**ORIGINAL ARTICLE**

# Prevalence and Influencing Factors of Irritable Bowel Syndrome in Medical Staff: A Meta-Analysis

Hongyuan Liu[1] · Yan Zou[1] · Yinshi Kan[1] · Xiangning Li[1] · Yu Zhang[1]

## Abstract

**Background** Irritable bowel syndrome (IBS) is a common functional digestive tract disease worldwide, with a high prevalence among medical staff. The purpose of this study is to systematically evaluate the prevalence and influencing factors of IBS in medical staff.

**Methods** We searched English online databases, including PubMed, The Cochrane Library, Web of Science, Embase, and EBSCOhost. The retrieval time was from database establishment to May of 2021. We screened the literature according to inclusion and exclusion criteria, extracted the relevant information, and evaluated the research quality. A meta-analysis was performed using the Stata 16.0 and Review Manager 5.4.1 software.

**Results** A total of 11 English studies from seven countries were included in this study, including 3,360 medical staff. The results of the meta-analysis showed an overall prevalence of IBS among medical staff of 16% [95%CI (0.15~0.17)] and that shift work (OR 2.27)), poor sleep quality (OR 4.27), and female gender (OR 2.29) are the major influencing factors of medical staff suffering from IBS.

**Conclusions** The prevalence of irritable bowel syndrome among medical staff is relatively high, and hospitals can start by looking for targeted interventions from the highly related factors of IBS among medical staff such as shift work patterns, females, and poor sleep quality.

**Keywords** Medical staff · Irritable bowel syndrome · Prevalence · Meta-analysis

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✉ Yu Zhang
yizhangyu@yzu.edu.cn

Hongyuan Liu
MZ120201748@yzu.edu.cn

Yan Zou
zouyan_01@yzu.edu.cn

Yinshi Kan
MZ120201739@yzu.edu.cn

Xiangning Li
MX120201110@yzu.edu.cn

[1] School of Nursing, Yangzhou University, 136 Jiangyang Road, Yangzhou City, Jiangsu Province, China

## Introduction

Irritable bowel syndrome (IBS) is a chronic functional digestive tract disorder accompanied with abdominal pain, bloating, and changes in bowel habits and/or stool characteristics [1]. The global prevalence of IBS is approximately 11.2% in the general population, which varies regionally [2]. Although IBS is not life-threatening, it can lead to a decrease in work efficiency and quality of life [3, 4]. It also increases society's medical burden [5].

Several studies have shown that medical staff are prone to IBS. The prevalence of IBS among medical staff worldwide ranges from 12.9 to 36.6%, which is affected by factors such as age, gender, psychology, etc. [6–16]. Medical staff face various challenges, including mental pressure, frequent shifts, and long-time working [17]. The COVID-19 epidemic has increased the workload and caused greater psychological pressure for many medical staff, and coupled with irregular meals and insomnia, has led to a higher prevalence of IBS accompanied by psychological problems such as anxiety and depression. These issues burden medical staff and hinder their ability to provide quality medical services [18].

Although research on IBS has involved subjects with a variety of occupations, there are few studies on medical staff. The research on IBS in medical staff groups has been limited to cross-sectional surveys, and there is a lack of a systematic evaluation of prevalence and influencing factors. This study aims to systematically evaluate the prevalence and influencing factors of IBS among medical staff and provide a theoretical basis for formulating scientific and reasonable intervention measures future to improve the physical and mental health of medical staff and overall service quality of the hospital.

## Methods

This meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. And our study was registered in PROSPERO (CRD42021253969) prior to initiate the study.

### Search Strategy

This meta-analysis was searched jointly by the first author and a professional librarian. We searched the online English databases PubMed, the Cochrane Library, Web of Science, Embase, and EBSCOhost, and simultaneously screened the references of the included literature. This combined a manual retrieval of related journals and gray literature to reduce missed inspections. The search time was from the establishment of the database to May of 2021. The retrieval method was a combination of subject words and free words. Search terms include all subject terms and free terms of "irritable bowel syndrome, IBS", "Doctors, Physicians, nurses, medical staff", and "Prevalence".

### Inclusion and Exclusion Criteria

Literature inclusion criteria were: ① English language; ② research objects were clinical medical workers; ③the diagnostic criteria of IBS used in the study were the Roman diagnostic criteria; ④the outcome indicators included prevalence and/or influencing factors; and ⑤ original research. Exclusion criteria were ① repetitious literature or incomplete information; ② a summary, literature review, or animal experiment; and ③ poor results of the literature quality evaluation.

### Data Extraction and Analysis

Endnote X9 and Excel software were used for literature screening and sorting. Two researchers independently screened the literature and extracted and cross-checked the data. In cases of disagreement, a third party was consulted to assist in judgment. The content of the data extraction included the first author, publication time, survey area, research object, sample size, diagnostic criteria, evaluation tools, and main conclusions.

### Quality Evaluation

We used the Joanna Briggs Institute (JBI) critical appraisal tools for this systematic review to analyze cross-sectional studies [19], including "1. Are the sample inclusion criteria clearly defined? 2. whether the research object and research site are described in detail; 3. whether the measurement methods of exposure factors are reliable and valid; 4. whether there are objective and consistent standards for the definition of diseases or health problems; 5. whether confounding factors are identified; 6. whether measures are taken to control confounding factors; 7. whether the measurement of outcome indicators are reliable and valid; and 8. whether the data analysis method is appropriate" Eight items, including research objects, diseases, influencing factors, confounding factors for measurement, data analysis, etc., we examined to evaluate the overall quality of the cross-sectional study. Each item was judged with "yes," "no," "unclear," and "not applicable". The scoring criteria were two points for "yes", zero points for "no" or "not applicable", and one point for "unclear", for a total of 16 points. A score ≥ 70% of the total score was considered to be low risk of bias and was included in the study. The quality of the literature was independently evaluated by two researchers who

had evidence-based training, and we compared their results. Disagreements were discussed and resolved or handed over to a third party to assist in a ruling.

## Statistical Methods

We used Stata 16.0 and Review Manager 5.4.1 software to perform statistical analysis on the data. We used the Q test and $I^2$ test for heterogeneity. If $P \geq 0.1$, and $I^2 \leq 50\%$, heterogeneity was small, and we chose the fixed-effect model for combined effect size. If $P < 0.1$ and $I^2 > 50\%$, the heterogeneity was large, and we selected a random effect model for the combined effect size. We conducted a sensitivity analysis to ensure the reliability and stability of the research. $P \leq 0.05$ indicates that the difference is statistically significant. We used the Egger's test to evaluate the publication bias.

## Results

### Search Results

We retrieved a total of 1,049 articles, and the Endnote software was used to check for and manually remove duplicates.

We screened layer by layer according to the inclusion and exclusion criteria. Finally, 11 studies [6–16] were included, all of which were in English with a publication period of 2010–2021. The literature screening process is shown in Fig. 1.

## Characteristics and Quality of Included Studies

The 11 included articles were all cross-sectional surveys, and the subjects were all clinical medical workers working in hospitals (3,360 people). The investigation area involved seven countries, including China, South Korea, the United States, Turkey, and Saudi Arabia, prevalence of IBS among medical staff ranges from 12.9 to 36.6%. The diagnostic criteria used in the literature are the Rome III and Rome IV diagnostic criteria. From the conclusions of 11 included studies, we have obtained 11 influencing factors of IBS among medical staff, which have been listed in Table 1. However, due to the different evaluation tools, we were unable to conduct a combined analysis of all influencing factors. In the end, the meta-analysis of the influencing factors of IBS among medical staff only included three factors: shift work, poor sleep quality, and female gender, and other influencing factors such as alcohol consumption, lack

**Fig. 1** Flow diagram of the study selection process



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Records identified through database
searching(n=1049):PubMed ( n=429 ) 、 the
Cochrane Library (n=128) 、Web of Science
( n=278 ) 、 EBSCOhost ( n=204 ) 、
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Records after duplicates
removed (n=574)
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Records screened for title
and abstract
(n=574)
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Records excluded(n=520)
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Full-text articles assessed
for eligibility (n=54)
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Full-text articles excluded, with
reasons (n=43):

Summary, comment (n=26)
Unqualified quality evaluation(n=8)
Does not meet the inclusion criteria
(n=9)
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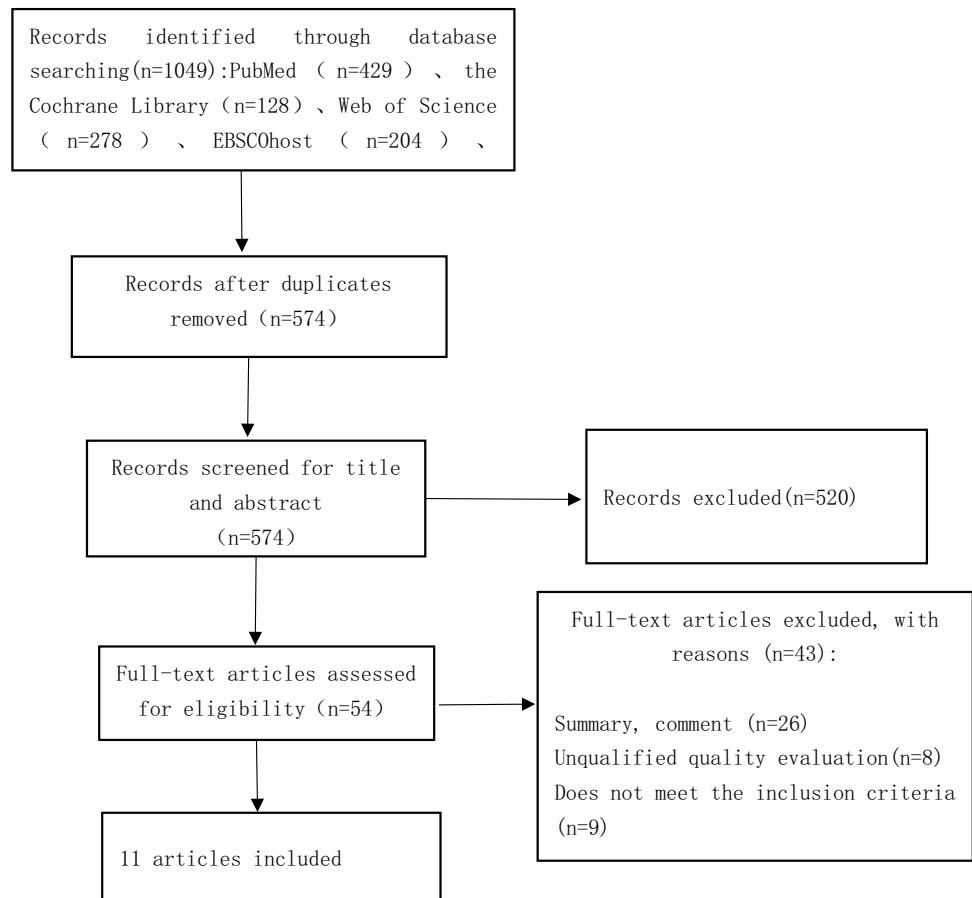
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11 articles included
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**Table 1** Characteristics of the included studies

| First Author | Year | Country | Research object | Sample size | Diagnostic criteria | Evaluation Tools | Number of patients | Prevalence | Influencing factors |
|---|---|---|---|---|---|---|---|---|---|
| Liang [13] | 2014 | China | Nurses | 340 | Rome III | Rome III Questionnaire, IBS-SSS, SCL-90-R, IBS-QOL | 59 | 17.40% | ①②③ |
| Hui-Qing [9] | 2017 | China | Nurses | 402 | Rome III | Nurses' IBS questionnaire、PSQI | 80 | 19.90% | ④⑤ |
| Hye [15] | 2013 | Korea | Nurses and nurse assistants | 207 | Rome III | K-BDQ、PSQI、BEPSI | 58 | 28% | ④ ⑤ |
| Borko [16] | 2010 | USA | Nurses | 399 | Rome III | Rome III Questionnaire、IBS-QOL、Modified Sleep-50 questionnaire | 146 | 36.59% | ⑤ |
| Soo-Kyung [10] | 2017 | Korea | Doctors (interns, residents, and fellows) | 170 | Rome III | BDQ-K、PSQI、Rome III Psychosocial Alarm Questionnaire | 28 | 16.50% | ③④ |
| Nahla [12] | 2016 | Saudi Arabia | Nurses | 229 | Rome III | IBS-SSS、HADS、PSQI | 33 | 14.40% | ③④⑥⑦⑧ |
| Ozge [11] | 2016 | Turkey | Physicians and nurses | 325 | Rome III | IBS related questionnaire(Diagnosis of IBS, family history, past history, etc.) | 44 | 13.50% | ⑨ |
| Seong-Joon [14] | 2014 | Korea | Nurses and nurse assistants | 301 | Rome III | PSQI、Rome III Psychosocial Alarm Questionnaire | 45 | 15% | ③⑤ |
| Roa'a [7] | 2019 | Jordan | Resident doctors | 201 | Rome III? | PSQI、PHQ-4 | 26 | 13% | ③ |
| Pisani [6] | 2021 | Malta | Medical students and junior doctors | 192 | Rome IV | K6、 Godin Leisure-Time Exercise Questionnaire、VSI | 34 | 17.70% | ⑨ |
| Turki [8] | 2019 | Saudi Arabia | Physicians | 594 | Rome IV | Rome IV Questionnaire | 97 | 16.30% | ⑨⑩⑪ |

①alcohol consumption;②lack of exercise;③psychological problems;④poor sleep quality;⑤shift work;⑥family history of IBS;⑦outpatient work; ⑧food allergies;⑨gender;

⑩age; ⑪ work long hours

*SCL-90-R*: Revised symptom checklist 90 questionnaire, IBS-SSS: IBS Severity Scoring System, *IBS-QOL*: Irritable bowel syndrome quality of life questionnaire, *HADS*: Hospital Anxiety and Depression Scale, *PSQI*: Pittsburgh Sleep Quality Index, *K-BDQ*: Korean version of bowel disease questionnaires, *BEPSI*: The Modified Brief Encounter Psychosocial Instrument, *PHQ-4*: The four-item patient health questionnaire for anxiety and depression, *K6*: The Kessler Psychological Distress Scale, *VSI*: The Visceral Sensitivity Index

of exercise, mental and psychological problems, family history of IBS, food allergies, etc., were not included due to difficulties in extracting data. Table 1 shows the basic information of the included literature. After quality evaluation, the scores of the included 11 studies were all between 12 and 14, and the risk of bias was low, which met the quality evaluation requirements of this study.

## Meta-Analysis Results

### Prevalence

All 11 articles were initially included in the meta-analysis of the prevalence of IBS among medical staff. The combined prevalence was 19% [95%CI (0.15~0.23)]. However, the heterogeneity test results showed that $I^2 = 88\%$ and $P < 0.001$, which represents a strong heterogeneity. Therefore, we conducted a sensitivity analysis to explore

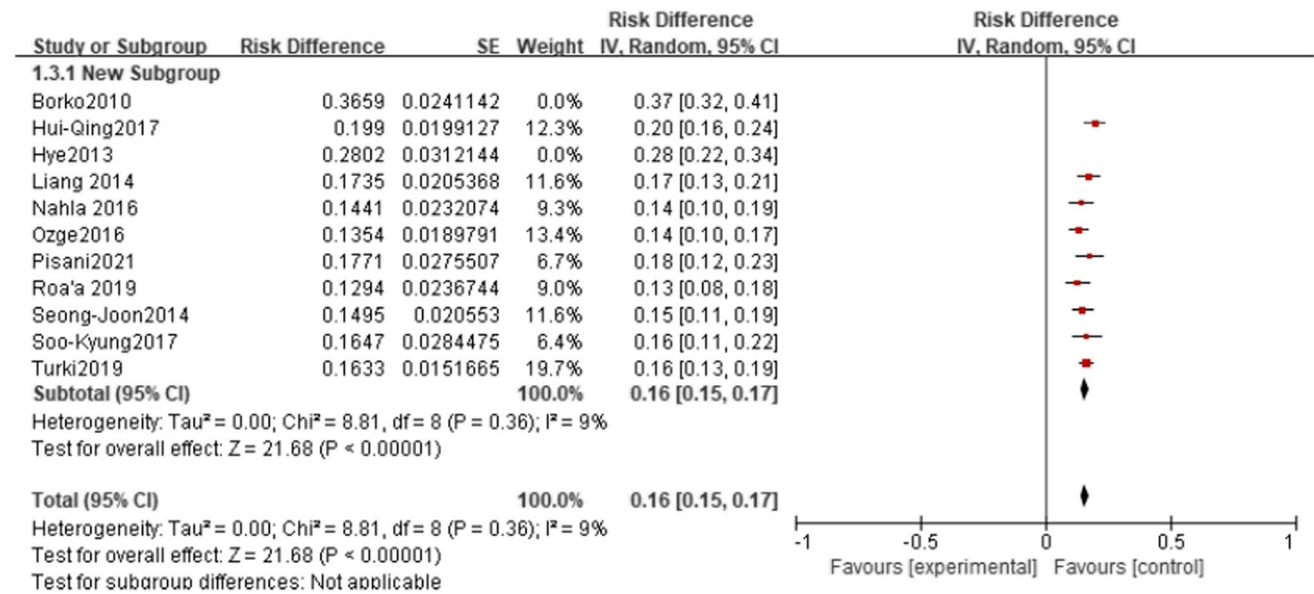**Fig. 2** Results of sensitivity analysis for 11 studies
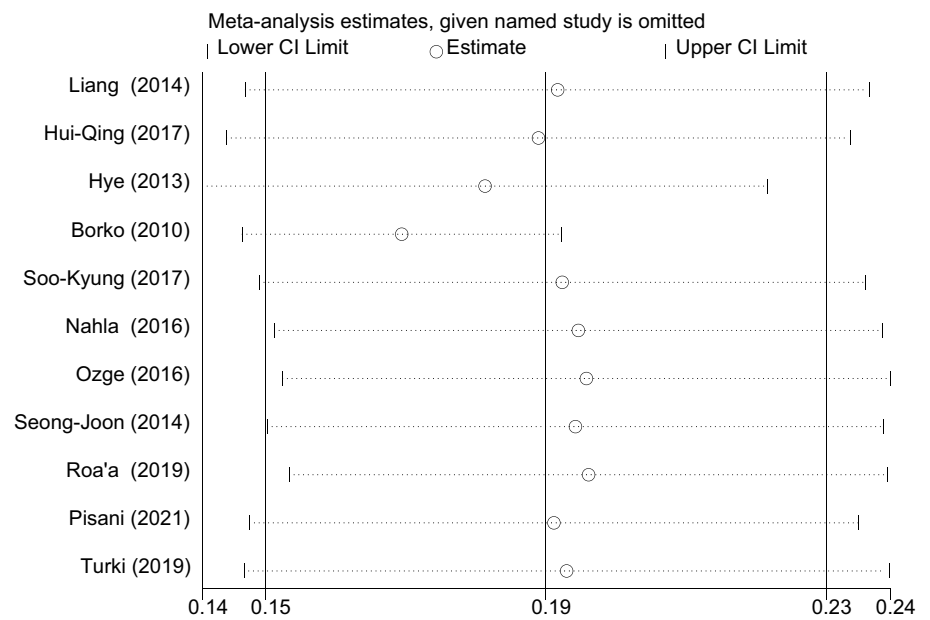


**Fig. 3** Forest plot of the prevalence of IBS among medical staff



the impact of a single study on the combined results. As shown in Fig. 2, two of the 11 studies [15, 16] have a greater impact on the combined results, which may be the source of this heterogeneity. After removing these two studies and reanalyzing, the heterogeneity test results show that $I^2 = 9\%$ and P = 0.36, indicating that the heterogeneity disappeared. The final meta-analysis of the prevalence of IBS among medical staff included nine studies [6–14], and

**(a)**

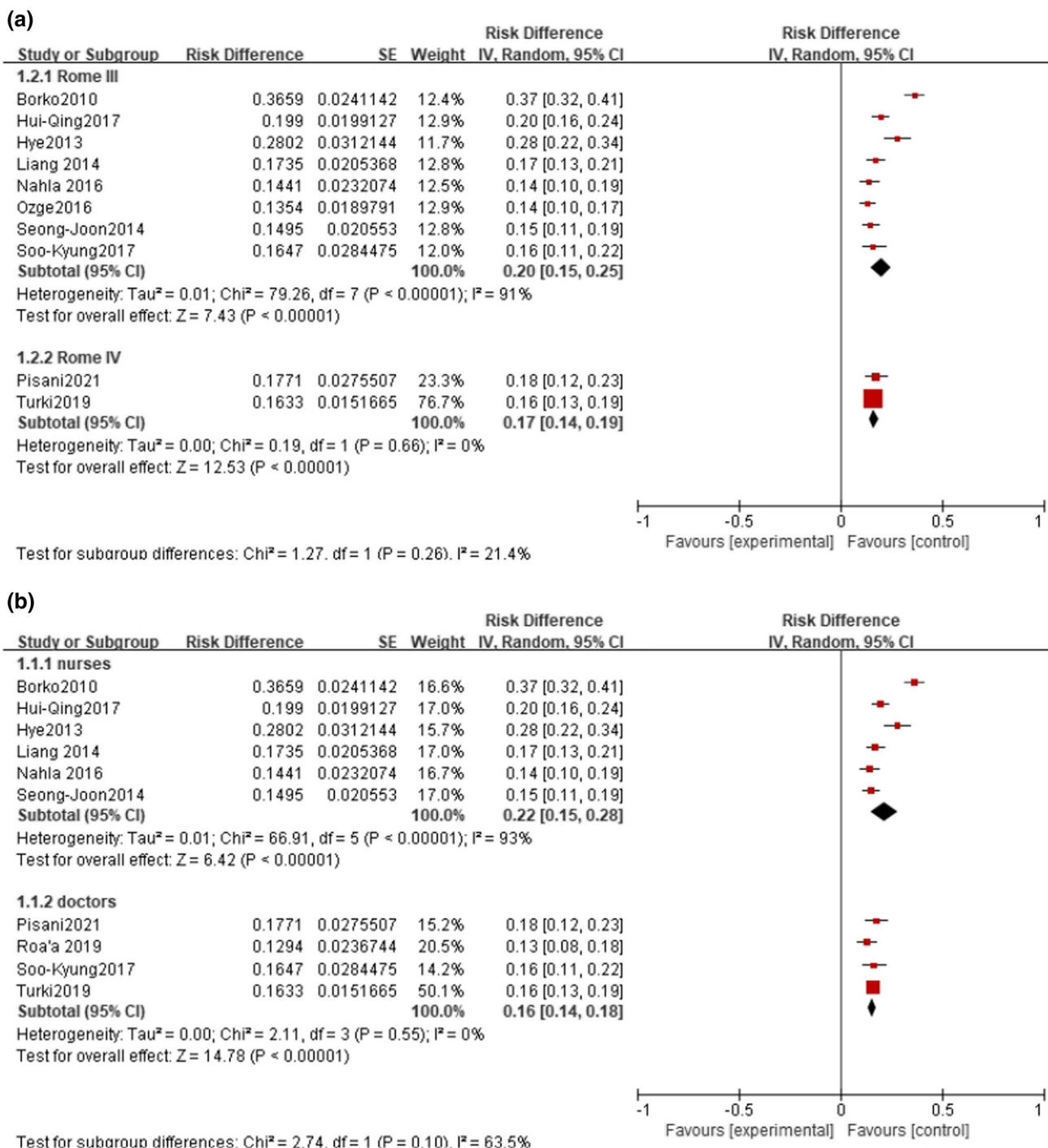| Study or Subgroup | Risk Difference | SE | Weight | Risk Difference IV, Random, 95% CI |
|---|---|---|---|---|
| **1.2.1 Rome III** | | | | |
| Borko2010 | 0.3659 | 0.0241142 | 12.4% | 0.37 [0.32, 0.41] |
| Hui-Qing2017 | 0.199 | 0.0199127 | 12.9% | 0.20 [0.16, 0.24] |
| Hye2013 | 0.2802 | 0.0312144 | 11.7% | 0.28 [0.22, 0.34] |
| Liang 2014 | 0.1735 | 0.0205368 | 12.8% | 0.17 [0.13, 0.21] |
| Nahla 2016 | 0.1441 | 0.0232074 | 12.5% | 0.14 [0.10, 0.19] |
| Ozge2016 | 0.1354 | 0.0189791 | 12.9% | 0.14 [0.10, 0.17] |
| Seong-Joon2014 | 0.1495 | 0.020553 | 12.8% | 0.15 [0.11, 0.19] |
| Soo-Kyung2017 | 0.1647 | 0.0284475 | 12.0% | 0.16 [0.11, 0.22] |
| **Subtotal (95% CI)** | | | 100.0% | 0.20 [0.15, 0.25] |

Heterogeneity: Tau² = 0.01; Chi² = 79.26, df = 7 (P < 0.00001); I² = 91%
Test for overall effect: Z = 7.43 (P < 0.00001)

| Study or Subgroup | Risk Difference | SE | Weight | Risk Difference IV, Random, 95% CI |
|---|---|---|---|---|
| **1.2.2 Rome IV** | | | | |
| Pisani2021 | 0.1771 | 0.0275507 | 23.3% | 0.18 [0.12, 0.23] |
| Turki2019 | 0.1633 | 0.0151665 | 76.7% | 0.16 [0.13, 0.19] |
| **Subtotal (95% CI)** | | | 100.0% | 0.17 [0.14, 0.19] |

Heterogeneity: Tau² = 0.00; Chi² = 0.19, df = 1 (P = 0.66); I² = 0%
Test for overall effect: Z = 12.53 (P < 0.00001)

Favours [experimental]  Favours [control]

Test for subgroup differences: Chi² = 1.27, df = 1 (P = 0.26), I² = 21.4%

**(b)**

| Study or Subgroup | Risk Difference | SE | Weight | Risk Difference IV, Random, 95% CI |
|---|---|---|---|---|
| **1.1.1 nurses** | | | | |
| Borko2010 | 0.3659 | 0.0241142 | 16.6% | 0.37 [0.32, 0.41] |
| Hui-Qing2017 | 0.199 | 0.0199127 | 17.0% | 0.20 [0.16, 0.24] |
| Hye2013 | 0.2802 | 0.0312144 | 15.7% | 0.28 [0.22, 0.34] |
| Liang 2014 | 0.1735 | 0.0205368 | 17.0% | 0.17 [0.13, 0.21] |
| Nahla 2016 | 0.1441 | 0.0232074 | 16.7% | 0.14 [0.10, 0.19] |
| Seong-Joon2014 | 0.1495 | 0.020553 | 17.0% | 0.15 [0.11, 0.19] |
| **Subtotal (95% CI)** | | | 100.0% | 0.22 [0.15, 0.28] |

Heterogeneity: Tau² = 0.01; Chi² = 66.91, df = 5 (P < 0.00001); I² = 93%
Test for overall effect: Z = 6.42 (P < 0.00001)

| Study or Subgroup | Risk Difference | SE | Weight | Risk Difference IV, Random, 95% CI |
|---|---|---|---|---|
| **1.1.2 doctors** | | | | |
| Pisani2021 | 0.1771 | 0.0275507 | 15.2% | 0.18 [0.12, 0.23] |
| Roa'a 2019 | 0.1294 | 0.0236744 | 20.5% | 0.13 [0.08, 0.18] |
| Soo-Kyung2017 | 0.1647 | 0.0284475 | 14.2% | 0.16 [0.11, 0.22] |
| Turki2019 | 0.1633 | 0.0151665 | 50.1% | 0.16 [0.13, 0.19] |
| **Subtotal (95% CI)** | | | 100.0% | 0.16 [0.14, 0.18] |

Heterogeneity: Tau² = 0.00; Chi² = 2.11, df = 3 (P = 0.55); I² = 0%
Test for overall effect: Z = 14.78 (P < 0.00001)

Favours [experimental]  Favours [control]

Test for subgroup differences: Chi² = 2.74, df = 1 (P = 0.10), I² = 63.5%

**Fig.4** **a** Forest plot for sub-group analysis according to diagnostic criteria. **b** Forest plot for sub-group analysis according to occupation type

the prevalence of IBS among medical staff was approximately16% [95%CI (0.15~0.17)]. Figure 3 shows a meta-analysis forest diagram of the prevalence of IBS among medical staff.

In order to find the source of heterogeneity, we then performed a sub-group analysis of the included literature according to diagnostic criteria and occupation types (Fig. 4). 8 and 2 studies, respectively, used Rome III and Rome IV diagnostic criteria, we used a random-effects model to conduct a sub-group analysis. As a result, the prevalence of IBS among medical staff diagnosed in Rome
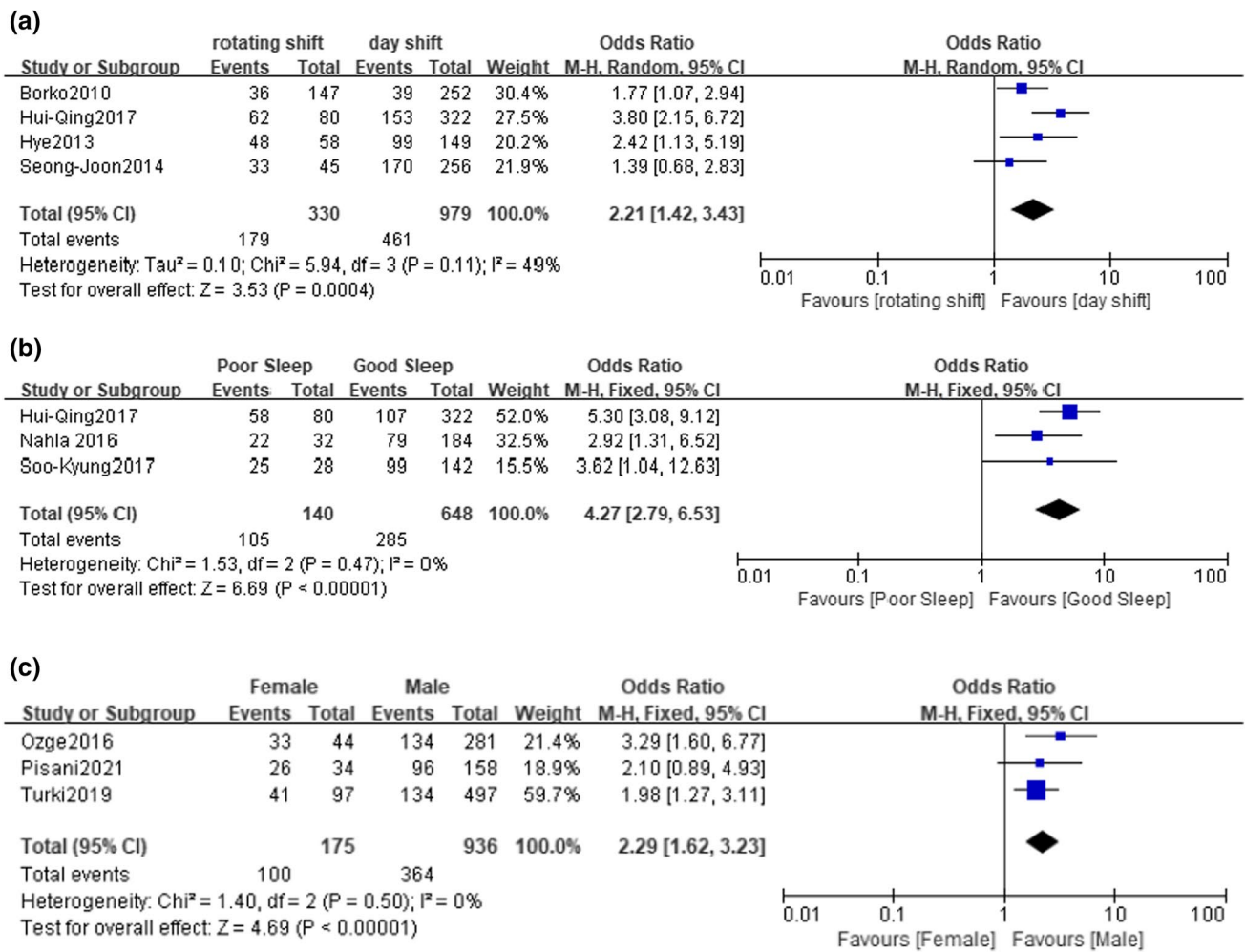
**(a)**



**(b)**



**(c)**



**Fig.5** **a** Forest plot of influencing factor of shift work. **b** Forest plot of influencing factor of sleep quality. **c** Forest plot of influencing factor of gender

III is 20% [95%CI ( 0.15 ~ 0.25)], and Rome IV is 17% [95%CI (0.14 ~ 0.19)].

Due to insufficient literature, we only roughly divided medical staff into two groups and did not stratify according to the different positions of doctors or the position types under different diagnostic criteria. 6 and 4 studies, respectively, reported the prevalence of IBS among nurses and doctors. The results showed that doctors' prevalence rate is 16% [95%CI (0.14 ~ 0.18)], whereas the prevalence of nurses is higher at 22% [95%CI (0.15 ~ 0.28)].

## Influencing Factors

Due to different evaluation tools and difficulties in data extraction, we only included shift work, poor sleep quality, and female gender into the meta-analysis of the influencing factors of IBS among medical staff. The meta-analysis forest diagram of each influencing factor is shown in Fig. 5.

Four studies [9, 14–16] reported the impact of shift work on IBS in medical staff. There was slight heterogeneity among the studies ($I^2 = 49.4\%$, P = 0.115). Therefore, the random-effects model was used for meta-analysis, and

**Table 2** Sensitivity analysis results of influencing factors

| Influencing factors | Random-effects model | | Fixed-effect model | |
|---|---|---|---|---|
| | OR [95%CI] | P | OR [95%CI] | P |
| Shift work | 2.209[1.423, 3.429] | <0.001 | 2.266[1.674, 3.067] | <0.001 |
| Sleep quality | 4.299[2.816, 6.563] | <0.001 | 4.266[2.789, 6.526] | <0.001 |
| Gender | 2.253[1.590, 3.190] | <0.001 | 2.285[1.617, 3.229] | <0.001 |

the results showed that: compared with non-shift medical staff, the prevalence of IBS was higher for shift medical staff, and the difference was statistically significant [OR 2.21, 95%CI (1.42, 3.43), P < 0.001].

After evaluating the sleep quality of medical staff using the Pittsburgh Sleep Quality Questionnaire, three studies [9, 10, 12] reported the impact of poor sleep quality on IBS in medical staff. There was no heterogeneity among the studies ($I^2 = 0.0\%$, P = 0.466), so the fixed-effect model was used for meta-analysis. The results indicate that medical staff with poor sleep quality have a higher IBS prevalence than medical staff with good sleep quality, and the difference is statistically significant [OR 4.27, 95%CI (2.79, 6.53), P < 0.001].

Three studies [6, 8, 11] reported the impact of female gender on IBS in medical staff. There was no heterogeneity among the studies ($I^2 = 0.0\%$, P = 0.496). Therefore, a fixed-effect model was used for meta-analysis. The results showed that compared with male medical staff, female medical staff have a statistically significantly higher prevalence of IBS [OR 2.29, 95% CI (1.62, 3.23), P < 0.001].

### Sensitivity Analysis

The included influencing factors were analyzed by a fixed-effects model and random-effects model, respectively, and the difference of the combined effect size was compared to determine the stability and reliability of the results. The outcomes show that the meta-analysis of shift work, poor sleep quality, and female gender are consistent, indicating stable results (Table 2).

### Publication Bias

Egger's test was used to test the publication bias of prevalence and influencing factors. The results all showed that P > 0.05, indicating that there is no obvious publication bias in the included literature.

## Discussion

We assessed 11 studies from seven countries and found that the prevalence of IBS in the medical staff population was about 16%, and the prevalence of nurses was higher than that of doctors. The influencing factors are shift work, poor sleep quality, and female gender.

The 11 studies included in our meta-analysis used Rome III and Rome IV diagnostic criteria, respectively. Studies have shown that the prevalence of IBS diagnosed in Rome IV is slightly lower than Rome III [20], and our sub-group analysis result also confirm this. In fact, the prevalence rate may be higher than 16%, because we eliminated two articles with higher prevalence due to high heterogeneity when

analyzing the data. There may be two reasons for the high heterogeneity of the two studies. First, it may be related to diagnostic criteria, as both studies used Rome III diagnostic criteria. According to the results of our sub-group analysis, the diagnosis rate of Rome III was higher than Rome IV, consistent with the Rome IV criteria being more stringent. Second, the subjects of these two studies are nurses, and compared with other included literature, the study subjects of these two studies accounted for a larger proportion of female. According to our analysis, nurses and female are both high-risk groups for IBS. Therefore, we believe that the choice of diagnostic criteria and samples may lead to a higher prevalence and thus higher heterogeneity.

The result of our meta-analysis of the prevalence of IBS among medical staff is 16%. However, the latest results of a large global sample study show that the global IBS prevalence rates under Rome III and Rome IV diagnostic criteria are 3.5%-10.1% and 1.5%-4.1%, respectively [20]. According to the results of our sub-group analysis, the prevalence rates of medical staff diagnosed in Rome III and Rome IV were 20% and 17%, respectively. Thus, no matter which diagnostic standard is used, the prevalence of IBS among medical staff is higher than the global general population, warranting greater attention, and intervention.

In this meta-analysis, there are three influencing factors for medical staff suffering from IBS: shift work, poor sleep quality, and female gender. Shift work generally refers to the work pattern that completes the planned work outside of the traditional day shift and does not follow the sleep pattern at night [21]. Shift work impacts the occurrence and development of many diseases. Data from South Korea show that compared with pure day shift, the prevalence of periodontal disease is higher for shift workers [22]. Another study found that shift work, especially at night, has a certain impact on employees' systolic blood pressure and Hb1Ac levels [23]. A study from Iran showed that among shift nurses, the incidence of psychological problems and gastrointestinal symptoms is higher [24]. Four studies in our analysis showed that the prevalence of IBS among medical staff on night shifts and shift work was higher than that of pure day shifts, and the incidence of abdominal pain among shift nurses was significantly higher than that of day shifts and night shifts (81%, 54%, and 61%, respectively) [16]. Circadian rhythm disorders may be related to the pathogenesis of IBS and abdominal pain. Studies have shown that, compared with nurses on mandatory shifts, nurses on voluntary shifts have higher rates of job satisfaction and receive fewer complaints [24]. If the hospital can pay attention to the reasonable needs related to the scheduling of medical staff and explore a more flexible scheduling model, it will not only help reduce the prevalence of IBS, but also improve the job satisfaction of medical staff, thereby increasing the satisfaction of patients

with medical care and improve the hospital's income [25, 26].

Poor sleep quality is also an important factor affecting medical staff suffering from IBS. Good sleep quality is vital to physical and mental health. Insufficient sleep and decreased sleep quality can become serious stress factors and cause emotional, cognitive, and physical problems [27]. A study from Shanghai, China have shown that lack of sleep is independently associated with IBS [28]. A previous study reported that sleep disorders affect the gastrointestinal symptoms of FGIDs subjects, a relationship that persists even when psychological distress and stress are controlled [29]. Three articles in this study [9, 10, 12] showed that poor sleep quality is an important factor in the onset of IBS among medical staff. However, the path through which sleep quality affects medical staff suffering from IBS requires further research. Studies have shown that aerobic exercise and appoint massage can improve sleep disorders [30, 31], hospital unions can organize these activities to improve the sleep conditions of employees.

Research indicates that women are more likely to suffer from IBS than men [20, 32]. In the United States, Canada, and Israel, the incidence of IBS symptoms in women is 1.5–2 times that of men, and the incidence may be higher in Asia [33]. The Rome Foundation has done a systematic review of 83 studies involving 41 countries and found that the prevalence of women is higher than that of men (10.2% vs 8.8%), and in each region, the prevalence of women is also higher than men [34]. The latest research shows that under the Rome III diagnostic criteria, the prevalence of female IBS is 4.1–12.6%, which is higher than that of males (3.0%-7.8%). When the diagnostic criteria were changed to Rome IV, the prevalence of women was still higher than that of men (2.0–5.2% vs 1.0–2.9%) [20]. Among medical staff, women also have a higher prevalence rate of IBS than men. Studies have shown that under the Rome III diagnostic criteria, the prevalence of IBS among female medical staff is 19.7%, which is higher than the 6.7% of males [11]. Under the Rome IV diagnostic criteria, the prevalence of female medical staff is still higher than that of males (21.3% vs 11.4%) [6]. From the above data, we can see that, first, the prevalence of IBS in women is higher than that of men in both the general population and the medical staff. This may be explained from a physiological perspective because studies have shown that female-specific sex hormones influence the symptoms of IBS [32, 35, 36]. Second, the prevalence of female medical staff seems to be higher than that of the general female. Women account for a larger proportion of medical staff, particularly nurses, and they often face high-intensity work, night shifts, and other stressful conditions, many clinical female workers report insomnia and poor sleep quality, psychological stress, and sleep quality

have been reported to be associated with IBS [10, 37]. This has given us some inspiration that it may be possible to improve the IBS symptoms of female medical staff from the perspective of reducing psychological pressure and improving sleep conditions.

Our meta-analysis does have some limitations. The studies we included are all cross-sectional surveys, with weak evidence levels. Due to the limitation of data extraction, we only combined and analyzed the three influencing factors of shift work, poor sleep quality, and female gender, other influencing factors such as alcohol consumption, lack of exercise, psychosocial problems, etc., cannot be include in our meta-analysis due to different evaluation tools. However, these influencing factors are also very important, in future, more studies may need to be included for systematic evaluation and to prove that they also have an important impact on IBS among medical staff. We have included the influencing factor of shift work, but because the included literature comes from different countries and regions, and the specific time allocation of shifts is not clearly given, we integrated the included literature and defined "shift work" as the work pattern that completes the planned work outside of the traditional day shift and affects night sleep or violates the circadian rhythm. In addition, due to insufficient literature, we were not able to conduct a sub-group analysis of the prevalence of more occupational types, therefore, the results of this study are not applicable to all types of medical staff, and more studies are needed in future to enrich our research results.

In conclusion, our meta-analysis summarized 11 studies from seven countries and found that the prevalence of IBS among medical staff is approximately 16%, and the prevalence of nurses is higher than that of doctors (22%, 16%). Shift work, poor sleep quality, and female gender are the influencing factors of IBS among medical staff. We hope that our systematic review can bring some theoretical help to hospital human resource management. Managers can refer to the results of our systematic review to provide targeted interventions from the perspective of improving the shift work mode, promoting the sleep quality of medical staff, and paying more attention to female employees.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to declare.

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