Received: 7 June 2020 | Revised: 22 October 2020 | Accepted: 18 November 2020
DOI: 10.1111/jan.14699

REVIEW

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Can foot reflexology be a complementary therapy for sleep disturbances? Evidence appraisal through a meta-analysis of randomized controlled trials

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Funding information
Taipei Medical University, Grant/Award Number: 106-6004-004-112

Abstract

Aims: To systematically summarize and quantify the effects of foot reflexology on improvements in sleep disturbances.

Design: Systematic review and meta-analysis.

Data sources: Datasets including PubMed, Web of Science, Scopus, EMBASE, Cochrane Library, Google Scholar, CINAHL and two Chinese electronic databases (i.e., AiritiLibrary and China National Knowledge Infrastructure) were used to search from their inception to 31 January 2019.

Review methods: Studies which were randomized controlled trials that reported changes in sleep disturbances after the intervention among adults over 18 years old and written in the English or Chinese language were included. Two reviewers' independently assessed the eligibility, extracted data, and conducted a quality assessment. Based on the extracted data, two separate meta-analyses were performed.

Results: Forty-two articles with a total sample of 3,928 participants were included in the systematic review and were eligible for the meta-analysis. The most commonly employed outcome measurement tool was the Pittsburgh Sleep Quality Index, followed by the therapeutic effect between the intervention and control groups (as evaluated by participants with sleep problems compared with those without sleep problems in each group after the intervention). Results revealed that foot reflexology resulted in a greater reduction in the sleep quality score compared with the controls (Hedges' g = −1.37; 95% confidence interval (CI) = −1.81~-0.94). As for the therapeutic effect, participants in the intervention group were less likely to have sleep problems than those in the control group (pooled odds ratio = 0.25; 95% CI = 0.19 ~ 0.31).

Conclusion: The findings suggested that foot reflexology produced significant improvements in sleep disturbances.

Impact: Foot reflexology is a non-invasive and convenient intervention and regularly receiving foot reflexology can be considered complementary therapy to improve the sleep quality of adults with sleep disturbances. Furthermore, healthcare providers can actively press the solar plexus and heart zones to alleviate sleep disturbances when performing foot reflexology.

KEYWORDS
foot reflexology, meta-analysis, sleep disturbances, sleep quality, systematic review

1 | INTRODUCTION

Sleep is a requirement for human life and normally occupies 20–40% of the day (Grandner, 2017). Sleep disturbances, such as difficulty falling asleep, long sleep latency, a short sleep duration, sleep maintenance difficulties, early morning awakening, and daytime sleepiness, are not exclusively a US health problem and are equally concerning in other countries, such as the United Kingdom, Germany, Japan, and Canada (Hafner et al., 2017; Lallukka et al., 2018). Additionally, the prevalence of chronic sleep disturbances in industrialized nations is about 5–10% (Ohayon, 2002, 2009). Sleep disturbances have negative impacts on cardiovascular health, metabolic health, mental health, immunological health, pain, human performance, cognition, injuries, and mortality (Hafner et al., 2017; Jike et al., 2018; Palmer & Alfano, 2017; Shi et al., 2018). Consequently, sleep disturbances are responsible for increased healthcare costs (Hui & Grandner, 2015), with one estimate suggesting costs of US$2–16 billion per annum (Daley et al., 2009). Accordingly, it is vital to have effective treatments for alleviating sleep disturbances.

2 | BACKGROUND

Treatments for sleep disturbances fall into two main categories: pharmacotherapies and non-pharmacotherapies. Pharmacotherapy is the major approach for treating sleep disturbances. However, it has not been demonstrated to be effective in managing some sleep disorders (i.e., insomnia) (Sateia et al., 2017). Short-term use of medications is perhaps effective, but long-term use may have potential for harm, such as decreased motor coordination, drowsiness, and difficulties with spatial navigation (Abbasi Fakhravari et al., 2018; Chen et al., 2019). Non-pharmacological therapies (e.g., cognitive behavioural therapies, sleep hygiene education, and complementary and alternative medicines (CAMs)) were identified as treatment options for sleep disturbances. Particularly, CAMs have become notable treatments for people with poor sleep quality (Kemppainen et al., 2018). In addition, the worldwide use of CAMs has increased in recent decades (de Jonge et al., 2018; Esmel-Esmel et al., 2017). CAMs include a wide list of interventions, such as meditation, tai chi, yoga, herbal medicines, homeopathy, and aromatherapy (de Jonge et al., 2018).

Reflexology is one of the top CAMs (Esmel-Esmel et al., 2017; Jones & Leslie, 2013). This non-invasive treatment produces beneficial effects on the human body by applying pressure to specific areas on some body parts, called reflex areas. Foot reflexology is the practice of using the thumb and forefinger to apply deep pressure to specific areas of the foot (Botting, 1997). Reflexes in the feet are matched to organs, glands, and various systems of the body. Foot reflexology differs from massage in that contact is more superficial and pressure is deeper on specific areas (Wang et al., 2008). According to hemodynamic theory, reflexology stimulation increases blood flow to the related organ and body part, increases a sense of relaxation and improves the healing ability (Smith et al., 2018). It was claimed that by applying pressure to 'reflex zones', energy blocks or disturbances such as calcium, lactate, or uric acid crystals are reabsorbed and later eliminated. This process is more commonly known as detoxification (Wang et al., 2008). Currently, some scholars tend to believe that foot reflexology stimulation enhances nervous connections to corresponding body parts, called the nerve impulse theory (Ramezanibadr et al., 2018). In conclusion, foot reflexology is the stimulation of neural pathways, through which reflex areas are stimulated using the fingers to transmit nerve impulses, restore proper flow of the bloodstream and maintain homeostasis. Foot reflexology is viewed as a potential treatment for sleep disturbances. Also, foot reflexology is treated as a profession where the practitioner applies manual techniques and may apply adjunctive therapies, with the intention of positively affecting the health and well-being of the client (Embong et al., 2015).

To the present, two systematic review studies were conducted to examine the effects of foot reflexology on sleep disturbances (Lee et al., 2011; Yeung et al., 2012). One study included 18 non-randomized control trial (RCT) studies to support a small effect of foot reflexology on sleep (Lee et al., 2011). The other one recruited five RCT studies but did not summarize how foot reflexology can improve sleep disturbances. Moreover differences in the characteristics of study participants and intervention components among studies that applied foot reflexology to improve sleep disturbances were not further examined. Since more RCTs have been published (e.g., Bakir et al., 2018; Chu et al., 2015; Lin et al., 2019; Valizadeh et al., 2015; Yi et al., 2015; Zhang et al., 2015; Zhang et al., 2015), an updated systematic review and meta-analysis need to be conducted to comprehensively evaluate the effectiveness of foot reflexology for treating sleep-related problems.

3 | THE REVIEW

3.1 | Aims

This study attempted to systematically summarize and quantify the effect of foot reflexology on improving sleep disturbances. The specific aims were to examine whether foot reflexology is associated with alleviation of sleep disturbances and further to explore the specific foot reflexology duration and potential mechanisms that are associated with sleep disturbances.

3.2 | Design

This review was conducted on the basis of guidelines in the 'preferred reporting items for systematic reviews and meta-analysis' (PRISMA) statement (Moher et al., 2009). Two independent researchers (HCH and IHC) separately assessed the eligibility, extracted data and checked the quality of the included studies. Additionally, reasons for exclusion were recorded. Any disagreements were resolved through discussion between these two, with adjudication by a third reviewer (KHC) if disagreement persisted.

3.3 | Search methods

A systematic search using designated keyword combinations of (foot reflexology OR foot reflex massage OR foot Chinese massage OR foot meridian massage OR tuina) AND (sleep OR sleep hygiene OR sleep quality OR insomnia OR sleep duration OR sleep disturbances OR sleep deprivation OR sleep latency) was conducted to search for eligible articles. Nine electronic databases, including PubMed, Web of Science, Scopus, Embase, Cochrane, Google Scholar, CINAHL, and two Chinese electronic databases (AiritiLibrary and China National Knowledge Infrastructure), were used to search from their inception to January 31, 2019. Furthermore, reference lists of some articles were reviewed to identify additional relevant articles. Articles were initially screened based on the title and abstract, with the full text sought if the abstract did not provide sufficient information to draw a conclusion regarding eligibility for inclusion in the current review.

3.4 | Study outcomes

To be included in this meta-analysis, studies had to have the following characteristics: the target population was adults over 18 years old (y); the type of foot reflexology was individual foot reflexology or foot reflexology with other interventions (e.g., foot bath, acupressure, or acupuncture); the comparison group(s) received routine care, no treatment, prescribed medications, or other activity controls; outcomes were any changes in sleep disturbances after the intervention; the study design was limited to RCTs; and articles were written in the English or Chinese language. Exclusion criteria were that the study population was pregnant women or postpartum women, because sleep problems are common in the third trimester of pregnancy (e.g., nocturnal waking to void, heartburn, or restless sleep due to foetal movement) and bed-sharing with the infant and breastfeeding behaviours of postpartum women which influence their sleep quality (Owais et al., 2018); and studies of foot massage, duplicate publications, animal studies, presentations, literature reviews, and announcements.

An electronic search of the databases and use of the hand-search approach identified 1985 potentially relevant citations. After removal of duplicates, 1666 citations underwent title and abstract screening according to the above-described study inclusion and exclusion criteria. Eighty-three articles for full-text review were identified and 42 were found to meet the eligibility criteria (Table 1). Of these studies, all 42 were eligible for a quantitative meta-analysis. The screening and article selection processes are summarized in Figure 1.

3.5 | Quality appraisal

The study quality was assessed by two authors (HCH and IHC) using the Cochrane risk of bias assessment tool to evaluate the following domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessments, incomplete outcome data, and selective reporting. Trials with a low risk for all six components were defined as having an overall low risk of bias. Trials where three or more of the six bias components were unclear or had high risk of bias were defined as having a high risk of bias. Any disagreement between reviewers was resolved by consulting the second author (KHC). However, there were no disagreements between the two reviewers.

3.6 | Data abstraction and synthesis

The reviewers independently extracted and assessed data from all eligible studies into a predesigned form in Excel software including the following information: study details (first author, year and country); patient characteristics (gender proportions, age, population, with the problem of insomnia at the baseline, and taking sleep medications); study design (setting, sample size, diagnosis of sleep disturbances, sleep outcome measurement and control treatment); and intervention details (mode of the intervention, reflex zones, applied acupoints, operator and duration and intensity of treatment). Wherever study reports allowed, we used data from the intent-to-treat analysis. In case of missing data, whenever possible, we contacted the trial authors to request missing data via e-mail.

3.6.1 | Statistical analysis

Each study's effect size (ES), demonstrated as Hedges' g, was calculated by comparing the mean and standard deviation (*SD*) of different sleep scales measured immediately after the intervention between the treatment and control groups (Gomez-Bruton et al., 2016). A negative ES infers lower values of a given parameter on treatments than the baseline. Hedges' g values equal to 0.2, 0.5 and 0.8 are respectively considered to be small, medium, and large effects (Kenny & Judd, 2019). For therapeutic effect measures, the odds ratio (OR) was chosen as the summary statistic. The therapeutic effect was evaluated by participants who had sleep problems compared with those without sleep problems in each group after the intervention; hence, data of 2×2 tables of calculating ORs of sleep problems regarding the group status were extracted (an OR of < 1 favours the intervention group). A fixed or random-effect model was adopted to demonstrate the overall effect of foot reflexology on diminishing sleep disturbances. Statistical heterogeneity between studies was investigated using the Q Cochrane statistic and I^2 statistic. A significant Q Cochrane statistic ($p < .10$) and I^2 of ≥ 25% indicate significant heterogeneity among studies (Higgins & Green, 2011).When heterogeneity was substantiated, a random-effect model was used to demonstrate

TABLE 1 Characteristics of the included randomized controlled trial studies

Author (Year)	Country	Women (%)	Mean age, years (*SD*)	Setting	Population	With the problem of insomnia	Sample size (E/C)	Diagnosis of sleep disturbance	Taking sleep medications
Asltoghiri and Ghodsi (2012)	Iran	100	50.1 (2.7)	Community	Menopausal women	Yes	53/47	PSQI > 5	Unclear
Bakir et al. (2018)	Turkey	77	50.2 (14.3)	OPD	RA	Yes	30/30	Unclear	No
Bi (2011)	China	56	45.9 (6.2)	Ward	NA	Yes	64/64	CCMD	Unclear
Cao and Li (2009)	China	46	NA	Unclear	NA	Yes	40/40	Unclear	Unclear
Chu et al. (2015)	China	50	68.0 (2.8)	Ward	Stroke	Yes	50/50	CCMD−3 PSQI > 7	Unclear
Fang (2011)	China	47	59.2 (13.7)	Unclear	DM	Yes	60/60	Unclear	Unclear
Gao (2013)	China	46	54.6 (12.7)	Unclear	DM	Yes	63/62	ICSD	Unclear
Gong et al. (2009)	China	65	51.5 (5.0)	OPD/ward	NA	Yes	60/60	CCMD−3-R	Unclear
He et al., 2014)	China	58	48.2 (1.3)	OPD	NA	Yes	32/32	CCMD PSQI > 7	No
Hou (2009)	China	39	NA	Ward	Elderly	Unclear	40/40	Unclear	Unclear
Lai (2006)	Taiwan	48	51.5 (10.7)	Dialysis clinic	Hemodialysis	Yes	33/25	Unclear	No
Lai (2006)	Taiwan	48	51.6 (10.1)	Dialysis clinic	Hemodialysis	Yes	33/25	Unclear	No
Lian (2016)	China	44	41.8 (5.1)	Ward	Neurasthenia	Yes	47/47	Unclear	Unclear
Lin et al. (2019)	China	40	66.9 (1.9)	Unclear	Elderly with tumor	Yes	30/30	Unclear	Unclear
Liu (2009)	China	55	65.4 (NA)	Ward	NA	Yes	47/46	DSM-IV-TR	Unclear
Liu (2016)	China	44	40.2 (6.2)	Unclear	Neurasthenia	Yes	42/42	Unclear	Unclear
Liu and Xiao (2016)	China	50	63.3 (9.1)	Ward	NA	Yes	75/50	CCMD CAIDTG PSQI > 7	No
Naseri et al. (2016)	Iran	NA	60.5 (12.3)	Ward	CCU patients	No	35/35	Unclear	No
Naseri et al. (2016)	Iran	NA	61.6 (11.7)	Ward	CCU patients	No	35/35	Unclear	No
Ozdelikara and Tan (2017)	Turkey	100	51.0 (11.2)	Ward	Breast cancer with CT	No	30/30	Unclear	Unclear
Shangguan et al. (2009)	China	65	63.8 (9.2)	Ward	Cancer	Unclear	78/78	Unclear	Unclear
Shen and Yao (2018)	China	41	62.7 (7.3)	Unclear	Stroke	No	35/35	PSQI > 17	Unclear
Shen and Xu (2013)	China	61	NA	Ward	Unclear	Yes	40/40	CCMD−3	Unclear
Unal and Balci Akpinar (2016)	Turkey	48	54.3 (13.0)	Dialysis center	Hemodialysis	Unclear	35/35	Unclear	Unclear
Unal and Balci Akpinar (2016)	Turkey	48	54.3 (13.0)	Dialysis center	Hemodialysis	Unclear	35/35	Unclear	Unclear
Valizadeh et al. (2015)	Iran	0	67.0 (4.2)	Health center	Male elderly	Both	23/23	Unclear	Yes
Valizadeh et al. (2015)	Iran	0	67.0 (4.2)	Health center	Male elderly	Both	23/23	Unclear	Yes

(Continues)

TABLE 1 (Continued)

Author (Year)	Country	Women (%)	Mean age, years (*SD*)	Setting	Population	With the problem of insomnia	Sample size (E/C)	Diagnosis of sleep disturbance	Taking sleep medications
Wang and Wu (2012)	China	46	56.0 (0.5)	Ward	CCU patients	Yes	52/52	Unclear	Unclear
Xia (2011)	China	50	37.6 (NA)	Unclear	NA	Yes	26/26	Unclear	Unclear
Xia Zhang (2015)	China	33	63.0 (7.7)	Unclear	Stroke	Yes	60/60	PSQI > 17	Unclear
Xiang (2012)	China	44	43.0 (14.1)	Ward	Kidney diseases	Yes	40/40	AIS ≥ 6	No
Yeh et al. (2014)	China	NA	NA	Ward	Hemodialysis	Yes	46/46	PSQI > 7	Unclear
Yi et al. (2015)	China	48	55.5 (8.0)	Ward	Malignant tumors	Yes	60/60	Unclear	Unclear
Yuan et al. (2012)	China	56	53.7 (13.1)	Ward	Hemodialysis	Yes	40/40	Unclear	No
Zengin and Aylaz (2019)	Turkey	53	NA	OPD	CT	No	84/83	Unclear	Unclear
Zhai et al. (2013)	China	56	53.5 (15.9)	OPD	NA	Yes	40/40	CCMD−3	Unclear
Zhang (2014)	China	59	40.7 (2.8)	Unclear	NA	Yes	40/40	CCMD−3 PSQI > 7	Unclear
Zhang, Chang, et al. (2015)	China	NA	NA	Ward	CV elderly	Yes	64/64	CCMD−3	Unclear
Zhao et al. (2013)	China	34	66.9 (6.5)	Unclear	Stroke elderly	Yes	60/60	PSQI > 7	Unclear
Zhao and Chen (2006)	China	46	74.5 (6.0)	Ward	Elderly	Yes	51/50	CCMD−3	Yes
Zhong et al. (2008)	China	53	40.2 (13.3)	Ward	NA	Yes	32/26	CCMD−3	Unclear
Zhong (2014)	China	43	72.8 (4.9)	Ward	Stroke	Yes	30/30	CCMD−3	Yes
Zhong et al. (2016)	China	41	41.2 (10.7)	Unclear	NA	Yes	53/47	Unclear	Unclear
Zhou et al. (2007)	China	51	38.1 (11.9)	Ward	NA	Yes	46/40	CCMD−3	Unclear
Zhou (2016)	China	41	70.3 (NA)	Ward	Elderly	Yes	38/38	Unclear	Unclear
Zong and Ji (2010)	China	54	54.3 (8.7)	OPD/ward	DM	Yes	32/31	CCMD−3	Unclear

Note.: Abbreviations: AIS, Athens Insomnia Scale; C, control group; CAIDTG, China Adult Insomnia Diagnosis and Treatment Guide; CCMD-3-R, Chinese Classification of Mental Disorders Third Edition Revision; CCU, cardiac care unit; CT, chemotherapy; CV, cardiovascular; DSM-IV-TR, Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (Text Revision); E, experimental group; ICSD, International Classification of Sleep Disorders; NA, no data; OPD, outpatient department; PSQI, Pittsburgh Sleep Quality Index; RA, rheumatoid arthritis; *SD*, standard deviation.

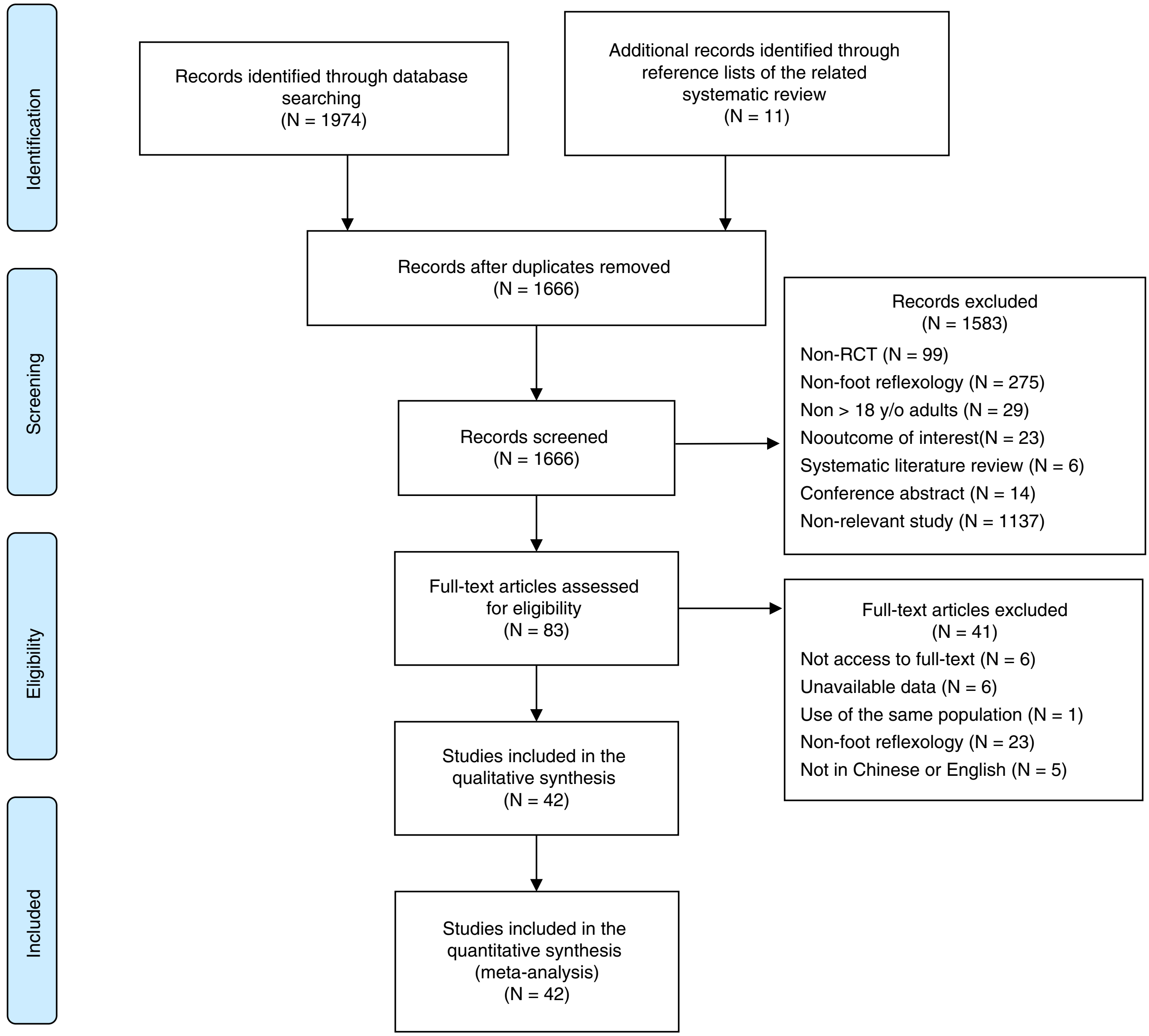

FIGURE 1 Flow diagram. RCT, randomized control trial

the overall effect of foot reflexology on sleep disturbances. Moreover a moderator analysis, including subgroup analyses for categorical variables and meta-regression analyses for continuous variables, was used to examine the potential moderators explaining heterogeneity among these studies (Borenstein et al., 2011). We planned a priori to limit our subgroup analyses to several characteristics such as age, percentage of women, the presence of insomnia, elderly participants, taking sleep medications, intervention modes, pressing acupoints, duration, intensity, operator, reflex zone, syndrome differentiation, and outcome measures. To assess publication bias, we employed Duval and Tweedie's trim and fill method for all sleep parameters (Duval & Tweedie, 2000). Sensitivity analyses were planned a priori for the analyses set by excluding studies with extreme data (>±2 SDs). Data were analysed using Comprehensive Meta-Analysis Software (vers. 3) (Borenstein et al., 2014).

4 | RESULTS

4.1 | Characteristics of the included studies

Table 1 outlines the characteristics of the 42 included studies in alphabetical order of the last name of the first author. Four of these studies used two treatments, thereby increasing the number of possible comparisons to 46. Thus, 46 ESs were used to examine the effect of foot reflexology on sleep disturbances.

Most studies were conducted in developing countries. Totally, 3,928 respondents participated in the 42 studies. The number of participants in each dataset ranged from 46–167, with 16 of them (35%) involving ≥100 participants. Participants were diverse, ranging from menopausal women to older adults and patients with rheumatoid

Model	Study name	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value	Scale
	Bakir (2018)	−1.495	0.289	0.084	−2.061	−0.928	−5.171	0.000	PSQI
	Bi (2011)	−1.515	0.200	0.040	−1.906	−1.123	−7.588	0.000	PSQI
	Chu (2015)	−5.037	0.408	0.166	−5.837	−4.238	−12.354	0.000	PSQI
	Fang (2011)	0.969	0.192	0.037	0.593	1.345	5.051	0.000	PSQI
	Gong (2009)	−0.029	0.181	0.033	−0.384	0.327	−0.159	0.874	PSQI
	He (2014)	−0.437	0.250	0.062	−0.927	0.053	−1.747	0.081	PSQI
	Lai (2006)A	−0.041	0.262	0.068	−0.554	0.471	−0.158	0.874	PSQI
	Lai (2006)B	−1.787	0.310	0.096	−2.394	−1.180	−5.768	0.000	PSQI
	Lian (2016)	−0.983	0.217	0.047	−1.408	−0.558	-4.534	0.000	PSQI
	Lin (2019)	−1.130	0.275	0.076	−1.669	−0.591	−4.110	0.000	PSQI
	Liu & Xiao (2016)	−5.803	0.409	0.168	−6.606	−5.001	−14.174	0.000	PSQI
	Naseri (2016)A	−0.103	0.237	0.056	−0.567	0.361	−0.435	0.663	VSH
	Naseri (2016)B	−1.054	0.253	0.064	−1.549	−0.559	−4.171	0.000	VSH
	Ozdelikara(2017)	−1.443	0.287	0.082	−2.005	−0.881	−5.031	0.000	Sleep subscale of QoL
	Shen (2018)	−2.342	0.308	0.095	−2.946	−1.738	−7.596	0.000	PSQI
	Unal (2016)A	−1.279	0.260	0.068	−1.789	−0.770	−4.921	0.000	PSQI
	Unal (2016)B	−3.090	0.352	0.124	−3.780	−2.399	−8.772	0.000	PSQI
	Valizadeh (2015)A	−0.240	0.291	0.085	−0.810	0.330	−0.825	0.410	PSQI
	Valizadeh (2015)B	−0.792	0.301	0.091	−1.382	−0.201	−2.627	0.009	PSQI
	Wang (2012)	−0.445	0.197	0.039	−0.831	−0.058	−2.256	0.024	AIS
	Xia Zhang (2015)	−2.272	0.233	0.054	−2.729	−1.815	−9.739	0.000	PSQI
	Yeh (2014)	−1.543	0.236	0.056	−2.006	−1.081	−6.540	0.000	PSQI
	Yi (2015)	−0.714	0.187	0.035	−1.081	−0.347	−3.814	0.000	PSQI
	Zengin & Aylaz (2018)	−3.505	0.246	0.061	−3.987	−3.023	−14.248	0.000	PSQI
	Zhang (2014)	−2.175	0.280	0.079	−2.724	−1.625	−7.757	0.000	PSQI
	Zhang (2015)	−0.827	0.183	0.034	−1.186	−0.468	−4.513	0.000	PSQI
	Zhang (2008)	−0.440	0.264	0.070	−0.957	0.077	−1.668	0.095	PSQI
	Zhou (2007)	−0.403	0.216	0.047	−0.828	0.021	−1.864	0.062	PSQI
	Zong (2010)	−0.647	0.255	0.065	−1.147	−0.146	−2.531	0.011	PSQI
Random		−1.374	0.223	0.050	−1.811	−0.938	−6.172	0.000	

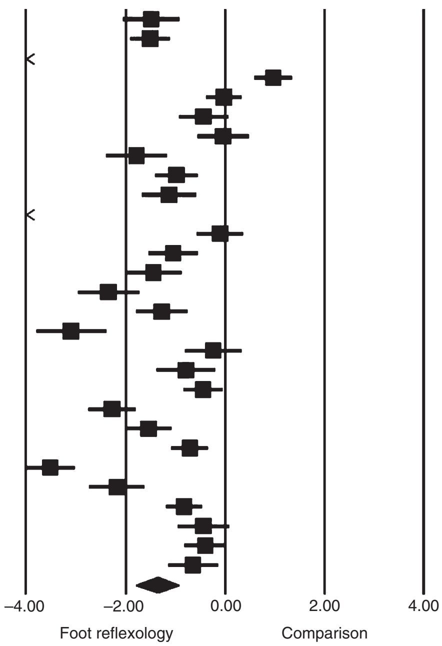

FIGURE 2 Forest plot of Hedges' g between foot reflexology and comparison of sleep quality. Results are shown as effect size and 95% confidence interval. PSQI, Pittsburgh Sleep Quality Index; QoL, Quality of Life; VHS, Verran & Synder-Halpern Sleep Quality; AIS, Athens Insomnia Scale. Note: *p* value of 0.000 indicates $p < .001$

arthritis, stroke, diabetes mellitus, haemodialysis, neurasthenia, cancers, and cardiovascular diseases. Of the 39 studies reporting gender composition, 16 (41.0%) reported a higher percentage of females relative to males. The average age of participants in each study ranged from 37.6– to 74.5 years, with 22 of them greater than 40 year and 15 of them greater than 60 year. Reflex zones varied, from one zone to the entire foot (Table S1). Foot reflexology was combined with acupressure in nine studies, with acupuncture in two studies and with auricular acupressure in two studies and consisted of various numbers of acupoints of from one to 10. Foot reflexology was performed by trained personnel in 19 studies, the subjects themselves in two studies and a foot massager machine in six studies. Foot reflexology in 16 studies lasted ≤14 days and lasted >14 days in 22 studies. As for the intensity of foot reflexology, treatment in four studies lasted ≤120 min and in 10 studies, it lasted >120 min. The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep health outcomes in 15 studies, the therapeutic effect was used in 13 studies and both in 12 studies, while the Athens Insomnia Scale (AIS), sleep subscale of the quality of life scale and Verran & Synder-Halpern (VSH) sleep quality were each used in one study.

4.2 | Risk of bias and quality assessment

Of the 42 studies, all were assessed to have a high risk of bias, with three or more domains being rated as 'high or unclear risk' (Table S2). The domain which had a low level of risk most frequently was bias associated with incomplete outcome data (i.e., no subjects lost), followed by random sequence generation bias (i.e., using a table of random numbers) for studies as assessed by the Cochrane Collaboration's tool for assessing the risk of bias.

4.3 | Sleep disturbance outcomes

4.3.1 | Sleep quality

As to the ES for the 29 foot reflexology trials where sleep quality was assessed, the pooled estimate revealed that foot reflexology achieved a significant increase in sleep quality (ES: −1.37; 95% CI: −1.81~-0.94; $p < .001$). Figure 2 displays a forest plot of the 29 different trails where sleep quality was measured. As suggested, we used a cutoff of $I^2 = 25\%$ when conducting heterogeneity analyses for between-subgroup differences. The test of heterogeneity for findings of studies that assessed sleep quality rejected the null hypothesis of sharing a common ES (Q = 664; $I^2 = 95.78\%$; $p < .001$). For publication bias, the trim and fill method revealed that when removing single studies, the overall ES remained unchanged.

As reported in Table 2, the findings of heterogeneity in the ES of studies entailing a subjective assessment of sleep quality promoted post-hoc exploration of 13 hypotheses to explain its origin. Results demonstrated that age ($p = .106$), the percentage of women ($p = .633$), participants with insomnia at the baseline ($p = .530$), taking sleep medication ($p = .389$), intervention mode ($p = .408$), acupoints ($p = .152$), duration ($p = .835$), intensity ($p = .168$), operators ($p = .073$), syndrome differentiation (referring

TABLE 2 Post-hoc evaluation of effect modifiers

	Summary of effect			Heterogeneity test		
Modifier	**ES (95% CI)**	**Z**	***p***	**Q**	***df***	***p***
Age	−0.04 (−0.10, −0.01)	−1.62	0.106	2.62	1	0.106
Women percentage	−0.01(−0.03,0.02)	−0.48	0.633	0.23	1	0.633
Insomnia				0.39	1	0.530
With insomnia	−1.31(−1.84, −0.77)	−4.80	<0.001			
Without insomnia	−1.69 (−2.75, −0.62)	−3.10	0.002			
Elderly				5.59	1	0.018
≥65 y	−2.04(−2.78, −1.29)	−5.34	<0.001			
<65 y	−0.93(−1.46,−0.39)	−3.38	0.001			
Taking sleep medications				0.74	1	0.389
Yes	−0.52 (−2.49, 1.46)	−0.51	0.609			
No	−1.50 (−2.56, −0.44)	−2.79	0.005			
Intervention mode				0.69	1	0.408
Pure foot reflexology	−1.18 (−1.81, −0.56)	−3.69	<0.001			
Combined intervention	−1.55 (−2.16, −0.95)	−5.03	<0.001			
Pressing acupoints				2.05	1	0.152
Yes	−1.94 (−2.83, −1.05)	−4.28	<0.001			
No	−1.20 (−1.70, −0.70)	−4.69	<0.001			
Duration				0.04	1	0.835
≤14 days	−1.33 (−2.06, −0.60)	−3.56	<0.001			
>14 days	−1.43 (−2.03, −0.82)	−4.63	<0.001			
Intensity				1.90	1	0.168
≤120 min	−0.77 (−1.48, −0.07)	−2.15	0.032			
>120 min	−1.42 (−2.01, −0.83)	−4.75	<0.001			
Operator				3.21	1	0.073
Trained	−1.78 (−2.44, −1.11)	−5.25	<0.001			
Untrained	−0.26 (−1.78, 1.26)	−0.34	0.737			
Reflex zone				10.34	1	0.001
Solar plexus & heart zones	−5.04 (−7.31, −2.77)	−4.35	<0.001			
Other zones	−1.25 (−1.66, −0.84)	−5.93	<0.001			
Syndrome differentiation				0.23	1	0.634
Yes	−1.62 (−2.63, −0.61)	−3.14	0.002			
No	−1.34 (−1.87, −0.81)	−4.97	<0.001			
Outcome measures				1.22	1	0.270
PSQI	−1.48 (−1.95, −1.0)	−6.08	<0.001			
Non-PSQI	−0.76 (−1.94, 0.43)	−1.25	0.21			

Note.: Abbreviations: CI, confidence interval; *df*, degrees of freedom; ES, effect size; min, minutes; PSQI, Pittsburgh Sleep Quality Index; y, years old.

to the diagnosis and treatment based on a patient's overall illness and condition, $p = .643$), and outcome measures ($p = .270$) had no significant effects, indicating that those variables were not related to the statistically significant increases in sleep quality. However, participants being older adults ($p = .018$) and the reflex zones ($p = .001$) had significant effects, indicating that being older adults and reflex zones were associated with statistically significant increases in sleep quality. A sensitivity analysis was performed. After excluding seven trials with an ES of >±2 SDs, the recalculated pooled results (ES: −0.73; 95% CI: −1.02~-0.45; $p < .001$) indicated that foot reflexology still achieved a significant improvement in sleep quality.

We further investigated subscales of the PSQI. The pooled estimates of the ES for the 17 foot reflexology trials, 14 trials, 15 trials,

Model	Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
	Asltoghiri & Ghodsi (2012)	0.334	0.134	0.828	−2.366	0.018
	Bi (2011)	0.174	0.037	0.830	−2.194	0.028
	Cao (2009)	0.053	0.007	0.432	−2.747	0.006
	Chu (2015)	0.031	0.004	0.240	−3.318	0.001
	Gao (2013)	0.0127	0.015	1.063	−1.904	0.057
	Gong (2009)	0.193	0.009	4.114	−1.053	0.292
	He (2014)	0.147	0.029	0.737	−2.330	0.020
	Hou (2009)	0.289	0.115	0.725	−2.644	0.008
	Lian (2016)	0.281	0.092	0.859	−2.227	0.026
	Liu (2009)	0.224	0.086	0.582	−3.070	0.002
	Liu (2016)	0.301	0.096	0.943	−2.061	0.039
	Liu & Xiao (2016)	0.167	0.056	0.496	−3.221	0.001
	Shangguan (2009)	0.123	0.058	0.257	−5.557	0.000
	Valizadeh (2015)A	0.432	0.118	1.581	−1.268	0.205
	Valizadeh (2015)B	0.303	0.084	1.095	−1.821	0.069
	Xia (2011)	0.480	0.041	5.646	−0.584	0.559
	Xiang (2012)	0.193	0.063	0.597	−2.857	0.004
	Zhai (2013)	0.407	0.131	1.259	−1.561	0.119
	Zhang (2014)	0.181	0.036	0.901	−2.087	0.037
	Zhang (2015)	0.266	0.069	1.015	−1.938	0.053
	Zhao (2013)	0.438	0.209	0.916	−2.194	0.028
	Zhao & Chen (2006)	0.344	0.111	1.064	−1.853	0.064
	Zhang (2008)	0.511	0.079	3.316	−0.704	0.482
	Zhong (2016)	0.128	0.027	0.614	−2.570	0.010
	Zhou (2016)	0.165	0.042	0.640	−2.605	0.009
	Zong (2010)	0.443	0.147	1.341	−1.441	0.150
Random		0.246	0.194	0.312	−11.620	0.000

Statistics for each study

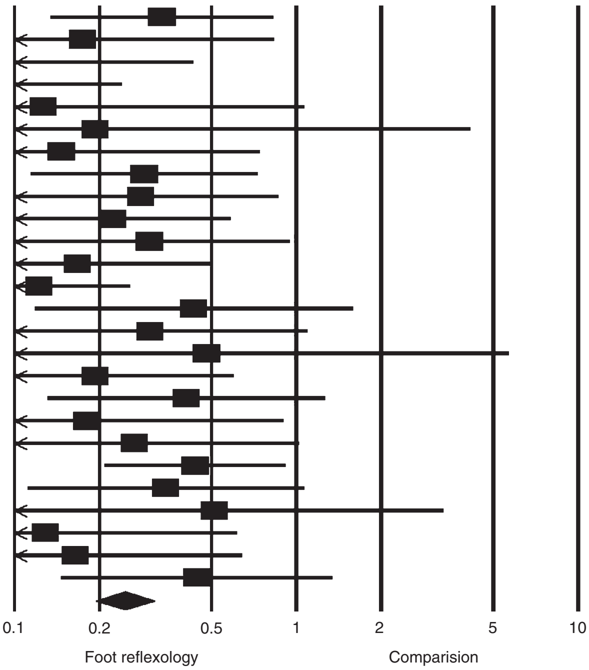

FIGURE 3 Forest plot of odds ratio and 95% confidence interval between foot reflexology and comparison of effective rate. Note: *p* value of 0.000 indicates $p < .001$

13 trials, 14 trials, nine trials, and 13 trials where the subjective sleep quality subscale, sleep latency subscale, sleep duration subscale, sleep efficiency subscale, sleep disturbances subscale, use of sleeping medication subscale and daytime dysfunction subscale were respectively assessed revealed that foot reflexology achieved a significant increase in the subjective sleep quality (ES: −0.69; 95% CI: −1.18~-0.20; $p = .006$), produced an improvement in sleep latency (ES: −1.36; 95% CI: −2.01~-0.71; $p < .001$), increased sleep duration (ES: −1.10; 95% CI: −1.71~-0.51; $p < .001$), improved sleep efficiency (ES: −1.23; 95% CI: −1.88~-0.59; $p < .001$), ameliorated sleep disturbances (ES: −1.18; 95% CI: −2.64~-0.97; $p < .001$), decreased the use of sleep medications (ES: −1.49; 95% CI: −2.41~-0.57; $p = .002$), and decreased daytime dysfunction (ES:-1.80; 95% CI: −2.60~-1.01; $p < .001$).

4.3.2 | Therapeutic effect

The pooled estimate of the ES for 26 foot reflexology trials where the therapeutic effect was assessed revealed a significant improvement in the therapeutic effect by foot reflexology (OR: 0.25; 95% CI: 0.19 ~ 0.31; $p < .001$). Figure 3 displays a forest plot of 26 different trials where the therapeutic effect was measured. The test of heterogeneity for findings of studies assessing the therapeutic effect failed to reject the null hypothesis of sharing a common ES (Q = 19.17; $I^2 = 0\%$; $p = .789$). The trim and fill test for publication bias showed that when removing a single study, the overall ES remained unchanged.

5 | DISCUSSION

This study is important in adding to the evidence about the benefits of foot reflexology in dealing with sleep disturbances. Foot reflexology is associated with fewer adverse events compared with pharmacological interventions (Dashti et al., 2016). Foot reflexology safety and product quality have become healthcare research interests. It is evident that foot reflexology helps eliminate stress, reduce pain, improve blood circulation and restore the mind's balance (Dashti et al., 2016; Nakamaru et al., 2008). Moreover foot reflexology was suggested to improve sleep health (Esmel-Esmel et al., 2017). The beneficial effects of foot reflexology have been researched in various settings using a variety of measures, ranging from self-reported questionnaires to the therapeutic effect. Many diverse investigations reported significant improvements in objectively assessed sleep parameters and/or subjectively rated sleep quality. Hence, an aspect of our review of the literature included identification of factors related to successful improvement in sleep by foot reflexology.

Our meta-analyses revealed that foot reflexology statistically significantly improved sleep quality and produced a reduction in the risk of having sleep problems by about 75%. Foot reflexology possibly works by stimulating the release of endorphins, decreasing sympathetic nervous system activity, increasing responses of the parasympathetic nervous system and stimulating circulation and in these ways may help increase feelings of well-being and relaxation (Esmel-Esmel et al., 2017; Ramezanibadr et al., 2018). Researchers have investigated the effects of foot reflexology on brain activity using functional magnetic resonance imaging (fMRI) and evaluated findings using the blood oxygen level demand response which is related to changes in blood flow to the brain during activation and results showed positive responses due to foot reflexology (Sliz et al., 2012). Additionally, research using fMRI demonstrated that foot reflexological stimulation induced a somatosensory process corresponding to the stimulated reflex areas (Nakamaru et al., 2008) and showed an immediate hemodynamic effect corresponding to the stimulated reflex areas by cardiac index or colour Doppler sonography (Jones et al., 2012; Sudmeier et al., 1999). Also, skin contact is considered a secondary mechanism because of relaxation and the release of oxytocin. Oxytocin is a neuropeptide hormone with a protective effect on the autonomic and cardiovascular systems, which in turn, may improve sleep health (Jain et al., 2017; Schuh-Hofer et al., 2018).

Results of this study further showed that foot reflexology can improve subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, sleep medication use, and daytime dysfunction. Particularly, evidence showed the existence of a strong relationship between the application of foot reflexology and the onset of sleep; further, no difference was demonstrated between those who had knowledge of reflexology and those who had no knowledge (Esmel-Esmel et al., 2017). Accordingly, foot reflexology can be used as a non-pharmacological treatment to induce sleep.

The solar plexus and heart zones were found to contribute to significantly improved sleep quality in this study. The sole of the foot was divided into three parts with the solar plexus on the border between the upper and middle one-third of sole (where a folding line is created when the sole folds) which is located near the second and third toes and its function is to help with metabolism and digestion problems, to reduce stress and anxiety with the help of deep relaxation and increase the body's tolerance for stress (Moghimi-Hanjani et al., 2015; Ramezanibadr et al., 2018; Salvo, 2016). The heart zone is located in the middle region of the ball of the left foot, in the area beneath the fourth and fifth toes (Rollinson et al., 2016) and its function is to slow the heart rate, increase arterial compliance, decrease blood pressure, improve insomnia caused by cardiac dysfunction and reduce mental stress (Jones & Leslie, 2013; Rollinson et al., 2016). Accordingly, it is suggested that the solar plexus and heart zones can be included as necessary reflex zones for treating sleep disturbances. It should be noted that each reflexological foot chart may have subtle differences leading to difficulties in pinpointing specific reflexes (Yan et al., 2015). The lack of precision and agreement may result in a perceived lack of validity of foot reflexology among medical professionals and laypeople. Recently, for instance, a technique that combined an optical projection and vision measurement was proposed to accurately identify reflexive zones of the foot. This method was claimed to be a simple, easy-to-use and low-cost approach (Yan et al., 2015) and may resolve the issue of the validity of foot reflexology.

Our study results demonstrated that foot reflexology had greater influences in older adults. Possible reasons are first, differences in reporting patterns. Compared with younger populations, older adults are more likely to use foot reflexology. Eighty-eight percent of adults aged ≥65 year, for instance, applied CAMs to reduce symptoms of disease in the US (Stockigt et al., 2013). The use of CAMs is more common in older people that have a chronic condition (e.g., insomnia) (Gallego et al., 2019). Furthermore, increasing numbers of older adults with cognitive impairment are resorting to various kinds of CAMs (Esmel-Esmel et al., 2017; Parmar et al., 2018). For instance, a study showed that worldwide prevalences of patients with Parkinson's diseases using CAMs ranged 25.7–76% and prevalences of using foot reflexology were 7%–10% (Wang et al., 2013). Second, older adults might not be optimistic about the safety of sleep drugs and prefer to use foot reflexology (Rhee et al., 2018); consequently, studies might recruit more older adults or researchers may tend to investigate older adults. Prevalences of sleep disturbances among older adults are high globally, ranging from 6% in Taiwan to 62.1% in Egypt (Gulia & Kumar, 2018). Shorter sleep durations and changes in sleep patterns occur as people age; older adults tend to have difficulty falling asleep and in staying asleep and spend more time in the N1 and N2 phases than in the N3 phase (Schroeck et al., 2016; Shi et al., 2018). Also, sleep disturbances among older adults are frequently related to an underlying medical or psychiatric condition (Chen et al., 2019) and insomnia is one of the most common sleep disturbances in this population (Shi et al., 2018). Although pharmacological interventions are usually employed to treat sleep disturbances, older adult populations are at increased risks of experiencing adverse reactions from sleep medications. A previous study demonstrated that more than one-third of a US national sample (n = 1,065 older adults) inappropriately used medications or aids to help with sleep. Thus, older adults using medications or aids might not be aware of potential safety risks (Maust et al., 2019). Third, the perceived effectiveness of reflexology may be related to the effects on activities of daily living and quality of life rather than a direct influence on sleep disturbances. Foot reflexology may make older adults feel empowered as to their ability to make informed health-related decisions, as foot reflexology promotes a participatory and more-active role (Gallego et al., 2019). In turn, older adults have higher self-responsibility and compliance, and their psychosocial aspect of health is better as sleep disturbances are mitigated. However, it is evident that only a few patients receive referrals to use CAMs from healthcare professionals (Wang et al., 2013), indicating that more-effective communication about the use of foot reflexology between patients and healthcare professionals is needed. Healthcare providers are often unaware of foot reflexology use as patients with sleep disturbances neglect to inform their physicians. This study provides scientific evidence explaining how foot reflexology may work and confers sleep disturbance benefits. Older adults should communicate about foot reflexology with their physicians, or healthcare providers can actively ask older adult patients about foot reflexology use and monitor any potential side effects.

Most included articles were conducted in developing countries and the reason perhaps is that the price of foot reflexology is lower in those countries, thereby contributing to higher public acceptance. In developed countries, a limitation on the use of foot reflexology is that the cost of foot reflexology is an out-of-pocket expenditure and it is recommended that patients with low incomes are the least capable of affording foot reflexology (Klein et al., 2012). For instance, traditional Chinese medicine practiced by a certified physician in Taiwan is covered by the mandatory health insurance. Likewise, foot reflexology may be covered by health insurance.

5.1 | Strengths and limitations

In this study, we found that syndrome differentiation, which is a person-centralized method viewed as an effective way to improve a person's health conditions (Rhee et al., 2018), did not significantly contribute to improvements in sleep quality. Additionally, having insomnia or not at the baseline did not influence significant improvements in sleep quality. These results suggest that foot reflexology may be transferable between different populations. Further, we could not find a dose–response effect of foot reflexology on sleep quality. It is suggested that foot reflexology can be used regularly to support sleep health. This meta-analytical study found that foot reflexology performed by either a mechanical reflexological device, oneself, or a professional was similarly effective; hence, professionals can be trained how to exactly perform pressure stimulation of reflex zones; self-administered foot reflexology should emphasize education for correct skills of foot reflexology with regular monitoring of cases with self-administered foot reflexology to achieve efficacy.

The results need to be interpreted in the light of some limitations. First, although we included articles written in English and Chinese, a few articles written in other languages were not included in the evaluation. Second, although foot reflexology has beneficial effects on sleep, the quality of most of the included studies was low and a detailed description of the intervention was not given; hence, this reduced the validity of confirming the basis for foot reflexology. Well-designed, large-scale RCTs that assess long-term effect are needed to confirm the present findings and provide more evidence of the effects of foot reflexology on sleep disturbances. It is suggested that studies can include a control group that involves no touch or pressure, which may reduce the incidence of the placebo effect, since touch or pressure is viewed as an integral part of the response to reflexology (Ramezanibadr et al., 2018), or studies can employ the same participant-operator interaction in the intervention and control groups which can reduce the difference between groups (Steenkamp et al., 2012). Third, variations existed among the included studies as to the types of patients. Fourth, because of the different diagnostic criteria for sleep disturbances across the included studies, the results may be biased and should be further validated. Fifth, despite its popularity, current RCT studies on the topic have mostly focused on subjective outcomes. Sixth, the meta-analysis was not registered with PROSPERO.

6 | CONCLUSION

Nowadays, the public is generally seeking more-holistic ways to maintain good health and well-being. Trends of sleep disturbances and the use of foot reflexology have both increased, indicating that a shift in the risk-benefit balance of pharmacological treatments has created growing interest in foot reflexology for sleep disturbances. Further research is needed to explain older adults' patterns of foot reflexology and medical pluralism engagement, which will better inform healthcare providers regarding impacts of this population's foot reflexology-related behaviours on their health needs. Additional research is needed to develop intervention guidelines to standardize foot reflexology so as to provide a reference for clinical practice and make better use of foot reflexology in caring for patients with sleep disturbances. We suggest that healthcare professionals add foot reflexology to their clinical practice and train their patients to apply this technique themselves, which would improve self-management of sleep disturbances and achieve better health results (Steenkamp et al., 2012). However, the effects of foot reflexology on sleep quality as determined in this meta-analysis should be interpreted with caution due to concerns about the methodological quality.

CONFLICT OF INTERESTS

The authors have no conflicts of interest to disclose.

AUTHOR CONTRIBUTIONS

HCH: conceptualization, writing-original draft, writing-review and editing, data curation, investigation. KHC: conceptualization, visualization, writing-review and editing. SFK: conceptualization, writing-review and editing. IHC: conceptualization, visualization, writing-original draft, writing-review and editing, data curation, investigation. All authors have agreed on the final version.

FUNDING INFORMATION

I-Hui Chen was supported by a Taipei Medical University Research Grant for New Faculty (grant no. 106-6004-004-112). The funder of this study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1111/jan.14699.

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NOTE.

Abbreviations: ?, unknown; AIS, Athens Insomnia Scale; CT, chemotherapy; PSQI, Pittsburgh Sleep Quality Index; QOL, quality of life; VHS, Verran & Synder-Halpern Sleep Quality; wks, weeks.

REFERENCES

References marked with an asterisk (*) indicate studies included in the meta-analysis.

Abbasi Fakhravari, A., Bastani, F., & Haghani, H. (2018). The effect of foot reflexology massage on the sleep quality of elderly women with restless leg syndrome. *Journal of Client-Centered Nursing Care*, *4*(2), 96–103. https://doi.org/10.32598/jccnc.4.2.96

Asltoghiri, M., & Ghodsi, Z.* (2012). The effects of reflexology on sleep disorder in menopausal women. *Procedia - Social and Behavioral Sciences*, *31*, 242–246. https://doi.org/10.1016/j.sbspro.2011.12.049

Bakir, E., Baglama, S. S., & Gursoy, S.* (2018). The effects of reflexology on pain and sleep deprivation in patients with rheumatoid arthritis: A randomized controlled trial. *Complementary Therapies in Clinical Practice*, *31*, 315–319. https://doi.org/10.1016/j.ctcp.2018.02.017

Bi, S.* (2011). Observation on curative effect of traditional Chinese drug foot bath in combination with foot sole massage to treat patients with insomnia and nursing care of them. *Chinese Nursing Research*, *25*(5), 1376–1377.

Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2011). *Introduction to meta-analysis*. John Wiley & Sons Ltd.

Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2014). *Comprehensive meta-analysis (version 3.3.070) [Computer software]*. : Biostat.

Botting, D. (1997). Review of literature on the effectiveness of reflexology. *Complementary Therapies in Nursing and Midwifery*, *3*(5), 123–130. https://doi.org/10.1016/S1353-6117(97)80012-1

Cao, X. F., & Li, S. F.* (2009). Nursing experience of foot reflex massage to prevent insomnia. *Chinese Medicine Modern Distance Education of China*, *7*(6), 168–169.

Chen, I.-H., Yeh, T.-P., Yeh, Y.-C., Chi, M.-J., Chen, M.-W., Chou, K.-R., Lien, Y.-Y., & Yuan, C.-F. (2019). Effects of acupressure on sleep quality and psychological distress in nursing home residents: A randomized controlled trial. *Journal of the American Medical Directors Association*, *20*(7), 822–829. https://doi.org/10.1016/j.jamda.2019.01.003

Chu, X., Kang, Q., & Hang, Y.* (2015). Application of foot acupoint massage in sleep disorders in patients with cerebral apoplexy. *Chinese Nursing Research*, *29*(11B), 4041–4043. https://doi.org/10.3969/j.issn.1009-6493.2015.32.025

Daley, M., Morin, C. M., LeBlanc, M., Grégoire, J. P., & Savard, J. (2009). The economic burden of insomnia: Direct and indirect costs for individuals with insomnia syndrome, insomnia symptoms and good sleepers. *Sleep*, *32*(1), 55–64. https://doi.org/10.5665/sleep/32.1.55

Dashti, S., Shahmari, M., Mirzaaghazadeh, A., & Mirzaaghazadeh, M. (2016). Effect of foot reflexology and olive oil foot massage on asthma control. *Global Journal of Health Science*, *8*(12), 53–59. https://doi.org/10.5539/gjhs.v8n12p53

de Jonge, P., Wardenaar, K. J., Hoenders, H. R., Evans-Lacko, S., Kovess-Masfety, V., Aguilar-Gaxiola, S., Al-Hamzawi, A., Alonso, J., Andrade, L. H., Benjet, C., Bromet, E. J., Bruffaerts, R., Bunting, B., Caldas-de-Almeida, J. M., Dinolova, R. V., Florescu, S., de Girolamo, G., Gureje, O., Haro, J. M., … Thornicroft, G. (2018). Complementary and alternative medicine contacts by persons with mental disorders in 25 countries: Results from the World Mental Health Surveys. *Epidemiology and Psychiatric Sciences*, *27*(6), 552–567. https://doi.org/10.1017/S2045796017000774

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, *56*(2), 455–463. https://doi.org/10.1111/j.0006-341x.2000.00455.x

Embong, N. H., Soh, Y. C., Ming, L. C., & Wong, T. W. (2015). Revisiting reflexology: Concept, evidence, current practice and practitioner training. *Journal of Traditional and Complementary Medicine*, *5*(4), 197–206. https://doi.org/10.1016/j.jtcme.2015.08.008

Esmel-Esmel, N., Tomas-Esmel, E., Tous-Andreu, M., Bove-Ribe, A., & Jimenez-Herrera, M. (2017). Reflexology and polysomnography: Changes in cerebral wave activity induced by reflexology promote N1 and N2 sleep stages. *Complementary Therapies in Clinical Practice*, *28*, 54–64. https://doi.org/10.1016/j.ctcp.2017.05.003

Fang, L. Y.* (2011). Observation of foot self-massage to improve sleep disturbance in diabetic patients. *Journal of Anhui Health Vocational & Technical College*, *10*(1), 73–74.

Gallego, G., Gugnani, S., Armour, M., Smith, C. A., & Chang, E. (2019). Attitudes and factors involved in decision-making around complementary and alternative medicines (CAMs) by older Australians: A qualitative study. *European Journal of Integrative Medicine*, *29*, 100930. https://doi.org/10.1016/j.eujim.2019.100930

Gao, Z.* (2013). Clinical analysis of foot bath massage for type 2 diabetic insomnia. *China & Foreign Medical Treatment*, *32*, 82–84.

Gomez-Bruton, A., Montero-Marin, J., Gonzalez-Aguero, A., Garcia-Campayo, J., Moreno, L. A., Casajus, J. A., & Vicente-Rodriguez, G. (2016). The effect of swimming during childhood and adolescence on bone mineral density: A systematic review and meta-analysis. *Sports Medicine*, *46*(3), 365–379. https://doi.org/10.1007/s40279-015-0427-3

Gong, Y. L., Zhang, Y. B., Han, C., Jiang, Y. Y., Li, Y., Chen, S. C., & Liu, Z. Y.* (2009). Clinical observation on therapeutic effect of the pressing plantar reflex area with wooden needle for treatment of patients with insomnia. *Zhongguo Zhen Jiu*, *29*(11), 935–937.

Grandner, M. A. (2017). Sleep, health and society. *Sleep Medicine Clinics*, *12*(1), 1–22. https://doi.org/10.1016/j.jsmc.2016.10.012

Gulia, K. K., & Kumar, V. M. (2018). Sleep disorders in the elderly: A growing challenge. *Psychogeriatrics*, *18*(3), 155–165. https://doi.org/10.1111/psyg.12319

Hafner, M., Stepanek, M., Taylor, J., Troxel, W. M., & van Stolk, C. (2017). Why sleep matters-the economic costs of insufficient sleep: A cross-country comparative analysis. *Rand Health Quarterly*, *6*(4), 11.

He, W., Zhou, H., & Huang, F.* (2014). Effect of Ningshen Zhumian Decoction combined with foot reflex therapy on insomnia. *Chinese Manipulation & Rehabilitation Medicine*, *5*(3), 123–124.

Higgins, J., & Green, S. (2011). Cochrane handbook for systematic reviews of interventions. Version 5.1.0. The Cochrane Collaboration.

Hou, W. L.* (2009). Effect of Chinese traditional medicine foot bath on sleep quality of elderly patients. *Hubei Journal of Traditional Chinese Medicine*, *31*(10), 53.

Hui, S. K. A., & Grandner, M. A. (2015). Trouble sleeping associated with lower work performance and greater health care costs: Longitudinal data from Kansas State employee wellness program. *Journal of Occupational and Environmental Medicine*, *57*(10), 1031–1038. https://doi.org/10.1097/JOM.0000000000000534

Jain, V., Marbach, J., Kimbro, S., Andrade, D. C., Jain, A., Capozzi, E., Mele, K., Del Rio, R., Kay, M. W., & Mendelowitz, D. (2017). Benefits of oxytocin administration in obstructive sleep apnea. *The American Journal of Physiology-Lung Cellular and Molecular Physiology*, *313*(5), L825–l833. https://doi.org/10.1152/ajplung.00206.2017

Jike, M., Itani, O., Watanabe, N., Buysse, D. J., & Kaneita, Y. (2018). Long sleep duration and health outcomes: A systematic review, meta-analysis and meta-regression. *Sleep Medicine Reviews*, *39*, 25–36. https://doi.org/10.1016/j.smrv.2017.06.011

Jones, J., & Leslie, S. J. (2013). Reflexology - science or belief, in: Alternative Medicine:Practices, Health Benefits and Controversies, pp. 27–60. Retrieved from http://www.scopus.com/inward/record.url?eid¼2-s2.084891970721&partnerID¼tZOtx3y1

Jones, J., Thomson, P., Lauder, W., Howie, K., & Leslie, S. J. (2012). Reflexology has an acute (immediate) haemodynamic effect in healthy volunteers: A double-blind randomised controlled trial. *Complementary Therapies in Clinical Practice*, *18*(4), 204–211. https://doi.org/10.1016/j.ctcp.2012.03.006

Kemppainen, L. M., Kemppainen, T. T., Reippainen, J. A., Salmenniemi, S. T., & Vuolanto, P. H. (2018). Use of complementary and alternative medicine in Europe: Health-related and sociodemographic determinants. *Scandinavian Journal of Public Health*, *46*(4), 448–455. https://doi.org/10.1177/1403494817733869

Kenny, D. A., & Judd, C. M. (2019). The unappreciated heterogeneity of effect sizes: Implications for power, precision, planning of research and replication. *Psychological Methods*, *24*(5), 578–589. https://doi.org/10.1037/met0000209

Klein, S. D., Frei-Erb, M., & Wolf, U. (2012). Usage of complementary medicine across Switzerland: Results of the Swiss Health Survey 2007. *Swiss Medical Weekly*, *142*, w13666. https://doi.org/10.4414/smw.2012.13666

Lai, P. C.* (2006). Effect of foots reflexology in patients with end-stage renal disease. (Master). National Taipei University of Nursing and Health Sciences, Taipei. Retrieved from https://hdl.handle.net/11296/t43f9a

Lallukka, T., Sivertsen, B., Kronholm, E., Bin, Y. S., Øverland, S., & Glozier, N. (2018). Association of sleep duration and sleep quality with the physical, social and emotional functioning among Australian adults. *Sleep Health*, *4*(2), 194–200. https://doi.org/10.1016/j.sleh.2017.11.006

Lee, J., Han, M., Chung, Y., Kim, J., & Choi, J. (2011). Effects of foot reflexology on fatigue, sleep and pain: A systematic review and meta-analysis. *Journal of Korean Academy of Nursing*, *41*(6), 821–833. https://doi.org/10.4040/jkan.2011.41.6.821

Lian, H. R.* (2016). Efficacy observation of treatment of insomnia resulted from neurasthenia by massage. *Clinical Journal of Chinese Medicine*, *8*(6), 118–119.

Lin, Y., Fang, A., & Fang, X.* (2019). The ameliorative effect of traditional Chinese medicine fumigating on the sleep disorders of elderly tumor patients due to heart-sleep deficiency. *Nursing of Integrated Traditional Chinese and Western Medicine*, *5*(1), 63–65.

Liu, L. H., & Xiao, D.* (2016). Application on combination of traditional Chinese medicine foot bath and foot acupoint massage in the treatment of insomnia patients with stagnation of liver fire type. *China Modern Medicine*, *23*(27), 140–142.

Liu, X. W.* (2016). Effect of massage treatment on insomnia caused by cerebral neurasthenia. Modern Health, 62.

Liu, Z. Y.* (2009). Foot massge with traditional Chinese medicine in the treatment of insomnia. *International Journal of Traditional Chinese Medicine*, *31*(5), 441.

Maust, D. T., Solway, E., Clark, S. J., Kirch, M., Singer, D. C., & Malani, P. (2019). Prescription and nonprescription sleep product use among older adults in the United States. *The American Journal of Geriatric Psychiatry*, *27*(1), 32–41. https://doi.org/10.1016/j.jagp.2018.09.004

Moghimi-Hanjani, S., Mehdizadeh-Tourzani, Z., & Shoghi, M. (2015). The effect of foot reflexology on anxiety, pain and outcomes of the labor in primigravida women. *Acta Medica Iranica*, *53*(8), 507–511.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Nakamaru, T., Miura, N., Fukushima, A., & Kawashima, R. (2008). Somatotopical relationships between cortical activity and reflex areas in reflexology: A functional magnetic resonance imaging study. *Neuroscience Letters*, *448*(1), 6–9. https://doi.org/10.1016/j.neulet.2008.10.022

Naseri, M., Rahmani, A., Nerir, B., Salari, M., & Farahani, M.* (2016). Effect of foot reflexology massage and foot bath on the sleep quality of patients with acute coronary syndrome: A comparative study. *Journal of Critical Care Nursing*, *9*(4), 1–8. https://doi.org/10.17795/ccn-10294

Ohayon, M. M. (2002). Epidemiology of insomnia: What we know and what we still need to learn. *Sleep Medicine Reviews*, *6*(2), 97–111. https://doi.org/10.1053/smrv.2002.0186

Ohayon, M. M. (2009). Observation of the natural evolution of insomnia in the American general population cohort. *Sleep Medicine Clinics*, *4*(1), 87–92. https://doi.org/10.1016/j.jsmc.2008.12.002

Owais, S., Chow, C. H. T., Furtado, M., Frey, B. N., & van Lieshout, R. J. (2018). Non-pharmacological interventions for improving postpartum maternal sleep: A systematic review and meta-analysis. *Sleep Medicine Reviews*, *41*, 87–100. https://doi.org/10.1016/j.smrv.2018.01.005

Ozdelikara, A., & Tan, M.* (2017). The effect of reflexology on the quality of life with breast cancer patients. *Complementary Therapies in Clinical Practice*, *29*, 122–129. https://doi.org/10.1016/j.ctcp.2017.09.004

Palmer, C. A., & Alfano, C. A. (2017). Sleep and emotion regulation: An organizing, integrative review. *Sleep Medicine Reviews*, *31*, 6–16. https://doi.org/10.1016/j.smrv.2015.12.006

Parmar, R., Brewer, B. B., & Szalacha, L. A. (2018). Foot massage, touch and presence in decreasing anxiety during a magnetic resonance imaging: A feasibility study. *Journal of Alternative and Complementary Medicine*, *24*(3), 268–275. https://doi.org/10.1089/acm.2016.0274

Ramezanibadr, F., Amini, K., Hossaingholipor, K., & Faghihzadeh, S. (2018). The impacts of foot reflexology on anxiety among male candidates for coronary angiography: A three-group single-blind randomized clinical trial. *Complementary Therapies in Clinical Practice*, *32*, 200–204. https://doi.org/10.1016/j.ctcp.2018.07.005

Rhee, T. G., Marottoli, R. A., van Ness, P. H., & Tinetti, M. E. (2018). Patterns and perceived benefits of utilizing seven major complementary health approaches in U.S. older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, *73*(8), 1119–1124. https://doi.org/10.1093/gerona/gly099

Rollinson, K., Jones, J., Scott, N., Megson, I. L., & Leslie, S. J. (2016). The acute (immediate) effects of reflexology on arterial compliance in healthy volunteers: A randomised study. *Complementary Therapies in Clinical Practice*, *22*, 16–20. https://doi.org/10.1016/j.ctcp.2015.11.001

Salvo, S. (2016). *Massage therapy: Principle and practice*, 5th ed. Elsevier.

Sateia, M. J., Buysse, D., Krystal, A. D., Neubauer, D. N., & Heald, J. L. (2017). Clinical practice guideline for the pharmacologic treatment of chronic insomnia in adults: An American academy of sleep medicine clinical practice guideline. *Sleep*, *40*, A147. https://doi.org/10.1093/sleepj/zsx050.394

Schroeck, J. L., Ford, J., Conway, E. L., Kurtzhalts, K. E., Gee, M. E., Vollmer, K. A., & Mergenhagen, K. A. (2016). Review of safety and efficacy of sleep medicines in older adults. *Clinical Therapeutics*, *38*(11), 2340–2372. https://doi.org/10.1016/j.clinthera.2016.09.010

Schuh-Hofer, S., Eichhorn, N., Grinevich, V., & Treede, R. D. (2018). Sleep deprivation related changes of plasma oxytocin in males and female contraceptive users depend on sex and correlate differentially with anxiety and pain hypersensitivity. *Frontiers in Behavioral Neuroscience*, *12*, 161. https://doi.org/10.3389/fnbeh.2018.00161

Shangguan, X. Y., Chen, X. Q., Lin, H. J., & Li, H. L.* (2009). Impact of hand-foot-point massage on cancer patients suffering from insomnia or constipation. *Nursing Journal of Chinese People's Liberation Army*, *26*(2), 14–15.

Shen, F. Z., & Xu, S. S.* (2013). Effect of holographic foot massage on sleep quality in patients with insomnia. *China TCM Science & Technology*, *20*(5), 514–515.

Shen, Z. Q., & Yao, Q. Y.* (2018). Clinical value of auricular pressure pill combined with foot massage / acupoint application in the treatment of sleep disorders after stroke. *Aerospace Medical Journal*, *29*(4), 435–436.

Shi, L. E., Chen, S.-J., Ma, M.-Y., Bao, Y.-P., Han, Y., Wang, Y.-M., Shi, J., Vitiello, M. V., & Lu, L. (2018). Sleep disturbances increase the risk of dementia: A systematic review and meta-analysis. *Sleep Medicine Reviews*, *40*, 4–16. https://doi.org/10.1016/j.smrv.2017.06.010

Sliz, D., Smith, A., Wiebking, C., Northoff, G., & Hayley, S. (2012). Neural correlates of a single-session massage treatment. *Brain*

Imaging and Behavior, *6*(1), 77–87. https://doi.org/10.1007/s11682-011-9146-z
Smith, C. A., Levett, K. M., Collins, C. T., Dahlen, H. G., Ee, C. C., & Suganuma, M. (2018). Massage, Reflexology and Other Manual Methods for Pain Management in Labour. *Cochrane Database of Systematic Reviews*, *3*(3), CD009290. https://doi.org/10.1002/14651858.CD009290.pub3
Steenkamp, E., Scrooby, B., & van der Walt, C. (2012). Facilitating nurses' knowledge of the utilisation of reflexology in adults with chronic diseases to enable informed health education during comprehensive nursing care. *Health SA Gesondheid*, *17*(1), 512. https://doi.org/10.4102/hsag.v17i1.567
Stockigt, B., Teut, M., & Witt, C. M. (2013). CAM use and suggestions for medical care of senior citizens: A qualitative study using the World Cafe Method. *Evidence-Based Complementary and Alternative Medicine Journal*, *2013*, 951245. https://doi.org/10.1155/2013/951245
Sudmeier, I., Bodner, G., Egger, I., Mur, E., Ulmer, H., & Herold, M. (1999). Changes of renal blood flow during organ-associated foot reflexology measured by color Doppler sonography. *Forsch Komplementarmed*, *6*(3), 129–134. https://doi.org/10.1159/000021238
Unal, K. S., & Balci Akpinar, R.* (2016). The effect of foot reflexology and back massage on hemodialysis patients' fatigue and sleep quality. *Complementary Therapies in Clinical Practice*, *24*, 139–144. https://doi.org/10.1016/j.ctcp.2016.06.004
Valizadeh, L., Seyyedrasooli, A., Zamanazadeh, V., & Nasiri, K.* (2015). Comparing the effects of reflexology and footbath on sleep quality in the elderly: A controlled clinical trial. *The Iranian Red Crescent Medical Journal*, *17*(11), e20111. https://doi.org/10.5812/ircmj.20111
Wang, M. Y., Tsai, P. S., Lee, P. H., Chang, W. Y., & Yang, C. M. (2008). The efficacy of reflexology: Systematic review. *Journal of Advanced Nursing*, *62*(5), 512–520. https://doi.org/10.1111/j.1365-2648.2008.04606.x
Wang, Y. L., & Wu, Y. X.* (2012). The effect of foot reflex massage plus antipsychotic pillow on sleep quality in patients with CCU sleep disorders. *Journal of Qilu Nursing*, *18*(1), 38–39.
Wang, Y., Xie, C., Wang, W. W., Lu, L., Fu, D., Wang, X. T., & Zheng, G. (2013). Epidemiology of complementary and alternative medicine use in patients with Parkinson's disease. *Journal of Clinical Neuroscience*, *20*(8), 1062–1067. https://doi.org/10.1016/j.jocn.2012.10.022
Xia, T. G.* (2011). Acupuncture massage combined with sleep disorders. *Chinese Manipulation & Rehabilitation Medicine*, *48*(4), 107.
Xiang, Q.* (2012). Nursing discussion on soaking foot in Chinese herbal solution combined with sole massage in the treatment of renal failure patients with insomnia. *Journal of Zhejiang Chinese Medical University*, *36*(7), 832–833.
Yan, Y., Ouyang, J., & Ma, X. (2015). Optical method locating the reflexive zones of the foot sole using image registration. *Journal of Medical Imaging and Health Informatics*, *5*(6), 1156–1162. https://doi.org/10.1166/jmihi.2015.1519
Yeh, B., Li, Z., & Xu, W.* (2014). Clinical study of point massage to improve sleep quality in hemodialysis patients. *Chinese Archives of Traditional Chinese Medicine*, *32*(10), 2554–2555.
Yeung, W.-F., Chung, K.-F., Poon, M.-K., Ho, F.-Y., Zhang, S.-P., Zhang, Z.-J., Ziea, E.-C., & Wong, V. T. (2012). Acupressure, reflexology and auricular acupressure for insomnia: A systematic review of randomized controlled trials. *Sleep Medicine*, *13*(8), 971–984. https://doi.org/10.1016/j.sleep.2012.06.003
Yi, Z. X., Zhang, P., & Zhang, C. C.* (2015). The influence of TCM rehabilitation on insomnia of patients with malignant tumors. *Henan Traditional Chinese Medicine [he Nan Zhong Yi]*, *35*(8), 1904–1906.
Yuan, Y. P., Luo, X. M., & Li, L.* (2012). Effect of two Chinese medicine physical theerapies on sleep quality of hemodialysis patients with sleeping disorders. *Journal of Nursing (China)*, *19*(2), 68–70.
Zengin, L., & Aylaz, R.* (2019). The effects of sleep hygiene education and reflexology on sleep quality and fatigue in patients receiving chemotherapy. *European Journal of Cancer Care*, *28*(3), 1–11. https://doi.org/10.1111/ecc.13020
Zhai, Y., Huo, R., & Ling, F.* (2013). Treatment of insomnia by traditional Chinese medicine medicinal liquor steam anion foot bath combined with foot massage randomized controlled research. *Journal of Practical Traditional Chinese Internal Medicine*, *27*(2), 31–33.
Zhang, C. J., Chang, L., & Sun, Y. H.* (2015). The clinical research on senile insomnia treated with integrative therapy of foot bath with Chinese medicine and massage of foot points. *Henan Traditional Chinese Medicine [he Nan Zhong Yi]*, *35*(1), 210–212.
Zhang, X., Zhang, X., & Xie, Y.* (2015). The clinical effect of auricular plaster combination with foot reflexology or point-application on dyssomnia after stroke. *Journal of Emergency in Traditional Chinese Medicine [zhong Guo Zhong Yi Ji Zheng]*, *24*(2), 298–300.
Zhang, Z. P.* (2014). Chinese medicine foot bath combined with foot massage for insomnia treatment of 40 cases. *Fujian Journal of Traditional Chinese Medicine*, *45*(5), 1.
Zhao, F. M., & Chen, Q. W.* (2006). Palma massage in the treatment of insomnia in eldr inpatients. *Chinese Journal of Clinical Rehabilitation*, *10*(39), 16–17.
Zhao, S. G., Peng, R. J., & Wang, A. Z.* (2013). Effects of foot bath and massage on elderly patients with sleep disturbance after stroke. *Bright Chinese Medicine*, *28*(7), 1405–1406.
Zhong, J. F.* (2014). Therapeutic effect of TCD combined with carotid color ultrasound on stroke insomnia patients with foot reflex area massage. *Journal of Nantong University (Medical Sciences)*, *34*(5), 400–402.
Zhong, Z. Q., Cai, H., Li, X. L., & Lu, D.* (2008). Effect of acupuncture combined with massage of sole on sleeping quality of the pateint with insomnia. *Chinese Acupuncture*, *28*(6), 411–413.
Zhong, Z. R., Zhong, Z. H., & Zhong, K. P.* (2016). Therapeutic effect of multifunctional sleep insomnia instrument and Xiaoyao Pill combined with foot massage on insomnia. Clinical Application Research, 87–88.
Zhou, Q. Y., Cai, H., Zhu, R. Y., & Bao, X. Q.* (2007). The effect of sleep quality on insomnia patients treating with footplate massaging combine with nursing intervention. *International Journal of Nursing*, *26*(5), 495–497.
Zhou, Y.* (2016). The effect of foot massage combined with traditional Chinese medicine foot bath in elderly patients with insomnia. Inner Mongolian Traditional Chinese Medicine, *13*, 119.
Zong, L., & Ji, X.* (2010). Observation on curative effect of foot bath and massage to treat type 2 diabetes patietns with insomnia. *Nursing Research*, *24*(2), 327–328.

SUPPORTING INFORMATION

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

How to cite this article: Huang H-C, Chen K-H, Kuo S-F, Chen I-H. Can foot reflexology be a complementary therapy for sleep disturbances? Evidence appraisal through a meta-analysis of randomized controlled trials. *J Adv Nurs*. 2020;00:1–15. https://doi.org/10.1111/jan.14699