statistical perspectives. Specifically, the statistical tools used mainly include

reliability and validity analysis, descriptive statistical analysis, Pearson's correlation analysis, factor analysis, ANOVA, and regression analysis.

3.4.1 Reliability analysis of the scale

The reliability analysis of the scale is the key step to evaluate the stability and consistency of the scale, ensuring that the scale can produce reliable and consistent results at different times, on different occasions, or by different investigators. This analysis usually includes the examination of the internal consistency (reliability) of the scale (e.g., Cronbach's α). The higher the coefficient (Cronbach's α), the more consistent, stable, and reliable the results of the measurement.

3.4.2 Validity analysis of the scale

The validity analysis of the scale is to evaluate whether the measurement results of the scale truly reflect the structure or attribute to be measured. Validity analysis usually involves content validity (i.e., whether the scale items fully cover the structures to be measured) and structure validity (exploratory factor analysis or confirmatory factor analysis is employed to accurately assess whether the structure of the scale meets the expectations). The results of validity analysis are the key determinants of whether the scale can be effectively applied to research or practice.

3.4.3 Descriptive statistical analysis

The basic information about doctors, such as gender, age, tenure, education level, professional title, hospital grade, number of beds in the hospital, department, and employment type, was mainly described through the mean value and standard deviation (SD) of relevant research variables.

3.4.4 Correlation analysis between variables

As a commonly used statistical method in research, correlation analysis is generally used to study the connection between related variables. In this study, we used Pearson's correlation analysis. The greater the absolute value of the correlation coefficient, the stronger the relationship.

3.4.5 Two independent samples t-tests and one-way ANOVA for multiple independent samples

The survey results not only depend on the respondents' answers to the questions but may also show differences depending on the background of the respondents. The purpose of analyzing demographic characteristics is to deeply understand whether there are differences in the mean value of the variables among doctors of different backgrounds. From the sample's comparable demographic characteristics, we selected characteristics such as gender, age, tenure, and hospital grade to carry out two independent samples t-tests and one-way ANOVA. When the variance was homogeneous, the least significant difference (LSD) would be analyzed; when the variance showed heterogeneity, Tamhane's T2 analysis would be performed for pairwise comparison.

3.4.6 Moderated mediation model test

The moderated mediation model test is to further explore the impact of relevant moderators on the mediation effect based on the mediation effect analysis. Specifically, it is to analyze whether there is a significant difference in the explanatory power (indirect effect) of the mediator to the dependent variable with different levels of the moderator. If a significant difference is observed, it indicates that the mediation effect is affected by the moderator, that is, there is a moderated mediation effect.

3.5 Reliability and validity test of the measurements

3.5.1 Job demands

Through Cronbach's α, the reliability of the job demands scale was tested. As shown in Table 3.1, Cronbach's α was 0.812, greater than 0.7, indicating good reliability. In addition, the values of Cronbach's α were all below 0.812 when each of the items was deleted. The test results showed that the job demands scale had good reliability.

Based on the results of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), and considering the residuals and factor loadings, we determined the final scale. Residual values were used to evaluate the model fit of the items, with higher residual values indicating poorer fit. Factor loadings quantify the correlation between the items and the corresponding latent factors, with lower factor loadings suggesting weaker associations. Based

on the results, we excluded five items with factor loadings below 0.4 and excessively high residual values.

Table 3.1 Statistics of the job demands scale

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's α if item deleted	Cronbach's α	KMO	Bartlett's test of sphericity		
							χ^2	df	Sig.
14	21.510	25.798	0.428	0.810					
17	22.140	23.924	0.599	0.777					
18	22.730	25.239	0.594	0.780					
19	22.280	24.724	0.558	0.785	0.812	0.793	2255.487	21	0.000
21	19.310	25.839	0.546	0.788					
22	19.480	24.592	0.577	0.782					
23	19.400	25.748	0.555	0.786					

Before subsequent EFA, we performed KMO and Bartlett's test of sphericity on the items. The results showed that KMO was 0.793, and $X^2 = 2255.487$, with significance ($p < 0.001$), based on which, it was deemed that the data would be suitable for EFA analysis.

Thus, we performed an EFA analysis on the job demands scale. According to the results in Table B.2 of Annex B, the eigenvalues of the two extracted factors were greater than 1; the cumulative explained variance of the two principal factors was 71.083%, greater than 60%; and the factor loadings of the seven items were all greater than 0.5. These results showed that the job demands scale had good convergent validity.

Then, we conducted CFA on the job demands scale. We first constructed the model, as shown in Figure 3.2, where "e" is a random error term. From the figure, we can see that the factor loadings of the measured items in the job demands scale were 0.75, 0.87, 0.81, 0.46, 0.82, 0.87, and 0.83, all between 0.45 and 0.95, indicating that the seven items could be well clustered on the latent variables, showing a good convergence.

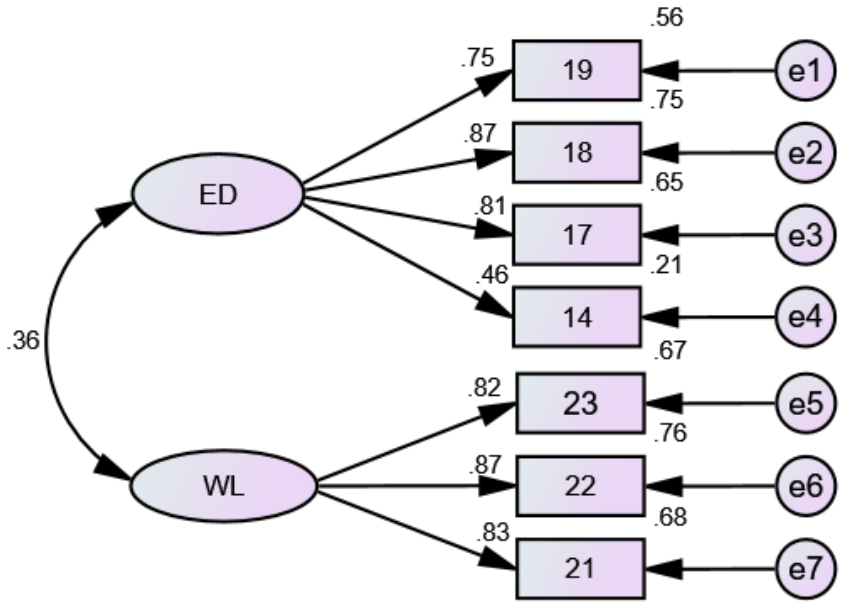

Figure 3.2 CFA model for job demands

From the model fit indices in Table 3.2, we can see that X^2/df, RMSEA, GFI, AGFI, NFI, CFI, and TLI all met the criteria, indicating good validity of the scale.

Table 3.2 Fit indices of the CFA model for job demands

	X^2	df	X^2/df	GFI	AGFI	NFI	TLI	CFI	RMSEA
Criteria			<6	>0.9	>0.9	>0.9	>0.9	>0.9	<0.08
Value	33.941	13	2.611	0.986	0.970	0.985	0.985	0.991	0.048

3.5.2 Doctor-patient relationship

Using Cronbach's α, a reliability test was performed on the doctor-patient relationship scale. As shown in Table 3.3, Cronbach's α was 0.927, greater than 0.7, indicating good reliability of the scale. Moreover, the values of Cronbach's α were all below 0.927 when each of the items was deleted. The results showed that the doctor-patient relationship scale had good reliability.

Based on the results of EFA and CFA, and considering the residuals and factor loadings, we determined the final scale. Residual values were used to evaluate the model fit of the items, with higher residual values indicating poorer fit. Factor loadings quantify the correlation between the items and the latent factors, with lower factor loadings suggesting weaker associations. Eventually, we excluded three items with factor loadings below 0.4 and excessively high residual values.

Table 3.3 Statistics of the doctor-patient relationship scale

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's α if item deleted	Cronbach's α	KMO	Bartlett's test of sphericity		
							χ^2	df	Sig.
1	33.630	13.227	0.783	0.910					
2	33.680	13.163	0.847	0.902					
3	33.710	13.223	0.850	0.902					
4	33.750	12.832	0.847	0.903	0.927	0.889	4594.038	21	0.000
5	33.330	15.561	0.677	0.920					
7	33.300	15.809	0.704	0.919					
8	33.300	15.767	0.700	0.919					

Before subsequent EFA, we tested KMO and Bartlett's sphericity on the items. The results showed that KMO was 0.898, $X^2 = 4594.038$, showing significance ($p < 0.001$). Based on the results, it was determined that the data would be suitable for EFA analysis.

Therefore, EFA was performed on the doctor-patient relationship scale. According to the results in Table B.2 of Annex B, the eigenvalues of the two extracted factors were greater than 1; the cumulative explained variance of the two principal factors was 85.471%, greater than 60%; and the factor loadings of the seven retained items were all greater than 0.6. These results showed that the doctor-patient relationship scale had good convergent validity.

Then, a CFA was performed on the doctor-patient relationship scale. First, the model was constructed, as shown in Figure 3.3, where "e" is a random error term. We can see that the factor loadings of the measured items included in the doctor-patient relationship scale were 0.92, 0.94, 0.92, 0.82, 0.89, 0.91, and 0.86, all between 0.5-0.95, indicating that the seven items could be well clustered on latent variables, showing good convergence.

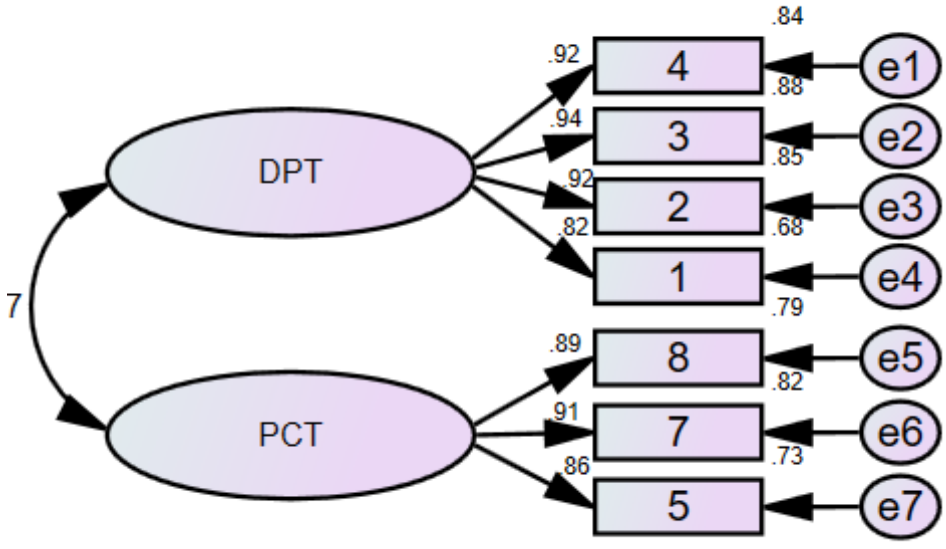

Figure 3.3 CFA model of doctor-patient relationship

From the model fit indices Table 3.4, we can see that X^2/df, RMSEA, GFI, AGFI, NFI, CFI, and TLI all met the criteria, indicating that the scale had good validity.

Table 3.4 Fit indices of the CFA model of doctor-patient relationship

	X^2	df	X^2/df	GFI	AGFI	NFI	TLI	CFI	RMSEA
Criteria			<5	>0.9	>0.9	>0.9	>0.9	>0.9	<0.08
Value	38.907	13	2.993	0.985	0.968	0.992	0.991	0.994	0.053

3.5.3 Work engagement

Using Cronbach's α, we first conducted a reliability test on the work engagement scale. As shown in Table 3.5, Cronbach's α was 0.898, greater than 0.7, indicating good reliability. Moreover, the values of Cronbach's α were all below 0.898 when each of the items was deleted. The results showed that the work engagement scale had good reliability.

Based on the results of CFA, and considering the model fit of the items through residuals (higher residual values indicate poorer fit), we excluded four items with excessively high residual values.

Table 3.5 Statistics of the work engagement scale

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's α if item deleted	Cronbach's α	KMO	Bartlett's test of sphericity		
							χ^2	df	Sig.
31	18.160	19.755	0.795	0.867					
33	18.040	20.022	0.807	0.865					
34	19.020	17.950	0.716	0.891	0.898	0.888	2172.623	10	0.000
36	17.800	20.792	0.758	0.876					
38	18.340	19.643	0.717	0.883					

In the next step, before performing EFA, we tested for KMO and Bartlett's sphericity on the items. The results showed that KMO was 0.888, and $X^2 = 2172.623$, showing significance ($p < 0.001$). Based on these results, it was deemed that the data would be suitable for EFA.

Therefore, an EFA analysis was performed on the work engagement scale. According to the results in Table B.3 of Annex B, the eigenvalue of one extracted factor was greater than 1; the cumulative explained variance of the principal factor was 72.476%, greater than 60%; and the factor loadings of the six retained items were all greater than 0.6. These results showed that the work engagement scale had good convergent validity.

Then, we conducted a CFA on the work engagement scale. We first constructed the model, as shown in Figure 3.4, where "e" is a random error term. We can see that the factor loadings of each relevant measured item included in the work engagement scale were 0.75, 0.81, 0.75, 0.87, and 0.86, respectively, all between 0.5 and 0.95, indicating that the five items could be well clustered on the latent variable, showing good convergence.

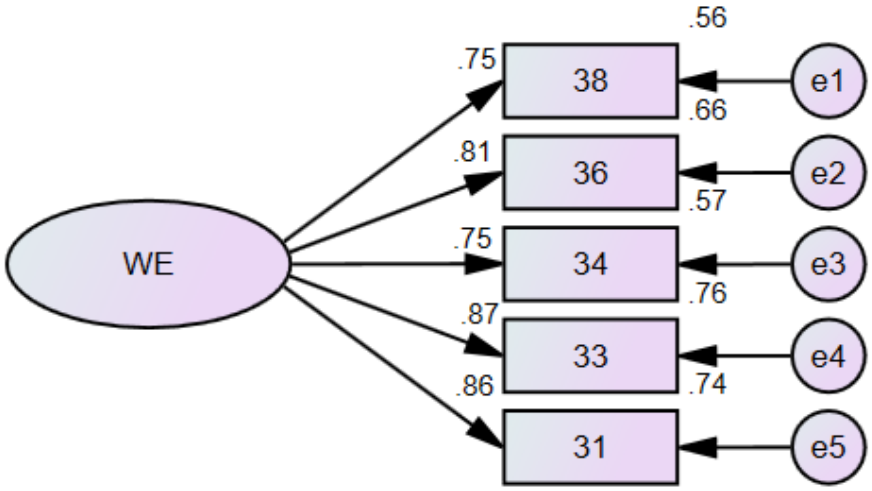

Figure 3.4 CFA model of work engagement

From the model fit indices in Table 3.6, we can see that X^2/df, RMSEA, GFI, AGFI, NFI, CFI, and TLI all met the criteria, indicating good validity of the scale.

Table 3.6 Fit indices of the CFA model of work engagement

	X^2	df	X^2/df	GFI	AGFI	NFI	TLI	CFI	RMSEA
Criteria			<6	>0.9	>0.9	>0.9	>0.9	>0.9	<0.08
Value	15.359	5	3.072	0.992	0.975	0.993	0.990	0.995	0.054

3.5.4 Burnout

Using Cronbach's α, reliability was tested for the burnout scale. As shown in Table 3.7, Cronbach's α was 0.937, greater than 0.7, showing good reliability. Moreover, when each of the items was deleted, the values of Cronbach's α were all below 0.937. The results showed that the burnout scale had good reliability.

Based on the results of CFA, and considering the model fit of the items through residuals (higher residual values indicate poorer fit), we deleted one item with excessively high residual value.

Table 3.7 Statistics of the burnout scale

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's α if item deleted	Cronbach's α	KMO	Bartlett's test of sphericity		
							χ^2	df	Sig.
24	10.300	21.289	0.844	0.920	0.937	0.863	2446.611	6	0.000
26	10.710	20.136	0.869	0.911					
27	10.260	20.519	0.849	0.918					
28	11.210	20.885	0.840	0.921					

In the next step, before performing EFA, we tested KMO and Bartlett's sphericity on the items. The results showed that KMO was 0.863, and $X^2 = 2446.611$, showing significance ($p <$

0.001). Based on the results, it was deemed that the data would be suitable for EFA.

Hence, we performed an EFA on the burnout scale. According to the results in Table B.4 of Annex B, the eigenvalue of one extracted factor was greater than 1; the cumulative explained variance of the principal factor was 84.115%, greater than 60%; and the factor loadings of the retained six items were all greater than 0.6. These results showed that the burnout scale had good convergent validity.

Then, a CFA was performed on the burnout scale. First, the model was constructed, as shown in Figure 3.5, where "e" is a random error term. We can see that the factor loadings of the measured items for burnout were 0.88, 0.88, 0.91, and 0.88, all between 0.5 and 0.95, indicating that the four items could be well clustered on the latent variable, showing good convergence.

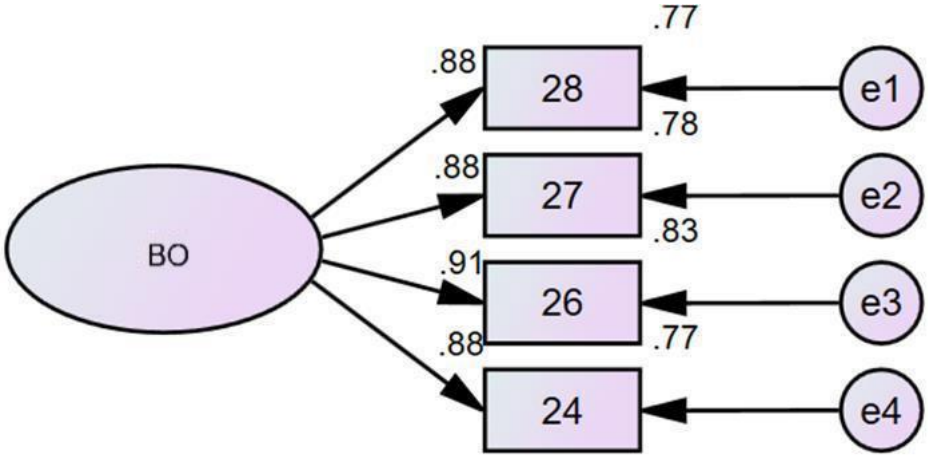

Figure 3.5 CFA model of burnout

From the model fit indices in Table 3.8, it can be seen that X^2/df, RMSEA, GFI, AGFI, NFI, CFI, and TLI all met the criteria, indicating good validity of the scale.

Table 3.8 Fit indices of the CFA model of burnout

	X^2	df	X^2/df	GFI	AGFI	NFI	TLI	CFI	RMSEA
Criteria			<6	>0.9	>0.9	>0.9	>0.9	>0.9	<0.08
Value	10.820	2	5.410	0.992	0.962	0.996	0.989	0.996	0.079

3.5.5 Leader-member exchange

Using Cronbach's α, we first tested the reliability of the LMX scale. As shown in Table 3.9, Cronbach's α was 0.908, greater than 0.7, indicating good reliability.

Based on the results of EFA and CFA, and considering the residuals and factor loadings, we determined the final scale. Residual values were used to evaluate the model fit of the items, with higher residual values indicating poorer fit. Factor loadings quantify the correlation between the items and the latent factors, with lower factor loadings suggesting weaker

associations. Based on the results, we excluded three items with factor loadings below 0.4 and excessively high residual values.

Table 3.9 Statistics of the LMX scale

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's α if item deleted	Cronbach's α	KMO	Bartlett's test of sphericity		
							χ^2	df	Sig.
50	14.820	10.211	0.751	0.896	0.908	0.827	2055.239	6	0
51	15.060	8.587	0.858	0.856					
52	15.000	8.666	0.872	0.851					
56	14.720	10.137	0.698	0.912					

In the next step, prior to EFA, we tested KMO and Bartlett's sphericity on the items. The results showed that KMO was 0.827, and X^2 = 2055.239, showing significance ($p < 0.001$). Based on these results, it was determined that the data was suitable for EFA.

Hence, an EFA was performed on the LMX scale. According to the results in Table B.5 of Annex B, the eigenvalue of one extracted factor was greater than 1; the cumulative explained variance of the principal factor was 78.443%, greater than 60%; and the factor loadings of the six retained items were all greater than 0.6. These results showed that the scale had good convergent validity.

Then, a CFA was performed on the scale. First, the model was constructed, as shown in Figure 3.6, where "e" is a random error term. We can see that the factor loadings of the measured items included in the doctor-patient relationship scale were 0.73, 0.93, 0.92, and 0.79, all between 0.5 and 0.95, indicating that the four items could be well clustered on the latent variable, showing good convergence.

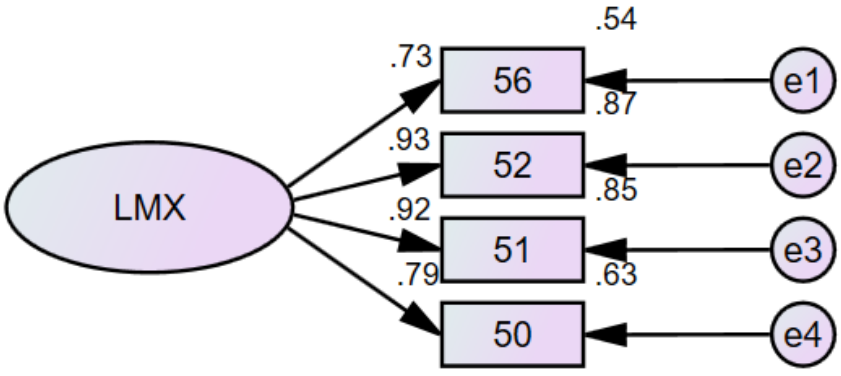

Figure 3.6 CFA model of LMX

From the model fit indices in Table 3.10, it can be seen that X^2/df, RMSEA, GFI, AGF, NFI, CFI, and TLI all met the criteria, indicating good validity of the scale.

Table 3.10 Fit indices of the CFA model of LMX

	X^2	X^2/df	GFI	AGFI	NFI	TLI	CFI	RMSEA
Criteria		<6	>0.9	>0.9	>0.9	>0.9	>0.9	<0.08
Value	6.009	3.005	0.996	0.978	0.997	0.994	0.998	0.053

3.5.6 Common method bias test

The data in this research all came from the same source, which might lead to the problem of common method bias, thus having an impact on the reliability of the research findings. Therefore, we used Harman's single-factor test to statistically examine the common method bias. Using AMOS 24.0, we set the common factor of all variables as 1 and took all items of all variables as manifest variables for CFA. The results showed that there was no serious common method bias as the model fit indices were not ideal (X^2/df = 30.444, GFI = 0.362, AGFI = 0.256, NFI = 0.337, TLI = 0.288, CFI = 0.343, RMSEA = 0.204).

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Chapter 4: Results

This chapter reports the results of descriptive analysis, correlation analysis of measurement variables, differences in the main variables between different sociodemographic groups, and hypothesis tests. We first present the results of descriptive analysis of the sociodemographic characteristics of the sample. On the basis of correlation analysis, we grouped the sample by demographic characteristics and performed independent sample t-tests and one-way ANOVA to examine the demographic variables' impact on each research variable. Using SPSS 26.0, SPSS' plug-in Process Macro, and AMOS 24.0, we carried out exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modeling (SEM) to scientifically examine the relationships and theoretical logic between the variables.

4.1 Descriptive analysis results

In this study, 708 doctors were selected as the research sample, in which male doctors had a higher percentage, accounting for 56.9% (n = 403).

In terms of the age of the respondents, the majority were young and middle-aged, with 42.4% (n = 300) between 31-40 years old and 32.2% (n = 228) between 41-50 years old. Doctors within these age ranges are the primary force providing medical services in public hospitals, possessing corresponding capability characteristics.

In terms of tenure, the majority of the respondents were doctors with less than 30 years of tenure, with those having 20 years or less accounting for over 70%. More specifically, doctors with less than 10 years of tenure accounted for 39.5% (n = 280) , those with 11–20 years of tenure made up 34.9% (n = 247) , those with 21–30 years of tenure comprised 18.6% (n = 132), and those with over 30 years of tenure represented 6.9% (n = 49). Overall, there were relatively few senior employees nearing retirement age among the respondents.

In terms of the education level, 54.7% (n = 387) held bachelor's degree or below, 41.4% (n = 293) were masters, and 4% (n = 28) held doctoral degrees. Overall, since the sample hospitals in this study covered public hospitals of different levels from different regions across the province, as well as doctors from various specialties, respondents with a bachelor's degree or below had the highest percentage, followed by those with a master's degree, while the doctors with a doctoral degree had the lowest percentage.

In terms of marital status, 86.4% (n = 612) were married, 11.6% (n = 82) were single, and doctors with other marital status (e.g., divorced) accounted for 2% (n = 14). It can be observed that the majority of the doctors in the sample were married and had established families, representing the population's characteristics.

Regarding professional titles, doctors with junior titles accounted for 18.9% (n = 134), those with intermediate titles accounted for 36.4% (n = 258), those with deputy senior titles accounted for 30.9% (n = 219), and senior doctors accounted for 13.7% (n = 97). It can be seen that a large proportion of the respondents consisted of doctors with intermediate and deputy senior titles, a group that generally serves as the main force in medical services at public hospitals, possessing corresponding clinical expertise and workload characteristics.

In terms of the employment type, doctors with permanent contracts accounted for 83.8% (n = 593), those with long-term contracts with reference to permanent contracts accounted for 9.6% (n = 68), and those with temporary contracts accounted for 6.6% (n = 47). It can be seen that under the current management system in public hospitals, the majority of doctors are employed with permanent contracts, which provides stronger job security for doctors.

In terms of the departments the doctors were serving at, internal medicine accounted for 30.2% (n = 214), surgery accounted for 24.4% (n = 173), obstetrics and gynecology accounted for 11.2% (n = 79), pediatrics accounted for 6.2% (n = 44), intensive care and anesthesia accounted for 7.1% (n = 50), medical examination accounted for 3.4% (n = 24), and other departments accounted for 17.5% (n = 124). Overall, doctors of internal medicine and surgery had higher percentages, which aligns with the current human resource allocation in public hospitals.

In terms of hospital grade, Grade III A hospitals accounted for 42.4% (n = 300), Grade III B hospitals accounted for 35.3% (n = 250), Grade II A hospitals accounted for 19.2% (n = 136), and other hospitals accounted for 3.1% (n = 22). It can be seen that the sample in this study covered public hospitals of different levels, with Grade III A hospitals, Grade III B hospitals, and Grade II A hospitals being the top three in terms of percentage. Thus, the selected sample is highly representative.

Regarding the number of beds in the hospital, 12.4% (n = 88) of the hospitals had less than 500 beds, 39.4% (n = 279) had 501-1000 beds, 26.8% (n = 190) had 1001-1500 beds, 21.3% (n = 151) had more than 1500 beds. The sample hospitals showed a significant difference in terms of bed numbers, which is related to factors such as the population of the regions where the hospitals are located, the hospitals' positioning and classification, as well as the hospital type (general or specialized hospitals).

In terms of the doctors' after-tax monthly income, doctors with an income of "10000 RMB or below" accounted for 46% (n = 326), those with "10001-15000 RMB" accounted for 44.1% (n = 312), and 9.9% (n = 70) of the doctors had an income above 15000 RMB. It can be observed that the majority of the respondents had an after-tax monthly income around 10,000 yuan. That is related to factors such as the economic development and average wage levels of the regions where the sample hospitals are located, the hospital's classification and operational quality, and individual doctors' professional abilities. In addition, the impact of COVID-19 on the operational quality of public hospitals and the performance of doctors during the research period is also a considerable factor.

More detailed results can be found in Table 4.1 below.

Table 4.1 Descriptive statistics of the sample

Characteristic	Options	Frequency	Percentage	Effective percentage	Cumulative percentage
Gender	Male	403	56.9	56.9	56.9
	Female	305	43.1	43.1	100
Age (years)	20-30	114	16.1	16.1	16.1
	31-40	300	42.4	42.4	58.3
	41-50	228	32.2	32.2	90.5
	Above 50	66	9.3	9.3	100
Tenure (years)	0-10	280	39.5	39.5	39.5
	11-20	247	34.9	34.9	74.4
	21-30	132	18.6	18.6	93.1
	Above 30	49	6.9	6.9	100
Education level	Bachelor or below	387	54.7	54.7	54.7
	Master	293	41.4	41.4	96
	Doctorate	28	4	4	100
Marital status	Single	82	11.6	11.6	11.6
	Married	612	86.4	86.4	98
	Others (e.g., divorced)	14	2	2	100
Professional title	Junior	134	18.9	18.9	18.9
	Intermediate	258	36.4	36.4	55.4
	Deputy senior	219	30.9	30.9	86.3
	Senior	97	13.7	13.7	100
Employment type	Permanent contract	593	83.8	83.8	83.8
	Long-term contract with reference to permanent contract	68	9.6	9.6	93.4
	Temporary contract	47	6.6	6.6	100
Department	Internal medicine	214	30.2	30.2	30.2
	Surgery	173	24.4	24.4	54.7
	Obstetrics and gynecology	79	11.2	11.2	65.8
	Pediatrics	44	6.2	6.2	72
	Intensive care or anesthesia	50	7.1	7.1	79.1
	Medical examination	24	3.4	3.4	82.5
	Others	124	17.5	17.5	100
Hospital	Grade III A	300	42.4	42.4	42.4

Characteristic	Options	Frequency	Percentage	Effective percentage	Cumulative percentage
grade	Grade III B	250	35.3	35.3	77.7
	Grade II A	136	19.2	19.2	96.9
	Others	22	3.1	3.1	100
Number of beds	≤500	88	12.4	12.4	12.4
	501-1000	279	39.4	39.4	51.8
	1001-1500	190	26.8	26.8	78.7
	>1500	151	21.3	21.3	100
After-tax monthly income (RMB)	≤10000	326	46	46	46
	10001-15000	312	44.1	44.1	90.1
	>15000	70	9.9	9.9	100

4.2 Correlation between variables

As can be seen from Table 4.2, the mean ± SD of job demands (JD) was 3.497 ± 0.823; the mean ± SD of doctor-patient relationship (DPR) was 5.588 ± 0.625; the mean ± SD of burnout (BO) was 3.540 ± 1.501; the mean ± SD of work engagement (WE) was 4.568 ± 1.094; and the mean ± SD of leader-member exchange (LMX) was 4.966 ± 1.007.

JD was negatively associated with DPR (r = -.19, $p < .01$), WE (r = -.14, $p < .01$), and LMX (r = -.119, $p < .01$), but positively associated with BO (r = .6, $p < .01$), age (r = .152, $p < .01$), and tenure (r = .133, $p < .01$). JD showed no significant relationship with education level, hospital grade, department, or number of beds.

DPR was negatively associated with BO (r = -.265, $p < 0.01$), but was positively related to WE (r = .327, $p < 0.01$) and LMX (r = .290, $p < 0.01$). DPR showed no significant relationship with gender, age, tenure, education level, hospital grade, department, or number of beds.

BO was negatively associated with WE (r = -.431, $p < .01$), LMX (r = -.338, $p < .01$), gender (r = -.095, $p < .05$), education level (r = -.082, $p < .05$), and department (r = -.097, $p < .05$), but was positively related to age (r = .075, $p < .05$). BO showed no significant relationship with tenure, hospital grade, or number of beds.

WE was positively associated with LMX (r = .551, $p < .01$), age (r = .212, $p < .01$), and tenure (r = .196, $p < .01$). WE showed no significant relationship with gender, education level, hospital grade, department, or number of beds.

LMX did not show significant relationship with gender, age, education level, tenure, hospital grade, department, or number of beds.

Table 4.2 Mean value and correlation analysis of main variables

Variable	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12
1. JD	3.497 (0.823)	***(0.812)***											
2. DPR	5.588 (0.625)	-0.190**	***(0.927)***										
3. BO	3.540 (1.501)	0.600**	-0.265**	***(0.937)***									
4. WE	4.568 (1.094)	-0.144**	0.327**	-0.431**	***(0.898)***								
5. LMX	4.966 (1.007)	-0.119**	0.290**	-0.338**	0.551**	***(0.908)***							
6. Gender		-0.127**	0.022	-0.095*	-0.057	0.019	-						
7. Age		0.152**	0.011	0.075*	0.212**	0.031	-0.127**	-					
8. Tenure		0.133**	0.004	0.064	0.196**	0.025	-0.089*	0.934**	-				
9. Education level		-0.058	0.040	-0.082*	-0.015	0.033	0.065	-0.229**	-0.318**	-			
10. Hospital grade		0.034	0.023	0.003	0.042	-0.020	-0.045	0.106*	0.167**	-0.431**	-		
11. Department		-0.066	-0.031	-0.097*	0.011	0.039	0.065	0.036	0.056	-0.146**	0.010	-	
12. Number of beds		-0.026	0.041	-0.037	0.038	0.061	-0.086*	-0.121**	-0.164**	0.349**	-0.464**	-0.086*	-

Note: ** indicates that *p* is significant at the 0.01 level (bidirectional); * indicates that *p* is significant at the 0.05 level (bidirectional); DPR = doctor-patient relationship, BO = burnout, JD = job demands, LMX = leader-member exchange, WE = work engagement.

4.3 Comparison between groups with different sociodemographic characteristics

In this study, the samples were grouped according to demographic characteristics, and we performed independent sample t-tests (for two groups) and one-way ANOVA (for more than two groups) to examine the sociodemographic variables' impact on each main variable. In independent sample t-tests, we first tested the homogeneity of variance ($p > 0.05$) and then examined whether the mean values showed significant differences between groups. For one-way ANOVA, we first examined whether the overall variance of the variables showed a significant difference ($p < 0.05$). If there was, we would further carry out an overall variance homogeneity test. If the variance showed homogeneity ($p > 0.05$), LSD pairwise t-tests would be performed to examine whether there was a significant difference in the mean values; if the variance did not show homogeneity, Tamhane's T2 analysis would be performed to examine whether there was a significant difference in the mean values. In addition, we performed independent sample t-tests on gender, while one-way ANOVA was performed on other sociodemographic variables.

4.3.1 Main variables' differences by gender and department

The variance homogeneity test of DPR showed that the *p*-value was 0.248, greater than 0.05, indicating that the variance homogeneity hypothesis for DPR was supported. The mean difference of DPR between different gender groups showed a *p*-value of 0.559, greater than 0.05, indicating that DPR did not show significant differences by gender. The *p* values of the homogeneity of variance test for JD, BO, WE, and LMX were 0.015, 0.006, 0.023, and 0.039, respectively, all below 0.05, and therefore, the homogeneity of variance of these variables was not tenable. The *p* values of the mean differences between different gender groups for JD and BO were 0.001 and 0.010, respectively, both below 0.05, indicating that gender made significant differences in JD and BO, with male doctors showing significantly higher job demands and burnout than female doctors. The *p* values of the mean differences between different gender groups for WE and LMX were 0.123 and 0.615, respectively, indicating that work engagement and leader-member exchange showed no significant difference by gender. See Table 4.3 for detailed results.

Table 4.3 ANOVA of gender

	Categories	N	Mean	Homogeneity of variance test		Mean difference test	
				F	Sig.	Sig.	Mean difference
JD	Male	403	3.587	5.954	0.015	0.001	0.242
	Female	305	3.377				
DPR	Male	403	5.576	1.335	0.248	0.559	-0.028
	Female	305	5.604				
BO	Male	403	3.664	7.634	0.006	0.010	0.288
	Female	305	3.376				
WE	Male	403	4.622	5.199	0.023	0.123	0.125
	Female	305	4.497				
LMX	Male	403	4.950	4.256	0.039	0.615	-0.038
	Female	305	4.988				

Note: DPR = doctor-patient relationship, BO = burnout, JD = job demands, LMX = leader-member exchange, WE = work engagement.

In this study, the departments of the sample were divided into seven categories. See table 4.4 for the results of the variance test. It can be seen that at the 95% confidence level, there were significant between-group differences in BO. However, there were no significant between-group differences in JD, DPR, WE, and LMX, and thus, pairwise comparison was not performed. Hence, we further examined the impact of department on BO.

Table 4.4 ANOVA of department

Variable		Sum of squares	df	Mean square	Mean difference test F	Sig.	Homogeneity of variance
JD	Intergroup	7.092	6	1.182	1.758	0.105	No
	Intragroup	471.288	701	0.672			
	Total	478.380	707				
DPR	Intergroup	1.301	6	0.217	0.554	0.767	Yes
	Intragroup	274.546	701	0.392			
	Total	275.847	707				
BO	Intergroup	38.592	6	6.432	2.900	0.008	No
	Intragroup	1554.593	701	2.218			
	Total	1593.185	707				
WE	Intergroup	13.956	6	2.326	1.960	0.069	Yes
	Intragroup	832.055	701	1.187			
	Total	846.011	707				
LMX	Intergroup	9.929	6	1.655	1.642	0.133	Yes
	Intragroup	706.507	701	1.008			
	Total	716.436	707				

Note: DPR = doctor-patient relationship, BO = burnout, JD = job demands, LMX = leader-member exchange, WE = work engagement.

The results of pairwise comparison between different departments can be found in Table 4.5. In terms of BO, the mean difference between doctors in pediatric department and doctors in the obstetrics and gynecology department or other departments (e.g., dermatology and stomatology) were 0.785 and 0.808, respectively, with *p* values below 0.05. The results showed that the burnout level of doctors in the pediatric department was significantly different from that in the obstetrics and gynecology department and other departments. Doctors in the pediatric

department showed significantly higher burnout than those in the obstetrics and gynecology department and other departments (e.g., dermatology, stomatology).

Table 4.5 Pairwise comparison of BO between different departments

Variable	Analysis	Group (I)	Group (J)	Mean difference (I-J)	Sig.
BO	Tamhane's T2	Pediatrics	Internal medicine	0.368	0.924
			Surgery	0.586	0.304
			Obstetrics and gynecology	0.785*	0.047
			Intensive care or anesthesia	0.738	0.197
			Medical examination	0.952	0.263
			Others	0.808*	0.028

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; BO = burnout.

4.3.2 Main variables' differences by other sociodemographic characteristics

In this study, in terms of age, tenure, and hospital grade, the survey samples were divided into four categories respectively. See Table 4.6 for the variance test results of these three characteristics. It can be seen that at the confidence level of 95%, DPR, BO, and LMX showed no significant difference by age and tenure, and JD and BO showed no significant difference by hospital grade, and thus, it did not make sense to make pairwise comparisons. However, age and tenure made significant differences on JD and WE, and hospital grade showed significant differences on DPR, WE, and LMX. Based on these result, further tests were carried out.

Table 4.6 ANOVA of age, tenure, and hospital grade

Variable			Sum of squares	df	Mean square	Mean difference test		Homogeneity of variance
						F	Sig.	
Age	JD	Intergroup	9.566	3	3.189	4.788	0.003	No
		Intragroup	468.814	704	0.666			
		Total	478.380	707				
	DPR	Intergroup	0.268	3	0.086	0.228	0.877	Yes
		Intragroup	275.579	4	0.391			
		Total	275.847	707				
	BO	Intergroup	8.549	3	2.852	1.266	0.285	Yes
		Intragroup	1584.636	704	2.251			
		Total	1593.185	707				
	WE	Intergroup	41.802	3	13.934	12.298	0.000	No
		Intragroup	804.209	704	1.142			
		Total	846.011	707				
	LMX	Intergroup	5.003	3	1.668	1.650	0.176	Yes
		Intragroup	711.433	704	1.011			
		Total	716.436	707				
Tenure	JD	Intergroup	5.521	3	1.840	2.740	0.042	Yes
		Intragroup	472.859	704	0.672			
		Total	478.380	707				

	Variable		Sum of squares	df	Mean square	Mean difference test F	Sig.	Homogeneity of variance
Hospital grade	DPR	Intergroup	1.083	3	0.361	0.925	0.428	Yes
		Intragroup	274.764	704	0.390			
		Total	275.847	707				
	BO	Intergroup	4.528	3	1.509	0.669	0.571	Yes
		Intragroup	1588.657	704	2.257			
		Total	1593.185	707				
	WE	Intergroup	36.066	3	12.055	10.480	0.000	Yes
		Intragroup	809.842	704	1.150			
		Total	846.011	707				
	LMX	Intergroup	1.847	3	0.616	0.607	0.611	Yes
		Intragroup	714.589	704	1.015			
		Total	716.436	707				
	JD	Intergroup	3.087	3	1.029	1.524	0.207	Yes
		Intragroup	475.293	704	0.716			
		Total	478.380	707				
	DPR	Intergroup	6.680	3	2.227	5.824	0.001	No
		Intragroup	269.167	704	0.382			
		Total	275.847	707				
	BO	Intergroup	12.11	3	4.037	1.797	0.146	Yes
		Intragroup	1581.076	704	2.246			
		Total	1593.185	707				
	WE	Intergroup	9.983	3	3.328	2.802	0.039	Yes
		Intragroup	836.028	704	1.188			
		Total	846.011	707				
	LMX	Intergroup	9.665	3	3.222	3.209	0.023	No
		Intragroup	706.772	704	1.004			
		Total	716.436	707				

Note: DPR = doctor-patient relationship, BO = burnout, JD = job demands, LMX = leader-member exchange, WE = work engagement.

See Table 4.7 for the results of pairwise comparisons between different age, tenure, and hospital grade groups.

Table 4.7 Pairwise comparison between different age, tenure, and hospital grade groups

	Variable	Analysis	Group (I)	Group (J)	Mean difference (I-J)	Sig.
Age	JD	Tamhane's T2	41-50	20-30	0.286*	0.046
				31-40	0.197*	0.030
				> 50	-0.025	1.000
	WE	Tamhane's T2	41-50	20-30	0.316	0.010
				31-40	0.259*	0.006
				> 50	-0.536*	0.000
		Tamhane's T2	> 50	20-30	0.851*	0.000
				31-40	0.795*	0.000
				41-50	0.536*	0.000
Tenure	JD	LSD	≤10	11-20	-0.088*	0.218
				21-30	-0.214*	0.014
				> 30	-0.255*	0.043
	WE	LSD	≤10	11-20	-0.280*	0.003
				21-30	-0.469*	0.000
				> 30	-0.757*	0.000

	Variable	Analysis	Group (I)	Group (J)	Mean difference (I-J)	Sig.
		LSD	11-20	21-30	-0.188	0.103
				> 30	-0.470*	0.005
	DPR	LSD	Grade III B	Grade III A	0.178*	0.001
				Grade II A	0.230*	0.001
				Others	-0.020	0.882
Hospital grade	WE	LSD	Grade III A	Grade III B	-0.267*	0.004
				Grade II A	-0.077	0.494
				Others	-0.080	0.741
	LMX	LSD	Grade II A	Grade III A	-0.199	0.056
				Grade III B	-0.285*	0.008
				Others	-0.531*	0.021

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; DPR = doctor-patient relationship, JD = job demands, LMX = leader-member exchange, WE = work engagement.

For age differences, the mean differences of JD between doctors aged 41-50 and those aged 20-30, 31-40, and >50 were 0.286, 0.197, and -0.025, respectively. Except for the >50 group, the *p* values were all below 0.05, indicating that the 41-50 group was significantly different from the 20-30 and 31-40 groups. The job demands of doctors aged 41-50 were significantly higher than those of doctors aged 20-30 or 31-40.

In terms of WE, the mean differences between doctors aged 41-50 and those aged 20-30, 31-40, and >50 were 0.316, 0.259, and -0.536, respectively. Except for the 20-30 age group, the *p* values were all below 0.05. The mean differences between doctors of >50 years old and the 20-30, 31-40, and 41-50 year-old groups were 0.851, 0.795, and 0.536, respectively, with *p* values all below 0.001.

The results showed that the 41-50 age group was significantly different from the 31-40 and the >50 groups, and the >50 group was significantly different from the 20-30 and 31-40 groups, respectively. Doctors aged 41-50 years old showed significantly higher work engagement than doctors aged 31-40, and doctors over 50 years old showed significantly higher work engagement than those aged 20-30, 31-40, or 41-50.

With respect to tenure, the mean differences of JD between doctors with ≤10 years of tenure and those with 11-20, 21-30, and >30 years of tenure were -0.088, -0.214, and -0.255, respectively. Except for the 11-20 years group, the *p* values were all below 0.05, indicating that doctors with ≤10 years of tenure were significantly different from those with 21-30 years and >30 years of tenure, respectively. The job demands of doctors with less than 10 years of tenure were significantly lower than those of doctors with 21-30 or over 30 years of tenure.

In terms of WE, the mean differences between the ≤10 years tenure group and the 11-20, 21-30, and >30 groups were -0.280, -0.469, and -0.757, respectively, and the *p* values were all below 0.01, indicating that there were significant differences between the ≤10 tenure group and

the 11-20, 21-30, and >30 groups. The mean differences between the 11-20 years tenure group and the 21-30 and >30 groups were -0.188 and -0.470, respectively, and the *p* value for the >30 years group was less than 0.01, indicating that there were significant differences between the 11-20 years group and the >30 years group. The results showed that doctors with less than 10 years of tenure showed significantly lower work engagement than those with 11-20, 21-30, or over 30 years of tenure. The work engagement of doctors with 11-20 years of tenure was significantly lower than that of doctors with over 30 years of tenure.

Regarding different hospital grades, the mean differences of DPR between the Grade III B group and Grade III A, Grade II A, and "others" were 0.178, 0.230, and -0.020, respectively. Except for "others", the *p* values were all below 0.01, indicating that the Grade III B group was significantly different from the Grade III A and Grade II A groups, respectively. Compared with Grade III A and Grade II A groups, doctors in the Grade III B group showed better doctor-patient relationships.

In terms of WE, the mean differences between the Grade III A group and Grade III B, Grade II A, and "others" were -0.267, -0.077, and -0.080, respectively. The *p* value for the Grade III B group was below 0.01, indicating that there were significant differences between Grade III A and Grade III B groups. Compared with those working in Grade III A hospitals, doctors in Grade III B hospitals showed higher work engagement.

In terms of LMX, the mean differences between the Grade II A group and Grade III A, Grade III B, and "others" were -0.199, -0.285, and -0.531, respectively. The *p* value for Grade III A group was greater than 0.05, indicating that there was no significant difference between Grade II A group and Grade III A group. Compared with doctors in Grade II A hospitals, doctors working in Grade III B hospitals and other levels of hospitals showed better leader-member exchange.

4.4 Hypotheses testing

4.4.1 Moderated mediation effect test

Table 4.8 reports the regression relationship between JD and DPR, WE, and BO, respectively, between DPR and WE, between DPR and BO, and WE and BO. It can be seen from the table that JD was negatively associated with DPR ($\beta = -0.190$, $p < 0.001$, see Model 1), and thus, H1 was supported; JD was negatively associated with WE ($\beta = -0.144$, $p < 0.001$, see Model 2), and thus, H2 was supported; there was a positive relationship between JD and BO ($\beta = 0.600$,

$p < 0.001$, see Model 3), and therefore, H3 was supported; DPR was positively related to WE ($\beta = 0.327$, $p < 0.001$, see Model 4), supporting H4; DPR was negatively related to BO ($\beta = -0.265$, $p < 0.001$, see Model 5), supporting H6; moreover, WE was negatively associated with BO ($\beta = -0.431$, $p < 0.001$, see Model 6), and therefore, H8 was supported.

Table 4.8 Regression results between the variables

Variable	Model 1 (DPR)		Model 2 (WE)		Model 3 (BO)		Model 4 (WE)		Model 5 (BO)		Model 6 (BO)	
	β	t	β	t	β	t	β	t	β	t	β	t
JD	-0.190	-5.155***	-0.144	3.872***	0.600	19.952***						
DPR							0.327	9.200***	-0.265	-7.314***		
WE											-0.431	12.698***
R^2	0.360		0.021		0.361		0.107		0.070		0.185	
F	26.574***		14.990***		398.096***		84.636***		54.490***		161.248***	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; DPR = doctor-patient relationship, BO = burnout, JD = job demands, WE = work engagement.

Table 4.9 summarizes the test results of the mediation effect of DPR. It can be seen that JD was negatively associated with DPR (β = -0.190, $p < 0.001$, see Model 1), JD was negatively associated with WE (β = -0.144, $p < 0.001$, see Model 2); JD was positively related to BO (β = 0.600, $p < 0.001$, see Model 3); after controlling JD, there was a positive relationship between DPR and WE (β = 0.311, $p < 0.05$, see Model 4); after controlling JD and WE, there was a negative relationship between DPR and BO (β = -0.336, $p < 0.001$, see Model 5). The results showed that JD indirectly affected WE and BO, respectively, through DPR, indicating a mediation effect. Therefore, H5 and H7 were supported.

Table 4.9 Mediation effect test results

Variable	Model 1 (DPR)		Model 2 (WE)		Model 3 (BO)		Model 4 (WE)		Model 5 (BO)	
	β	t	β	t	β	t	β	t	β	t
JD	-0.190	-5.155***	0.144	3.872***	0.600	19.952***	-0.085	-2.353*	0.542	19.584***
DPR							0.311	8.612***	-0.052	-1.801
WE									-0.336	-11.683***
R^2	0.360		0.021		0.361		0.114		0.484	
F	26.574***		14.990***		398.096***		45.375***		220.310***	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; DPR = doctor-patient relationship, BO = burnout, JD = job demands, WE = work engagement.

Then, we built a moderation effect model, where LMX moderates DPR's effect on BO and moderates the mediation effect of JD→DPR→BO, corresponding to model 83 in Process.

With BO as the dependent variable, JD as the independent variable, DPR and WE as mediators, and LMX as the moderator, data were input to Process, and the results can be found in Table 4.10.

Table 4.10 Moderated mediation effect test results

Variable	Model 1 (DPR)		Model 2 (WE)		Model 3 (BO)	
	β	t	β	t	β	t
Constant	0.012	0.325	0.000	0.000	0.000	0.000
JD	-0.183	-4.980***	-0.085*	-2.352*	0.542***	19.584***
LMX	0.253	6.966***	-	-	-	-
JD×LMX	0.098	2.754**	-	-	-	-
DPR			0.311***	8.612***	-0.052	-1.801
WE			-		-0.336***	-11.683***
R^2	0.118		0.114		0.484	
F	31.502***		45.357***		220.310***	

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; DPR = doctor-patient relationship, BO = burnout, JD = job demands, LMX = leader-member exchange, WE = work engagement.

From Table 4.10, results of the interaction term JD×LMX (β = 0.098, $p < 0.01$, see Model 1) showed that LMX moderated JD's effect on DPR, and thus, H10 as supported. As JD was positively associated with BO through DPR and WE sequentially (see Model 3), H9 was supported.

Then, we produced the moderation effect plot for further verification. Through the simple slopes, we analyzed the actual impact of doctors' JD on BO with different levels of LMX.

The simple slope plot for LMX's moderation effect in JD→DPR can be found in Figure 4.1 below.

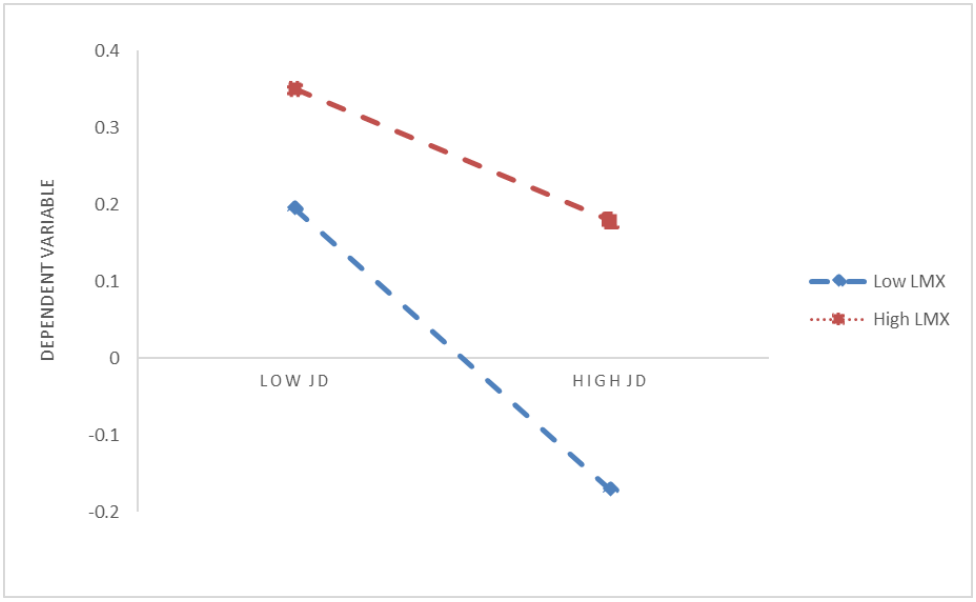

Figure 4.1 Moderation effect of LMX between JD and DPR

It can be seen from Figure 4.1 that when LMX level is relatively low, JD is significantly negatively associated with the DPR, and the downward slope is quite steep. When LMX is high, although JD is still negatively associated with DPR, the effect is relatively weaker compared with the level-level LMX. In other words, the higher the LMX quality, the weaker the negative relationship between the JD and the DPR; the lower the LMX quality, the stronger the negative relationship between the JD and the DPR. Therefore, H10 was supported.

Besides moderating JD's effect on DPR, LMX may also moderate the mediation effects in JD→DPR→BO and JD→DPR→WE→BO. Results of the moderated mediation effect analysis are shown in Table 4.11.

Table 4.11 Moderated mediation effect test results

Path	LMX	Effect	BootSE	BootLLCI	BootULCI
JD→DPR→BO	-0.960	0.015	0.008	0.012	0.033
	0.034	0.009	0.005	0.001	0.022
	1.027	0.004	0.003	-0.001	0.013
JD→DPR→WE→BO	-0.960	0.030	0.010	0.014	0.050
	0.034	0.019	0.006	0.009	0.032
	1.027	0.009	0.005	-0.001	0.020

Note: DPR = doctor-patient relationship, BO = burnout, JD = job demands, LMX = leader-member exchange, WE = work engagement.

We analyzed the moderated mediation model as follows:

(1) Differences in the impact on the mediation effect. We can see from the analysis results in Table 4.11 that regarding the moderator LMX's effect on the mediation of JD→DPR→BO, 0 was not included in the interval of the low-level group but was found in the interval of the high-level group, showing a significant difference. This result indicates that the mediation effect of JD→DPR→BO was different under different level moderation effects. Regarding LMX's effect on the mediation of JD→DPR→WE→BO, 0 was not contained in the interval of the low-level group, but was found in the high-level group, showing a significant difference. This result shows that the mediation effect of JD→DPR→BO was different under different moderation effects.

(2) Index analysis. The moderated mediation model analysis results showed that in the path JD→DPR→BO, the Index of the moderator LMX was -0.0051, BootSE was 0.0031, BootLLCI and BootULCI were -0.0122 and -0.0002, and the confidence interval did not include 0. In the path JD→DPR→WE→BO, the Index was -0.0102, BootSE was 0.0043, BootLLCI and BootULCI were -0.01961 and -0.0026, and the confidence interval did not include 0. The Index results showed significance.

(3) Paired comparison. Regarding the moderator LMX's effect on the mediation of JD→

DPR→BO, data analysis showed that the value of high-level group (+1SD) minus low-level group (-1SD) was -0.0102, BootSE was -0.0046, and BootLLCI and BootULCI were -0.0015 and -0.0191. Besides, after paired subtraction, the confidence interval did not contain 0, showing that the paired comparison had a significant effect. Regarding LMX's effect on the mediation of JD→DPR→WE→BO, the value of high-level group (+1SD) minus low-level group (-1SD) was -0.0202, BootSE was -0.0040, and BootLLCI and BootULCI were -0.0147 and -0.0298. In addition, after paired subtraction, the confidence interval did not include 0, showing that the paired comparison had a significant effect.

Through the above three steps of analysis on the moderated mediation model, we can determine that both the moderation effect and the mediation effect were significant. Therefore, the moderated mediation model was verified. Based on the above-presented results, H11, H12, and H13 were supported.

4.4.2 Summary of hypothesis testing results

In Chapter 2 of this thesis, research hypotheses were put forward according to the literature review, the relevant theoretical basis, and the reality of doctor profession. By using SPSS 26.0, SPSS' plug-in Process Macro, and AMOS 24.0, through EFA, CFA and SEM, the relationship and theoretical logic between the variables were scientifically confirmed. The specific hypothesis testing results are shown in the Table 4.12.

Table 4.12 Summary of hypothesis testing results

	Hypotheses	Results
H1	*Job demands (JD) are negatively associated with the doctor-patient relationship (DPR).*	Supported
H2	*Job demands (JD) are negatively associated with work engagement (WE).*	Supported
H3	*Job demands (JD) are positively associated with burnout (BO).*	Supported
H4	*The doctor-patient relationship (DPR) is positively associated with work engagement (WE).*	Supported
H5	*The doctor-patient relationship (DPR) mediates the relationship between job demands (JD) and work engagement (WE).*	Supported
H6	*The doctor-patient relationship (DPR) is negatively associated with burnout (BO).*	Supported
H7	*The doctor-patient relationship (DPR) mediates the relationship between job demands (JD) and burnout (BO).*	Supported
H8	*Work engagement (WE) is negatively associated with burnout (BO).*	Supported
H9	*Job demands (JD) are positively associated with burnout (BO) through the doctor-patient relationship (DPR) and work engagement (WE).*	Supported
H10	*The leader-member exchange (LMX) mitigates the relationship between job demands (JD) and the doctor-patient relationship (DPR).*	Supported
H11	*The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) in the negative relationship between*	Supported

	Hypotheses	Results
	job demands (JD) and work engagement (WE).	
H12	*The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) in the positive relationship between job demands (JD) and burnout (BO).*	Supported
H13	*The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) and work engagement (WE) in the positive relationship between job demands (JD) and burnout (BO).*	Supported

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Chapter 5: Discussion and Conclusions

This chapter summarizes the findings of the empirical analysis and carries out discussions accordingly, including public hospital doctors' job demands, doctor-patient relationship, work engagement, burnout, and leader-member exchange (LMX) across different sociodemographic groups, as well as the results of hypothesis model testing. It will also present this study's theoretical contributions, managerial implications, and limitations and put forward prospects for future related research.

5.1 Overall findings

With the continuous advancement of China's economic and social development and the increasingly prominent trend of population aging, Chinese residents are having higher expectations for the quality and efficiency of medical services. As the main force of medical services in China, doctors in public hospitals are facing increasing job demands, which may affect the doctor-patient relationship and doctors' work engagement and burnout. In this process, LMX may play a moderating role, mitigating the negative outcomes. Therefore, based on the Job Demands-Resources (JD-R) model and the Conservation of Resources (COR) Theory, this study explored the influence paths of doctors' job demands in public hospitals and the moderation effect of LMX. The research findings have great practical significance regarding how to scientifically cope with the negative effects brought by job demands.

This study adopted a cross-sectional design, using samples of 708 doctors from 18 public general or specialized hospitals in 14 regions/cities of different administrative levels in Jiangsu Province. Through the questionnaire, we collected information on 11 sociodemographic characteristics of the sample, including gender, age, tenure, education level, professional title, marital status, after-tax monthly income, hospital grade, number of beds, department, and employment type.

The mean values of the main variables and the results of Pearson's correlation analysis are presented in Table 4.2. With the six-point Likert scale for scoring, the mean ± SD was 3.497 ± 0.823 for job demands, 5.588 ± 0.625 for the doctor-patient relationship, 3.540 ± 1.501 for burnout, 4.568 ± 1.094 for work engagement, and 4.966 ± 1.007 for LMX.

The results showed that doctors' job demands were at a medium to high level. As Chinese

public hospitals at level II or above are positioned to be the core medical centers at the county/district level or above, they have long faced problems such as heavy workload per capita, long working hours, overwhelming clinical teaching and research tasks, and mismatching between salaries and work engagement. In particular, the research process of this study experienced the outbreak of COVID-19 starting in 2020. With the development of the pandemic, due to the requirements for pandemic prevention and control, there was an extreme shortage of doctors and anti-pandemic supplies, and doctors were constantly facing heavy workloads, resulting in great energy depletion at the physical and psychological levels. That might also be one of the reasons for the high level of job demands in the research results.

A high-level doctor-patient relationship was reported, which seems to be inconsistent with previous research findings of tense or low-level doctor-patient relationships in China. However, we should take into account the background of COVID-19 that doctors in public hospitals were experiencing during this research. Except for that, we can see that our results are generally consistent with the characteristics of doctor-patient relationships in the post-pandemic period or after the pandemic. Although COVID-19 brought significant physical and psychological stress to the doctors and medical supplies became very scarce during the peak of the pandemic, the health care workers showed the whole society their constant dedication and intense efforts regardless of personal gains and losses. Through media reports or personal witnesses, the general public developed a positive impression of this occupation, which might lead to a better understanding and increased respect for the health care workers and a general recognition of this profession. That may have contributed greatly to the improvement of the doctor-patient relationship, which was quite tense in the past.

The doctors reported a high level of work engagement. Doctors in public hospitals who have recently experienced the pandemic period of several years generally possess a strong sense of professional mission in dealing with major public health events and serving the public's medical and health needs, which stimulated their work motivation. At the same time, as mentioned above, the pandemic experience resulted in an improvement in the doctor-patient relationship, which could help reduce doctors' emotional stress, improve their professional identification, and enhance their work enthusiasm, thereby enhancing their work engagement level.

The results showed that doctors reported a medium to high level of burnout. Chinese public hospitals at level II or above undertake heavy workloads and high work stress due to their function of ensuring regional medical services. Their high job demands in workload, work standards, and work efficiency may lead to the risk of burnout. In addition, the survey data may

also reflect doctors' psychological feedback of stress resulting from their long-term participation in the pandemic prevention and control work with heavy workloads and high requirements. In the face of these job demands and stressors, once the chronic physical or psychological stress cannot be well managed, and doctors may show serious syndrome such as anxiety and insomnia. Such a problem needs to be paid attention to by hospital managers.

A high level of LMX was reported by the doctors. As the National Health Commission of China required public hospitals to actively promote a modern hospital management system, including the human resource management system, the talent training and management system, and the culture construction, public hospitals have been increasingly aware of and have been continuously improving the organizational culture. The professional management training for heads of clinical departments (doctors' direct superiors) organized by the hospital leadership continued to improve in both frequency and quality. At the same time, professional quality trainings for doctors have become increasingly common in public hospitals. The trainings and relevant system construction may enable both doctors and their superiors to be more aware of their shared goals and interests, which can lead to a more positive LMX in their work. In addition, doctors' self-consciousness of cooperation with superiors, which was developed during COVID-19, may have also contributed to LMX improvement.

In summary, this study showed that after COVID-19, Chinese doctors continued to face challenges of high job demands (including psychological demands and workload) and high level of burnout, but yet perceived a more positive doctor-patient relationship and healthier LMX and showed high work engagement. Overall, this study showed that after going through COVID-19, while facing high job demands and burnout, Chinese doctors also reported some positive facts, including improved doctor-patient relationships, good LMX, and high work engagement. These results deserve the attention of the government and hospital managers.

5.2 Analysis of variance (ANOVA) results discussion

In this study, job demands were measured by seven items extracted through principal components analysis, including two dimensions: psychological demands and workload. The results of analysis of variance (ANOVA) showed that the job demands of doctors in the 41-50 age group were significantly higher than those in the 20-30 and 31-40 age groups; the job demands of doctors with more than 30 years of tenure were significantly higher than those of doctors with 21-30 years or less than 10 years of tenure; the job demands of male doctors were significantly higher than those of female doctors; however, other sociodemographic

characteristics did not make significant differences in job demands.

Specifically, for doctors in similar professional posts in Chinese public hospitals, those with older age or longer tenure tend to have a higher education level in medicine, more clinical work experience, and a higher professional and technical title, and may simultaneously hold relevant business or administrative management positions. When these doctors are given greater professional authority, work autonomy, and business management rights by their superiors, they are often assigned tasks with higher standards and greater difficulties, assuming more responsibilities, compared to doctors of younger age or with less tenure. At the same time, they may also need to undertake teaching tasks for younger or less experienced doctors and interns from medical schools. Therefore, the psychological demands and workload may lead to greater energy depletion among these doctors. In addition, in terms of gender, due to the tradition of Chinese medical treatment, the specific requirements of different medical tasks, and the physical differences between males and females, in public hospitals, as far as the same medical specialty is concerned, tasks with higher physical demands and medical risks tend to be allocated to male doctors rather than female doctors, such as emergency rescue, surgery, and emergency security, which result in significantly higher job demands for male doctors than female doctors.

In terms of the doctor-patient relationship, the ANOVA results showed that doctors working in hospitals of Grade III B reported better doctor-patient relationships than those in Grade III A and Grade II A groups; however, other sociodemographic characteristics did not make significant differences in the doctor-patient relationship.

More specifically, at present, China implements a hierarchical management system for hospitals, dividing hospitals into three levels and ten classifications. Hospitals at different levels and of different classifications are managed according to different standards and requirements. The hierarchy is determined mainly based on the hospital's functions, tasks, scale, technical level, facilities, service quality, and management level (G. Sun, 1993). Among public hospitals, which is the research objective of this study, Grade III A hospitals and Grade II A hospitals are regional medical centers at the provincial/municipal and county/district levels, respectively, and doctors' work should meet the evaluation criteria for the respective levels (A. Wang & Huang, 2022). At the same time, they need to face relatively complex, high-risk, and challenging cases and severe patients, and thus, doctors are constantly in a high-workload and high-stress work environment (H. Zhang et al., 2022), which may lead to emotional impairment of doctors and tension between doctors and patients. In particular, although Grade II A hospitals undertake fewer difficult case treatment tasks compared to Grade III A hospitals, they need to implement

China's hierarchical medical reform goal of "all severe diseases managed within the county". Moreover, compared to Grade III A hospitals, they have access to fewer resources and thus face greater stress and a larger resource gap when undertaking medical treatment tasks (M. Wang et al., 2016). Grade III B hospitals are found between those two in terms of function positioning and resource allocation. In treatment of emergent, risky, and severe conditions and response to public health emergencies, doctors in these hospitals have lower workload, stress, and difficulty in communication with patients than Grade III A and Grade II A hospitals, leading to a better level of doctor-patient relationship.

The ANOVA results showed that the work engagement of doctors of over 50 years old was significantly higher than that of doctors in the age groups of 20-30, 31-40 and 41-50; the work engagement of doctors in the 41-50 age group was significantly higher than that in the 31-40 age group. In terms of tenure, the work engagement of doctors with less than 10 years of tenure was significantly lower than that of doctors with 11-20, 21-30, or more than 30 years of tenure; the work engagement of doctors with 11-20 years of tenure was significantly lower than that of doctors with more than 30 years of tenure. Regarding hospital grade, compared with the doctors in Grade III A hospitals, the doctors in Grade II B hospitals reported higher work engagement. However, other sociodemographic characteristics did not make significant differences in doctors' work engagement.

Previous studies showed that doctors' sense of professional mission was significantly positively associated with their work engagement (Y. Wang & Zhang, 2020), and the work engagement of doctors in public hospitals might be affected by the practice environment, knowledge level, identification, career development, and institutional mechanism (L. Zhang et al., 2021). Specifically, in Chinese public hospitals, among doctors in similar professional positions, those with an older age or a longer tenure tend to have a higher education level in medicine and more hospital working experience. Since China's reform and opening-up, with the continuous progress of economic and social development, as well as the continuous adjustment of the national family planning policy that has led to changes in the family environment for children, the opportunities for young people to receive higher education have been increasing. In addition, the modern education philosophy and the personalized education concept have become more popular; for university graduates, their employment mode shifted from the unified job distribution by the state in early times to the two-way free choice between employers and job seekers. In such a context, newly employed young doctors tend to pursue freedom and personalized employment. Relatively speaking, in public hospitals, older doctors tend to be more influenced by the concept of collectivism and dedication emphasized by

traditional education and thus have stronger professional identification and sense of mission in their work. Therefore, in terms of work engagement in medical services, doctors with an older age and a longer tenure are likely to show higher work engagement. At the same time, this result also reflects an emergent challenge faced by hospitals, that is, how to improve the work engagement of young doctors? It is a problem that is worth paying attention to in future research.

In addition, the results showed that doctors in Grade III B hospitals reported higher work engagement than those in Grade III A hospitals, which may be related to the above-mentioned fact that the doctor-patient relationship and the working climate in Grade III B hospitals are more harmonious as they are between Grade III A and the Grade II A in terms of function positioning and resource allocation, which may be conducive to maintaining strong professional identification and high work engagement in doctors' medical work.

In terms of burnout, according to the ANOVA results, doctors in the pediatric department reported significantly higher burnout than those in the obstetrics and gynecology department and "others" (e.g., dermatology and stomatology). In addition, male doctors reported a significantly higher level of burnout than female doctors. However, there was no significant between-group difference in burnout for other sociodemographic characteristics. According to previous studies, the risk of burnout mainly depends on the fit degree between individuals and occupations, rather than the individual or the occupation unilaterally (Maslach et al., 2001). An environment with higher job demands and fewer job resources is more likely to lead to burnout; when the job resources are insufficient to meet the job demands, it will cause a decline in work engagement (Demerouti et al., 2001).

Specifically, in recent years, there have been fewer graduates majoring in Pediatrics from medicine schools in China, resulting in a more significant shortage of human resources in pediatrics compared with other clinical specialties in most public hospitals. This problem is further accentuated by the high volume of outpatient and emergency visits in pediatrics due to China's huge family base and child population, and the per capita workload of pediatricians continues to be higher than that of other clinical specialties. Especially in seasons of high incidence of respiratory infectious diseases among children, accessing outpatient or emergency visits in pediatrics is extremely difficult in public hospitals, and it may take hours of waiting time for on-site visits. That further leads to reduced actual visit time for each child, resulting in the dissatisfaction of the parents and a vicious circle in the doctor-patient relationship, thus leading to energy depletion of pediatricians at both physical and psychological levels. In addition, currently, most Chinese families with children are one-child families, making the parents extremely concerned with the child's health. Moreover, with the relaxation of China's

family planning policy in recent years, the increase of childbirths in middle-aged families has led to a centralized and phased increase in the number of children. The parents in these two types of families clearly show more anxiety during their children's treatment. This reality, intertwined with the physical and mental fatigue of pediatricians in completing their tasks, results in an increased incidence of doctor-patient conflicts, leading to continuous physical and psychological impairment among pediatricians, which further results in a significantly higher risk of burnout among pediatricians than doctors in obstetrics and gynecology or other departments. Public awareness of this reality has further led to a decline in high school graduates' willingness to choose Pediatrics when applying for schools of medicine, resulting in an imbalance between the cultivation and supply of pediatric medical talents and social demands.

Furthermore, in the whole doctor population, male doctors reported a significantly higher level of burnout than female doctors. That is related to the above-mentioned reality that male doctors tend to have significantly higher job demands than female doctors. As male doctors constantly undertake tasks with greater workload, higher technical difficulties, and more medical risks, it may lead to more physical and psychological energy depletion among male doctors than female doctors, further resulting in burnout.

Finally, the ANOVA results showed that doctors in Grade III B hospitals reported better LMX than those in Grade II A hospitals; however, other sociodemographic characteristics did not make a significant difference in LMX. More specifically, Grade III B hospitals' better LMX may be related to the better doctor-patient relationship and working climate in Grade III B hospitals mentioned above, as Grade III B hospitals are between Grade III A and the Grade II A hospitals in terms of function positioning and resource allocation, which is conducive to establishing a more positive and harmonious LMX in medical work.

5.3 Hypothesis testing results discussion

In Chapter 2, research hypotheses were put forward according to the literature review, theoretical basis, and current status of the doctor profession. Using SPSS 26.0, SPSS' plug-in Process Macro, and AMOS 26.0, we conducted exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modeling (SEM) to scientifically examine the relationships and theoretical logic between the variables.

5.3.1 The relationship between job demands and the doctor-patient relationship, work

engagement, and burnout

As predicted by the energy depletion path in the JD-R model, this study showed that job demands were negatively associated with the doctor-patient relationship and work engagement, but positively related to burnout, and was positively associated with burnout through the doctor-patient relationship and work engagement sequentially. Therefore, Hypothesis 1 (H1), Hypothesis 2 (H2), Hypothesis 3 (H3), and Hypothesis 9 (H9) proposed in this study were supported.

The energy depletion path of the JD-R model is caused by excessive job demands, which further leads to negative outcomes such as burnout (Bakker & Demerouti, 2007). Excessive job demands can lead to individuals' high error rate in work, low job satisfaction, emotional exhaustion, higher burnout, and increased turnover intention (Song et al., 2017). High job demands and low job resources will lead to burnout, whereas the combination of high challenge job demands with job resources can enhance employees' work engagement (Bakker et al., 2023).

H1: *Job demands (JD) are negatively associated with the doctor-patient relationship (DPR)*.

Previous relevant studies showed that the constant high job demands faced by doctors in public hospitals would lead to individuals' energy depletion, which would further result in doctors' poor working status or even cause doctor-patient disputes (A. Wang et al., 2016). In the context of public hospitals in China, when doctors' job demands (workload and work standards) significantly exceed what they can provide within normal working hours at a regular pace using existing resources, doctors, as the main actors of medical services, have to bear both physical and psychological stress in order to complete their medical work. They may not have enough time and energy to carry out sufficient communication with patients on the details of disease diagnosis and treatment in order to reach the necessary understanding and cooperation between doctors and patients. At the same time, under the work stress caused by excessive job demands, doctors may face significant emotional burden, and these negative emotions may affect doctors' attitude and behavior towards patients in the process of diagnosis and treatment. Due to physical fatigue or psychological stress, doctors may show indifference or impatience in front of patients. In addition, under this stress, doctors may make mistakes in their judgment and decision-making regarding the disease, resulting in negative outcomes in terms of treatment effect and medical safety. The above-mentioned situations are likely to cause patients' dissatisfaction with the doctor's diagnosis reference, treatment plan, and communication manner, which will undermine the trust between doctors and patients, reducing the quality of the doctor-patient relationship, further leading to doctor-patient contradictions or even medical

disputes.

H2: *Job demands (JD) are negatively associated with work engagement (WE)*.

According to previous relevant studies, an environment with higher job demands and fewer job resources is more likely to lead to burnout; when the job resources are insufficient to meet the job demands, it will lead to a decline in work engagement (Demerouti et al., 2001). In the context of Chinese public hospitals, when doctors are faced with excessive job demands, such as completing intense and challenging medical work within a limited time, working continuously for long hours, or having no guarantee for normal sleeping time and vacation, it may lead to doctors' emotional exhaustion and physical and psychological fatigue. In addition, doctors may perceive that they will still be unable to meet such high job demands despite their efforts, or that the work environment is not favorable to their work, and thus, their job satisfaction may decrease. The above-mentioned situations are likely to lead to doctors' increased dissatisfaction and even more negative attitudes towards medical work. In their work, they may give priority to efficiency rather than quality, which will naturally result in reduced work engagement.

H3: *Job demands (JD) are positively associated with burnout (BO)*.

Previous related studies showed that when doctors' stress cannot be relieved, it will lead to a decline in doctors' job satisfaction, which will further cause burnout, greatly affecting their level of work engagement (T. Yang et al., 2017). In the context of Chinese public hospitals, doctors may perceive great work stress when facing high job demands. The stress may come from demands such as receiving a large number of patients in a short time, bearing the risk of complex disease diagnosis and treatment, and undertaking tasks beyond their work plan. Stress may also be caused by the imbalance between work and family in terms of time and energy allocation due to high job demands. As doctors may have to sacrifice more personal time to meet the job demands, it makes their relationship with family and friends estranged. These scenarios are likely to lead to self-frustration, emotional exhaustion, and physical and psychological exhaustion in medical practice, resulting in burnout. According to H1 and H2, high job demands have a negative impact on the quality of the doctor-patient relationship and doctors' work engagement. Such negative effects will further increase doctors' physical or psychological stress and consume doctors' emotional resources, thereby increasing the risk of burnout. That is consistent with the positive relationship between job demands and burnout hypothesized in H3.

H9: *Job demands (JD) are positively associated with burnout (BO) through the doctor-patient relationship (DPR) and work engagement (WE)*.

In other words, H9 states that job demands are positively related to burnout through the sequential mediation of the doctor-patient relationship and work engagement. According to previous relevant studies, the root cause of individuals' burnout may be the decisive impact of the depletion of individual psychological resources on individuals' motivation and behavior, which leads to individuals' reduced self-efficacy and separation from work (Bakker, Demerouti, & Taris et al., 2003). In the context of Chinese public hospitals, the high demands for medical work may bring continuous physical and psychological stress and emotional impairment to doctors, which will have a negative impact on doctor-patient communication and interaction during medical services and may even undermine the trust between both sides, resulting in tension between doctors and patients. Subsequently, the tense doctor-patient relationship will negatively impact the doctor-patient cooperation during medical services, which can further cause doctors' physical or psychological burden and lead to continuous emotional impairment, thus reducing doctors' professional identification and work enthusiasm, further leading to a decline in their work engagement. If doctors are not sufficiently engaged when providing medical services, it will further aggravate the physical or psychological stress caused by reasons such as workload. Low work engagement may also result in doctors' reduced concentration and patience during medical services, leading to declined medical quality and undermined doctor-patient trust, which will, in turn, be reflected in negative feedback to doctors from patients, further reducing the doctors' sense of professional accomplishment and work enthusiasm, thus increasing the risk of burnout.

5.3.2 The relationship between the doctor-patient relationship and work engagement and burnout

In line with what is predicted by the JD-R model and the COR theory, the results of this study showed that the doctor-patient relationship was positively related to work engagement but negatively associated with burnout, supporting Hypothesis 4 (H4) and Hypothesis 6 (H6) proposed in this study, respectively.

In current medical service environment in China, the doctor-patient relationship, as a challenge demand, not only means physical and psychological stress to doctors but also implies economic and professional returns for them (Zeng et al., 2022). The doctor-patient relationship is not only closely related to patient satisfaction and treatment effect (Eveleigh et al., 2012; Mohseni & Lindstrom, 2007), but also has a great impact on health care workers' work status and career development prospects (Baker et al., 2003). As a kind of job resource, good doctor-patient relationship has a motivational effect, driving individuals to show a high level of work

engagement and excellent job performance (Bakker & Demerouti, 2007; Demerouti et al., 2001), thus meeting the psychological needs of employees and enhancing their work enthusiasm and commitment.

H4: T*he doctor-patient relationship (DPR) is positively associated with work engagement (WE)*.

In the context of Chinese public hospitals, doctors are commonly faced with high workload and work stress. A high level of doctor-patient relationship is conducive to good communication and interaction between doctors and patients during the medical process. With enhanced mutual trust, patients can more clearly and accurately describe their symptoms, and better understand and cooperate with doctors in the diagnosis and treatment of diseases. Patients' understanding, trust, and cooperation that derive from a good doctor-patient relationship may make doctors perceive that they are needed and respected, thus growing a sense of professional pride. In addition, doctors with good doctor-patient relationships are more likely to be recognized by society and the industry, enabling them to be rewarded through career promotion and personal income, which will further stimulate their professional identification and work enthusiasm, thus further enhancing their work engagement, making them more focused on providing professional and high-quality medical services for patients.

H6: *The doctor-patient relationship (DPR) is negatively associated with burnout (BO)*.

In the context of Chinese public hospitals, doctors constantly face physical or psychological stress caused by heavy workloads and work pressure. A high level of doctor-patient relationship is conducive to enhancing the trust between doctors and patients and improving the quality of communication and interaction between the two sides, and doctors will perceive the understanding and cooperation of patients and their families during the medical process. This kind of mutual trust and working climate brought by a good doctor-patient relationship may provide a better professional experience to doctors. As a psychological resource, it can continuously enhance doctors' enthusiasm for medical work, motivating them to actively improve themselves in work, thus reducing the risk of burnout.

5.3.3 The relationship between work engagement and burnout

Consistent with the proposition of the JD-R model, this study showed that work engagement was negatively associated with burnout, supporting Hypothesis 8 (H8).

Relevant literature has pointed out that when employees' work engagement is at a high level, they will harness themselves to the work role and seek self-efficacy in the role, which will reduce the risk of burnout; on the contrary, when employees' work engagement is at a low

level, individuals will separate themselves from their work roles (Schaufeli et al., 2006). As employees lose energy resources and interest in work, it becomes more unlikely for them to invest in cognitive resources such as attention, and such reduced work enthusiasm and concentration may lead to burnout (Hobfoll et al., 2018).

H8: *Work engagement (WE) is negatively associated with burnout (BO)*.

In the context of Chinese public hospitals, when doctors are highly engaged when carrying out medical services, the physical or psychological stress caused by workload, doctor-patient relationships, or other reasons may be relieved due to the sense of professional accomplishment and personal satisfaction brought by increased work engagement. In this case, doctors are more likely to recognize the professional value and social significance of the medical work, thereby stimulating their work enthusiasm and reducing the risk of burnout. At the same time, a higher level of work engagement enables doctors to be more attentive and patient in communicating with patients and their families during the whole medical process, which makes it more likely to gain patients' understanding and active cooperation in the diagnosis and treatment of diseases. Such a high level of trust from patients can mitigate doctors' depletion of emotional resources, thus reducing the risk of burnout.

5.3.4 Mediation effect

5.3.4.1 Mediation of the doctor-patient relationship

As predicted by the JD-R model, this study found that the doctor-patient relationship mediated the relationship between job demands and work engagement and the relationship between job demands and burnout, supporting Hypothesis 5 (H5) and Hypothesis 7 (H7) proposed in this study.

Previous related studies showed that the doctor-patient relationship affected the working status and career development prospects of health care workers (Baker et al., 2003). A tense doctor-patient relationship will lead to doctors' serious emotional exhaustion and burnout, which will affect the quality and safety of medical treatment and in turn, further undermine the doctor-patient relationship (Dewa et al., 2017; Moradi et al., 2015). In the current medical service environment in China, the doctor-patient relationship, as a challenge job demand, has an impact on work engagement (Zeng et al., 2022).

H5: *The doctor-patient relationship (DPR) mediates the relationship between job demands (JD) and work engagement (WE)*.

In the context of Chinese public hospitals, the high demands for medical work may bring

continuous physical and psychological stress and emotional impairment to doctors, thus negatively affecting doctor-patient communication and interaction in medical services or even the trust between both sides, leading to tension between doctors and patients. Further, the tense doctor-patient relationship will negatively affect doctor-patient cooperation in medical process, which will further increase the physical or psychological burden of doctors and lead to continuous emotional impairment, thus reducing doctors' professional identification and work enthusiasm, resulting in a decline of work engagement. In this process, the doctor-patient relationship showed a mediation effect between job demands and work engagement. That is, given the negative relationship between job demands and the doctor-patient relationship and the positive relationship between the doctor-patient relationship and work engagement, job demands affect work engagement by influencing the doctor-patient relationship.

H7: *The doctor-patient relationship (DPR) mediates the relationship between job demands (JD) and burnout (BO)*.

In the context of Chinese public hospitals, high demands for medical work may bring continuous physical and psychological stress and emotional impairment to doctors, which will negatively affect doctor-patient communication and interaction in medical services or even the trust between both sides, leading to tension between doctors and patients. Further, the tense doctor-patient relationship may make doctors doubt whether they would ever be able to gain respect, understanding, and cooperation from patients through intense work, which will lead to doubts about their professional value and reduced work enthusiasm, resulting in burnout. In this process, the doctor-patient relationship mediated between job demands and burnout. That is, given the negative relationship between job demands and the doctor-patient relationship and the negative relationship between the doctor-patient relationship and burnout, job demands affect burnout by influencing the doctor-patient relationship.

5.3.4.2 Moderation of LMX

Consistent with the motivational path of the JD-R model and the related hypothesis derived from the COR theory, LMX showed a moderation effect in the hypothesis model of this study, supporting Hypothesis 10 (H10), Hypothesis 11 (H11), Hypothesis 12 (H12), and Hypothesis 13 (H13) proposed in this study regarding LMX.

Related literature showed that LMX was significantly positively associated with employees' job performance (J. Li & Masterson, 2014). The relationship between leaders and subordinates is related to the roles and obligations of each one of them, and an individual's identification of such relationship will affect his/her subsequent interpersonal interaction behavior (B. S. Cheng

et al., 2006). Employees tend to make the best efforts to obtain and maintain their limited resources at work, and the quality of LMX will directly affect the resources and related support that employees have access to (Xi et al., 2015). When excessive job demands have a negative physical or psychological impact on individuals and lead to energy depletion, abundant job resources can play a buffering role (Bakker & Demerouti, 2007, 2024; Bakker et al., 2005).

H10: *The leader-member exchange (LMX) mitigates the relationship between job demands (JD) and the doctor-patient relationship (DPR)*.

In the context of Chinese public hospitals, doctors' physical or psychological stress and emotional impairment caused by high job demands may lead to insufficient doctor-patient communication and interaction and a decline in medical quality due to doctors' continuous energy depletion, which will further undermine the doctor-patient relationship, which is consistent with the negative relationship between job demands and the doctor-patient relationship hypothesized in H1. According to the motivational path in the JD-R model and the COR theory, a high-level LMX between doctors and their superiors and the leadership support brought by it serve as the resource replenishment for doctors in medical work, stimulating motivation and fostering resource gain, which is conducive to improving doctors' enthusiasm and focus for medical work, increasing their patience, and enhancing the quality of doctor-patient communication, thereby mitigating the negative relationship between job demands and the doctor-patient relationship. That is, the higher the quality of LMX, the weaker the negative relationship between job demands and the doctor-patient relationship.

H11: *The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) in the negative relationship between job demands (JD) and work engagement (WE)*.

In the context of Chinese public hospitals, high job demands of medical work may result in physical and psychological stress and emotional impairment to doctors, having a negative impact on doctor-patient communication and interaction during medical services, thus undermining the doctor-patient relationship. Subsequently, the tense doctor-patient relationship will further increase doctors' physical or psychological burden and lead to continuous emotional impairment, resulting in a decline in their work engagement. It is consistent with H5, which states that the doctor-patient relationship mediates the relationship between job demands and work engagement. In this case, a high-level LMX between doctors and their superiors, as a resource supplement for doctors in their medical work, can help to improve doctors' work enthusiasm and focus, and increase their patience, and enhance the quality of doctor-patient communication, thereby mitigating the negative relationship between job demands and the

doctor-patient relationship and reducing the tension between doctors and patients caused by high job demands. That is consistent with H10, which can further lead to the mitigation of the impact of job demands on work engagement through the doctor-patient relationship. In this process, LMX moderated the mediation of the doctor-patient relationship in the negative relationship between job demands and work engagement. More specifically, the higher the quality of LMX, the weaker the negative relationship between job demands and work engagement through the doctor-patient relationship.

H12: *The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) in the positive relationship between job demands (JD) and burnout (BO)*.

In the context of Chinese public hospitals, high job demands for medical work may cause physical and psychological stress and emotional impairment to doctors, which will negatively impact doctor-patient communication and interaction or even the trust between both sides during medical services, resulting in a tension between doctors and patients. This tense relationship may make doctors perceive that despite intense work, they may still not able to gain respect, understanding, and cooperation from patients, which will lead to doubts about their professional value and reduce their work enthusiasm, resulting in burnout. That is consistent with H7, which states that the doctor-patient relationship mediates the relationship between job demands and burnout. In this case, a high level of LMX between doctors and their superiors, as a resource supplement for doctors in their medical work, can help to improve doctors' work enthusiasm and focus, increase their patience, and enhance the quality of doctor-patient communication, thus mitigating the negative relationship between job demands and the doctor-patient relationship and reducing the tension between doctors and patients caused by high job demands. That is consistent with H10, which will further lead to a mitigation of job demands' impact on burnout through the doctor-patient relationship. In this process, LMX moderated the mediation of the doctor-patient relationship in the positive relationship between job demands and burnout, such that the higher the quality of LMX, the weaker the positive relationship between job demands and burnout through the doctor-patient relationship.

H13: *The leader-member exchange (LMX) moderates the mediation of the doctor-patient relationship (DPR) and work engagement (WE) in the positive relationship between job demands (JD) and burnout (BO)*.

In the context of Chinese public hospitals, as analyzed above, high demands for medical work may result in physical and psychological stress and emotional impairment to doctors and lead to tension between doctors and patients during medical services. The tense doctor-patient relationship's negative impact on medical work may further increase doctors' physical or

psychological burden and lead to continuous emotional impairment, which will lead to a decline in doctors' work engagement. If doctors are not sufficiently engaged in work when carrying out medical services, it will further aggravate the physical or psychological stress resulting from workload and some other reasons and may lead to the reduction of doctors' concentration and patience during medical treatment, thus undermining the medical quality and doctor-patient trust. Further, the negative feedback from patients will result in doctors' reduced sense of professional accomplishment and a continuous decline in work enthusiasm, which will further lead to burnout. That is consistent with H9, which states that job demands are positively associated with burnout through the doctor-patient relationship and work engagement sequentially. In this case, a high level of LMX between doctors and their superiors, as a resource supplement for doctors in their medical work, is conducive to improving doctors work enthusiasm and focus, increasing their patience, and enhancing the quality of doctor-patient communication, thereby weakening the negative relationship between job demands and the doctor-patient relationship and reducing the tension between doctors and patients caused by high job demands, which is consistent with H10. In short, LMX moderated the sequential mediation of doctor-patient relationship and work engagement in the positive relationship between job demands and burnout, such that the higher the quality of LMX, the weaker the positive relationship between job demands and burnout through the doctor-patient relationship and work engagement.

5.4 Main findings

Based on the literature review, theoretical basis, and current reality of doctors' practice, this study proposed relevant research hypotheses. Using SPSS 26.0, SPSS' plug-in Process Macro, and AMOS 26.0, we examined the relationships and theoretical logic between the variables through EFA, CFA, and SEM. The results of this study are consistent with the conclusions of previous related studies. By finding out the relationships between the variables, we can scientifically explain the related work status of doctors in Chinese public hospitals.

5.4.1 Finding 1: Job demands' energy depletion effect on doctors' well-being

By analyzing the results of this study, we found that job demands were mainly manifested in doctors' psychological demands and workload. This study showed that job demands were significantly negatively associated with the doctor-patient relationship and work engagement but positively related to burnout. Based on these results and considering the context of Chinese

public hospitals, we can conclude that job demands have an energy depletion effect on doctors in public hospitals.

According to the theoretical hypothesis of the JD-R model, job demands and job resources have a comprehensive impact on employees' work engagement and burnout, where job demands are related to physical and psychological impairment at work (Bakker et al., 2023; Bakker et al., 2014). Job demands, as a main predictor, cause employees' energy depletion at work, including physical and psychological depletion, which further leads to employees' burnout and negative work outcomes (Bakker & Demerouti, 2007).

Specifically, due to their unique operation and management system and resource input mechanism, Chinese public hospitals often have a limited number of permanent employees and lack financial and other supporting resources. Under the background of relatively insufficient resource guarantee, high job demands may include the requirement for doctors to receive a large number of patients in a short time, bear risks of complex disease diagnosis and treatment, and undertake tasks beyond their work plan such as clinical teaching, clinical research, and social volunteer services. Doctors may need to sacrifice more personal time to meet the job demands because the work requires excessive time to be completed, or the work standards are overly high. That will result in an imbalance between work and family in terms of time and energy allocation, undermining doctors' relationships with their family and friends. That may further increase doctors' physical and psychological stress and emotional impairment, resulting in a sense of self-frustration and a decline in work enthusiasm in medical practice, which may reduce their willingness to actively interact with patients and the quality of communication during medical services, thus leading to reduced medical quality and safety and further undermining the trust between doctors and patients and the doctor-patient relationship. That will result in doctors' continuous emotional depletion, leading to emotional exhaustion and physical and psychological fatigue, thereby reducing their work engagement and causing burnout.

5.4.2 Finding 2: The doctor-patient relationship's positive role as a challenge job demand in healthcare

The results of this study showed that the doctor-patient relationship was positively associated with work engagement and LMX, but negatively related to burnout. At the same time, the doctor-patient relationship mediated the relationship between job demands and work

engagement and the relationship between job demands and burnout. Based on the above research results and considering the context of Chinese public hospitals, we can conclude that the doctor-patient relationship, as a challenge job demand, plays a positive role in the medical work of public hospitals.

Previous studies showed out that the doctor-patient relationship was not only closely related to patients' satisfaction with medical treatment and treatment effect (Eveleigh et al., 2012; Mohseni & Lindstrom, 2007), but also had a great impact on the medical work status and career development prospects of health care workers (Baker et al., 2003). As a challenge demand in current medical service environment in China, the doctor-patient relationship not only means physical and psychological stress to doctors, but also implies economic and professional returns for them (Zeng et al., 2022). The doctor-patient relationship, as a challenge job demand in the medical field, can also be understood as a resource that is conducive to improving the work quality (Schaufeli & Taris, 2014; Zeng et al., 2023).

Specifically, in the case of high workload and stress of doctors in public hospitals, a high level of doctor-patient relationship is conducive to good communication and interaction between doctors and patients on disease diagnosis and treatment in medical practice, so as to establish a high-level doctor-patient relationship with mutual trust. In this case, patients can more accurately and comprehensively describe their symptoms or express related concerns and can better understand and cooperate with doctors' diagnosis opinions and treatment plans. At the same time, doctors can perceive the understanding and cooperation of patients and their families during medical services. Although challenge job demands may make individuals feel uncomfortable at work, they may still be regarded as beneficial and worthwhile work experience for them (Bakker & Demerouti, 2017). In public hospitals, patients' understanding, trust, and cooperation that derive from good doctor-patient relationship may make doctors feel needed and respected throughout the whole medical process, thus further strengthening their professional identification, stimulating their work enthusiasm, and improving the level of work engagement.

5.4.3 Finding 3: LMX's moderation as resource supplement

According to the results of this research, LMX, as a resource supplement in the energy depletion path, showed a moderation effect in the hypothesis model of this study. The moderation of LMX weakened the relationship between job demands and the doctor-patient relationship. It also showed moderated mediation effect in the negative relationship between job demands and work

engagement through the doctor-patient relationship, the positive relationship between job demands and burnout through the doctor-patient relationship, and the positive relationship between job demands and burnout through doctor-patient relationship and work engagement.

Based on the JD-R model and the COR theory, job demands and resources have all-around effects on employees' job performance and behavior. The "buffer" hypothesis of the JD-R model states that when the excessive job demands bring negative physical or psychological effects and energy depletion to individuals, sufficient job resources can play a role in buffering such negative effects (Bakker & Demerouti, 2007, 2024; Bakker et al., 2005). As a resource supplement in medical practice, encouraging communication between doctors and their superiors and establishing group preferences can help reduce employees' burnout and its practical impact (Wong, 2020).

Specifically, good LMX between doctors and their superiors in public hospitals and the leadership support brought by it, as a resource supplement in doctors' medical practice, plays a role of stimulating motivation and fostering resource gain, which is conducive to improving doctors' work enthusiasm and focus, increase their patience, and improve the quality of doctor-patient communication, so as to weaken the negative relationship between job demands and the doctor-patient relationship, buffering the negative impact of high job demands on doctor-patient relationship. In medical practice, a good doctor-patient relationship will bring positive feedback to doctors, which can further enhance doctors' professional identification and work enthusiasm, thus improving their work engagement and medical quality and efficiency, thereby reducing the risk of burnout. Therefore, LMX, as a resource supplement, showed a sequential moderated mediation effect in the positive relationship between job demands and burnout through the doctor-patient relationship and work engagement.

5.5 Theoretical contributions

The theoretical contributions of this study are three folds.

First, by integrating the JD-R model and the COR theory, this study explored the relationships between job demands and the doctor-patient relationship, work engagement, and burnout of doctors in public hospitals, confirming the positive or negative relationships between these variables in the context of medical practice in Chinese public hospitals. The study also revealed the mediation of the doctor-patient relationship in the relationship between related

variables. In particular, by studying the job characteristics of doctors in public hospitals across regions, hospital grades, and hospital categories, we confirmed job demands' energy depletion effect in the JD-R model. This conclusion enriched the research on the JD-R model and the COR theory.

In addition, previous theoretical research on job demands and burnout based on the JD-R model mostly focused on the enterprise management in the early stage. Later, the research was expanded to the field of medical management, and most studies focused on nurses in the hospital or the hospital's health care workers as a whole as the research object. Some studies focused on doctors in a specific specialty, such as the emergency department and intensive care department. To our knowledge, at present, there are very few empirical studies that apply this theory to research on doctors in Chinese public hospitals at various levels across different regions and specialties. Taking doctors of various specialties in public hospitals at various levels in different regions in Jiangsu Province of China as the research sample, this study extended theoretical research using the JD-R model in the field of medical management.

Furthermore, the LMX theory has become the frontier and a popular field of management psychology and leadership research in Western countries, but there is a lack of localized empirical research in mainland China. To our knowledge, at present, there are very few studies that have applied this theory to hospital organizational behavior and human resource management in China, especially research on the job characteristics of doctors in public hospitals. Based on the context of medical practice in Chinese public hospitals, taking doctors of various specialties in public hospitals of different levels and categories across different regions as the research sample, from the perspective of job resources, this study explored and confirmed the role of LMX as a resource supplement in buffering the negative impact of job demands on the doctor-patient relationship and the sequential mediation between relevant variables related to job characteristics, enriching the theoretical research on LMX in the field of hospital management in China.

5.6 Managerial implications

According to the results of the survey on 708 doctors from 18 public hospitals of different categories in 14 regions/cities across different administrative levels in Jiangsu Province, doctors' job demands were at a medium to high level, the level of doctor-patient relationship was relatively high, doctors showed a medium to high level of burnout and good work engagement, and LMX was at a good level. Through analysis, we considered the obtained results in line with

the actual situation of medical practice in Chinese public hospitals and the impact of COVID-19 on doctors in public hospitals during the research period. Based on the above-mentioned research findings, we put forward targeted policy suggestions for government authorities and policy-makers, public hospital managers, and doctors in public hospitals, respectively.

5.6.1 Government authorities and policy-makers

As the main organizers and administrators of public hospitals, government authorities and policy-makers should carry out sufficient research on the operation and management status of public hospitals, learn about the human resource allocation status in public hospitals regarding doctors, get to know the current status of the doctor-patient relationship, the influencing factors, and their impact on doctors' working status and medical service quality, so as to issue corresponding policies and take effective measures to further improve doctors' work environment.

In view of the energy depletion effect of job demands and its impact on the doctor-patient relationship, work engagement, and burnout, government authorities and policy-makers should attach great importance to improving the institutional environment of medical and health services. In response to the constant high job demands faced by doctors, measures should be taken to effectively reduce doctors' work burden, such as expanding the training and education of clinical doctors in short supply such as pediatrics, improving human resources allocation (e.g., by increasing the offering of permanent contracts to doctors in public hospitals), reducing the interference of non-medical work (e.g., administrative tasks in daily operation) on clinical work, and optimizing the workflow of medical services and medical administration/management.

Given the impact of the doctor-patient relationship on work engagement and burnout as shown in the results of this study, government authorities and policy-makers should be aware of the improvement of the doctor-patient relationship since COVID-19 and consolidate this achievement by further improving the relationship. They should strengthen health education for the whole society and the whole population and guide the patient population to individually develop their health awareness and a scientific view of diseases, life, and death.

In addition, they are suggested to support public hospitals to advance the standardization and regulation of medical facilities and equipment, promote hospitals to carry out training on medical service etiquette and doctor-patient communication skills, and create a good diagnosis and treatment environment for doctors, so as to continuously improve the doctor-patient relationship. Finally, competent government authorities should strive to establish and improve

a fair and efficient mechanism for handling medical service complaints and medical disputes, to reduce and prevent the occurrence of violence in medical settings through the institutional system, thereby effectively improving doctors' perception of occupational safety and job satisfaction.

In view of the sequential moderated mediation effect of LMX in the positive relationship between job demands and burnout through the doctor-patient relationship and work engagement, government authorities and policy-makers should optimize the allocation of hospital-level leaders in public hospitals, improve the selection and promotion mechanism for administrative and management talents, guide to build hospital- and department-level management teams equipped with strong ability and morality, strengthen managers' care and support for doctors, and provide doctors with more emotional support, job resources, and broader career development paths, so as to enhance doctors' work engagement and professional commitment, thereby reducing the risk of burnout.

5.6.2 Public hospital managers

As the helmsman of the scientific development of the hospital and the executor of the hospital's daily operation management, public hospital managers should fully understand the national medical and health policies and the health needs of the local society, have a comprehensive view of the core strengths of the hospital's medical services, the status quo of the workforce, and the satisfaction of employees and patients, be aware of the pain points and difficulties in the hospital's operation management and medical services, and take effective measures to improve the management quality.

Considering the energy depletion effect of job demands on doctors in their medical practice, as shown by the results of this study, we suggest public hospital managers pay attention to the scientificity and suitability of the hospital's strategic development goals and the operation supervision system. In view of the heavy workload and high job demands of clinicians, taking into account the specific shortages in the hospital's human resources, managers should accelerate building the team of specialist doctors by introducing and cultivating talents, adopt a reasonable mechanism for personnel allocation and task allocation, speed up the hospital's digital transformation to improve work quality and efficiency, optimize the medical service process and staffing efficiency within clinical departments, and improve the professional autonomy and job satisfaction of doctors, so as to reduce the risk of burnout.

Given the impact of the doctor-patient relationship on work engagement and burnout as well as its mediation between job demands and work engagement or burnout, as shown in the

results of this study, public hospital managers should view the doctor-patient relationship as a challenge job demand that is conducive to improving medical services, actively review and optimize the medical service process accordingly, provide a more friendly and convenient medical environment and services in accordance with the patient's needs, improve the emergency handling mechanism for doctor-patient conflicts and medical disputes within the hospital, organize and carry out training on medical ethics and doctor-patient communication skills for doctors, so as to improve the level of the doctor-patient relationship and strengthen doctors' self-realization and professional identification.

In view of the sequential moderated mediation effect of LMX in the positive relationship between job demands and burnout through the doctor-patient relationship and work engagement, public hospital managers should pay sufficient attention to LMX. As Zeng et al. (2022) pointed out, as China's medical system is huge and complex, it is more feasible to solve the current problems from the hospital organization level, such as LMX. This study's findings related to LMX provide practical managerial implications for coping with the negative effects of job demands from the hospital organization level. Hospitals should regard LMX as a critical resource supplement in daily medical practice, strengthen leadership quality and leaders' personality charm, establish a fair, transparent, and dynamic supervision and management mechanism for the selection, training, and assessment of medical talents, guide the administrative and clinical management team to increase support for doctors in grassroots positions, strengthen the care and help for doctors on both physical and psychological levels, and buffer doctors' energy depletion brought by job demands, so as to stimulate the doctors' shared visions and enhance their work engagement.

5.6.3 Doctors in public hospitals

As front-line providers of national public healthcare services and medical professionals, doctors in public hospitals should fully understand the significant value of medical and health services and the public welfare of public hospitals, know about the medical tasks of their hospitals and departments and the professional requirements and standards, strictly follow medical and healthcare regulations, actively improve their capabilities in medical services, scientific research, and teaching, and constantly adapt to the relevant requirements for public healthcare services and public health security.

Given the impact of the doctor-patient relationship on work engagement and burnout and its mediation between job demands and work engagement or burnout, as shown in the results

of this study, doctors in public hospitals recognize that the doctor-patient relationship is a challenge job demand that is conducive to their medical practice, and based on that, strive to improve clinical capabilities and doctor-patient communication skills. They should actively participate in the training on medical service etiquette and doctor-patient communication skills organized by the hospital, abide by medical ethics and regulations in medical services, and maintain patient, meticulous, and professional and show empathy when facing patients' health demands. Through self-regulation and team cooperation, they should transform the high-level doctor-patient relationship into an important job resource to improve the sense of professional accomplishment and job satisfaction.

Considering the factors affecting burnout identified in this study, medical graduates, upon employed by public hospitals, should proactively make a personal career development plan based on the health needs of society, the development prospects of the hospital's departments, and the characteristics of their specialty. Doctors in public hospitals should consciously raise their public welfare awareness and cultivate service innovation spirit, actively participate in all kinds of continuing medical education and practical skills training, continuously upgrade their clinical capabilities and teamwork skills, improve the quality and efficiency of their daily medical practice, and enhance the quality of communication and mutual trust between doctors and patients, so as to meet relevant job demands, strengthen their sense of professional accomplishment, and expand professional development opportunities.

In view of the sequential moderated mediation effect of LMX in the positive relationship between job demands and burnout through the doctor-patient relationship and work engagement, doctors in public hospitals should actively improve their professional quality and technical skills, strive to improve their ability to communicate with department heads and other superiors and to acquire resources, complete the work assigned by their superiors with full dedication, actively participate in team activities, take the initiative to undertake collective tasks, and establish and maintain good LMX and a harmonious work environment, so as to win leaders' support and use that as a resource supplement to buffer the energy depletion caused by job demands, thereby reducing the risk of burnout.

5.7 Limitations

Using the JD-R model and the COR theory as the theoretical basis, based on a literature review, the relevant theories, and the current situation of doctors' practice, this study proposed relevant research hypotheses and examined and analyzed the relationships and theoretical logic between

the main variables. Based on the results, this study drew valuable conclusions and put forward policy recommendations. However, it is not without limitations.

First, limitations of a cross-sectional design. This study, based on the JD-R model, adopted a cross-sectional design. Its conclusions are mainly about the relationship between doctors' job demands in public hospitals and the doctor-patient relationship, work engagement, and burnout, as well as the sequential moderated mediation effect of LMX in the positive relationship between job demands and burnout through the doctor-patient relationship and work engagement. However, with this design, data were collected at the same time point, and thus, it was impossible to determine the causal relationship between the variables, which needs to be further explored through longitudinal research in the future.

Second, limitations in sample representativeness and sample size. In this research on doctors in public hospitals, the representativeness and size of the selected research samples constitute a key limitation. Although the sample of this study covered as many as 708 doctors in 18 public hospitals of different grades in 14 regions/cities of different administrative levels in Jiangsu Province, due to time, capital, and other resource constraints, it could not cover all types of public hospitals and a wider group of doctors, which could lead to bias or limited generalizability of the results.

Third, the impact of COVID-19. The data was collected right after the COVID-19 pandemic, which might have significant impact on the respondents. For example, as mentioned in the introduction, COVID-19 increased health care workers' job demands such as workload and risks. However, it has also been reported that the doctor-patient relationship was improved during COVID-19. Thus, caution is needed when interpreting the results by considering this research context.

5.8 Research prospects

This research studied the job characteristics of doctors in public hospitals based on the JD-R model, building on which, further exploration is needed in the future. Future related research can consider the following aspects.

First, a more in-depth understanding of the internal mechanism of the model. Future research can further explore the mediation and moderation effect among the various constructs in the JD-R model. For example, future researchers can consider how doctors' personal traits (e.g., psychological capital and coping mode) and organizational contextual factors (e.g., team climate and organizational support) affect the paths of job demands and job resources

influencing the doctor-patient relationship, work engagement, and burnout. By doing so, the application of the model can be expanded to the personal and organizational levels. At the personal level, in addition to the doctors in public hospitals, as well as the nurses, who have received a lot of attention in previous studies, the JD-R model can also be applied to professionals in other medical fields, such as pharmacists, rehabilitation therapists, and biomedical engineers, to test the universality and specificity of the model. At the organizational level, researchers can consider applying the model to different types of hospitals, such as private hospitals, community hospitals, and nursing homes with some medical functions, or conducting comparative studies between different countries and regions to find out the similarities and differences across different contexts.

Second, longitudinal and dynamic research. In view of the limitations of the cross-sectional design, future research can adopt a longitudinal design to capture the dynamic changes and causal relationships among job demands, the doctor-patient relationship, work engagement, and burnout. By tracking the working experience and job characteristics of doctors at different stages of career development, we can gain a better understanding of how the relationships between these variables evolve over time, thus showing different degrees of impact on burnout. By doing so, we can make up for the limitations of the cross-sectional research. In addition, more advanced and objective measurement methods and tools can be used in the future, for example, using big data and artificial intelligence technology for data collection and analysis regarding doctors' work behavior, emotional response, and physiological indicators, so as to provide more comprehensive, accurate, and dynamic data support.

Third, multi-level and cross-level analysis. Future research can consider combining personal factors (e.g., doctors' personal traits, technical ability, and psychological status) with organizational factors (e.g., the hospital's organizational culture, management policy, and leadership style) for multi-level and cross-level analysis. In addition, future studies can simultaneously study and compare the operation and management systems of hospitals with different ownership structures (e.g., public hospitals, social-capital-funded hospitals, and foreign-funded holding hospitals) and different types of medical institutions (e.g., general hospitals, specialized hospitals, community hospitals, and rehabilitation institutions), as well as their impact on relevant research variables, which will help to reveal how factors at different levels interact with each other and jointly affect the working experience and burnout of doctors.

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Annex A: Questionnaire

Questionnaire on Burnout of Doctors in Public Hospitals

Dear madam/sir,

Hello! Thank you for participating in this survey. All items in this questionnaire are single-choice questions. Please tick " √ " on the number that most matches your actual situation. The questionnaire filling is anonymous. Your personal information and answers will not be disclosed to any third party. Thank you for your participation!

Part I Through the following items, we intend to know about your relationship you're your patient at work. Please select the number that most matches your current situation:

No.	Item	1 = "Completely disagree" → 6 = "Completely agree"					
1	My patient trusts that I will put his/her medical need in the first place.	1	2	3	4	5	6
2	My patient trusts the treatment plan I made for him/her.	1	2	3	4	5	6
3	My patient is willing to follow the treatment plan I suggested.	1	2	3	4	5	6
4	My patient believes that the examinations I requested are reasonable.	1	2	3	4	5	6
5	I often patiently communicate with my patient and his/her family over and over.	1	2	3	4	5	6
6	I always carefully inform my patient of the possible risks in his/her diagnosis and treatment.	1	2	3	4	5	6
7	I always carefully help my patient and his/her family.	1	2	3	4	5	6
8	I often provide the best treatment plan to my patient by comparing different schemes.	1	2	3	4	5	6
9	I am proud that my expertise can effectively help my patient.	1	2	3	4	5	6
10	I am happy to receive my patient's follow-up visit.	1	2	3	4	5	6

Part II Through the following items, we intend to know about the job demands of your position. Please select the number that most matches your current situation:

No.	Item	1 = "Never" → 6 = "Always"					
11	I face patients' deaths at work.	1	2	3	4	5	6
12	I have to care for patients with severe chronic pain.	1	2	3	4	5	6
13	I face unexpected or dramatic deaths at work.	1	2	3	4	5	6
14	I face difficulties in giving/obtaining pain relief.	1	2	3	4	5	6
15	I have to care for patients with prolonged disease.	1	2	3	4	5	6
17	I have experienced threats from patients.	1	2	3	4	5	6
18	I have been exposed to violence from patients.	1	2	3	4	5	6
19	I have to care for aggressive and threatening patients.	1	2	3	4	5	6
20	I have to care for dying patients.	1	2	3	4	5	6
21	I have to work very intensively.	1	2	3	4	5	6
22	My work demands too much effort.	1	2	3	4	5	6
23	I have to work very fast.	1	2	3	4	5	6

Part III Through the following items, we intend to know about your genuine feelings about

your current job. Please select the number that most matches your current situation:

No.	Item	1 = "Completely disagree" → 6 = "Completely agree"					
24	I feel burned out from my work.	1	2	3	4	5	6
25	I feel used up at the end of the workday.	1	2	3	4	5	6
26	I feel fatigued when I get up in the morning and have to face another day on the job.	1	2	3	4	5	6
27	Working with people all day is really a strain for me.	1	2	3	4	5	6
28	I feel like I'm at the end of my rope.	1	2	3	4	5	6

Part IV Through the following items, we intend to know about the current status of your work engagement. Please select the number that most matches your current situation:

No.	Item	1 = "Completely disagree" → 6 = "Completely agree"					
29	At my job, I feel strong and vigorous.	1	2	3	4	5	6
30	At my work, I feel bursting with energy.	1	2	3	4	5	6
31	I am enthusiastic about my job.	1	2	3	4	5	6
33	My job inspires me.	1	2	3	4	5	6
34	When I get up in the morning, I feel like going to work.	1	2	3	4	5	6
35	I feel happy when I am working intensely.	1	2	3	4	5	6
36	I am proud on the work that I do.	1	2	3	4	5	6
37	I am immersed in my work.	1	2	3	4	5	6
38	When I am working, I forget everything else around me.	1	2	3	4	5	6

Part V Through the following items, we intend to know about your relationship with your direct leaders. Please select the number that most matches your current situation:

No.	Item	1 = "Completely disagree" → 6 = "Completely agree"					
50	I usually know how satisfied my leader is with what I do.	1	2	3	4	5	6
51	I think my leader understands my job problems and needs to a great deal.	1	2	3	4	5	6
52	I think my leader fully recognizes my potential.	1	2	3	4	5	6
53	Regardless of how much formal authority he/she has built into his/her position, my leader would use his/her power to help me solve problems in my work.	1	2	3	4	5	6
54	Regardless of the amount of formal authority my leader has, he/she would "bail me out" at his/her expense.	1	2	3	4	5	6
55	I have enough confidence in my leader that I would defend and justify his/her decision if he/she were not present to do so.	1	2	3	4	5	6
56	My working relationship with my leader is effective.	1	2	3	4	5	6

Part VI Basic information (please answer based on your current situation):

No.	Item	Options
57	The grade of your hospital:	A. Grade III A B. Grade III B C. Grade II A D. Others
58	Number of beds in your hospital:	A. ⩽500 B. 501-1000 C. 1001-1500 D. >1500
59	The department you work at:	A. Internal medicine B. Surgery C. Obstetrics and gynecology D. Pediatrics E. Intensive care F. Anesthesia G. Medical examination H. Others
61	Your employment type:	A. Permanent contract B. Long-term contract with reference to permanent contract C. Temporary contract

No.	Item	Options
62	Your tenure (please fill in a number):	( ) years
63	Your education level:	A. College or below B. Bachelor C. Master D. Doctorate
64	Your professional title:	A. Junior B. Intermediate C. Deputy senior D. Senior
65	Your age (please fill in a number):	( ) years old
66	Your gender:	A. Male B. Female
67	Your marital status:	A. Single B. Married C. Others (e.g., divorced)
68	Your after-tax monthly income (RMB):	A. ≤10000 B. 10001-15000 C. 15000-20000 D. >20000

You have completed the questionnaire survey. Thank you for your support!

The 20 health care workers participating in the pilot test using paper-and-pencil questionnaires spent 7-8 minutes on average. The participants' feedback: if the questionnaire survey is conducted online using Sojump, it is estimated to take about 10 minutes to complete it.

One attention test item was inserted in every 15 items:

16) COVID-19 is an infectious disease that can be transmitted from human to human.

☐ Completely disagree ☐ Disagree ☐ Mostly disagree

☐ Mostly agree ☐ Agree ☐ Completely agree

32) This year is 2023.

☐ Completely disagree ☐ Disagree ☐ Mostly disagree

☐ Mostly agree ☐ Agree ☐ Completely agree

48) Please choose "Completely agree" from the following options.

☐ Completely disagree ☐ Disagree ☐ Mostly disagree

☐ Mostly agree ☐ Agree ☐ Completely agree

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Annex B: Tables

Table B.1 Explained variance and factor loading of the job demands scale

Item	Factor 1	Factor 2	Communality	Eigenvalue	Percentage of variance	Cumulative %
14	0.586	0.203	0.364			
17	0.843	0.151	0.734	3.325	47.504	47.504
18	0.883	0.085	0.787			
19	0.821	0.121	0.689			
21	0.143	0.879	0.793			
22	0.175	0.890	0.823	1.650	23.578	71.083
23	0.157	0.872	0.786			

Table B.2 Explained variance and factor loading of the doctor-patient relationship scale

Item	Factor 1	Factor 2	Communality	Eigenvalue	Percentage of variance	Cumulative %
1	0.825	0.311	0.778			
2	0.891	0.300	0.884	3.325	47.503	47.503
3	0.894	0.299	0.889			
4	0.875	0.324	0.870			
5	0.297	0.865	0.836	2.658	37.968	85.471
7	0.312	0.878	0.869			
8	0.315	0.870	0.856			

Table B.3 Explained variance and factor loading of the work engagement scale

Item	Factor 1	Communality	Eigenvalue	Percentage of variance	Cumulative %
31	0.879	0.773			
33	0.887	0.787			
34	0.817	0.667	3.624	72.476	72.476
36	0.853	0.728			
38	0.818	0.669			

Table B.4 Explained variance and factor loading of the burnout scale

Item	Factor 1	Communality	Eigenvalue	Percentage of variance	Cumulative %
24	0.913	0.834			
26	0.929	0.862	3.365	84.115	84.115
27	0.916	0.839			
28	0.91	0.829			

Table B.5 Explained variance and factor loading of the LMX scale

Item	Factor 1	Communality	Eigenvalue	Percentage of variance	Cumulative %
50	0.858	0.737			
51	0.927	0.859	3.138	78.443	78.443
52	0.934	0.872			
56	0.819	0.670			

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