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Factors associated with burnout among Chinese operating room nurses: a meta-analysis

Xiaoxia Dai[1,2], Caixia Xie[3,2*], Yunlian Wu[1,2], Tian Chen[2,3] and Fang Lu[4]

Abstract

Background Burnout is prevalent among nursing staff, especially in the operating room, which is a high-intensity, high-pressure and fast-paced work environment. As the prevalence of nurse burnout increases, reducing the burnout of operating room nurses helps to improve the physical and mental health of nurses. Thus, stabilising the nursing team can also guarantee the quality of medical care, which in turn improves patient satisfaction. In this study, we conducted a meta-analysis based on the Pearson correlation coefficient to quantitatively analyse the factors related to burnout among operating room nurses and to provide a reliable basis for preventing and intervening in burnout among operating room nurses.

Methods CNKI, Wanfang Database, Wipro Database, China Biomedical Database, PubMed, Web of Science, Embase, CINAHL and Cochrane Library Database were searched, and the keywords 'operating room', 'nurses', 'burnout' and the corresponding English terms were used for the search. The time limit for the search was set from the creation of the databases to April 2024. Two researchers with evidence-based knowledge conducted the search, independently screened the literature according to the inclusion and exclusion criteria, extracted the information and assessed the quality of the included literature using the quality assessment criteria for observational studies recommended by the Agency for Healthcare Quality and Research, and performed a meta-analysis of the literature using the r value as an indicator of the outcome in RevMan 5.4 software.

Results A total of 25 papers were included, with a sample size of 6,061 cases. The quality of the literature was moderate. The meta-analysis showed that job stress ($r=0.56$, 95% confidence interval [CI]: 0.42–0.68, $I^2=86\%$), work–family conflict ($r=0.52$, 95% CI: 0.36–0.64, $I^2=82\%$), willingness to leave ($r=0.42$, 95% CI: 0.34–0.49, $I^2=0\%$) and hidden absenteeism ($r=0.49$, 95% CI: 0.41–0.57, $I^2=55\%$) were positively correlated with burnout ($p<0.01$), job immersion ($r=-0.39$, 95% CI: −0.40 to −0.32, $I^2=0\%$), social support ($r=-0.46$, 95%: −0.58 to −0.33, $I^2=74\%$), psychological capital ($r=-0.53$, 95% CI: −0.60 to −0.45, $I^2=72\%$) and well-being ($r=-0.54$, 95% CI: −0.73 to −0.27, $I^2=88\%$) were negatively correlated ($p<0.01$).

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Conclusions and recommendation This study shows that burnout of operating room nurses is related to various factors, such as job stress, social support, work–family conflict, psychological capital and well-being. Therefore, it is suggested that hospital management should alleviate the burnout of operating room nurses from the multi-dimensional aspects of improving the work environment, enhancing social support and improving personal psychological capital and well-being to effectively alleviate burnout.

Trial registration (PROSPERO) International prospective register of systematic reviews: CRD42024547524.

Keywords Operating room, Nurse, Burnout, Meta-analysis, China

Introduction

Burnout is a state of physical and mental exhaustion due to chronic work stress and emotional burdens characterised by three dimensions: emotional exhaustion, depersonalisation and decreased personal accomplishment [1, 2]. The World Health Organization included burnout in the 11th revision of the International Classification of Diseases in 2019, indicating that burnout has become a serious health issue for nurses worldwide [1]. In a recent meta-analysis of burnout among nurses globally, the prevalence of burnout among nurses increased to approximately 11.23% [3]. In recent years, with the increasing intensity of workload in the healthcare industry, the problem of burnout has become more and more prominent, especially for the critical position of operating room nurses [4, 5], and the percentage of burnout among nurses is as high as 42.5% in the high-intensity working environment of operating rooms [6]. Burnout can have serious negative effects on both patients and nurses. It not only affects the physical and mental health of nurses but also reduces job satisfaction, increases the willingness to leave, affects the quality of care and even leads to the occurrence of adverse nursing events, which seriously affect patient safety [7–10].

Understanding the factors associated with burnout among operating room nurses facilitates early targeted interventions. Therefore, it is necessary to have a comprehensive understanding of the factors related to burnout among operating room nurses. Several studies [11–17] have explored these factors, such as psychological capital, job immersion and social support. However, based on these studies, there needs to be a more systematic reporting of factors associated with burnout among operating room nurses, and there is a lack of further quantitative analysis of these factors.

Summarising the correlates of burnout among operating room nurses can provide a reliable basis for early prevention and intervention. Therefore, we systematically reviewed the factors associated with burnout among operating room nurses and performed a meta-analysis based on the Pearson correlation coefficients reported for each factor.

Methods

Design and search strategy

This meta-analysis was conducted according to the PRISMA 2020 checklist. The study was registered in the international database PROSPERO under registration number CRD42024547524.

Computerised searches were conducted on PubMed, Web of Science, Embase, Cochrane Library, CINAHL, CNKI, Wanfang Database, Wipro Database and China Biomedical Database. The time limit for the search was set from the creation of the databases to April 2024. A combination of subject headings and free words was used to obtain the literature and retroactively complete the references of the obtained literature with the following search terms: 'burnout/job burnout/career exhaustion/occupational burnout'; 'nurses, nursing'; 'operating room'; and 'China/Taiwan/Hong Kong/Macau'. We used the Boolean operators AND and OR for concatenation.

Eligibility criteria

The inclusion criteria were as follows: (1) The study population included Chinese operating theatre nurses. (2) The type of study was a cross-sectional study. (3) The study variables were the Maslach Burnout Scale and its derivative scales, with good reliability tests.

The exclusion criteria were as follows: (1) studies not in Chinese or English, (2) repeatedly published studies, (3) articles with unavailable full text or incomplete data, (4) conference papers, abstracts and reviews, (5) studies in which the Pearson correlation analysis was not used in the statistical analysis and (6) studies that did not report the total score of the Pearson correlation coefficients related to burnout or from which the total score could not be extrapolated.

Literature screening and data extraction

Duplicate studies were automatically identified and removed using NoteExpress, and manual checking was performed to confirm suspected duplicates. First, titles and abstracts were compared using NoteExpress to exclude irrelevant literature. Second, the titles and abstracts were manually reviewed for possible relevant

Table 1 Critical appraisal results of eligible studies in this study

First author/Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Score	Literature level
Jiang 2018 [11]	Yes	No	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	4	medium
Cui 2019 [12]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Jin 2021 [13]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Zhao 2021 [14]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Wang 2023 [15]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Li 2023 [16]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Gao 2023 [17]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Long 2020 [19]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Lv 2020 [20]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Li 2021 [21]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Xu 2022 [22]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Hu 2019 [23]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Li 2017 [24]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Shi 2018 [25]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Yang 2021 [26]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Ju 2023 [27]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Liu 2023 [28]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Shi 2020 [29]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Luan 2023 [30]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Liu 2018 [31]	Yes	No	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	4	medium
Zou 2019 [32]	Yes	No	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	4	medium
Yu 2020 [33]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Bian 2020 [34]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	Medium
Zhou 2022 [35]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium
Ma 2018 [36]	Yes	Yes	Yes	Yes	Unclear	NO	NO	NO	NO	Yes	-	5	medium

Q1: Source of research subjects; Q2: Eligibility criteria; Q3: Time period of the study population; Q4: Continuity of the study population; Q5: Other circumstances of the research subjects; Q6: Reassessment; Q7: Rationale for the exclusion analysis; Q8: Confounding factor control measures; Q9: Lost data processing; Q10: Response and data collection integrity; Q11: Follow-up

literature. Finally, according to the inclusion and exclusion criteria, the full text was obtained for a detailed review of inclusion in the final literature. If there was any doubt, the two researchers decided whether to include the literature. If they could not reach a consensus, the third researcher arbitrated. The contents of the literature extraction were as follows: (1) basic information of the included literature: title, first author, publication time, study area, burnout scale evaluation tool with good reliability and validity, and related factors; (2) basic characteristics of the study population: sample size and sampling method; and (3) overall correlation coefficient *r* value.

Literature quality assessment

A quality assessment of the literature was performed by two researchers trained in evidence-based nursing knowledge using the quality assessment criteria for observational studies recommended by the Agency for Healthcare Quality and Research (AHRQ) [18]. The selected studies were independently evaluated in 11 areas: source of the study population, inclusion and exclusion criteria, period of study population, continuity of study population, reassessment, rationale for exclusion from analyses, control measures for confounders, treatment of missing data, completeness of response and data collection, and follow-up. The terms 'Yes', 'No' and 'Unclear' were used to respond to each entry, with a total score of 11. A score of 1–3 was considered low quality, 4–7 was considered moderate quality, and 8–11 was considered high quality. Each criterion's interpretation and scoring rules were based on the AHRQ guidelines. If the difference between the evaluation scores of the two researchers exceeds a certain threshold, the original text should be consulted for discussion and decision, or a third-party arbitration should be introduced (Table 1).

Data analysis methods

The meta-analysis was performed using the internationally recognised RevMan 5.4 software developed by the Cochrane Collaboration for systematic evaluation and meta-analysis. The statistical parameters of Fisher's Z-test and SE were calculated using the formula. Then, the summary Fisher's Z and 95% CI were combined using the inverse variance method of RevMan 5.4. The final formula

was used to calculate the summary *r* value. The formula is as follows [37]:

$$Fisher'sZ = 0.5 \times In\frac{1+r}{1-r};\ u_z = \frac{1+r}{1-r}; SE = \sqrt{u_z}; Summaryr = \frac{e^{2z}-1}{e^{2z}+1}$$

(The combined Z-values are the summary Fisher's Z-values). Heterogeneity was judged according to the I^2 statistic, and the effect model was selected: a random-effects model was used for $I^2 \geq 50\%$, and a fixed-effects model was used for the opposite. Descriptive evaluation analyses were used for correlates that could not be combined with a small number of studies.

Results

Search results

Electronic online and manual searches of the CNKI, Wanfang Database, Wipro Database, China Biomedical Database, PubMed, Web of Science, Embase, CINAHL and Cochrane Library Database yielded 836 records, of which 423 duplicates were identified and removed. Title and abstract screening excluded 302 irrelevant articles. The remaining 111 articles were then reviewed in full text. Of these, 86 were excluded based on predetermined eligibility criteria. Finally, 25 articles [11–17, 19–36] were included in the meta-analysis (Fig. 1).

Study characteristics

The total sample size was 6,061 cases, with 3 studies in English and 22 studies in Chinese. The measurement sites were all hospitals, and the burnout measurements were based on the Mars Burnout Scale and its derivatives, with good reliability and validity. The studies were included in the essential characterisation (Table 2).

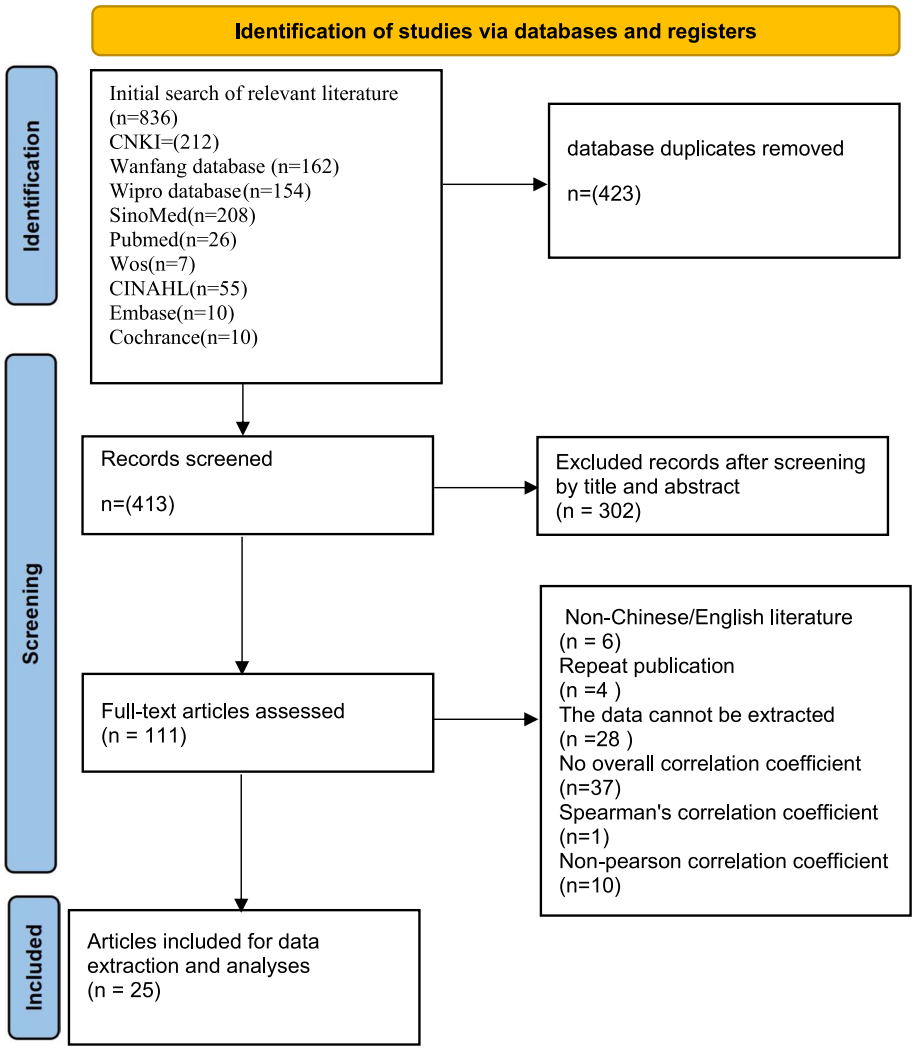

Fig. 1 PRISMA flow diagram of the selection process of studies

Table 2 Basic characteristics of the included studies

First author/Year	Sample size	Sampling methods	Region	Evaluation tools	Relevant factors
Jiang 2018 [11]	106	not mentioned	Guangxi	MBI-GS	C
Cui 2019 [12]	86	Convenient sampling	Jiangsu	MBI-GS	CG
Jin 2021 [13]	242	random sampling	Qingdao	MBI	CD
Zhao 2021 [14]	230	Convenient sampling	Jilin	MBI	C
Wang 2023 [15]	421	Convenient sampling	Shandong	MBI	CE
Li 2023 [16]	75	Convenient sampling	Beijing	MBI-GS	AC
Gao 2023 [17]	293	Convenient sampling	Shandong	MBI	CE
Long 2020 [19]	128	Convenient sampling	Sichuan	MBI-GS	S
Lv 2020 [20]	98	Purposeful sampling	Shandong	MBI	H
Li 2021 [21]	509	Convenient sampling	Beijing	MBI-GS	D
Xu 2022 [22]	236	Convenient sampling	Jingsu	MBI	IJ
Hu 2019 [23]	289	Convenient sampling	Shandong	MBI	AB
Li 2017 [24]	570	stratified cluster sampling	Xinjiang	MBI	K
Shi 2018 [25]	85	Convenient sampling	Henan	MBI	D
Yang 2021 [26]	364	Convenient sampling	Beijing	MBI	BD
Ju 2023 [27]	600	Convenient sampling	Jiangsu	MBI	F
Liu 2023 [28]	110	Convenient sampling	Jiangsu	MBI	D
Shi 2020 [29]	212	Convenient sampling	Ningbo	MBI-GS	G
Luan 2023 [30]	78	Convenient sampling	Hebei	MBI-GS	G
Liu 2018 [31]	300	Convenient sampling	Beijing	MBI	H
Zou 2019 [32]	37	not mentioned	Guangdong	MBI	D
Yu 2020 [33]	218	Convenient sampling	Jiangsu	MBI	F
Bian 2020 [34]	263	Convenient sampling	Beijing、Wuhan	MBI	Q
Zhou 2022 [35]	235	Multi-stage sampling	Shandong	MBI	R
Ma 2018 [36]	276	Convenient sampling	Shanxi	MBI	A

Remarks: A: Social Support; B: Work–Family Conflict Scale; C: Psychological Capital; D: Job Stress; E: Job Immersion; F: Hidden Absenteeism; G: Well-being; H: Willingness to Leave; I: Occupational Coping Self-Efficacy; J: Self-Regulation of Fatigue; K: Safety Culture; L: Job Demands; M: Job Resources; N: Occupational Identity; O: Occupational Stress; P: Perceived Risk; Q: Self-Compassion; R: Organisational Silence; S: Willingness to Stay

Results of the meta-analysis of burnout and associated factors

For the 25 articles whose ending variables were correlation coefficients r, the formula in the data analysis method was used to convert Fisher's Z-value and SE, which were then input into RevMan 5.4 software. According to the merged Fisher's Z-value, the formula was used to calculate the summary Fisher's Z-value. A total of 19 correlation factors were extracted in the study, and eight correlation factors of the literature number ≥ 2 were analysed through meta-analysis (Table 3). The remaining 11 correlation factors were evaluated descriptively, as shown in Table 4.

Correlation between burnout and job immersion

The combined results are shown in Fig. 2. Fisher's Z-value was − 0.41 (95% CI: between − 0.48 and − 0.33, $p < 0.01$), and it was found to be statistically significant. Converted to the r value and 95% CI using the formula, the r value was − 0.39 (95% CI: between − 0.45 and − 0.32), $p < 0.01$. The heterogeneity test showed no statistical heterogeneity between the groups ($I^2 = 0\%$, $p = 0.69$). Thus, the fixed effect model was used for the meta-analysis.

Correlation between burnout and work–family conflict

The combined results are shown in Fig. 3. Fisher's Z-value was 0.56 (95% CI: 0.48–0.63, $p < 0.01$), and it was found to be statistically significant. Converted to the r value and 95% CI using the formula, the r value was 0.52 (95% CI: 0.36–0.64), $P < 0.01$. The heterogeneity test results showed a high degree of statistical heterogeneity between the groups ($I^2 = 82\%$, $P = 0.02$). Thus, a meta-analysis was conducted using the random-effects model.

Correlation between burnout and job stress

The combined results are shown in Fig. 4. Fisher's Z-value was 0.64 (95% CI: 0.45–0.82, $p < 0.01$), and it was found to be statistically significant. Converted to the r value and 95% CI by the formula, the r value was 0.56 (95%

Table 3 Eight relevant factors

Number	Relevant factors	Fisher's Z and 95%CI	Summaryr and 95%CI
1	job immersion	−0.41 (−0.48,−0.33)	−0.39 (−0.45,−0.32)
2	work-family conflict	0.56 (0.48,0.63)	0.52 (0.36,0.64)
3	job stress	0.64 (0.45,0.82)	0.56 (0.42,0.68)
4	willingness to leave	0.45 (0.35,0.54)	0.42 (0.34,0.49)
5	social support	−0.47 (−0.55,−0.39)	−0.46 (−0.58,−0.33)
6	psychological capital	−0.58 (−0.70,−0.47)	−0.53 (−0.60,−0.45)
7	well-being	−0.60 (−0.92,−0.28)	−0.54 (−0.73,−0.27)
8	hidden absenteeism	0.54 (0.43,0.65)	0.49 (0.41,0.57)

CI: 0.42–0.68, $p<0.01$). The heterogeneity test results showed a high degree of statistical heterogeneity between the groups ($I^2=86\%$, $p<0.001$). Thus, a random-effects model was used for the meta-analysis.

Correlation between burnout and willingness to leave

The combined results are shown in Fig. 5. Fisher's Z-value was 0.45 (95% CI: 0.35–0.54, $p<0.01$), and it was found to be statistically significant. Converted to the r value and 95% CI using the formula, the r value was 0.42 (95% CI: 0.34–0.49, $p<0.01$). The heterogeneity test showed no statistical heterogeneity between the groups ($I^2=0\%$, $p=0.50$). Thus, the fixed effect model was used for the meta-analysis.

Correlation between burnout and social support

The combined results are shown in Fig. 6. Fisher's Z-value was −0.47 (95% CI: between −0.55 and −0.39, $p<0.01$), and it was found to be statistically significant. Converted to r value and 95% CI using the formula, the r value was −0.46 (95% CI: between −0.58 and −0.33, $p<0.01$). The heterogeneity test showed moderate statistical heterogeneity between the groups ($I^2=74\%$, $p=0.02$). Thus, the meta-analysis was conducted using the random-effects model.

Table 4 Eleven relevant factors

Number	Relevant factors
1	Occupational Coping Self-Efficacy
2	Self-Regulation of Fatigue
3	Safety Culture
4	Job Demands
5	Job Resources
6	Occupational Identity
7	Occupational Stress
8	Perceived Risk
9	Self-Compassion
10	Organizational Silence
11	Willingness to Stay

Correlation between burnout and psychological capital

The combined results are shown in Fig. 7. Fisher's Z-value was −0.58 (95% CI: between −0.70 and −0.47, $p<0.01$), and it was found to be statistically significant. Converted to r value and 95% CI using the formula, the r value was −0.53 (95% CI: between −0.60 and −0.45, $p<0.01$). The heterogeneity test showed moderate statistical heterogeneity between the groups ($I^2=76\%$, $p=0.001$). Thus, a meta-analysis was performed using the random-effects model.

Correlation analysis between burnout and well-being

The combined results are shown in Fig. 8. The summary Fisher's Z-value was −0.60 (95% CI: between −0.92 and −0.28, $p<0.01$), and it was found to be statistically significant. Converted to the *r* value and 95% CI using the formula, the combined converted r value was −0.54 (95 CI%: between −0.73 and −0.27, $p<0.01$). The heterogeneity test results showed high statistical heterogeneity between the groups ($I^2=88\%$, $p=0.001$). Thus, a random effect model was used for the meta-analysis.

Correlation between burnout and hidden absenteeism

The combined results are shown in Fig. 9. The summary Fisher's Z-value was 0.54 (95% CI: 0.43–0.65, $p<0.01$), and it was found to be statistically significant. The formula converted the r value and 95% CI. After the combined conversion, the r value was 0.49 (95% CI: 0.41–0.57, $p<0.001$). The heterogeneity test showed moderate statistical heterogeneity between the groups ($I^2=55\%$, $p=0.14$). Thus, a random-effects model was used for the meta-analysis.

Publication bias and sensitivity analyses

Publication bias and sensitivity analyses were conducted in this study only for the correlates included in the larger body of literature—that is, job stress and psychological capital.

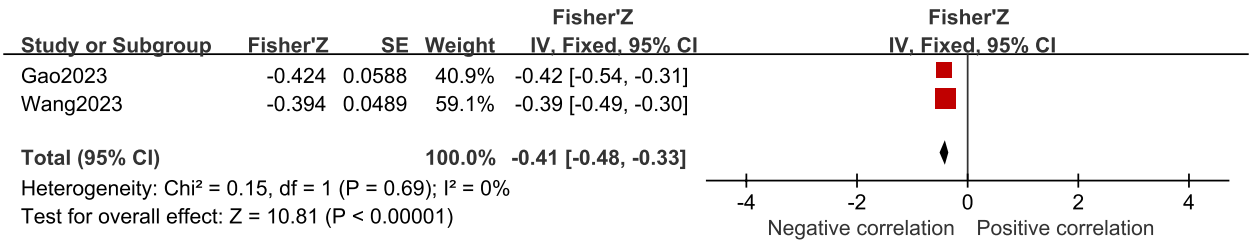

Fig. 2 Fisher's Z forest plot for burnout and job immersion

The funnel plots of the studies included in the correlation of burnout with job stress and psychological capital showed comparative symmetry, no significant publication bias and good representation (Figs. 10 and 11).

After removing Shi Jiangli 2018 [25], Yang Yingying 2021 [26], Liu Xiuchen 2023 [28], Zou Hongwen 2019 [32] and Li 2021 [21] from the study of the correlation between burnout and job stress, the results of the sensitivity analysis are shown in Table 5. The Z-value remained statistically significant, indicating that the correlation between burnout and job stress results was relatively stable.

After removing Yuanjing Cui 2019 [12], Hongyan Wang 2023 [15], Dongdong Jin 2021 [13], Yiming Gao 2023 [17], Huilin Jiang 2018 [11], Feng Zhao 2021 [14] and Kai Li 2023 [16] one by one, which were included in the study of the correlation between burnout and psychological capital (Table 6), the Z-value remained statistically significant, indicating that the results of the burnout–psychological capital correlation were relatively stable. The capital correlation results were also relatively stable.

Subgroup analysis

Due to the limited number of studies retrieved for each correlation factor, only the burnout correlations with job stress and psychological capital included in the larger body of literature were subgrouped and analysed in this study.

Burnout and job stress correlations were analysed in subgroups by year of publication of the literature, region and sample size. The results showed that the correlation between burnout and job stress among operating room nurses became stronger as the year of publication became more recent. The correlation coefficient between burnout and work stress was higher in southern operating room nurses than in northern operating room nurses, while the correlation coefficient of the sample size had no significant effect (Table 7). Similarly, the subgroup analyses of burnout and psychological capital according to the number of years of publication of the literature, the region and the sample size showed that the correlation coefficients of burnout and psychological capital among operating room nurses of the southern region were higher than those of the northern region. The number of years of publication and the sample size had no significant effect (Table 8).

Discussion

The meta-analysis results showed that work–family conflict, job stress, willingness to leave and hidden absenteeism were positively correlated with burnout. Conversely, job immersion, social support, psychological capital and well-being were negatively correlated with burnout.

Work–family conflicts

This study showed that burnout was positively correlated with work–family conflict ($r = 0.52$) and that the degree of correlation was moderate. This indicates that the higher the level of work–family conflict faced by operating room nurses, the higher their level of burnout. This result may be due to operating room nurses being more likely to exacerbate burnout when they take on multiple roles, have negative emotions when their work interferes with their families and work with these emotions. Given the significant differences in

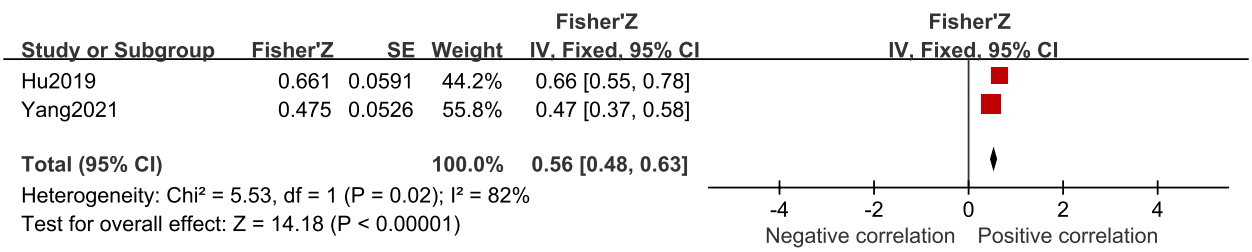

Fig. 3 Fisher's Z forest plot for burnout and work–family conflict

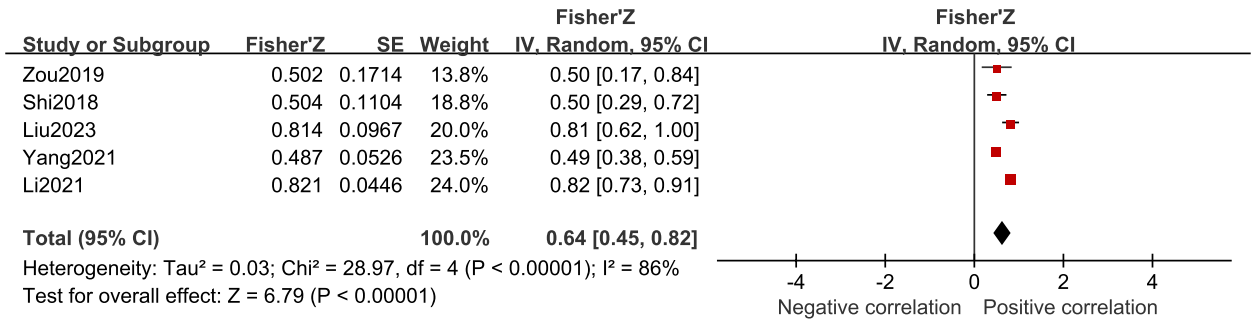

Fig. 4 Fisher's Z forest plot for burnout and job stress

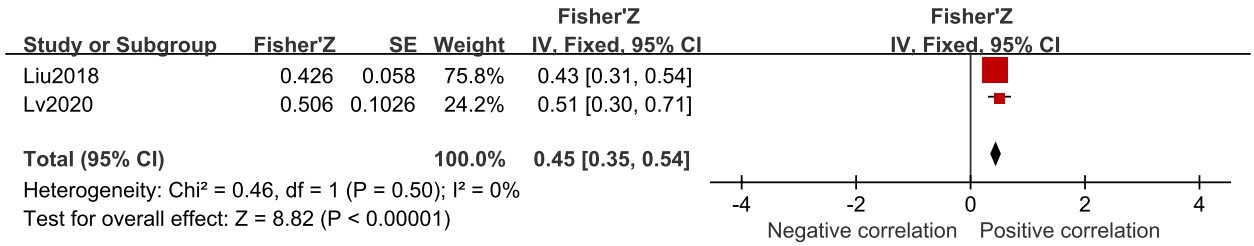

Fig. 5 Fisher's Z forest plot for burnout and willingness to leave

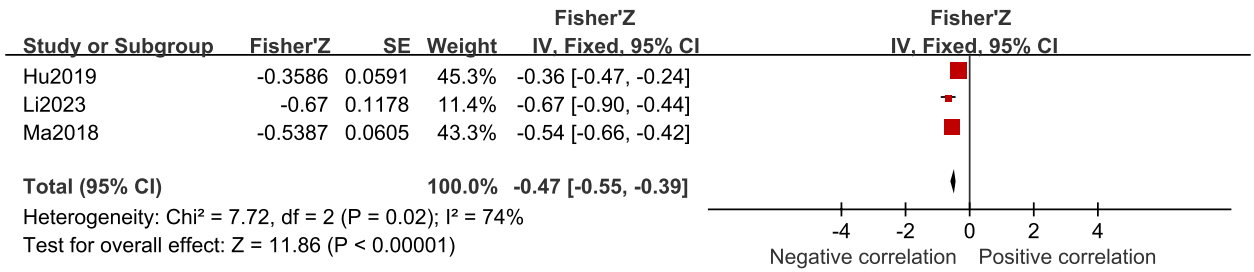

Fig. 6 Fisher's Z forest plot for burnout and social support

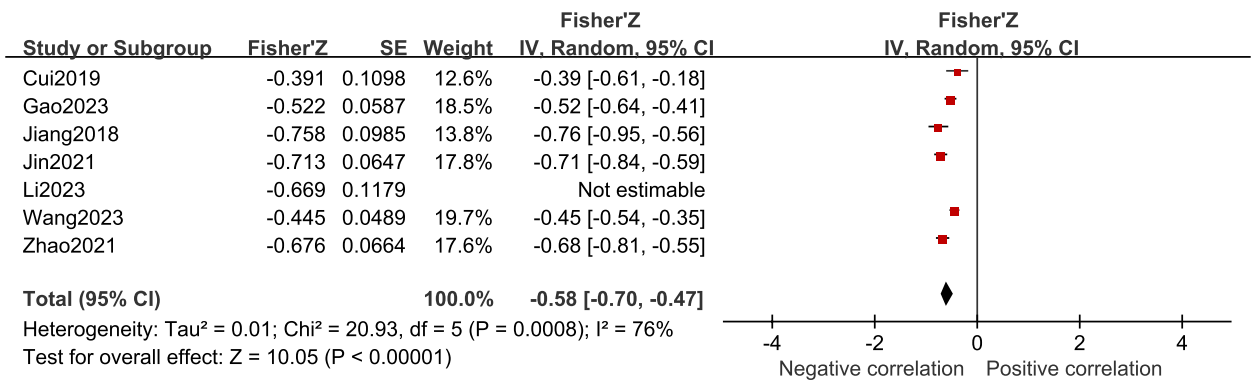

Fig. 7 Fisher's Z forest plot for burnout and psychological capital

the cultural and economic backgrounds of the regions included in the study (Beijing and Shandong) [23, 26] and the fact that Beijing, as the capital city, possesses a deep cultural heritage and strong economic strength, is an important symbol of Chinese civilisation and an important window for international communication, future research should explore how work–family conflict patterns in different regional cultural and economic contexts specifically affect burnout to develop more regionalised intervention strategies.

Job stress

The meta-analysis revealed that burnout among operating room nurses was positively correlated with job stress ($r = 0.56$) and that the degree of correlation was significant. This result suggests that increased job stress significantly elevates burnout among operating room nurses. This finding is consistent with previous studies showing that high job stress significantly predicts burnout [38, 39]. In the operating room, which is a high-intensity, high-risk and closed working environment, nurses face a variety of work pressures, such as heavy workload, long working hours and high levels of expertise and patient care. Therefore, identifying these job stressors has a positive significance in reducing the level of burnout among nurses. Heterogeneity was present in all five studies included in this group, which could be related to the differences in geographic location, type of hospital and job stressors of the respondents. The results remained statistically significant after the sensitivity analyses of each study were excluded one by one, indicating the stability and reliability of the results of this group of studies. The funnel plot showed no publication bias; thus, the results of this study were informative. After the subgroup analysis, the correlation coefficient between burnout and job stress of operating room nurses in the south was larger than that in the north, which could be due to the dense population in the southern region and the high demand for medical care. Operating room nurses may face more surgical coordination work, which could increase their workload. In addition, compared with the northern region, the southern region may have more intense competition due to more concentrated medical resources, and operating room nurses may face more challenges in career development, which may lead to high job stress and burnout. In summary, this study comprehensively analysed the correlation between job stress and burnout among operating room nurses through a larger sample size. Future studies could explore the specific associations between specific work stressors (e.g., workload and patient relationship management) and various dimensions of burnout to design more refined interventions.

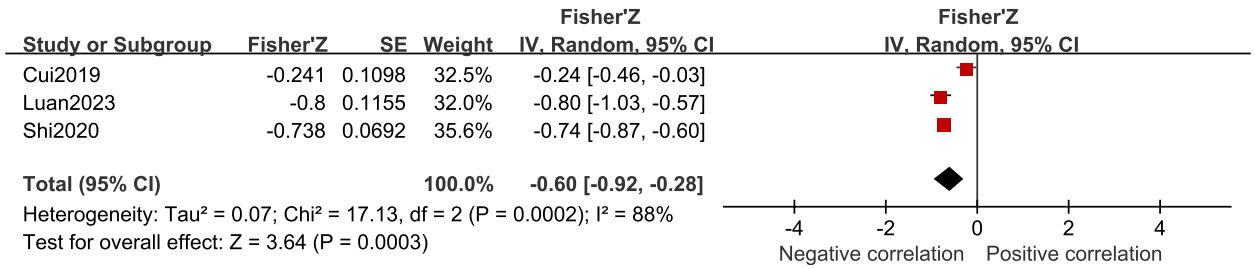

Fig. 8 Fisher's Z forest plot for burnout and well-being

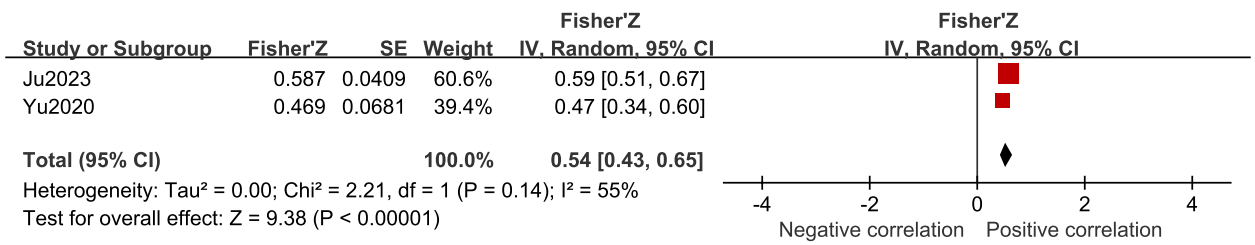

Fig. 9 Fisher's Z forest plot for burnout and hidden absenteeism

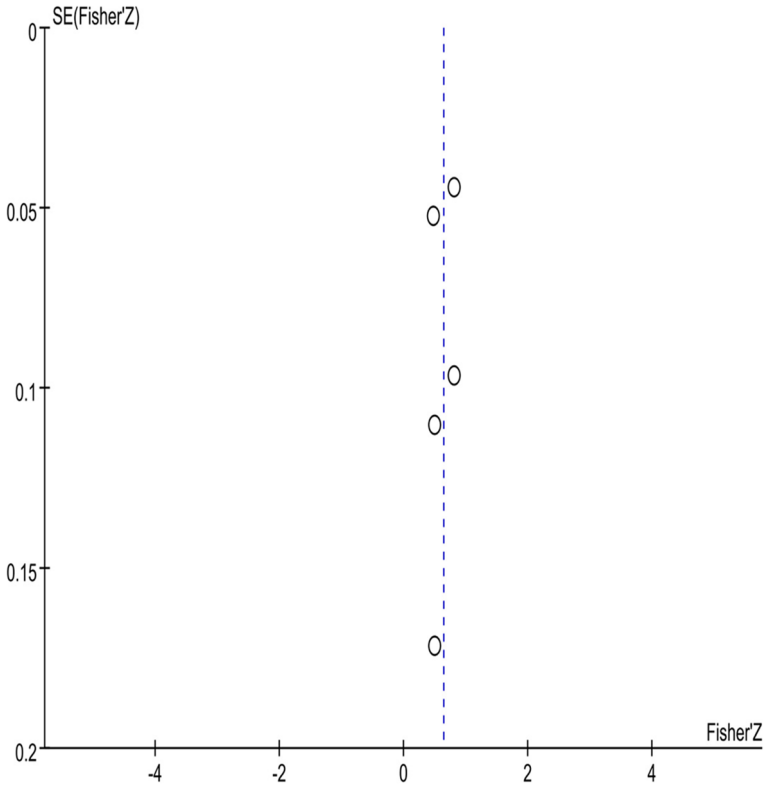

Fig. 10 Funnel plot for burnout and job stress correlation analysis

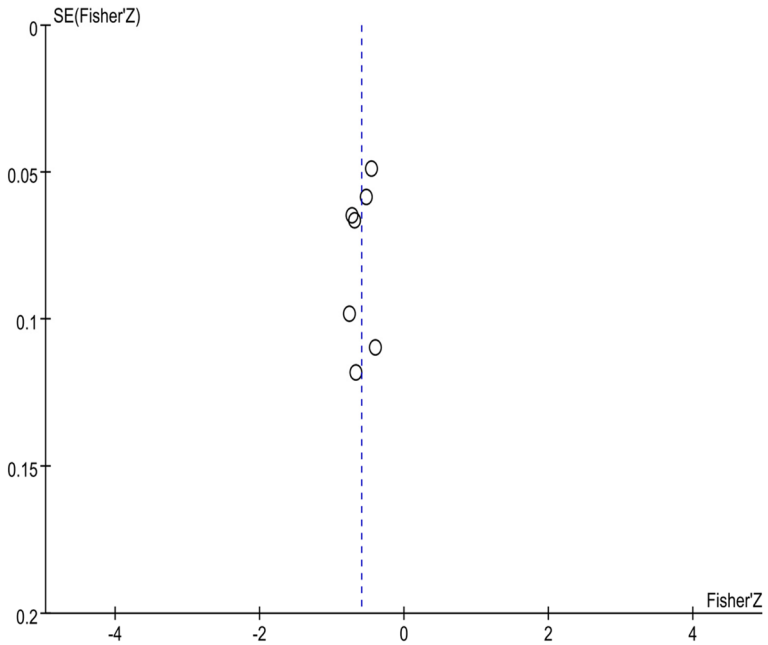

Fig. 11 Funnel plot for burnout and psychological capital correlation analysis

Table 5 Sensitivity analysis of the correlation between burnout and job stress

Program	Z-value	95%CI	I^2 (%)
Shi 2018	0.67	(0.46,0.88)	89
Yang 2021	0.7	(0.53,0.86)	69
Liu 2023	0.59	(0.37,0.81)	89
Zou 2019	0.66	(0.46,0.86)	89
Li 2021	0.58	(0.41,0.75)	67

Willingness to leave

The meta-analysis of this study showed that burnout was positively correlated with willingness to leave ($r=0.42$) and that the degree of correlation was moderate. This indicates that the stronger the willingness to leave, the higher the level of burnout. This result is consistent with the findings of the existing literature [20, 31] and further validates the significant influence of willingness to leave on nurse burnout. The two included studies had an I^2value of 0% and a p-value of 0.05, which indicates low heterogeneity between the two studies and good consistency and reliability of the results. This also suggests that the effect of willingness to leave on burnout has general applicability across studies, even though the subjects and specific contexts may differ. Although the current study confirmed the correlation between burnout and willingness to leave, future research should explore the direct link between actual leaving behaviour and burnout, as well as the actual effect of willingness to leave interventions on reducing burnout. Therefore, the state and hospital levels should develop good strategies to cope with the willingness to leave of nurses in the operating room to avoid a large number of talent losses that affect the stability of the hospital and patient safety. For example, the state and hospitals could establish a reasonable incentive mechanism, optimise the working environment, provide career development opportunities and strengthen mental health support to reduce operating room nurses' willingness to leave and improve their burnout.

Table 6 Sensitivity analysis of the correlation between burnout and psychological capital

Program	Z-value	95% CI	I^2 (%)
Cui 2019	−0.62	(−0.73, −0.51)	73
Wang 2023	−0.63	(−0.73, −0.52)	58
Jin 2021	−0.57	(−0.68, −0.46)	69
Gao 2023	−0.61	(−0.73, −0.48)	76
Jiang 2018	−0.57	(−0.68, −0.46)	72
Zhao 2021	−0.58	(−0.7, −0.46)	73
Li 2023	−0.58	(−0.7, −0.47)	76

Table 7 Subgroup analysis of the correlation between burnout and job stress

Program	Literature Volume	Merged Z-value	95% CI	Heterogeneity (I^2)
Year				
2018–2019	2	0.5	(0.32, 0.69)	0
2021	2	0.68	(0.61, 0.75)	96
2023	1	0.81	(0.62, 1)	
Region				
North	3	0.61	(0.36, 0.86)	92
South	2	0.69	(0.39, 0.99)	60
Sample size				
< 100	2	0.5	(0.32, 0.69)	0
≥ 100	1	0.81	(0.62, 1)	
> 200	2	0.68	(0.61, 0.75)	96

Hidden absenteeism

The meta-analysis of this study showed that burnout was positively correlated with hidden absenteeism ($r=0.49$) and that the correlation was moderate. This is consistent with the findings of Wang et al. [40] that is, the higher the level of hidden absenteeism, the higher the level of burnout. However, the correlation coefficient of this study was greater than that of Wang et al.'s study. This could be due to the operating room being one of the departments with the highest intensity of work and tension among hospital departments [41]. Moreover, its long-term, high-intensity work and irregular scheduling are prone to disrupting nurses' work–life balance, further exacerbating burnout. Any negligence on the part of the nurses in the operating room may lead to serious consequences, making them extremely vulnerable to physical and mental fatigue, thus increasing the risk of burnout, which affects the level of hidden absenteeism. In the future, a mixed methodology

Table 8 Subgroup analysis of the correlation between burnout and psychological capital

Program	Literature volume	Merged Z-value	95% CI	Heterogeneity (I^2)
2018–2019	2	−0.59	(−0.74, −0.45)	84
2021	2	−0.69	(−0.79, −0.60)	0
2023	3	−0.49	(−0.56, −0.42)	42
Region				
North	5	−0.57	(−0.62, −0.51)	74
South	2	−0.59	(−0.74, −0.45)	84
Sample Size				
< 100	2	−0.52	(−0.68, −0.36)	66
≥ 100	1	−0.76	(−0.95, −0.56)	
> 200	4	−0.56	(−0.62, −0.51)	79

that combines quantitative data with qualitative interviews can be used to gain insight into the motivations and psychological mechanisms behind burnout and hidden absenteeism, providing insights for developing effective interventions.

Job immersion

This study showed that burnout was negatively correlated with job immersion ($r = -0.39$), with a low to moderate correlation. This suggests that the greater the job immersion of the operating room nurses, the lower their level of burnout. Job immersion is defined as nurses' total commitment to the work process, enjoying the work and deriving pleasure from it [42]. During work immersion, operating room nurses are better able to cope with the challenges and pressures of their work and experience a sense of accomplishment and fulfilment at work, which reduces the burnout level [17]. The degree of correlation between the two is not significant; thus, hospitals and nursing administrators can refer to it appropriately when developing measures and intervention strategies to reduce the occurrence of burnout. As only two studies were included in this study for meta-analysis, more unincluded studies could be used in the future to explore the correlation between the two to ensure more accurate results. Despite the inclusion of two studies, heterogeneity was low ($I^2 = 0$, $p = 0.69$), indicating the consistency and reliability of the findings.

Social support

This study showed a negative correlation between burnout and social support ($r = -0.46$) with a moderate degree of correlation. This indicates that the greater the social support, the lower the level of burnout, consistent with the results of the current study [16, 23, 36]. The meta-analysis results showed a high degree of heterogeneity in the present study, which could be related to the different assessment tools for burnout, the differences in sample sizes and the fact that the respondents' different years of working experience made the degree of required social support different. Adequate social support can provide emotional support and resources to help operating room nurses feel more confident and motivated in their work, thus reducing the occurrence of burnout [43].Therefore, social organisations and hospitals should establish psychological counselling mechanisms, provide health management, optimise the work environment and reasonably arrange workloads to respect and protect nurses and provide them with strong support and protection.

Psychological capital

This study showed that burnout was negatively correlated with psychological capital ($r = -0.53$) and that the degree of correlation was significant. This indicates that the higher the level of psychological capital of operating room nurses, the lower the level of burnout. This is consistent with the findings of Qiao et al. [44]. Psychological capital refers to the positive psychological state shown when encountering difficulties at work, including self-efficacy, optimism, resilience and self-confidence [45]. Nurses with high psychological capital tend to have self-confidence and the courage to overcome difficulties and are better able to cope with stress in the workplace, promote job engagement and enhance job performance [46]. This meta-analysis exhibited a stronger correlation than Qiao's study, potentially due to the demanding nature of operating room work. Nurses in this environment require high psychological capital to manage complexity and stress, enabling them to better face challenges, enhance resilience and complete their tasks with higher quality.

Heterogeneity was present in all five studies included in this group, which could be due to the age stage of the operating room nurses, their work experience and the level of support from their families. The results remained statistically significant after the sensitivity analyses of each study were excluded one by one, indicating the stability and reliability of the results of this group. The funnel plot showed no publication bias; thus, the results of this study were informative. Subgroup analyses were conducted in this study, which showed that the correlation coefficient between burnout and the psychological capital of operating room nurses in the south was greater than that in the north. However, the difference was not significant, which could be due to the number of included studies. This will need to be further verified in the future.

Well-being

This study showed that burnout was negatively correlated with well-being (−0.54) and that the correlation was significant, consistent with the results of existing studies [12, 29, 30]. This indicates that the higher the well-being, the lower the level of burnout. Well-being is a motivational psychological state that can give nurses a greater sense of existence, exaltation, significance and harmony in self-development, interpersonal interactions, work and life. It can help nurses cope with the pressure and psychological problems at work more positively and enable them to maintain healthy psychological states and supportive behaviours so that they can better adapt to work in the operating room [29]. Therefore,hospitals and nursing managers should develop a comprehensive and detailed performance appraisal system and provide mindfulness training and career counseling to help operating room nurses relax physically and mentally, face the pressure of

work positively, and enhance their sense of well-being to reduce burnout.

Conclusion and recommendation

This study comprehensively analysed the correlates of burnout among nurses in the operating room. The results of the meta-analysis showed that work–family conflict, work stress, willingness to leave, hidden absenteeism, job immersion, social support, psychological capital and well-being were the correlates of burnout among nurses in the operating room. However, the remaining 11 correlates, such as occupational identity, occupational tension and job resources, were not meta-analysed because the number of studies was less than two. Thus, their correlations need further verification. Hospitals and nursing managers can draw on the results of this study to strengthen the attention and screening of burnout of nurses in the operating room from a multidimensional perspective and to combine the individual characteristics of nurses to develop appropriate management methods and interventions to alleviate nurse burnout. In the future, the r value of each dimension of burnout and its correlates could be included to analyse its correlation more comprehensively and accurately and to provide a stronger evidence-based basis for reducing burnout among operating room nurses. Despite some limitations, this study provides a valuable and comprehensive perspective for understanding the complexity of burnout among operating room nurses. Future research should focus on deepening the understanding of the interaction of related factors, developing and testing intervention models and translating the findings into effective policies and practices in real work settings to achieve a complete promotion of nurses' well-being and a sustainable improvement in the quality of healthcare services.

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Authors' contributions
DXX (First Author): writing-Original Draft, Formal analysis. XCX (Corresponnding Author): Funding Acquisition, Supervision, Stduy Design, Validation, writing-Original Draft. WYL: Data Curation, Validation. CH: Data Management, Literature quality assessment, Literature Screening. LF: Funding Acquisition,supervision. All authors read and approved final manuscript.

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Data availability
The datasets generated and/or analyzed during the current study are available from the Corresponding Author upon reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval and informed consent are not required because this study is a meta-analysis that only involves the use of previously published data.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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