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Effectiveness of Acupressure on Sleep Quality Among Inpatients: A Systematic Review and Meta-Analysis

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ABSTRACT

Sleep quality in adult inpatients is frequently and severely disturbed by various factors such as noise, pain, and unfamiliar surroundings, which can impair disease recovery. Acupressure is widely used to improve sleep quality in hospitalized patients, but its overall effectiveness is unclear. This meta-analysis aims to analyze the efficacy of acupressure therapy on sleep quality and sleep parameters in adult inpatients. Eight electronic databases were searched for randomized controlled trials published before April 2024. Two researchers independently screened, assessed, and extracted data from the included studies. A total of 41 studies involving 3680 subjects were included. The meta-analysis showed a significant difference between the acupressure and control groups in sleep quality (SMD = −1.58, 95% CI [−1.85, −1.31]), total sleep time (SMD = 1.12, 95% CI [0.40, 1.83]), sleep efficiency (SMD = 0.90, 95% CI [0.29, 1.52]), sleep onset latency (SMD = −0.73, 95% CI [−1.14, −0.33]), and wake after sleep onset (SMD = −1.32, 95% CI [−2.55, −0.09]). The meta-regression results suggested that the number of sessions daily and the duration of each session were significant factors influencing heterogeneity. Acupressure is an effective intervention to improve sleep quality and sleep parameters in inpatients.

1 | Introduction

Approximately 71 million patients are hospitalized worldwide annually (Moses et al. 2019), and up to 95.1% of inpatients report poor sleep quality (Bellon et al. 2022; D'souza et al. 2019; Kulpatcharapong et al. 2020). Sleep quality is described as an individual's self-satisfaction with sleep, which can be influenced by physical, psychological, environmental, family, and social factors (Nelson et al. 2022). Evidence suggests that pain, discomfort, environmental noise, bright lights, irregular light exposure, and disrupted circadian rhythms are the most common causes of poor sleep quality among inpatients in clinical settings (Morse and Bender 2019).

Poor sleep quality during hospitalization can lead to adverse clinical outcomes, including increased in-hospital mortality, incidence of acute cerebrovascular accidents, and perioperative risk (Cheisson et al. 2018; Vedantam et al. 2022). It is also associated with immune system dysregulation, inflammatory responses, and worsened disease progression (Garbarino et al. 2021). The health effects of poor sleep quality may not only delay disease recovery and prolong hospitalization but also increase hospitalization costs (Hendy et al. 2012; Nerbass and Peruchi 2015; Vin-Raviv et al. 2018). The American Academy of Sleep Medicine has emphasized the urgent need for better sleep health in hospitals (Ramar et al. 2021). Therefore, healthcare professionals should actively consider

Summary

- While poor sleep quality is common among inpatients and seriously affects their recovery, there is a lack of comprehensive evidence about the effect of acupressure therapy on sleep quality in adult-hospitalized patients.
- Acupressure effectively improves sleep quality and sleep parameters in adult-hospitalized patients.
- More rigorously designed randomized controlled trials, including a wide range of disease types and regional participants, are needed to validate the findings and develop optimal acupressure protocols.

implementing effective interventions to improve sleep quality in hospitalized patients.

To improve sleep quality in hospitalized patients, pharmacological treatments such as sedative analogues (e.g., benzodiazepines) and melatonin are commonly used in clinical practice, particularly during the acute phase of hospitalization (Hillman 2021; Kanji et al. 2016; White et al. 2023). However, these treatments may cause side effects, such as fatigue, dizziness, low blood pressure, cognitive impairment, and confusion, and could even increase the risk of in-hospital falls (Foley and Steel 2019; Herzig et al. 2021; White et al. 2023). Considering the aforementioned side effects, evidence-based, safe, and non-invasive non-pharmacological interventions are recommended as first-line strategies to address poor sleep quality in hospitalized patients (Cho et al. 2022; White et al. 2023).

Acupressure is a type of non-pharmacological intervention rooted in traditional Chinese medicine (TCM) (Jun et al. 2021), which uses fingers, knuckles, or blunt instruments to apply pressure at specific points on the body for therapeutic purposes (C.-H. Lin, Lin, et al. 2021). Meta-analyses have reported the effectiveness of acupressure in improving sleep quality in diverse populations (Lu et al. 2022; Waits et al. 2018; Wang et al. 2020). Given its simplicity and safety, patients can self-administer acupressure, potentially reducing the costs and adverse effects associated with medication (Dincer et al. 2022; Xie et al. 2023).

According to TCM, the human body is connected by meridians that link the organs, limbs, head, and body surface into a whole. These meridians serve as channels for the flow of Qi and form connections between acupoints (Lozano 2014; Matos et al. 2021). Qi is responsible for propelling blood, nourishing the body, and providing energy to internal organs and other tissues, while acupoints are used for unblocking the meridians (Wang et al. 2024). From the TCM perspective, sleep quality is primarily associated with Wei Qi (a type of Qi) and two organs (the heart and liver). The heart controls consciousness and manages the activities of the higher nervous system; Wei Qi regulates circadian rhythms and sleep–wake cycles; and the liver mobilizes and manages the circulation of Wei Qi through the body (Li et al. 2023; Wang et al. 2023; Yang and Song 2023). When there is difficulty in mobilizing and transferring Wei Qi through the body, the result is poor sleep quality (Li et al. 2023). In such situations, acupressure, as a form of acupoint palpation, can effectively regulate disturbances in the meridian system and is a core element of nursing practice (Li et al. 2024; Lindquist et al. 2022). From the perspective of biomedical mechanisms, acupressure can activate the small myelinated nerves in the muscles; transmit stimulation to higher nerve centers, including the spinal cord, midbrain, hypothalamus, and pituitary axis; release β-endorphin and serum 5-hydroxytryptamine; and improve sleep quality (Guo et al. 2024; Hutsalenko et al. 2022; S.-N. Lee, Kim, et al. 2021). Meanwhile, acupressure can also be beneficial in addressing the factors associated with poor sleep quality, such as pain and inflammation (Yeh et al. 2023). In addition, a study showed a significant increase in serum melatonin in college students receiving 2 weeks of acupressure for primary insomnia (Chen et al. 2022), which may reflect endogenous melatonin secretion (Ohki et al. 2022).

While a meta-analysis has validated the effectiveness of acupressure in improving sleep, its impact on hospitalized patients has not been specifically examined (Waits et al. 2018). Two previous reviews have included acupressure as a nursing intervention to improve sleep quality in hospitalized patients (Ashghab et al. 2024; Bellon et al. 2021). However, acupressure, as a safe and accessible symptom management approach, can be administered by both professionals and patients themselves (Hsieh et al. 2021; Jiang-Siebert et al. 2025). This may lead to the potential evidence for acupressure being overlooked. Additionally, Beswick et al. investigated the effects of non-pharmacological sleep interventions on improving sleep in hospitalized patients but failed to report the effectiveness of acupressure in improving sleep quality in inpatients (Beswick et al. 2023). Available reviews on the effect of acupressure on sleep quality in inpatients are limited. Therefore, a systematic review that aims to explore the effectiveness of acupressure on sleep quality in adult inpatients is required.

2 | Aim

This study aimed to evaluate the effectiveness of acupressure on sleep quality and sleep parameters in inpatients.

3 | Methods

3.1 | Design

The protocol for this systematic review and meta-analysis has been registered with PROSPERO under the reference number BLINDED. This systematic review and meta-analysis was conducted according to the PRISMA 2020 statement (Page et al. 2021).

3.2 | Search Methods

Eight databases, namely PubMed, Embase, Cochrane Library, Web of Science, PsycINFO, CINAHL, CNKI, and Wanfang, were comprehensively searched for relevant studies from their inception through April 15, 2024. Search strategies were adopted using selected keywords and MeSH terms related to inpatients, acupressure, and sleep quality. The full search strategy can be found in the Supporting Information: Appendix A.

Two reviewers (L.W.H. and Y.C.X.) independently screened the titles and abstracts and then independently conducted a full-text evaluation based on the eligibility criteria. Any disagreement between the two reviewers was resolved by consulting a third reviewer (L.J.J.).

3.3 | Inclusion and/or Exclusion Criteria

Studies were eligible for inclusion if they met the following Population, Intervention, Comparison, Outcome, and Study design (PICOS) criteria: (1) Population: studies involving adult inpatients (aged 18 years or older) in hospital settings; (2) Intervention: the intervention group used a standardized acupressure protocol (targeting the same acupoints) during hospitalization; (3) Comparison: usual care, standard care, patient education, no treatment, placebo (receiving acupressure at false points or taping without pressure), or medication (benzodiazepine); (4) Outcome: sleep quality was measured using any valid measurement scale; and (5) Design: randomized controlled trials (RCTs).

Studies were excluded if (1) the participants were in nursing homes, community service centers, postpartum care centers, or long-term care facilities; (2) acupressure was combined with other TCMs, such as acupuncture and herbal patches; (3) only the rates of sleep quality improvement were reported; (4) sleep quality was not assessed at baseline; or (5) the full text was not available in English or Chinese.

3.4 | Search Outcome

A total of 6369 studies were found through database searches, with no additional studies identified via other sources. Of these, 2077 duplicate publications were excluded, and a further 4251 studies were excluded for failing to meet the inclusion criteria. Finally, 41 studies were included in this systematic review and meta-analysis. The detailed study selection process is presented in Figure 1.

3.5 | Quality Appraisal

The risk of bias for each study was assessed independently by two reviewers (L.W.H. and Y.C.X.), and any disagreements were resolved by consulting the third reviewer (L.J.J.). The Cochrane Risk of Bias Tool version 2.0 was used to evaluate the methodological quality of the included articles, based on the following five main risk of bias domains: the randomization

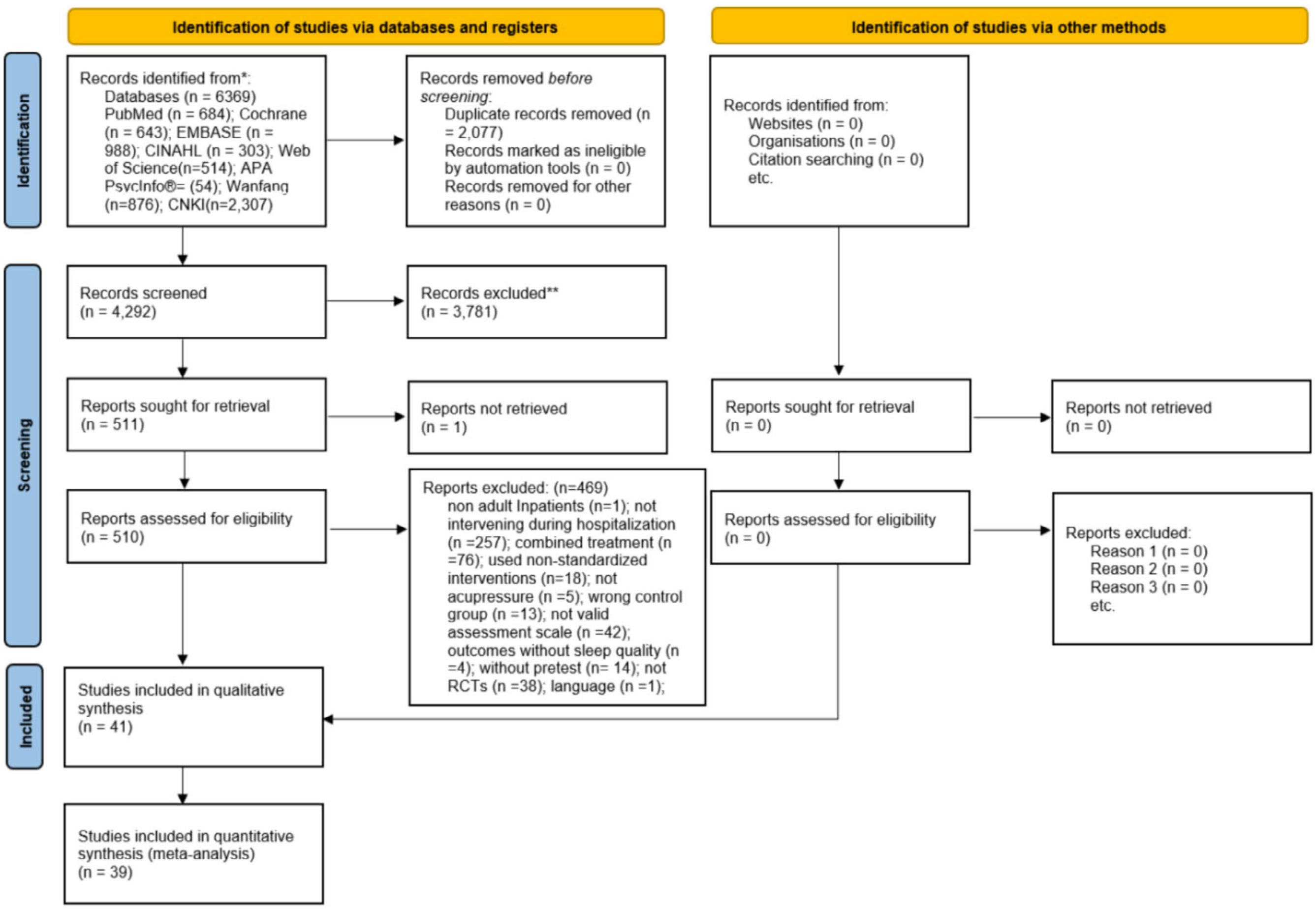

FIGURE 1 | PRISMA flow diagram.

process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported results. Studies were considered to have a high or low risk of bias or some concern of bias if the ROB2 tool assessed the overall risk of bias as high, low, or some concern (Higgins et al. 2023). The GRADE methodology was used to assess the certainty of the body of evidence, which was designated as high, medium, low, and very low based on the outcomes (Schünemann et al. 2020).

3.6 | Data Abstraction

Two reviewers (L.W.H. and Y.C.X.) independently screened the studies for inclusion based on the predetermined criteria and extracted and recorded the following data in a Microsoft Excel spreadsheet: study characteristics (e.g., region and sample size), participant characteristics (e.g., age and diagnosis), intervention details (e.g., acupressure duration and frequency), outcomes, results, and adverse events. The names of the acupoints and the alphanumeric codes were required to conform to the World Health Organization standard for the location of acupuncture points and China's national standards for the names of acupuncture points (National Technical Committee on Acupuncture 2008; World Health Organization 1993). Any discrepancies were resolved through discussion or consultation with the third reviewer (L.J.J.).

3.7 | Synthesis

For outcomes that were reported by sufficient studies, a meta-analysis was performed using Review Manager 5.4.1 and R 4.2.2 software to combine data. A narrative approach was used for studies that could not be quantitatively analyzed in the meta-analysis. The pooled standard mean difference (SMD) values with a 95% confidence interval (CI) were calculated using a random-effects model to summarize the sleep quality outcomes with different measures. A p value <0.05 was considered statistically significant. The I^2 statistic and Cochran's Q test were used to determine heterogeneity. The I^2 values with upper limits of 25%, 50%, and 75% were considered to indicate low, moderate, and high heterogeneity, respectively (Higgins et al. 2023). Moreover, for sleep quality, subgroup analysis was conducted to investigate the source of heterogeneity and the efficacy of acupressure with subgroups stratified by different settings of inpatients, types of acupoint, providers, simulation tools, and types of control groups, while subgroup analysis for sleep parameters was not conducted due to the limited number of studies.

Leave-one-out analysis was conducted for sensitivity analyses to evaluate the association of individual studies with the overall results of the meta-analyses. The publication bias was evaluated using funnel plots and Egger's test, with $p<0.05$ considered statistically significant. The trim-and-fill method was performed to adjust publication bias, which involves trimming studies that cause asymmetry in the funnel plot and filling imputed missing studies in the funnel plot to address the publication bias. Furthermore, univariate meta-regression was conducted to investigate the associations of sleep quality with the characteristics of participants (sample size and gender ratio), the number of acupoints used, the duration of each session, the number of sessions daily, and the duration of acupressure.

4 | Results

4.1 | Characteristics of the Included Studies

The details of the included studies are provided in Table 1 and Figure 2. The 41 studies involved a total of 3680 participants, and they were published from 2012 onwards. The sample sizes in the studies ranged from 34 to 422 participants. Among them, 36 studies were conducted in China, three in Iran, and one each in Korea and Taiwan. Thirty-five studies used a two-arm RCT design, while two studies used a three-arm parallel-group design (Bagheri-Nesami et al. 2015; Zhang et al. 2023), three used a four-arm parallel-group design (Fu et al. 2021; Qi et al. 2016; Sha et al. 2016), and one used a five-arm parallel-group design (Asgari et al. 2020). All participants in the included studies were over 18 years of age and were hospitalized. Their mean ages ranged from 28.10 to 71.13 years across the studies, and the percentages of females in the study samples ranged from 0% to 100%. All of the included studies assessed the effect of the intervention immediately after its completion (i.e., post-intervention). Only one study conducted two follow-up assessments and found a significant difference at the 2-month follow-up, but no significant difference at the 3-month follow-up (Yin et al. 2014).

4.1.1 | Setting

Most of the included studies ($n=36$) were conducted in general inpatient wards, except for five studies that were conducted in the intensive care unit (ICU) (Asgari et al. 2020; Bagheri-Nesami et al. 2015; Han et al. 2021; Li et al. 2019; Yang 2021), two of which were from the cardiac care unit (Asgari et al. 2020; Bagheri-Nesami et al. 2015).

4.1.2 | Intervention Characteristics

Nineteen studies did not report intervention providers (Asgari et al. 2020; Fu et al. 2021; Han et al. 2021; Han et al. 2019; Hou et al. 2017; Huang et al. 2014; Li et al. 2019; Lin 2023; Y. Liu, Chen, et al. 2021; Luo et al. 2016; Meng et al. 2017; Qi et al. 2016; Sha et al. 2016; Sun 2021; Wu et al. 2015; Xiao and Ye 2015; Yang 2021; Zhang et al. 2023; Zhu et al. 2020). In 10 and 9 studies, acupressure was administered by the participants themselves (i.e., self-administered) (Bang and Park 2020; Chen et al. 2021; J. Li, Jing, et al. 2021; Liang et al. 2021; Liu 2020; Liu et al. 2012; Ni et al. 2016; Wang 2023; Yao 2023; Ye et al. 2019) and by healthcare professionals, including nurses, acupuncturists, and trained professionals (Bagheri-Nesami et al. 2015; Chen et al. 2014; Liu et al. 2016; Lu et al. 2013; Salajegheh et al. 2024; Sun and Chen 2022;

TABLE 1 | Characteristics of the 41 included studies.

		Patients characteristics	Intervention (acupressure)								Outcomes (outcome measurement)		
First author, year, region	RCT design	Sample size, mean age (range or SD), % female, follow-up	Provider	Stimulation tools	Type of acupoint	No. of acupoints	Time of each acupoint	Frequency of treatment (daily)	Duration of treatment	Control	Primary outcome	Secondary outcome	Side effects
Asgari et al. 2020 Iran	Five-arm	CCU patients, 34, A: 56.4 ± 11.6, C: 57.6 ± 7.8, 0%, NA	NA	Wristbands	Somatic	1	NA	1	1 day	Usual care	Sleep quality (VAS)	NA	NA
Bagheri-Nesami et al. 2015 Iran	Three-arm	CCU patients, 60, A: 60.30 ± 11.7, C: 61.60 ± 10.52, 50%, NA	Acupuncturist	No stimulation material (by hand)	Auricular combined with somatic	5	2 min	1	3 days	Sham acupoints	Sleep quality (SMHSQ)	TST (SMHSQ)	NA
Bang and Park 2020 Korea	Two-arm	Patients with cardiac surgery, 42, A: 67.52 ± 11.85, C: 64.71 ± 12.43, 57%, NA	Self-administered	Semen vaccariae	Auricular	5	NA	4	12 days	Sham acupoints	Sleep quality (Korea Sleep Scale A)	NA	NA
Chen et al. 2014 China	Two-arm	Patients with depression, 54, A: 47.6 ± 4.5, C: 45.6 ± 3.8, 61%, NA	Nurse	Semen vaccariae	Auricular	9	NA	3–5	60 days	Usual care	Sleep quality (PSQI)	TST, SE, SOL (PSQI)	NA
Chen et al. 2021 China	Two-arm	Patients with uterine leiomyoma surgery, 60, A: 28.1 ± 2.5, C: 27.6 ± 2.3, 100%, NA	Self-administered	Semen vaccariae	Auricular	More or equal–5	NA	3–5	NA	Sleep education	Sleep quality (PSQI)	NA	NA
Fu et al. 2021 China	Four-arm	Patients with peritoneal hyperthermic perfusion chemotherapy after gastric cancer surgery, 60, A: 60.3 ± 12.6, C: 60.9 ± 9.9, 37%, NA	NA	Semen vaccariae	Auricular	More or equal–5	0.5 min	NA	NA	Usual care	Sleep quality (PSQI)	NA	NA

(Continues)

TABLE 1 | (Continued)

First author, year, region	RCT design	Patients characteristics	Intervention (acupressure)							Outcomes (outcome measurement)		
		Sample size, mean age (range or SD), % female, follow-up	Provider	Stimulation tools	Type of acupoint	No. of acupoints	Time of each acupoint	Frequency of treatment (daily)	Duration of treatment	Control	Primary outcome	Secondary outcome	Side effects
Han et al. 2019 China	Two-arm	Patients with pre-eclampsia, 90, A: 30.73 ± 5.94, C: 31.53 ± 5.38, 100%, NA	NA	No stimulation material (by hand)	Somatic	6	NA	3	NA	Sleep education	Sleep quality (PSQI)	NA	NA
Han et al. 2021 China	Two-arm	ICU patients, 68, A: 52.65 ± 2.48, C: 52.70 ± 2.51, 43%, NA	NA	Auricular: semen vaccariae; somatic: NA	Auricular combined with somatic	17	Auricular: NA; somatic: 5 min	Auricular: 3; somatic: NA	7 days	Sleep education	Sleep quality (PSQI)	NA	NA
Hou et al. 2017 China	Two-arm	Patients with stroke, 86, A: 65.02 ± 5.38, C: 64.26 ± 5.63, 43%, NA	NA	Semen vaccariae	Auricular	More or equal–4	NA	3	30 days	Sleep education	Sleep quality (PSQI)	NA	NA
Huang et al. 2014 China	Two-arm	Patients with insomnia, 60, A: 61.10 ± 5.36, C: 60.63 ± 5.94, 37%, NA	NA	No stimulation material (by hand)	Somatic	7	2 min	1	8 days	Sleep education	Sleep quality (PSQI)	NA	NA
Liang et al. 2021 China	Two-arm	Patients with arthroplasty, 70, A: 66.72 ± 7.24, C: 68.36 ± 6.85, 46%, NA	Self-administered	Semen vaccariae	Auricular	9	NA	3	7 days	Diazepam (2.5 mg)	Sleep quality (PSQI)	NA	NA
Li et al. 2019 China	Two-arm	ICU patients, 128, A: 56.21 ± 2.41, C: 51.25 ± 2.42, 43%, NA	NA	No stimulation material (by hand)	Somatic	3	NA	NA	NA	Usual care	Sleep quality (PSQI)	NA	NA
Li, Jiang, et al. 2021; Li, Song, et al. 2021 China	Two-arm	Patients with COVID-19, 62, A: 52.17 ± 11.22, C: 56.21 ± 12.01, 58%, NA	Self-administered	Semen vaccariae	Auricular	More or equal–7	NA	3–5	14 days	Usual care	Sleep quality (ISI)	NA	NA

(Continues)

TABLE 1 | (Continued)

		Patients characteristics	Intervention (acupressure)								Outcomes (outcome measurement)		
First author, year, region	RCT design	Sample size, mean age (range or SD), % female, follow-up	Provider	Stimulation tools	Type of acupoint	No. of acupoints	Time of each acupoint	Frequency of treatment (daily)	Duration of treatment	Control	Primary outcome	Secondary outcome	Side effects
Lin 2023 China	Two-arm	Patients with hypertension, 130, A: 60.28 ± 2.37, C: 60.32 ± 2.45, 43%, NA	NA	Semen vaccariae	Auricular	4	NA	4	10 days	Sleep education	Sleep quality (PSQI)	NA	NA
Liu 2020 China	Two-arm	Patients with lung cancer surgery, 60, A: 57.5 ± 2.5, C: 58.4 ± 3.2, 38%, NA	Self-administered	Semen vaccariae	Auricular	6	NA	3–5	NA	Usual care	Sleep quality (PSQI)	NA	NA
Liu et al. 2012 China	Two-arm	Patients with ERCP, 124, 29.5 (21–48), 45%, NA	Self-administered	No stimulation material (by hand)	Somatic	4	3 min	2	NA	Sleep education	Sleep quality (PSQI)	NA	NA
Liu et al. 2016 China	Two-arm	Patients with breast cancer surgery, 80, 47.03 (25–60), 100%, NA	Healthcare professionals	No stimulation material (by hand)	Somatic	10	5–30 s	2	7 days	Usual care	Sleep quality (AIS)	NA	NA
Liu, Tong, et al. 2021; Liu, Chen, et al. 2021 China	Two-arm	Patients with thyroid surgery, 122, A: 56.34 ± 4.41, C: 57.15 ± 4.47, 47%, NA	NA	No stimulation material (by hand)	Somatic	More or equal–8	NA	2	7 days	Sleep education	Sleep quality (PSQI)	NA	NA
Lu et al. 2013 Taiwan	Two-arm	Psychogeriatric inpatients, 60, 69.6 ± 9.01, 48%, NA	A Chinese medicine nursing specialist	No stimulation material (by hand)	Somatic	3	3 min	1	28 days	Usual care	Sleep quality (PSQI)	TST, SE, SOL, WASO (Actigraphy)	NA
Luo et al. 2016 China	Two-arm	Patients with depression, 59, A: 34.1 ± 15.9, C: 35.6 ± 16.5, 53%, NA	NA	Semen vaccariae	Auricular	4	NA	2	28 days	Tape without semen vaccariae	Sleep quality (PSQI)	TST, SE, SOL, WASO (PSG)	No

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TABLE 1 | (Continued)

		Patients characteristics	Intervention (acupressure)								Outcomes (outcome measurement)		
First author, year, region	**RCT design**	**Sample size, mean age (range or SD), % female, follow-up**	**Provider**	**Stimulation tools**	**Type of acupoint**	**No. of acupoints**	**Time of each acupoint**	**Frequency of treatment (daily)**	**Duration of treatment**	**Control**	**Primary outcome**	**Secondary outcome**	**Side effects**
Meng et al. 2017 China	Two-arm	Patients with generalized anxiety disorder, 70, A: 48.09 ± 5.93, C: 46.83 ± 6.60, 51%, NA	NA	Semen vaccariae	Auricular	3	NA	3	28 days	Tape without semen vaccariae	Sleep quality (PSQI)	TST, SE, SOL (PSG)	NA
Ni et al. 2016 China	Two-arm	Surgical inpatients, 422, A: 45.56 ± 5.47, C: 46.03 ± 5.42, 40%, NA	Self-administered	Semen vaccariae	Auricular	10	NA	2–3	7 days	Usual care	Sleep quality (PSQI)	NA	NA
Qi et al. 2016 China	Four-arm	Patients with colorectal cancer surgery, 68, A: 61.06 ± 9.09, C: 62.00 ± 8.83, 43%, NA	NA	Semen vaccariae	Auricular	5	20 s	4	10 days	Usual care	Sleep quality (PSQI)	NA	NA
Salajegheh et al. 2024 Iran	Two-arm	Patients with burn injuries, 72, A: 39.36 ± 8.47, S: 41.17 ± 7.33, 47%, NA	A nurse with a certificate for acupressure administration	Auricular: a small plastic pin; somatic: no stimulation material (by hand)	Auricular combined with somatic	2	10 min	1	3 days	Sham acupoints	Sleep quality (SMHSQ)	NA	No
Sha et al. 2016 China	Four-arm	Patients with thoracotomy, 113, A: 57.49 ± 10.62, C: 54.86 ± 10.44, 45%, NA	NA	Semen vaccariae	Auricular	6	20–30 s	3	NA	Sleep education	Sleep quality (PSQI)	NA	NA
Sun 2021 China	Two-arm	Patients with lobectomy, 88, A: 63.55 ± 4.91, C: 62.69 ± 5.18, 38%, NA	NA	Semen vaccariae	Auricular	8	1.5 min	6 (within 24 h of surgery); 3–4 (after 24 h of surgery)	6 days	Usual care	Sleep quality (PSQI)	NA	NA

(Continues)

TABLE 1 | (Continued)

First author, year, region	RCT design	Patients characteristics	Intervention (acupressure)							Control	Outcomes (outcome measurement)		Side effects
		Sample size, mean age (range or SD), % female, follow-up	Provider	Stimulation tools	Type of acupoint	No. of acupoints	Time of each acupoint	Frequency of treatment (daily)	Duration of treatment		Primary outcome	Secondary outcome	
Sun and Chen 2022 China	Two-arm	Patients with femoral neck fracture surgery, 86, A: 49.76 ± 2.34, C: 49.79 ± 2.30, 48%, NA	Auricular: self-administered; somatic: NA	Auricular: semen vaccariae; somatic: no stimulation material (by hand)	Auricular combined with somatic	12	Auricular: 2 min; somatic: 2–4 min	Auricular: 3–5; somatic: 1	7 days	Usual care	Sleep quality (PSQI)	NA	NA
Wang 2023 China	Two-arm	Patients with orthopedic spine surgery, 100, A: 55.85 ± 9.30, C: 55.82 ± 9.24, 41%, NA	Self-administered	Semen Vaccariae	Auricular	5	1 min	NA	NA	Estazolam (1 mg)	Sleep quality (PSQI)	NA	Skin infection ($n = 1$)
Wei 2014 China	Two-arm	Internal medicine inpatients, 60, A: 57.74 ± 1.07, C: 58.21 ± 1.29, 55%, NA	Nurse	Semen vaccariae	Auricular	4	1 min	3	14 days	Sleep education	Sleep quality (PSQI)	NA	NA
Wei et al. 2021 China	Two-arm	Patients with thyroid cancer surgery, 60, NA (23–70), 67%, NA	Nurse	No stimulation material (by hand)	Somatic	4	2 min	1	NA	Usual care	Sleep quality (PSQI)	NA	NA
Wu et al. 2015 China	Two-arm	Patients with hypertension, 76, 56.05 (40–75), 41%, NA	NA	No stimulation material (by hand)	Somatic	3	5 min	2	NA	Sleep education	Sleep quality (PSQI)	NA	NA
Wu et al. 2017 China	Two-arm	Patients with breast cancer surgery, 80, NA (18–70), 100%, NA	Auricular: self-administered; somatic: nurse	Auricular: semen vaccariae; somatic: no stimulation material (by hand)	Auricular combined with somatic	9	Auricular: NA; somatic: 3 min	Auricular: 6; somatic: 3	6 days	Usual care	Sleep quality (PSQI)	NA	NA

(Continues)

TABLE 1 | (Continued)

		Patients characteristics	Intervention (acupressure)								Outcomes (outcome measurement)		
First author, year, region	RCT design	Sample size, mean age (range or SD), % female, follow-up	Provider	Stimulation tools	Type of acupoint	No. of acupoints	Time of each acupoint	Frequency of treatment (daily)	Duration of treatment	Control	Primary outcome	Secondary outcome	Side effects
Xiao and Ye 2015 China	Two-arm	Patients with depression, 60, A: 54.1 ± 15.9, C: 53.6 ± 16.5, 52%, NA	NA	Semen Vaccariae	Auricular	4	NA	2	14 days	Tape without semen vaccariae	Sleep quality (PSQI)	NA	No
Yang 2019 China	Two-arm	Patients with Type 2 diabetes, 60, A: 58.10 ± 8.62, C: 58.36 ± 6.97, 58%, NA	Nurse	Semen Vaccariae	Auricular	9	1–2 min	2	14 days	Sleep education	Sleep quality (PSQI)	NA	NA
Yang 2021 China	Two-arm	ICU patients, 80, A: 48.54 ± 5.44, C: 48.51 ± 5.42, 35%, NA	NA	Auricular: Semen Vaccariae; somatic: NA	Auricular combined with somatic	More or equal–12	Auricular: NA; somatic: 5 min	Auricular: 3; somatic: NA	7 days	Usual care	Sleep quality (PSQI)	NA	NA
Yao 2023 China	Two-arm	Patients with laparoscopic cholecystectomy, 254, A: 55. 46 ± 2.96, C: 55.50 ± 3.15, 100%, NA	Self-administered	NA	Auricular	6	0.5 min	3	3 days	Usual care	Sleep quality (PSQI)	NA	NA
Ye et al. 2019 China	Two-arm	Patients with perioperative patients with anorectal diseases, 80, A: 40 ± 13, C: 36 ± 11, 43%, NA	Self-administered	Semen vaccariae	Auricular	9	3–5 min	5	NA	Usual care	Sleep quality (PSQI)	NA	No
Yin et al. 2014 China	Two-arm	Patients with liver transplantation, 51, 44.5 (28–61), 25%, 2 months and 3 months	Nurse	Semen vaccariae	Auricular	10	1 min	3	24 days	Sham acupoints	Sleep quality (PSQI)	NA	NA

(Continues)

TABLE 1 | (Continued)

		Patients characteristics	Intervention (acupressure)								Outcomes (outcome measurement)		
First author, year, region	**RCT design**	**Sample size, mean age (range or SD), % female, follow-up**	**Provider**	**Stimulation tools**	**Type of acupoint**	**No. of acupoints**	**Time of each acupoint**	**Frequency of treatment (daily)**	**Duration of treatment**	**Control**	**Primary outcome**	**Secondary outcome**	**Side effects**
Zhang et al. 2023 China	Three-arm	Patients with Type2 diabetes, 134, A: 51.69 ± 7.85, C: 52.64 ± 8.14, 47%, NA	NA	semen vaccariae	Auricular	7	NA	3	30 days	Usual care	Sleep quality (PSQI)	NA	No
Zhou et al. 2023 China	Two-arm	Patients with nasal endoscopy, 74, A: 33. 21 ± 5. 40, C: 32. 68 ± 4. 89, 51%, NA	Auricular: self-administered; somatic: NA	Auricular: semen Vaccariae; somatic: no stimulation material (by hand)	Auricular combined with somatic	More or equal to 10	Auricular: NA; somatic: 5 min	3	NA	Usual care	Sleep quality (PSQI)	NA	NA
Zhu et al. 2020 China	Two-arm	Patients with chronic heart failure, 83, A: 69.34 ± 3.57, C: 68.97 ± 3.16, 41%, NA	NA	No stimulation material (by hand)	Auricular	6	2 min	3	21 days	Sleep education	Sleep quality (PSQI)	NA	NA

Abbreviations: A, acupressure group; AIS, Athens Insomnia Scale; C, control group; CCU, coronary care unit; COVID-19, Coronavirus disease 2019; ICU, intensive care unit; ISI, Insomnia Severity Index; NA, not available information; PSG, polysomnography; PSQI, Pittsburgh sleep quality index; RCT, randomized controlled trial; SD, standard deviation; SE, sleep efficiency; SMHSQ, St. Mary's Hospital sleep questionnaire; SOL, sleep onset latency; SRSS, self-rating scale of sleep; TST, total sleep time; VAS, visual analogue scale; WASO, wake after sleep onset.

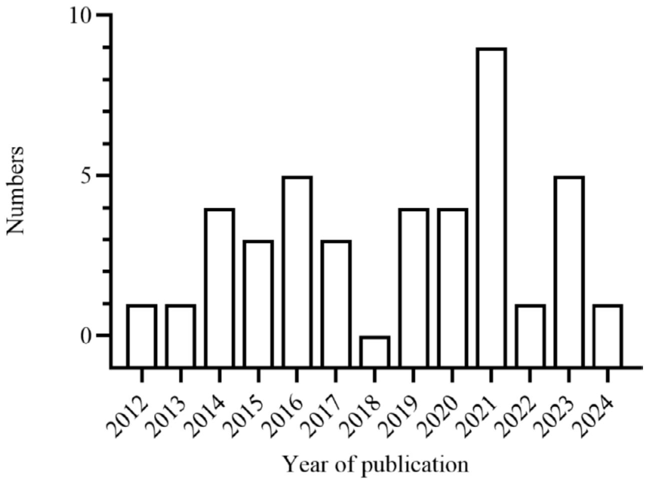

FIGURE 2 | Included studies by years.

Wei 2014; Wei et al. 2021; Yang 2019; Yin et al. 2014), respectively. In one study, the participants performed auricular acupressure, while the nurses performed somatic acupressure (Wu et al. 2017). In two studies, the participants performed auricular acupressure themselves, while the providers of somatic acupressure were not reported (Sun and Chen 2022; Zhou et al. 2023).

The stimulation materials for acupressure were Semen vaccariae ($n=22$) (Bang and Park 2020; Chen et al. 2021; Chen et al. 2014; Fu et al. 2021; Hou et al. 2017; J. Li, Jing, et al. 2021; Liang et al. 2021; Lin 2023; Liu 2020; Luo et al. 2016; Meng et al. 2017; Ni et al. 2016; Qi et al. 2016; Sha et al. 2016; Sun 2021; Wang 2023; Wei 2014; Xiao and Ye 2015; Yang 2019; Ye et al. 2019; Yin et al. 2014; Zhang et al. 2023) and wristbands with a pressure function ($n=1$) (Asgari et al. 2020). In 11 studies (Bagheri-Nesami et al. 2015; Han et al. 2019; Huang et al. 2014; Li et al. 2019; Liu et al. 2012; Y. Liu, Chen, et al. 2021; Liu et al. 2016; Lu et al. 2013; Wei et al. 2021; Wu et al. 2015; Zhu et al. 2020), pressure was applied manually to the acupoints. Some studies used combinations of stimulation tools, including manual combined with Semen vaccariae ($n=3$) (Sun and Chen 2022; Wu et al. 2017; Zhou et al. 2023) and manually combined with plastic needles ($n=1$) (Salajegheh et al. 2024). Moreover, in two studies, auricular acupressure was performed using Semen vaccariae, while the stimulating material for somatic acupressure was not reported (Han et al. 2021; Yang 2021), and one study did not report the stimulating material for auricular or somatic acupressure (Yao 2023).

For the type of acupoints, auricular acupoints were chosen in 24 studies (Bang and Park 2020; Chen et al. 2021; Chen et al. 2014; Fu et al. 2021; Hou et al. 2017; J. Li, Jing, et al. 2021; Liang et al. 2021; Lin 2023; Liu 2020; Luo et al. 2016; Meng et al. 2017; Ni et al. 2016; Qi et al. 2016; Sha et al. 2016; Sun 2021; Wang 2023; Wei 2014; Xiao and Ye 2015; Yang 2019; Yao 2023; Ye et al. 2019; Yin et al. 2014; Zhang et al. 2023; Zhu et al. 2020), somatic acupoints in 10 studies (Asgari et al. 2020; Han et al. 2019; Huang et al. 2014; Li et al. 2019; Liu et al. 2012; Y. Liu, Cheng, et al. 2021; Liu et al. 2016; Lu et al. 2013; Wei et al. 2021; Wu et al. 2015), and a combination of the two in the others ($n=7$) (Bagheri-Nesami et al. 2015; Han et al. 2021; Salajegheh et al. 2024; Sun and Chen 2022; Wu et al. 2017; Yang 2021; Zhou et al. 2023).

4.1.3 | Type of Control Group

In seven studies, the control groups received a placebo intervention, including sham acupressure ($n=4$) (Bagheri-Nesami et al. 2015; Bang and Park 2020; Salajegheh et al. 2024; Yin et al. 2014) and taping without pressure ($n=3$) (Luo et al. 2016; Meng et al. 2017; Xiao and Ye 2015). The control group received usual care with sleep education in 13 studies (Chen et al. 2021; Han et al. 2021; Han et al. 2019; Hou et al. 2017; Huang et al. 2014; Lin 2023; Liu et al. 2012; Y. Liu, Cheng, et al. 2021; Sha et al. 2016; Wei 2014; Wu et al. 2015; Yang 2019; Zhu et al. 2020) and benzodiazepine in two studies (Liang et al. 2021; Wang 2023). In the remaining studies, the control group received usual care without sleep education.

4.1.4 | Assessment Tool for Sleep Quality

All of the included studies used validated subjective sleep assessment tools. Two studies used St. Mary's Hospital Sleep Questionnaire (SMHSQ) (Bagheri-Nesami et al. 2015; Salajegheh et al. 2024) and one each used the Athens Insomnia Scale (Liu et al. 2016), Insomnia Severity Index (J. Li, Jing, et al. 2021), visual analogue scale (Asgari et al. 2020), and Korea Sleep Scale A (Bang and Park 2020). The other studies used the Pittsburgh Sleep Quality Index (PSQI).

Five of the included studies reported additional sleep parameters, including total sleep time (TST), sleep efficiency (SE), sleep onset latency (SOL), and wake after sleep onset (WASO). Regarding measurement tools, two of these studies used polysomnography (Luo et al. 2016; Meng et al. 2017) and one each used actigraphy (Lu et al. 2013), the SMHSQ (Bagheri-Nesami et al. 2015), and the PSQI (Chen et al. 2014).

4.1.5 | Side Effects

Six studies reported the adverse effects of acupressure (Luo et al. 2016; Salajegheh et al. 2024; Wang 2023; Xiao and Ye 2015; Ye et al. 2019; Zhang et al. 2023), one of which reported an ear skin infection in one patient with no information about the cause or severity (Wang 2023).

4.2 | Risk of Bias of the Included Studies

Based on the Cochrane Risk of Bias Tool version 2.0, most of the studies were considered to have "some concerns" (Figure 3), particularly in the domains of the randomization process, outcome measurement, and selective reporting. All studies clarified the randomization strategy, except for 16 studies (Chen et al. 2014; Huang et al. 2014; Li et al. 2019; Liu 2020; Y. Liu, Cheng, et al. 2021; Liu et al. 2016; Ni et al. 2016; Sun and Chen 2022; Sun 2021; Wei 2014; Wu et al. 2017; Wu et al. 2015; Xiao and Ye 2015; Yang 2021; Yang 2019; Zhou et al. 2023). Only two studies applied allocation concealment (Salajegheh et al. 2024; Sun 2021). Four studies were rated as "high risk" for missing data greater than 5% without using an intention-to-treat analysis (Bang and Park 2020; Sha et al. 2016; Xiao and Ye 2015; Yin et al. 2014). In the domain of outcome measurement bias, due to the difficulty of adequately blinding participants and

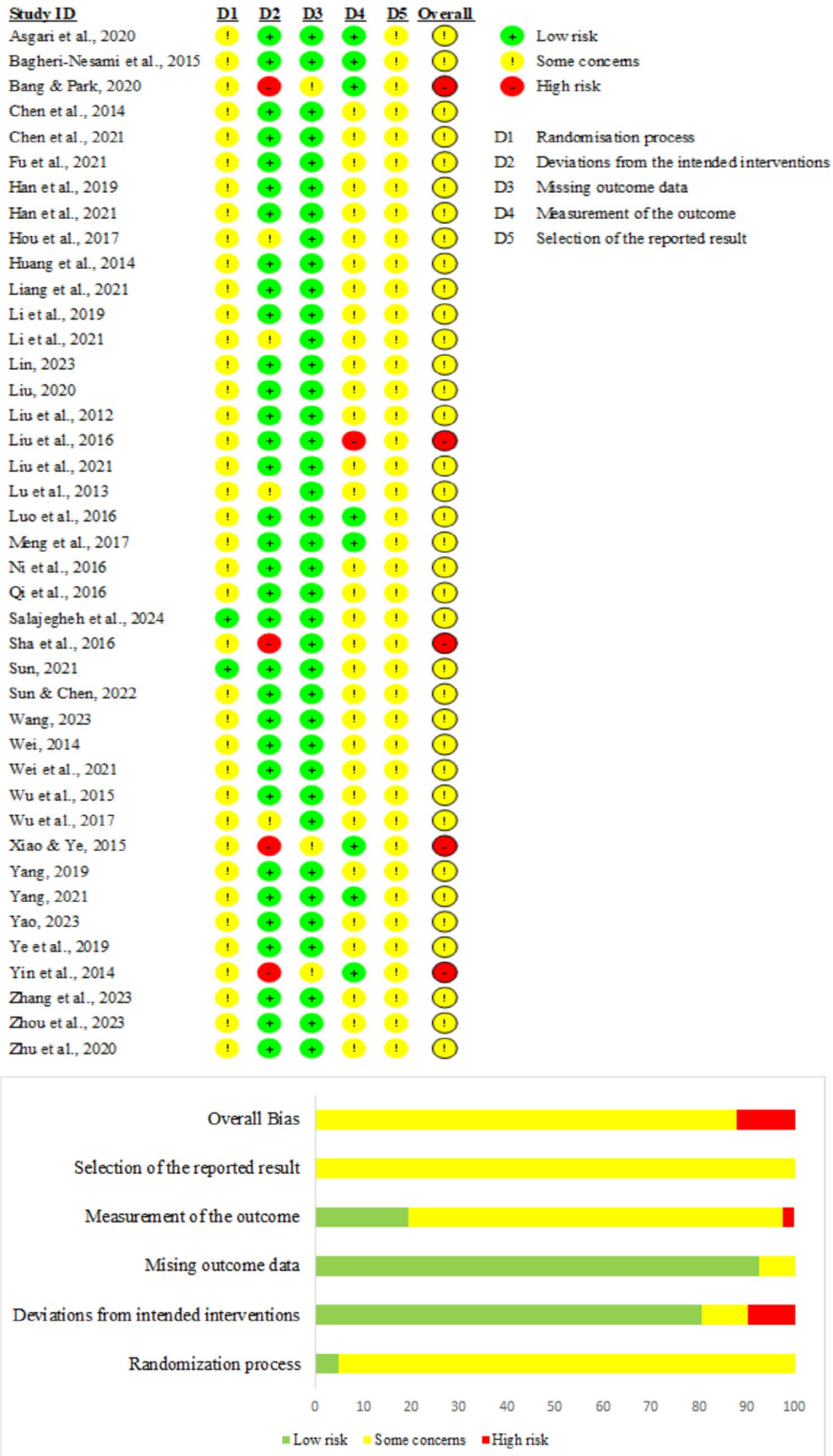

FIGURE 3 | Risk of bias graph.

providers and the fact that all measurement tools for primary outcome were self-report scales, most of the studies were rated as "some concerns" and one study (Liu et al. 2016) was rated as "high risk" due to a tendency to induce outcomes by explaining the purpose of acupressure to patients before the intervention. Three registered trials failed to provide specific analysis plans (Asgari et al. 2020; Bagheri-Nesami et al. 2015; Salajegheh et al. 2024), and 38 other trials were not preregistered; therefore, the overall risk of bias in the selection of reported results was rated as "some concerns."

4.3 | Meta-Analysis Results

4.3.1 | Effects of Acupressure on Sleep Quality in Inpatients

Only 39 studies involving a total of 3540 participants were included in this meta-analysis. Two studies (Wei et al. 2021; Ye et al. 2019) did not report the required data for meta-analysis and were therefore not included in the analysis. The overall results of the meta-analysis showed that acupressure significantly improved sleep quality in inpatients compared with the pre-intervention and post-intervention controls (SMD = −1.58, 95% CI [−1.85, −1.31], $p < 0.001$, $I^2 = 92\%$) (Figure 4).

4.3.2 | Effects of Acupressure on Sleep Parameters

Five of the included studies reported additional sleep parameters (Supporting Information: Appendix B). The results of these five studies showed that acupressure caused a significant increase in the TST of inpatients (SMD = 1.12, 95% CI [0.40, 1.83], $p < 0.01$, $I^2 = 88\%$) (Bagheri-Nesami et al. 2015; Chen et al. 2014; Lu et al. 2013; Luo et al. 2016; Meng et al. 2017). Four of these studies reported inconsistent results for SOL and SE ($n = 243$) (Chen et al. 2014; Lu et al. 2013; Luo et al. 2016; Meng et al. 2017). The summarized results showed that acupressure had a statistically significant effect on SOL (SMD = −0.73, 95% CI [−1.14, −0.33], $p < 0.001$, $I^2 = 58\%$) and SE (SMD = 0.90, 95% CI [0.29, 1.52], $p < 0.01$, $I^2 = 81\%$) in inpatients. Two of the studies ($n = 119$) demonstrated that acupressure significantly reduced WASO (SMD = −1.32, 95% CI [−2.55, −0.09], $p = 0.04$, $I^2 = 89\%$) in inpatients (Lu et al. 2013; Luo et al. 2016).

4.3.3 | Subgroup Analysis of Sleep Quality in Inpatients

Thirty-nine of the included studies were subjected to five subgroup analyses to investigate the effects of hospitalization unit, type of acupoints, intervention provider, stimulation tool, and type of control group on the sleep quality of inpatients (Table 2).

	Acupressure			Control				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Asgari et al., 2020	-4.37	1.12	17	0.16	0.58	17	1.6%	-4.96 [-6.38, -3.54]
Bagheri-Nesami et al., 2015	-2.34	4.61	30	-0.17	5.17	30	2.6%	-0.44 [-0.95, 0.08]
Bang & Park, 2020	7.29	5.62	21	14.86	6.82	21	2.5%	-1.19 [-1.85, -0.53]
Chen et al., 2014	-11.38	2.64	27	-7.66	3.05	27	2.5%	-1.29 [-1.88, -0.70]
Chen et al., 2021	-9.92	1.26	30	-5.6	1.24	30	2.3%	-3.41 [-4.22, -2.60]
Fu et al., 2021	-1.78	3.3	30	2.7	2.12	30	2.5%	-1.59 [-2.18, -1.01]
Han et al., 2019	-4.27	1.92	45	-2.73	2.18	45	2.7%	-0.74 [-1.17, -0.32]
Han et al., 2021	-7.57	1.93	34	-4.62	2.17	34	2.6%	-1.42 [-1.96, -0.88]
Hou et al., 2017	-10.38	2.3	43	-7.54	2.23	43	2.7%	-1.24 [-1.71, -0.78]
Huang et al., 2014	-4.63	2.29	30	-2.73	2.89	30	2.6%	-0.72 [-1.24, -0.20]
Liang et al., 2021	-8.8	3.21	35	-4.08	2.57	35	2.6%	-1.61 [-2.15, -1.06]
Li et al., 2019	-7.57	3.51	64	-3.7	3.34	64	2.8%	-1.12 [-1.50, -0.75]
Li et al., 2021	-7.37	6.88	30	-0.78	5.2	32	2.6%	-1.07 [-1.61, -0.54]
Lin, 2023	-7.59	1.83	65	-3.94	1.83	65	2.7%	-1.98 [-2.40, -1.56]
Liu, 2020	-5	3.28	30	-3.2	2.7	30	2.6%	-0.59 [-1.11, -0.07]
Liu et al., 2012	-3.89	3.41	62	-2.18	2.94	62	2.8%	-0.53 [-0.89, -0.18]
Liu et al., 2016	-8.15	2.32	40	-2.9	2.3	40	2.6%	-2.25 [-2.82, -1.69]
Liu et al., 2021	-10.72	1.47	61	-4.99	1.48	61	2.5%	-3.86 [-4.47, -3.25]
Lu et al., 2013	-9.17	1.7	30	-1.14	1.04	30	1.9%	-5.62 [-6.78, -4.47]
Luo et al., 2016	-6.4	3.12	29	-2.7	4.16	30	2.6%	-0.99 [-1.53, -0.45]
Meng et al., 2017	-4.86	0.89	35	-1.63	0.93	35	2.4%	-3.51 [-4.27, -2.75]
Ni et al., 2016	-2	3.16	211	-0.13	3	211	2.9%	-0.61 [-0.80, -0.41]
Qi et al., 2016	-1.09	1.8	33	0.31	2.12	35	2.6%	-0.70 [-1.19, -0.21]
Salajegheh et al., 2024	-8.52	2.04	36	1.42	2.04	36	2.1%	-4.82 [-5.75, -3.89]
Sha et al., 2016	2.01	3.92	55	4.43	3.95	58	2.7%	-0.61 [-0.99, -0.23]
Sun, 2021	-8.85	3.87	44	-5.73	3.48	44	2.7%	-0.84 [-1.28, -0.40]
Sun & Chen, 2022	-7.41	1.99	43	-3.76	2.29	43	2.6%	-1.69 [-2.18, -1.19]
Wang, 2023	-5.35	1.97	50	-3.12	2	50	2.7%	-1.11 [-1.54, -0.69]
Wei, 2014	-4.15	2.97	30	-1.84	2.7	30	2.6%	-0.80 [-1.33, -0.28]
Wu et al., 2015	-4.3	3.65	38	-2.32	3.37	38	2.7%	-0.56 [-1.02, -0.10]
Wu et al., 2017	-4.88	4.99	40	0.38	6.36	40	2.7%	-0.91 [-1.37, -0.45]
Xiao & Ye, 2015	-8	3.12	31	-3	4.18	29	2.6%	-1.34 [-1.91, -0.78]
Yang, 2019	-12	1.91	30	-8.2	1.44	30	2.5%	-2.22 [-2.87, -1.57]
Yang, 2021	-10	3.17	40	-4.05	3.12	40	2.6%	-1.87 [-2.40, -1.34]
Yao, 2023	-8.14	1.55	127	-5.4	1.57	127	2.8%	-1.75 [-2.04, -1.46]
Yin et al., 2014	-1.63	1.62	24	1.69	1.74	27	2.5%	-1.94 [-2.62, -1.27]
Zhang et al., 2023	-3.5	2.03	67	-1.99	2.23	67	2.8%	-0.70 [-1.05, -0.35]
Zhou et al., 2023	-7.39	1.9	37	-3.97	2.15	37	2.6%	-1.67 [-2.20, -1.14]
Zhu et al., 2020	-8.5	2.13	42	-5.56	2.27	41	2.7%	-1.32 [-1.80, -0.85]
Total (95% CI)			**1766**			**1774**	**100.0%**	**-1.58 [-1.85, -1.31]**

Heterogeneity: Tau² = 0.64; Chi² = 457.33, df = 38 (P < 0.00001); I² = 92%

Test for overall effect: Z = 11.62 (P < 0.00001)

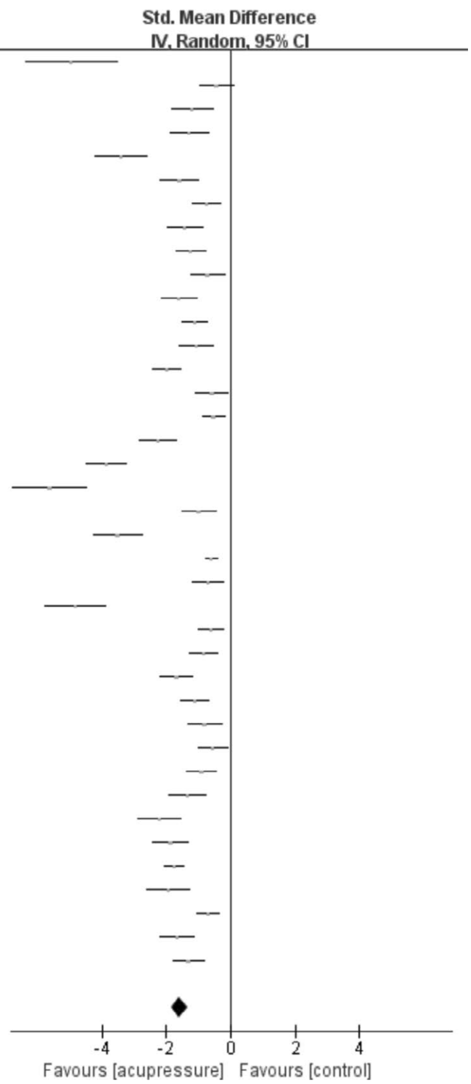

FIGURE 4 | Forest plot of the total effects of acupressure on sleep quality in inpatients.

TABLE 2 | Effect sizes of the subgroup analysis.

Title	Number of trials	Number of participants	Effect size SMD, 95% CI	Overall effect, p	Heterogeneity I^2 value	Q test, p
Overall effect	39	3540	−1.58 [−1.85, −1.31]	$p<0.001$	92%	$p<0.001$
1. Subgroup analysis by setting						
1.1 ICU	5	370	−1.72 [−2.53, −0.91]	$p<0.001$	90%	$p<0.001$
1.2 General ward	34	3170	−1.57 [−1.85, −1.28]	$p<0.001$	92%	$p<0.001$
2. Subgroup analysis by type of acupoint						
2.1 Auricular	23	2246	−1.36 [−1.63, −1.09]	$p<0.001$	87%	$p<0.001$
2.2 Somatic	9	774	−2.13 [−2.99, −1.26]	$p<0.001$	96%	$p<0.001$
2.3 Auricular combined with somatic	7	520	−1.77 [−2.49, −1.04]	$p<0.001$	92%	$p<0.001$
3. Subgroup analysis by intervention provider						
3.1 Healthcare professionals	8	497	−2.35 [−3.34, −1.37]	$p<0.001$	95%	$p<0.001$
3.2 Self-administered	9	1194	−1.27 [−1.72, −0.81]	$p<0.001$	91%	$p<0.001$
4. Subgroup analysis by stimulation tool						
4.1 No stimulation tools (by fingers)	10	883	−1.63 [−2.32, −0.94]	$p<0.001$	95%	$p<0.001$
4.2 Semen vaccariae	25	2403	−1.37 [−1.63, −1.12]	$p<0.001$	87%	$p<0.001$
5. Subgroup analysis by type of control group						
5.1 Usual care without sleep education	17	1824	−1.54 [−1.90, −1.17]	$p<0.001$	91%	$p<0.001$
5.2 Usual care with sleep education	13	1132	−1.46 [−1.96, −0.96]	$p<0.001$	93%	$p<0.001$
5.3 Tape without semen vaccariae	3	189	−1.92 [−3.29, −0.55]	$p=0.01$	93%	$p<0.001$
5.4 Sham acupressure	4	225	−2.06 [−3.66, −0.47]	$p=0.01$	96%	$p<0.001$
5.5 Benzodiazepine	2	170	−1.33 [−1.81, −0.85]	$p<0.001$	49%	$p=0.16$

4.3.3.1 | Subgroup Analysis by Setting. Acupressure significantly improved sleep quality in patients hospitalized in ICUs (SMD = −1.72, 95% CI [−2.53, −0.91], $p<0.001$, $I^2=90\%$) and general wards (SMD = −1.57, 95% CI [−1.85, −1.28], $p<0.001$, $I^2=92\%$), with the effect size being larger in ICUs.

4.3.3.2 | Subgroup Analysis by Type of Acupoints. Auricular acupressure (SMD = −1.36, 95% CI [−1.63, −1.09], $p<0.001$, $I^2=87\%$), somatic acupressure (SMD = −2.13, 95% CI [−2.99, −1.26], $p<0.001$, $I^2=96\%$), and auricular combined with somatic acupressure (SMD = −1.77, 95% CI [−2.49, −1.04], $p<0.001$, $I^2=92\%$) were all shown to significantly improve the sleep quality of inpatients, with the effect size of somatic acupressure being larger than that of the other acupressures.

4.3.3.3 | Subgroup Analysis by Intervention Provider. Both the participants who received acupressure from healthcare professionals (SMD = −2.35, 95% CI [−3.34, −1.37], $p<0.001$, $I^2=95\%$) and the participants who self-administered acupressure (SMD = −1.27, 95% CI [−1.72, −0.81], $p<0.001$, $I^2=91\%$) demonstrated significantly higher sleep quality compared to the control group, with the effect size being larger for acupressure delivered by healthcare professionals.

4.3.3.4 | Subgroup Analysis by Stimulation Tools. Significant improvements in sleep quality were observed in the subgroup that carried out acupressure by hand without any stimulation tools (SMD = −1.63, 95% CI [−2.32, −0.94], $p<0.001$, $I^2=95\%$) and in the subgroup that used Semen vaccariae (SMD = −1.37, 95% CI [−1.63, −1.12], $p<0.001$, $I^2=87\%$).

4.3.3.5 | Subgroup Analysis by Type of Control Group. The results indicated that acupressure was significantly superior to usual care without sleep education (SMD = −1.54, 95% CI [−1.90, −1.17], $p<0.001$, $I^2=91\%$), usual care with sleep education ($SMD = -1.46$, 95% CI [−1.96, −0.96], $p < 0.001$, $I^2 = 93\%$), taping without Semen vaccariae ($SMD = -1.92$, 95% CI [−3.29, −0.55], $p = 0.01$, $I^2 = 93\%$), sham acupressure ($SMD = -2.06$, 95% CI [−3.66, −0.47], $p = 0.01$, $I^2 = 96\%$), and benzodiazepine ($SMD = -1.33$, 95% CI [−1.81, −0.85], $p < 0.001$, $I^2 = 49\%$) in improving the sleep quality of inpatients.

4.3.4 | Sensitivity Analysis

To investigate each study's effect on SMD, leave-one-out analyses were conducted by excluding each study individually. The sensitivity analysis of sleep quality showed no significant changes in effect sizes ranging from −1.52 (95% CI [−1.85, −1.20]) to −1.66 (95% CI [−2.03, −1.28]), with I^2 ranging from 90% to 92% (Supporting Information: Appendix C). Meanwhile, the sensitivity analyses of sleep parameters showed no significant changes in effect sizes for any study. Therefore, the overall results of the meta-analysis were considered reliable and robust.

4.3.5 | Publication Bias

Funnel plot asymmetry was evident (Supporting Information: Appendix D), and Egger's test (Supporting Information: Appendix E) indicated a statistically significant publication bias in sleep quality among inpatients ($t = -5.27$, $p < 0.001$). The trim-and-fill method (Supporting Information: Appendix F) estimated 11 potentially missing studies with corrected effect sizes ($SMD = -1.01$, 95% CI [−1.49, −0.53], $p < 0.001$) smaller than the original effect size of −1.58. Therefore, this review had a significant publication bias.

4.3.6 | Meta-Regression

The results of the meta-regression analysis (Supporting Information: Appendix G) showed that the number of sessions daily ($p = 0.03$) and the duration of each session ($p = 0.03$) were significant factors influencing heterogeneity, whereas the sample size ($p = 0.26$), the number of acupoints ($p = 0.13$), the proportion of females ($p = 0.78$), and the duration of acupressure ($p = 0.81$) were not found to be statistically significant factors.

4.3.7 | Narrative Reporting of Other Studies

The results of sleep quality from two studies (Wei et al. 2021; Ye et al. 2019) were not included in the meta-analysis and were therefore synthesized qualitatively. Both studies reported that acupressure significantly improved sleep quality in hospitalized patients compared with usual care. In the study by Wei et al. (2021), nurses performed acupressure on somatic acupoints once daily for postoperative thyroid cancer patients. In the study by Ye et al. (2019), anorectal surgery patients were guided to perform self-administered acupressure on the ear acupoints five times daily.

5 | Discussion

5.1 | Summary and Interpretation of Findings

The results of the systematic review, which involved 41 RCTs with 3680 participants, suggest that acupressure can significantly improve sleep quality in hospitalized adult patients compared with usual care without sleep education, usual care with sleep education, taping without Semen vaccariae, sham acupressure, and benzodiazepine, which is consistent with the results of a previous review (Waits et al. 2018) involving menopausal women, nursing home residents, hypertensive patients, and surgery patients. Furthermore, this systematic review found that acupressure significantly improved sleep parameters such as TST, SE, SOL, and WASO. This further complements the evidence from a previous similar review of perioperative patients, whose results indicated that acupoint stimulation, including acupressure, significantly increased the TST and SE of perioperative patients (Liu et al. 2024).

The improvements in sleep quality and sleep parameters after acupressure are associated with the regulation of Qi operation and complex neurohormonal responses (Dincer et al. 2022). TCM believes that poor sleep quality is associated with the weak flow of Wei Qi, leading to excess or insufficient Qi and blood in the internal organs, such as the heart and liver (Birling 2021; Lozano 2014). Applying pressure to acupoints on the meridians allows Wei Qi to pass smoothly through the body, ensuring the normal functioning of energy channels and internal organs, which facilitates the restoration of good-quality sleep (Dincer et al. 2022; Lozano 2014; Montakab 2014). Furthermore, pressing the acupoints can activate nerve fibers, stimulating the hypothalamus and pituitary gland, which increases the release of the neurotransmitters endorphins and serotonin (Mehta et al. 2017). Endorphins can interact with μ-opioid receptors in the central nervous system to inhibit the transmission of pain signals, which promotes body relaxation and improves sleep quality (Jain et al. 2019). Serotonin can activate the pineal region of the brain to produce melatonin, which is mainly responsible for regulating the sleep–wake cycle, can help to shorten the latency to fall asleep, and can increase the total duration of sleep (Jones et al. 2020; B. H. Lee, Hille, et al. 2021; Xie et al. 2017).

Subgroup analyses showed that acupressure had a significant effect on the sleep quality of adult inpatients in both ICUs ($SMD = -1.72$) and general wards ($SMD = -1.57$). The difference in the two effect sizes may be related to the lower baseline sleep quality of patients in ICUs. The evidence suggests that the prevalence of sleep disorders in ICU patients exceeds 50%, with noise being one of the main influencing factors (Younis and Hayajneh 2018). Reportedly, the average hourly noise range in ICU wards (56.1 ± 1.3 dB–60.3 ± 1.7 dB) is statistically significantly higher than that in general wards (44.6 ± 2.1 dB–53.7 ± 3.6 dB) (Jaiswal et al. 2017). This means that ICU patients are likely to have poorer sleep quality than general ward patients. However, considering the limited studies conducted in ICUs ($n = 5$), further research is needed to enhance the efficacy of acupressure in ICU patients.

Interestingly, the results of this review showed that acupressure on somatic acupoints had a better effect (SMD = −2.13) than that on auricular acupoints (SMD = −1.36) and on auricular combined with somatic acupoints (SMD = −1.77) on the sleep quality of inpatients. The differences in these effect sizes may be related to the stronger stimulation of skeletal muscles by somatic acupressure than by auricular acupressure. A study indicated that somatic acupressure, by mechanically stimulating skeletal muscles, can dilate blood vessels and increase tissue blood flow, thus reducing the discomfort associated with poor sleep quality, such as muscle stiffness and muscle pain (Sato-Suzuki et al. 2019). More than three quarters of the body's skeletal muscle is located in the limbs (Gonzalez and Heymsfield 2017), and very little is in the ears. Therefore, this mechanical stimulation of skeletal muscle may allow somatic acupressure to produce an additional sleep-promoting effect compared to auricular acupressure. The exact mechanism underlying the differences in the effects of somatic acupoints and auricular combined somatic acupoints is not known, although it is presumed to be affected by the clinical effect specificity of the acupoints, the antagonistic effect of improperly combined acupoints, and the variability of acupoint localization by the intervention providers (Godson and Wardle 2019; Zhao et al. 2012). Comparative studies on different acupoints are insufficient in the literature and can be explored in the future.

In another subgroup analysis, acupressure provided by healthcare professionals had a greater impact (SMD = −2.35) than self-administered acupressure (SMD = −1.27) on the sleep quality of inpatients. Although acupressure can be self-administered by trained participants, its efficacy can be affected by the accuracy of acupoint localization and intervention compliance. The evidence suggests that owing to the proximity of many acupoints to each other, skills practice and deliverer education and training are key factors influencing the accuracy of acupoint localization, which directly impacts the efficacy and reliability of the intervention (Godson and Wardle 2019). However, the included studies did not adequately describe the content of training for patients who self-administered acupressure and conducted no follow-up sessions to evaluate the patients' acquired skills, which resulted in failure to ensure the fidelity of the interventions (Cheng et al. 2023). Meanwhile, patients may fail to adhere to the acupressure intervention due to factors such as doubts about the effectiveness of the treatment, aggravation of the condition, and lack of support from family members, which can directly affect the efficacy of the intervention (Lin et al. 2020). Therefore, in clinical practice, patients' mastery of acupressure skills should be continuously and systematically evaluated to ensure the accuracy and effectiveness of the intervention. In addition, health education for patients and their families should be strengthened to improve their intervention compliance. Additionally, as clinical front-line healthcare professionals, the nurses in the included studies served as acupressure providers and health educators, meaning that acupressure has the potential to be incorporated into clinical nursing and midwifery practice.

Meanwhile, the results of this review emphasize that acupressure is effective both with and without the use of acupressure stimulation tools. Semen vaccariae is the dry mature seed of *Vaccaria hispanica* (Mill.) Rauschert, which is spherical, black, and approximately 2 mm in diameter (Tian et al. 2021). As a traditional stimulating material used in auricular acupressure therapy, it is commonly attached to tape for continuous pressure stimulation on auricular acupoints to achieve therapeutic effects (M. Liu, Tong, et al. 2021). The studies included in this review similarly used Semen vaccariae as a tool for auricular stimulation. In Western medicine, acupressure is considered a therapeutic touch that involves directly applying pressure to a part of the body with the fingers (Hu et al. 2019; Lindquist et al. 2022). This touch stimulation can reduce cortisol levels, which has a definite bidirectional relationship with sleep quality (De Nys et al. 2022; Eckstein et al. 2020). This may explain the greater effect size produced by hands than by Semen vaccariae. In addition, magnetic beads and portable acupressure devices are commonly used as tools for acupressure (L. Lin, Zhang, et al. 2021; Mehta et al. 2017). However, to date, the evidence comparing the effects of different physical stimulation tools on sleep quality is limited, and further investigation is needed.

In the subgroup analyses by type of control group, acupressure had a significant positive effect on sleep quality in inpatients compared with usual care without sleep education, usual care with sleep education, taping without Semen vaccariae, sham acupressure, and benzodiazepines. Remarkably, the control groups with sham acupressure (SMD = −2.06) and taping without Semen vaccariae (SMD = −1.92) had larger effect sizes than the other groups. In RCTs of non-pharmacological interventions, a placebo is commonly implemented to achieve blinding and reduce or eliminate bias and distinguish the specific and nonspecific effects of the intervention (Tan et al. 2015; Zhang et al. 2014). Both sham acupressure and taping without Semen vaccariae were used as placebos in the reviewed studies. In general, studies using a placebo for control groups may observe reduced efficacy of interventions in RCT settings due to the possibility of a placebo effect (Relton 2013). However, the findings of this review were contrary to that observation, which may be related to the inconsistency in the definition and scope of usual care in the included studies. Most of the included participants were postoperative inpatients whose usual care may include the use of anesthetics and routine analgesic and sedative medications, which can directly affect sleep quality (Huang et al. 2021; S. Li, Song, et al. 2021) and, in turn, the true effectiveness of acupressure. Similarly, benzodiazepines, as the preferred sleep-promoting drugs recommended by the World Sleep Society, have been proven to significantly promote sleep quality (Morin et al. 2021). Therefore, the effectiveness of acupressure in hospitalized patients with different diseases or treatment protocols needs to be further investigated.

The meta-regression results suggest that the number of sessions daily (regression coefficient = 0.60, $p = 0.03$) was positively correlated with sleep quality, while the duration of each session (regression coefficient = −0.01, $p = 0.02$) was negatively correlated with sleep quality. Based on the same TCM principles as acupuncture, acupressure treats various diseases by activating points on the meridians (Mehta et al. 2017). The "dose–response relationship" of acupuncture suggests that the higher-dose condition of a higher frequency of acupoint stimulation may achieve better therapeutic results (Yoon et al. 2022). In contrast, patients may experience localized discomfort when receiving acupressure. Although this discomfort resolves by itself in a short time (Nielsen et al. 2020), patients may still have difficulty adhering to acupressure (Bang and Park 2020), which can directly affect the effectiveness of the intervention. This may explain the negative correlation between the duration of each session and the outcome. However, the optimal stimulation parameters have not yet been examined. Therefore, there is a need for future large-scale, well-designed studies to explore the ideal acupressure protocol, including the frequency and duration of the intervention, while taking into account patient complaints.

This review found that acupressure is relatively safe, with the only reported adverse event being a case of ear skin infection, which may be related to the prolonged application of localized skin pressure by Semen vaccariae (Nielsen et al. 2020). However, other common adverse events, such as localized skin irritation, discomfort, and pain pressure at the application site, might have existed but gone unreported as most of them are mild, short-term, and well tolerated (Tan et al. 2014). Therefore, a future systematic collection of adverse events in acupressure studies is necessary to further support the safety of acupressure.

The review has some limitations. First, a high degree of heterogeneity was found among the included studies. Although potential sources of heterogeneity were identified through subgroup and meta-regression analyses, their specific impacts on heterogeneity were not further analyzed. Second, the limited number of studies included in certain subgroups may have impaired the representativeness and statistical power of the combined estimates. Third, despite applying the trim-and-fill method, the results showed a significant publication bias, which might have weakened the credibility of the evidence. Fourth, only articles published in English or Chinese were included, which might have led to potential selection bias, thereby limiting the generalizability of the results. Finally, methodological limitations, which mainly result from the lack of appropriate blinding of patients and personnel, may have led to the overestimation of the results. Given these limitations, the findings of this review should be interpreted with caution.

6 | Conclusions

This review shows that acupressure is an effective and relatively safe non-invasive intervention to improve sleep quality and sleep parameters, including TST, SE, SOL, and WASO, in inpatients. Based on the existing limited evidence, an acupressure modality with short and frequent daily sessions appears feasible. However, no definitive conclusions can be drawn about the optimal protocol for acupressure. Therefore, it is necessary to further explore the intervention components of acupressure, the effectiveness of acupressure in different inpatients, and the systematic collection of adverse effects of acupressure to provide high-quality scientific evidence for the clinical application of acupressure.

7 | Relevance for Clinical Practice

This review is the first to focus on the effect of acupressure on sleep quality and sleep parameters in inpatients, and the large number of RCTs and participants included provide strong evidence supporting the clinical application of acupressure to improve sleep quality in inpatients. Given the positive outcomes, healthcare practitioners should consider incorporating acupressure into the care plans for inpatients, particularly those experiencing sleep disturbances. Particularly, nurses can play a crucial role in the practical application of acupressure and health education, which can inform clinical and policy decisions. Integrating acupressure into nursing practice could expand the scope of nursing interventions and contribute to interdisciplinary health services. The study also highlights the safety of acupressure, with minimal adverse events reported, making it a viable noninvasive option for sleep improvement. Future clinical guidelines and training programs should highlight the importance of acupressure techniques and the need for ongoing patient education to maximize adherence and effectiveness.

Author Contributions

Weihong Ling: conceptualization, methodology, validation, writing – original draft, writing – review and editing, data curation, resources, formal analysis, project administration, investigation, visualization. **Chenxi Yang:** methodology, data curation, validation, software, visualization. **Mu-Hsing Ho:** writing – review and editing, validation, supervision. **Jung Jae Lee:** conceptualization, methodology, writing – review and editing, visualization, supervision, validation.

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Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data for this study are available upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.