

# Fatigue as a Cause of Professional Dissatisfaction Among Chinese Nurses in Intensive Care Unit During COVID-19 Pandemic

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**Aim:** To clarify the mediating role of burnout and the moderating role of turnover intention in the association between fatigue and job satisfaction among Chinese nurses in intensive care units (ICU) during the COVID-19 pandemic.

**Methods:** A cross-sectional survey of fifteen provinces in China was conducted, using an online questionnaire, from December 2020 to January 2021, during the COVID-19 pandemic. A total of 374 ICU nurses (effective response rate: 71.37%) provided sufficient responses. Sociodemographic factors, job demographic factors, fatigue, burnout, job satisfaction, and turnover intention were assessed using questionnaires. General linear modeling (GLM), hierarchical linear regression (HLR) analysis, and generalized additive modeling (GAM) were performed to examine all the considered research hypotheses.

**Results:** Fatigue was found to be negatively and significantly associated with job satisfaction. Moreover, burnout played a partial mediating role and turnover intention played a moderating role in the relationship between fatigue and job satisfaction.

**Conclusion:** Over time, a state of physical and mental exhaustion and work weariness among Chinese ICU nurses potentially results in job burnout and consequently promotes the level of job dissatisfaction. The results also found that turnover intention played a moderating role in the relationship between burnout and job satisfaction. Specific policies could be considered to eliminate nurses' fatigue and negative attitudes during times of public health emergencies.

**Keywords:** ICU nurses, fatigue, burnout, job satisfaction, turnover intention, COVID-19 pandemic

## Introduction

Work-related fatigue widespread in the global population, particularly among working people is simply referred to as work fatigue,<sup>1</sup> and is associated with an increased risk of human error and long-term negative health outcomes. Nurses work in a special occupational environment, characterized by excessive work demands, continual shift work, severe shortages of qualified staff, high overtime, poor provider-customer relationship, and high levels of job insecurity. Thus, work fatigue, as a known security threat and health challenge for nursing staff, has become a heated topic in the field of occupational health and has been widely discussed in the literature. Nurses with high levels of psychological stress are more prone to stronger turnover intentions, which can further initiate job dissatisfaction. Exploring the underlying interrelationships between work fatigue, burnout, job satisfaction, and turnover intention can provide scientific reference and evidence for intensive care nurses to improve their work environment and job satisfaction during the COVID-19

outbreak. But, few studies have provided clear insight into these complex interrelationships among Chinese ICU nurses, much less in an epidemic outbreak. Based on the above review, this study filled the research gap by evaluating the interrelationships between work fatigue, job satisfaction, burnout, and turnover intention among Chinese ICU nurses during the COVID-19 pandemic.

## Literature and Hypothesis

### Literature

Work fatigue is a multidimensional, dynamic, and complex phenomenon that generally arises from excessive work demand. It received the latest and concise definition proposed by Xu, who considered work fatigue as either an objective condition or a subjective feeling of tiredness, caused by a work-related external stimulus.<sup>2</sup> A study conducted during the COVID-19 pandemic, found considerable fatigue among young adults in Switzerland.<sup>3</sup> Nurses experience relatively elevated levels of work fatigue, which is an influencing factor linked to performance decline in healthcare workers. A study in the neonatal intensive unit, revealed that fatigue worsened after 12-hour day and night shifts, with a greater change occurring after night shifts.<sup>4</sup> A recent review proposed that fatigue risk management systems are likely to have positive safety outcomes.<sup>5</sup> Another recent study proved the importance of rest breaks for nurses in reducing acute fatigue during the COVID-19 pandemic; further appealing that routine rest breaks should be facilitated by nursing management in hospital units.<sup>6</sup> Different work schedules (day work, three-shift, five-shift, and irregular shift work), are more likely to lead to employee fatigue.<sup>7</sup> A review study revealed that high-level job demands impede recovery from shift-work-related fatigue in shift working nurses, leading to self-regulation failure, which causes the potential accumulation of fatigue over time.<sup>8</sup> The perceived fatigue after night shifts is higher among direct patient care nurses (DCRNs) than non-DCRNs [15], owing in part to lack of energy and weak motivation.<sup>9</sup> Moreover, fatigue tends to accumulate during night shifts,<sup>9</sup> causing shorter sleep duration,<sup>10</sup> insufficient opportunities for leisure vacations,<sup>11</sup> and performance decrements.<sup>12</sup> Overall, fatigue is a condition in which a person is unable to detect the continuous feeling of physical and mental performance, and capacity reduction is experienced. Fatigue may result from highly demanding work and various psychological and environmental factors.<sup>13</sup> Work-related accumulated fatigue among nurses has become a global concern.<sup>14</sup> Job satisfaction is an emotional state that results from evaluating a job or experience in the workplace. Locke defined job satisfaction as “a general pleasurable or positive emotional state, resulting from the appraisal of one’s job or job experiences.” Job dissatisfaction contributes to increased stress and, consequently, to the rate of turnover. Previous studies have revealed that among nurses, work fatigue has significant consequences in terms of job satisfaction, job performance, stress, burnout, and absence from work.<sup>15–17</sup> Burnout impairs day-to-day behavior regulation, which tends to cause more self-undermining (ie, creating additional obstacles) and less job crafting (ie, optimizing job demands and resources) as a negative feedback mechanism, further leading to low motivation and less ability to regulate their behavior, resulting in impaired job satisfaction.<sup>18</sup> Thus, continued work fatigue can lead to burnout and decreased job satisfaction. Generally, job burnout is considered the result of a combination of contextual and personal factors. Elevated levels of burnout are associated with lower job satisfaction among nursing professionals.<sup>19</sup> Shanafelt et al, investigated the positive effects of reducing working hours and reported improvements in burnout and job satisfaction.<sup>20</sup> Therefore, we hypothesized that burnout might serve as a potential mediating variable in the relationship between work fatigue and job satisfaction. Turnover intention refers to an employee’s option to voluntarily leave their job within a given period. Predicated on Mobley’s heuristic model of the employee withdrawal decision process, a significant correlation was found between turnover intention and job satisfaction.<sup>21</sup> One meta-analysis found a significant negative correlation between job satisfaction and turnover intention among nurses.<sup>22</sup> Simultaneously, studies of attitude theory in psychology have found that employees’ perceptions and evaluation of their jobs (job satisfaction) are negatively correlated with their emotional response (burnout).<sup>23</sup> Additionally, turnover intention is the main cognitive precursor of turnover behavior and has been demonstrated to be associated with job satisfaction and burnout among nurses and specialists.<sup>24</sup>

### Hypothesis

The coronavirus disease of 2019 (COVID-19) pandemic profoundly disrupted the normal functioning of society and continued to pose challenges for health care systems globally, with a series of unpredictable dilemmas. Providing care for

demanding COVID-19 patients, nurses have been at the forefront of the fight against the pandemic, in the face of grueling and stressful situations,<sup>25</sup> implying a large number of challenges. In particular, this pandemic has placed an unprecedented demand on providing healthcare services in intensive care units (ICU).<sup>26</sup> Consequently, work fatigue is one of many kinds of difficulties for nurses, especially those working in ICU who have played a major role in providing clinical nursing services, with a professional obligation to care for patients with COVID-19, despite the potential to become infected.<sup>27</sup> Work fatigue would wear down the mental energy of nurses leading to further feelings of emotional fatigue. There is a lack of communication between nurses and COVID-19 patients due to time pressure and wearing full protective clothing. More, hardworking ICU nurses did not reduce the number of COVID-19 patients, and their sense of personal accomplishment cannot be aroused after tired work. Conceptual model is shown in Figure 1. Therefore, we proposed the following hypotheses:

Hypothesis 1: Work Fatigue is Positively Related to Burnout Among ICU Nurses (H1).

The COVID-19 pandemic outbreak contributed to the special requests for everybody to comply with the COVID-19 measures, particularly nurses,<sup>28</sup> while it necessitated learning from, and adjusting to, a rapidly changing situation,<sup>29</sup> which consequently tended to cause pandemic fatigue, owing to newly required avoidance behaviors.<sup>30</sup> To combat COVID-19, nurses have been substantially burdened, which may cause work-related fatigue, leading to job stress, low work efficiency, and even serious medical disputes or accidents. In this situation, it is easy for tired ICU nurses to complain about work and hospitals, resulting in the accumulation of negative emotions. Therefore, we proposed the following hypotheses:

Hypothesis 2: Work Fatigue is Negatively Related to Job Satisfaction (H2).

It's well known that burnout is a state of emotional, physical, and mental exhaustion caused by excessive and prolonged stress. Thus, burnout is a state which takes time to develop, while fatigue is a more temporally state. Previous studies have found that ICU nurses generally suffer from fatigue,<sup>31</sup> and job burnout,<sup>32</sup> and which was no exception during COVID-19 pandemic.<sup>33</sup> We speculate that chronic fatigue and burnout are in an homeostasis for ICU nurses in the China's health system, newly added and sudden fatigue aggravated burnout syndrome of ICU nurses, which potentially leading to a new wave of dissatisfaction. Therefore, we proposed the following hypotheses:

Hypothesis 3: Burnout plays a partial mediating role in the association between work fatigue and job satisfaction (H3).

Elevated levels of turnover intention are associated with lower job satisfaction and higher levels of burnout.<sup>34</sup> Job satisfaction and burnout are two different cognitive and affective perspectives. Job satisfaction and burnout are key factors that determine turnover intentions. Existing studies have found that job satisfaction benefits physical and mental health and is negatively related to burnout and turnover intention. Furthermore, there might be an intrinsic interrelationship between job satisfaction, burnout, and turnover intention; we speculate that the relationship between job satisfaction and burnout may be moderated by turnover intention. Therefore, we proposed the following hypotheses:

Hypothesis 4: Turnover intention plays a moderating role in the association between burnout and job satisfaction (H4).

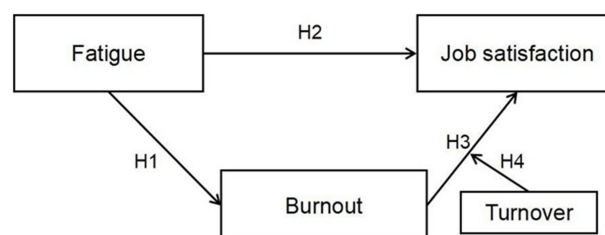


Figure 1 Conceptual model.

## Methods and Materials

### Procedure and Participants

The study was conducted from 20th of December 2020, to 28th of January 2021, during the COVID-19 pandemic. This cross-sectional study was aimed at investigating nurses who had worked in a major general hospital for at least one year and were still holding their posts in intensive care unit during the investigation for their experiences and viewpoints on work fatigue, burnout, job satisfaction and turnover intention. Both multistage stratified sampling and convenience sampling methods were used together to collect the data. In the first sampling stage, mainland China was divided into three regions according to geographical location: eastern, central, and western regions of China. A total of 15 provinces were selected for this study, including six provinces from the eastern region, four provinces from the central region, and four provinces from the western region. In the second sampling stage, considering the convenience of inviting coordinators, two hospitals were selected from each sampling province suggested by the coordinators in the current study. Approximately 20 ICU nurses from each hospital were invited to complete an anonymous online questionnaire, which required the nurses to cover a variety of demographic characteristics using convenience sampling, where coordinators selected their colleagues solely based on convenience. Sociodemographic variables were categorized based on prior recommendations.<sup>35</sup> Ultimately, 524 nurses participated in the survey. The coordinator invited each selected nurse to click on a webpage link (<https://www.wenjuan.com/>), to access a self-administered questionnaire. To avoid response bias or non-response bias, we conducted an immediate interview with non-responders via coordinators, realizing that there was no significant difference in core characteristics, such as gender, age, educational level, monthly income, years of working, professional title between the response sample and either the ICU nurses or the non-responder group; they did not respond immediately to our invitation, which was the primary reason for their non-response.

### Minimal Sample Size Calculation

Referring to the G\*power 3.1.9.7 software (multiple regression: R<sup>2</sup> deviation from zero),<sup>36,37</sup> a minimal number of 159 nurses were required to secure significance when considering the following statistical parameters: type I error  $\alpha = 5\%$ , power  $1 - \beta = 80\%$ , a small effect size  $f^2 = 5\%$ , and a total number of 4 variables to be integrated in the multivariable analysis. Regarding the minimal sample size to perform a confirmatory factor analysis, a minimal sample of 360 participants was deemed necessary to validate the 3D-WFI scale, based on 20 participants per 1 scale item.<sup>38</sup>

### Instruments

#### Work Fatigue (Predictor)

The three-dimensional work fatigue inventory (3D-WFI) was used to measure fatigue.<sup>39</sup> The 3D-WFI includes 18 items, divided into three subscales with six items each: physical work fatigue (e.g. “During the past 2 months, how often did you feel physically exhausted at the end of the workday?”), mental work fatigue (e.g. “During the past 2 months, how often did you feel mentally exhausted at the end of workday?”), and emotional work fatigue (e.g. “During the past 2 months, how often did you feel emotionally exhausted at the end of the workday?”) The coefficient alphas were 0.94 for physical work fatigue, 0.95 for mental work fatigue, and 0.96 for emotional work fatigue. The 3D-WFI has a good internal consistency, concurrent validity, which allows its use in research. Respondents were asked to rate items on a response scale: 1= “never”, 2= “at least once a month”, 3= “a few times a month”, 4= “at least once a week”, and 5= “nearly every day.” A sample item was “I feel burdened by the increase in quantity of ICU nursing work.” For each subscale, the total score was calculated, indicating the symptom-specific perceived level of work fatigue. Higher scores reflect higher work fatigue among nurses. In this study, Cronbach’s alpha were 0.813, 0.825 and 0.859 for the physical, mental, and emotional subscales, respectively.

#### Burnout (Mediator)

Brief and single-item measures of burnout might facilitate the identification of burnout in healthcare workers.<sup>40,41</sup> Furthermore, the single-item measure demonstrated high discriminatory power on the emotional exhaustion burnout domain, indicating high sensitivity and specificity.<sup>40</sup> In this survey, burnout was measured using single-item: “Have you experienced burnout symptoms for at least 2 weeks?”, It was divided into five categories, ranging from 0 to 4, with

0=never experienced such a feeling, 1= infrequently experienced such a feeling, 2=sometimes experienced such a feeling, 3=frequently experienced such a feeling, and 4=always experienced such a feeling. And the scores of two or high indicated high burnout.

### Job Satisfaction (Outcome)

The single-item survey method for assessing job satisfaction has been widely used in social science studies.<sup>42,43</sup> In this survey, job satisfaction was evaluated by asking the participants about their current views on the overall level of their satisfaction with work (e.g. “How satisfied are you with your ICU nursing work?”). According to the 5-point Likert scale, the response options included very dissatisfied, dissatisfied, fair, satisfied, and very satisfied, which were scored from 1 to 5, respectively, and the scores of three or below indicated low job satisfaction. The statistical reliability of the single-item survey method for assessing job satisfaction and its significant correlation with the multi-item survey method have been demonstrated in a previous study.<sup>44</sup>

### Turnover Intention (Moderator)

Nurses’ turnover intention was assessed by asking the nurses to score one statement “I’m actively seeking alternative employment” adopted from prior study.<sup>45</sup> Response were measured with a five point Likert-type scale ranging from 1=“strongly disagree” to 5=“strongly agree” A higher score reflects higher turnover intention among nurses.

## Statistical Analysis

We used SPSS (version 20.0, IBM, Armonk, NY, USA) for data cleaning, and Cronbach’s  $\alpha$  reliability coefficients for each variable. The descriptive statistics of all measures were conducted using STATA (version 15.1, StataCorp LLC, College Station, TX, USA). General linear modeling (GLM) was used to identify the association between fatigue and job satisfaction. Hierarchical linear regression (HLR) analysis was performed to examine the relationship between the variables and the moderating effect. A generalized additive model (GAM) was used to smooth the mediator effect on the outcome.  $\beta$  values and their 95% confidence intervals (CIs) were calculated. All p values were 2-sided and  $p < 0.05$  was considered statistically significant.

## Quality Control

The purpose and significance of this study were clarified on the first page of an online questionnaire. The progress of the survey was monitored daily. After the deadline, we checked the accuracy and completeness of the data and excluded the questionnaire if (a) it was not within the range of this study, (b) the answering time was less than 180 s, or (c) there were logical contradictions in the answers. We adopted several procedures to minimize common method bias, for example, using anonymous surveys to protect privacy, reduce speculation for measurement, and rationalize the questionnaire design.

## Ethical Approval

This study adhered to the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board (IRB) of Harbin Medical University. All participants voluntarily participated in the survey, and the information in the database was completely anonymized. Since the survey was anonymous, it was impossible to obtain informed written consent, owing to the nature of the online survey. In this case, an informed consent form was included at the beginning of the questionnaire to select invited guests. Dialogue and alert pop up boxes were used to remind participants who agreed to complete the survey to send their replies to our research group. Thus, once a questionnaire was completed, it was assumed that the nurses had verbally agreed to participate in our survey. Confidentiality was maintained for all information collected in the survey.

## Results

### Participants and Characteristics

A total of 524 nurses participated in this survey. Owing to existing incompleteness and false information, 150 questionnaires were excluded. Finally, after a quality audit and data cleaning, 374 valid questionnaires were included

in the analysis, with an effective rate of 71.37%. Among the 374 eligible participants, the mean age was  $30.38 \pm 5.31$  years, with 92.51% female. A total of 144 (35.50%) participants were from the eastern region of China, 82 (21.93%) were from the central region, and 148 (39.57%) were from the western region. A total of 279 (74.60%) participants had a bachelor's degree, 81 (21.66%) had a junior title, and 248 (66.31%) were married. Moreover, 88 (23.53%) had high physical activity, whereas 145 (38.77%) and 74 (19.79%) had high mental and emotional work fatigue respectively. More details on the demographic factors are provided in Table 1.

**Table 1** Demographic Information (N=374)

Characteristics	N	%
<b>Sex</b>		
Male	28	7.49
Female	346	92.51
<b>Marriage</b>		
Unmarried	120	32.09
Married/cohabited	248	66.31
Divorced/widowed	6	1.60
<b>Hospital level</b>		
Level III	369	98.66
Level II	5	1.34
<b>Years in professional working (years)</b>		
≤3	77	20.59
4–10	180	48.13
11–20	98	26.20
≥21	19	5.08
<b>Education</b>		
Technical secondary school and below	2	0.53
Junior college	86	22.99
Bachelor's degree	279	74.60
Master's degree or above	7	1.87
<b>Title</b>		
No title	4	1.07
Junior title	81	21.66
Middle title	274	73.26
Senior title	15	4.01
<b>Position</b>		
Nursing assistant	23	6.15
General nursing	250	66.84
Nursing group leader	76	20.32
Nursing supervisor	25	6.68
<b>Employment type</b>		
Permanent	120	32.09
Contract	247	66.04
Temporary	7	1.87
<b>Working hours per week</b>		
≤35	19	5.08
36–40	130	34.76
41–45	129	34.49
46–50	76	20.32
≥51	20	5.35

(Continued)



**Table 1** (Continued).

Characteristics	N	%
<b>Income (yuan/month)</b>		
≤3000	17	4.55
3001–5000	90	24.06
5001–7000	121	32.35
7001–9000	75	20.05
≥9001	71	18.98
<b>Area</b>		
Eastern region	144	35.50
Central region	82	21.93
Western region	148	39.57
<b>WFI physical score</b>		
Low (≤17)	16	4.28
Moderate (18–24)	270	72.19
High (≥25)	88	23.53
<b>WFI mental score</b>		
Low (≤16)	5	1.34
Moderate (17–23)	224	59.89
High (≥24)	145	38.77
<b>WFI emotional score</b>		
Low (≤15)	99	26.47
Moderate (16–24)	201	53.74
High (≥25)	74	19.79
	<b>Mean</b>	<b>SD</b>
<b>Age</b>	30.38	5.31

## Correlations Among Variables

The means, standard deviations, and Pearson's correlation coefficients of the variables are presented in Table 2. As evident from the findings, all four variables were significantly correlated with each other. Fatigue was positively correlated with burnout ( $r=0.322$ ,  $P<0.01$ ) and turnover intention ( $r=0.344$ ,  $P<0.01$ ). In contrast, job satisfaction was negatively associated with fatigue ( $r=-0.257$ ,  $P<0.01$ ), burnout ( $r=-0.345$ ,  $P<0.01$ ), and turnover intention ( $r=-0.496$ ,  $P<0.01$ ). Burnout was positively associated with turnover intention ( $r=0.536$ ,  $P<0.01$ ).

## Association Between Burnout, Satisfaction, Turnover Intention, and Fatigue Scores in ICU Nurses

The association between fatigue and burnout among nurses in the GLM analysis, is demonstrated in Table 3. Compared with the “never” group (6.68%), the “sometimes” group (39.57%), “frequently” group (5.08%), and “always” group

**Table 2** Means, Standard Deviations (SD), and Correlations of Continuous Variables

variable	Median (Q1–Q3)	Fatigue	Burnout	Job Satisfaction	Turnover Intention
Fatigue	64.00 (60.00–69.00)	1.000			
Burnout	2.00 (2.00–3.00)	0.322**	1.000		
Job Satisfaction	2.00 (1.00–3.00)	−0.257**	−0.345**	1.000	
Turnover intention	3.00 (3.00–4.00)	0.344**	0.536**	−0.496**	1.000

**Note:** \*\* $P<0.01$ ; Correlation is significant at the 0.01 level (2-tailed).

**Table 3** The Association of Burnout, Satisfaction, Turnover Intention and Fatigue Score in the ICU Nurses

Variables	N (%)	Non-Adjusted Model		Model I <sup>a</sup>		Model II <sup>b</sup>	
		(95% CI LL, UL)	P value	(95% CI LL, UL)	P value	(95% CI LL, UL)	P value
Burnout							
Never	25 (6.68)	0		0		0	
Infrequently	167 (44.65)	1.96 (−0.47, 4.38)	0.115	1.84 (−0.75, 4.43)	0.165	1.92 (−0.74, 4.58)	0.158
Sometimes	148 (39.57)	4.26 (1.81, 6.71)	0.0007	4.16 (1.54, 6.79)	0.0020	4.22 (1.52, 6.92)	0.0023
Frequently	19 (5.08)	6.25 (2.80, 9.70)	0.0004	6.26 (2.69, 9.83)	0.0007	6.29 (2.64, 9.95)	0.0008
Always	15 (4.01)	9.24 (5.54, 12.94)	<0.0001	9.05 (5.21, 12.90)	<0.0001	9.28 (5.37, 13.19)	<0.0001
P value for Trend	<0.001						
Job Satisfaction							
Very dissatisfied	15 (4.01)	0		0		0	
Not satisfied	29 (7.75)	−0.68 (−4.32, 2.97)	0.717	−1.85 (−5.72, 2.02)	0.349	−2.39 (−6.31, 1.54)	0.235
Fair	148 (39.57)	−2.04 (−5.14, 1.07)	0.199	−2.96 (−6.31, 0.40)	0.0848	−3.37 (−6.76, 0.02)	0.0523
Satisfied	157 (41.98)	−4.51 (−7.16, −1.41)	0.0046	−5.48 (−8.82, −2.14)	0.0014	−5.88 (−9.25, −2.51)	0.0007
Very satisfied	25 (6.68)	−6.60 (−10.34, −2.86)	0.0006	−7.66 (−11.70, −3.62)	0.0002	−8.03 (−12.13, −3.92)	0.0002
P value for Trend	<0.001						
Turnover intention							
Strongly disagree	103 (27.54)	0		0		0	
Disagree	150 (40.11)	2.41 (0.97, 3.84)	0.0011	2.40 (0.93, 3.87)	0.0015	2.43 (0.96, 3.91)	0.0014
Fair	85 (22.73)	3.95 (2.31, 5.59)	<0.0001	3.96 (2.27, 5.65)	<0.0001	4.09 (2.38, 5.80)	<0.0001
Agree	25 (6.68)	6.30 (3.80, 8.80)	<0.0001	6.30 (3.74, 8.86)	<0.0001	6.66 (4.08, 9.24)	<0.0001
Strongly agree	11 (2.94)	8.98 (5.42, 12.53)	<0.0001	8.41 (4.62, 12.20)	<0.0001	8.49 (4.66, 12.33)	<0.0001
P value for Trend	<0.001						

**Notes:** <sup>a</sup>Adjusted for age, sex and marriage; <sup>b</sup>Adjusted for age, sex, marriage, education, hospital level, education, title, position, employment type.

(4.01%), showed a close connection with the fatigue score ( $P < 0.0001$ ). After adjustment for age, sex, and marriage, nurses with higher fatigue levels reported more burnout in ICU nursing work ( $\beta = 9.05$ , 95% CI: 5.21–12.90). Additionally, fatigue and burnout were closely connected after adjusting for other factors affecting fatigue in the multivariate model ( $\beta = 9.28$ , 95% CI: 5.37–13.19). Overall, fatigue is positively and significantly associated with burnout. The P value for trend was  $< 0.001$ .

The association between fatigue and job satisfaction from the GLM analysis is also demonstrated in Table 3. With an increase in job satisfaction, nurses' fatigue gradually decreased in the age/sex/marriage-adjusted model ( $\beta = -7.66$ , 95% CI: −11.70–3.62). Furthermore, job satisfaction was associated with fatigue after adjusting for other factors affecting fatigue in a multivariate model ( $\beta = -8.03$ , 95% CI: −12.13–3.92). Overall, job satisfaction is inversely and significantly associated with fatigue. The P value for trend was  $< 0.001$ .

The association between turnover intention and fatigue in the GLM analysis is reflected in Table 3. With the increase in turnover intention, nurses' fatigue gradually increased in the age/sex/marriage-adjusted model ( $\beta = 8.41$ , 95% CI: 4.62–12.20). Additionally, turnover intention was associated with fatigue after adjusting for other factors affecting fatigue in a multivariate model ( $\beta = 8.49$ , 95% CI: 4.66–12.33). Overall, turnover intention is positively and significantly associated with fatigue. The P value for trend was  $< 0.001$ .



## Burnout as a Mediator in the Fatigue-Job Satisfaction Relationship

Hierarchical linear regression analysis was performed to examine the relationship between fatigue, burnout, and job satisfaction, after eliminating the effects of demographic variables (sex, age, marriage, hospital level, education, title, position, and employment type). This study regarded “fatigue” as the independent variable, “burnout” as the mediator variable, and “job satisfaction” as the dependent variable. A generalized additive model (GAM) was used to smooth the mediating effect on the outcome. Table 4 shows that burnout partially mediates the relationship between fatigue and job satisfaction. The indirect effect of fatigue on job satisfaction was  $-0.014$  ( $P < 0.001$ ), and the direct effect of fatigue on job satisfaction through burnout was  $-0.024$  ( $P < 0.001$ ). The total effect of fatigue on job satisfaction was  $-0.039$  ( $P < 0.001$ ).

## Turnover Intention as a Moderator in the Burnout-Job Satisfaction Relationship

Table 5 shows the results of the moderator test for burnout, job satisfaction, and turnover intention among ICU nurses, to provide a breakthrough in the interpretation of the relationship between burnout and job satisfaction. Results shown in Table 5 indicated that turnover intention ( $\beta = -0.19$ ,  $P < 0.01$ ) played a moderating role in such a relationship. Figure 2 illustrates the different effects of turnover intention on the relationship between burnout and job satisfaction.

**Table 4** Mediation Analysis in Generalized Additive Model (GAM)

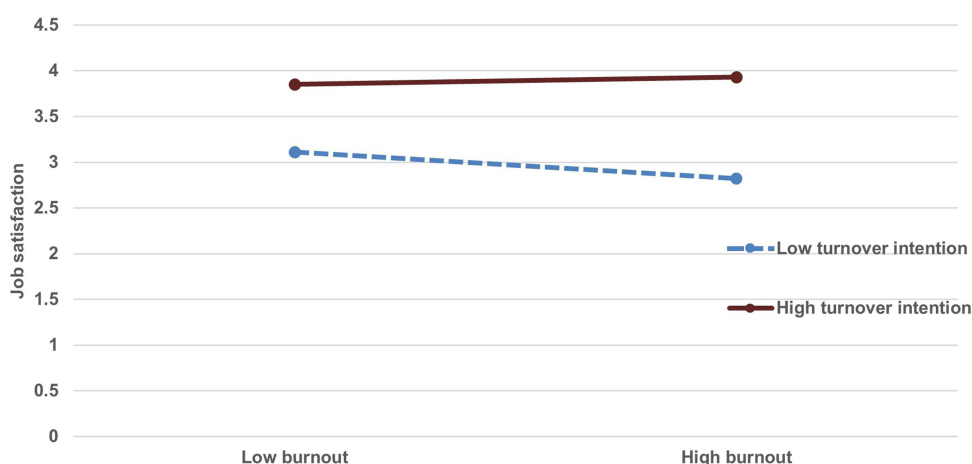
Variables	Satisfaction	Burnout	Satisfaction
Constant	5.87 (12.07)**	-0.56 (-1.18)	5.71 (12.21)**
Fatigue	-0.039(-5.13)**	0.048(6.57)**	-0.024(-3.20)**
Mediator: Burnout			-0.29(-5.76)**
R <sup>2</sup>	0.07**	0.11**	0.14**
Adjusted R <sup>2</sup>	0.06**	0.10**	0.14**
F	26.27**	43.10**	30.86**

**Notes:** Independent variable: fatigue; dependent variable: job satisfaction; mediator variable: burnout; adjusting variables: sex, age, marriage, hospital level, education, title, position, employment type; \*\* $p < 0.01$  (two-tailed).

**Table 5** Moderated Regression Analysis

Variables	Model I	Model II	Model III
	$\beta$ (t)	$\beta$ (t)	$\beta$ (t)
Constant	3.39(76.36)**	3.39(82.92)*	3.48(86.09)**
Burnout	-0.35(-7.09)**	-0.11(-2.09)**	-0.10(-2.04)**
Turnover intention		-0.39(-8.22)**	-0.36(-8.01)**
Burnout $\times$ Turnover intention			-0.19(-7.18)**
R <sup>2</sup>	0.12	0.26	0.35
Adjusted R <sup>2</sup>	0.12	0.25	0.34
F	50.22 **	63.40 $p=0.00$	65.24**
$\Delta R^2$	0.12**	0.14**	0.091**
$\Delta F$	50.22**	67.60**	51.61**

**Notes:** Independent variable: burnout; dependent variable: job satisfaction; moderator variable: turnover intention; \* $p < 0.05$ , \*\* $p < 0.01$  (two-tailed).



**Figure 2** Moderating effect of turnover intention on the relationship between burnout and job satisfaction.

## Discussion

### Status Quo of Work Fatigue of Chinese ICU Nurses During the COVID-19 Outbreak

The results of our study were alarming, showing high rates (intermediate-to-high) of mental (98.66%), physical (95.72%) and emotional (73.53%) work fatigue in ICU nurses, which was higher than the result of a previous study regarding the systemic review of the fatigue level of nurses (44.6%) from Anshan, of Liaoning province in China.<sup>46</sup> Our results were also higher than a similar study reported an high fatigue level (68.2%) among Chinese healthcare professionals in Zhuhai, Guangdong province, which used a similar approach and experienced similar results to our findings,<sup>47</sup> implying that the current finding is reliable and that Chinese ICU nurses suffer from prevalent high levels of fatigue. The fatigue level of ICU nurses in this study was also higher than that of the general population,<sup>48</sup> as well as that of scientific and technical personnel in China.<sup>49</sup> In the United States, nurses commonly experience physical and mental fatigue. O'Donnell et al reported that nearly half of nurses (45.4%) had high levels of fatigue, and there was a strong positive association between fatigue and dissatisfaction with practicing medicine.<sup>50</sup> Similarly, nurses in Japan suffer from prolonged fatigue.<sup>51</sup> Indeed, compared to other countries, the degree of figures in this study seems to be higher than that among Indian healthcare professionals (25%),<sup>52</sup> French physicians (49%),<sup>53</sup> Turkish physicians (under 20%),<sup>54</sup> Middle East healthcare providers (ranging between 40 and 60%),<sup>55</sup> and United States physicians (under 44.0%).<sup>56</sup> It is alarming that the intensity of and prevalence of fatigue among Chinese ICU nurses is more severe than those working in many other countries. In addition, COVID-19 pandemic exposing ICU nurses to higher working hours, more stressful work conditions and a higher number of night shifts per month can be another reason behind those high level of work fatigue. Nurses' fatigue is associated with sick leave and injury, which can increase the frequency of task errors and affect patient safety.<sup>57</sup> As a common and serious problem among nurses worldwide, work fatigue needs to be paid more attention, by them and hospital managers.

### The Relationship Between Work Fatigue and Job Satisfaction in the ICU Nurses

This study investigated the relationships between work fatigue and job satisfaction among ICU nurses, and the mediating role of job burnout in this relationship. The results showed a significant inverse correlation between work fatigue and job satisfaction. These findings agree with the results of previous studies.<sup>58–60</sup> This may be explained by the fact that most ICU nurses show an elevated level of dissatisfaction with their work conditions. Long working hours, heavy workloads, and severe job stress can easily produce burnout and lead to fatigue.<sup>61</sup> A state of prolonged fatigue may threaten the mental health of professionals and consequently reduce their level of job satisfaction.<sup>62</sup> Meanwhile, in the present study, it was determined that nurses working in the ICU, had higher fatigue levels and lower job satisfaction than that of others. Similar results are seen in other studies.<sup>63–65</sup>

Strained ICU capacity is likely to increase concomitantly with the growing fundamental supply and demand mismatch in ICU resources.<sup>66</sup> Stress is an important predictor of exhaustion among ICU nurses who experience job dissatisfaction. ICU nurses may face increased workloads, longer working hours, and highly challenging tasks,<sup>67</sup> which may explain why they

experience low job satisfaction and elevated fatigue levels. The increased workload and stressors of stress caused by the COVID-19 pandemic, have become adversities for Chinese ICU nurses,<sup>68</sup> generating increased burnout and fatigue. Existing studies indicate that the high prevalence of prolonged fatigue, burnout syndromes, and depressive symptoms in Chinese ICU nurses deserves immediate attention.<sup>69</sup> The outcomes of prolonged fatigue include reduced job performance, increased risk of adverse events, decline in the quality of care, negative patient experience, poor patient safety, increased medication errors and infections, and high turnover intention.<sup>70–72</sup> The causes of fatigue consist of interpersonal, workload, occupational, organizational, social, and cultural factors. Thus, nurses' fatigue is a systemic problem, not an individual dilemma, and must be addressed with systematic solutions for all health professionals in China.<sup>73</sup>

## Mediating Role of Burnout in This Relationship Between Work Fatigue and Job Satisfaction

The results indicated that job burnout played a partial mediating role in the relationship between work fatigue and job satisfaction. A similar study found that burnout mediated the relationship between job performance and job satisfaction,<sup>74,75</sup> suggesting that job burnout is a mechanism that partially transmits negative psychological effects on career outcomes, which also indicates that it is a critical mediating mechanism in the relationship between work fatigue and job satisfaction. Prolonged fatigue may result in job burnout, which has extensive evidence.<sup>76</sup> Many previous studies have indicated that physical and mental fatigue are positively correlated with job burnout.<sup>77</sup> Several scholars have noted that both chronic fatigue syndrome and burnout are characteristic of fatigue.<sup>78–80</sup> One study confirmed that increasing physical and mental fatigue among ICU nurses can lead to increased job burnout, further reducing job engagement and satisfaction.<sup>81</sup> Nurses suffering from burnout are prone to present multiple aspects, including chronic fatigue, moral distress, inefficiency, emotional instability, and unexplained turnover.<sup>82</sup> Burnout impairs day-to-day behavior regulation, which tends to cause more self-undermining (ie, creating additional obstacles) and less job crafting (ie, optimizing job demands and resources) as a negative feedback mechanism, further leading to low motivation and poor ability to regulate one's own behavior, resulting in impaired job satisfaction.<sup>83</sup> Based on an analysis of multiple theories, including the hierarchy of needs theory,<sup>84</sup> the two-factor theory<sup>85</sup> and the cognitive process of motivation theory,<sup>86</sup> job satisfaction in the nursing profession was defined as the fulfillment of desired needs within the work environment, happiness or gratifying emotional response towards workplace conditions, and job values or equity.<sup>87</sup> Interaction exists between burnout and low levels of job satisfaction, and suggestive evidence has found that one leads to the other.<sup>88</sup> Burnout not only has a deep impact on nurses' physical and mental health, job performance, job satisfaction, and turnover intention, but also has an increasingly wider scope.<sup>70</sup> Burnout is becoming increasingly important for the nursing profession, and it has a greater impact on job satisfaction, which needs to be paid great attention.

## Moderating Role of Turnover Intention in the Relationship Between Burnout and Job Satisfaction

This study also found that turnover intention moderates the relationship between burnout and job satisfaction. Specifically, the impact of burnout on job satisfaction is stronger in nurses with increased turnover intention than in those with decreased turnover intention. Most nurses in China still encounter low salaries, less independence, insufficient social support, tense nurse-patient relationships, and few promotion prospects, which could lead to job burnout, dissatisfaction, and even turnover.<sup>89</sup> As an occupational group with considerable risk, pressure, and skill demands, ICU nurses deserve higher payment for maintaining a state of effort-reward balance. Nurses with high turnover intention have comprehensive workplace attitudes, including a lower sense of organizational belonging and identity, lower psychological contract, and weak job embeddedness, in which the impact of burnout on job satisfaction lacks dampers. Once nurses with high-level turnover intention experience high-degree burnout, they tend to experience greater job satisfaction than those with low-level turnover intention. It is necessary for nurses to adopt a reasonable mechanism of financial incentive and performance management, to regulate nightshift work, create a fairly informal and relaxed atmosphere, and simultaneously achieve demand-resource balance, thereby contributing to reduced turnover intention. More attention should be paid to nurses' psychological states, especially those with lofty educational backgrounds and academic qualifications. In this way, nurses' motivation and enthusiasm can, to some extent, be improved.

## Limitations

There are several limitations of this study that must be acknowledged. First, data were collected using an online survey through a self-report method, which is likely to produce a response bias, owing to negative effects or social desirability. Second, the non-random sampling method potentially causes a sample bias, which can affect the study results. Third, this study included a total of 374 ICU nurses, and the small sample size limited the credibility, representativeness, and extrapolation of the analysis results. The sample size should be increased in the future. Fourth, the cross-sectional nature of the variables indicates that these results cannot be regarded as describing a causal relationship, which suggests that one important direction for future research involves longitudinal studies. Fifth, several single-item tools in this study were used to collect the data to abbreviate survey material, and potentially increase response rates, but this may have reduced the validity and reliability of the measurements; therefore, a widely used measurement tool should be adopted in the future. Additionally, we did not intentionally collect special variables regarding the work environment and behavioral changes during the COVID-19 pandemic. This study was conducted only in the context of the COVID-19 pandemic, suggesting that a specific factor caused by or related to the COVID-19 pandemic should be considered and included in the survey in future research.

## Conclusion

In summary, the findings of this study showed a significant negative correlation between work fatigue and job satisfaction among Chinese ICU nurses during the COVID-19 pandemic. Work fatigue is positively and significantly correlated with burnout and turnover intention. Moreover, work fatigue had a significant indirect effect on job satisfaction, through the transmission of burnout as a mediator. Over time, a state of physical and mental exhaustion and work weariness among Chinese ICU nurses potentially results in job burnout and consequently promotes the level of job dissatisfaction. The results also found that turnover intention played a moderating role in the relationship between burnout and job satisfaction. The link between burnout and job satisfaction was stronger among ICU nurses with high turnover intention. Nursing managers, hospital administrators, and health policymakers should consider the current findings to develop top-down intervention strategies that establish a balance-oriented work design and friendly working environment to guard against nurses' work fatigue and turnover intention. Specific policies could be considered to eliminate nurses' fatigue and negative attitudes during times of public health emergencies. First, nurse managers should reduce the number of rotating shifts of ICU nurses. Second, hospital managers need to consider improving nurses' quality of life by increasing chance of recovery of ICU nurses. Third, financial subsidy mechanisms could be established for the purpose of rewarding nurses. Fourth, cognitive-behavioral intervention programs should be provided in the hospital during the COVID-19 pandemic for ICU nurses with the aim of improving coping ability to reduce stressors.

## Data Sharing Statement

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request from [hydsuntao@126.com](mailto:hydsuntao@126.com).

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## Disclosure

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