Journal of Psychiatric Research 181 (2025) 312–319

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/jpsychires

Effect of five traditional Chinese medicine exercises on insomnia: A systematic review and network meta-analysis

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ARTICLE INFO

Keywords:
Traditional Chinese medicine exercise
Liuzijue
Insomnia
Health
Sleep quality

ABSTRACT

Background: Insomnia has become a significant public health issue. Traditional Chinese medicine (TCM) exercises are used in the treatment of insomnia. The purpose of this study was to compare the effectiveness of five TCM exercise regimens (yijinjing, wuqinxi, liuzijue, baduanjin, and taijiquan) as an intervention for insomnia.

Method: We searched six databases—China National Knowledge Infrastructure, Wanfang, PubMed, Embase, Cochrane Library, and Web of Science—for relevant articles, published in English or Chinese, from their inception till April 2024. Data from the included literature were analyzed and evaluated using a network meta-analysis of random effects with a frequency-based framework.

Results: A total of 50 papers were included, comprising 4226 patients with insomnia. The results of the direct comparison of the five TCM exercises (yijinjing, wuqinxi, liuzijue, baduanjin, and taijiquan) with the control group indicated that all five TCM exercises were able to improve insomnia ($p < 0.05$). In the indirect comparison between the five TCM exercises, there was a significant difference between liuzijue and wuqinxi ($p < 0.05$), and taijiquan ($p < 0.05$). We used the areas under the receiver operating curves to rank the effectiveness of the five TCM exercises in treating insomnia as follows: liuzijue (Surface Under the Cumulative Ranking Curve, SUCRA = 96.4%) > yijinjing (SUCRA = 72.6%) > baduanjin (SUCRA = 55.1%) > taijiquan (45%) > wuqinxi (SUCRA = 30.9%).

Conclusion: The studied TCM exercises can be used as an effective treatment for insomnia, and liuzijue is the most effective of the studied options.

1. Introduction

Sleep is an important physiological function which maintains human life and health (St-Onge et al., 2016). However, sleep disorders are often caused by long-term mental overburden, high-stress work, and other illnesses. Patients with long-term sleep disorders are prone to insomnia, and in severe cases, symptoms such as mental incapacity, irritability, and depression (K Pavlova and Latreille, 2019; Gottesman et al., 2024). The occurrence of insomnia is increasing and is now a significant public health concern (Freeman et al., 2017; Sutton, 2021).

Patients with insomnia usually opt for medical therapy, but long-term medication can cause significant side effects and financial burden. Some studies have indicated that exercise can improve sleep quality as a complementary therapy to assist in the treatment of insomnia (Jurado-Fasoli et al., 2020; Xie et al., 2021). Traditional Chinese medicine (TCM) exercises including yijinjing, wuqinxi, liuzijue, baduanjin, and taijiquan are used as an aerobic form of physical and mental exercise. TCM exercises regulate the coordination of breath, movement, and intention to promote the circulation of Qi and blood, enhance physical health, and achieve balance and self-healing of the body and mind. A significant body of research indicates that traditional Chinese medicine exercises have a remarkable effect on improving insomnia, significantly enhancing sleep quality and alleviating sleep disorders (Xu et al., 2019; Yang et al., 2020). Although a previous meta-analysis evaluated the effects of TCM exercises on insomnia, a comparison of the effectiveness of the five types of TCM exercises on the treatment of insomnia has not been published to the best of our knowledge (Liu et al., 2023; Yang et al., 2023). To comprehensively assess and compare the effects of various interventions of traditional Chinese medicine exercises, it is necessary to conduct a systematic network meta-analysis.

Network meta-analysis is an advanced statistical method that can simultaneously compare and rank the efficacy of different interventions for the same disease. We chose the Pittsburgh sleep quality index (PSQI)

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https://doi.org/10.1016/j.jpsychires.2024.12.004
Received 6 May 2024; Received in revised form 27 November 2024; Accepted 1 December 2024
Available online 3 December 2024

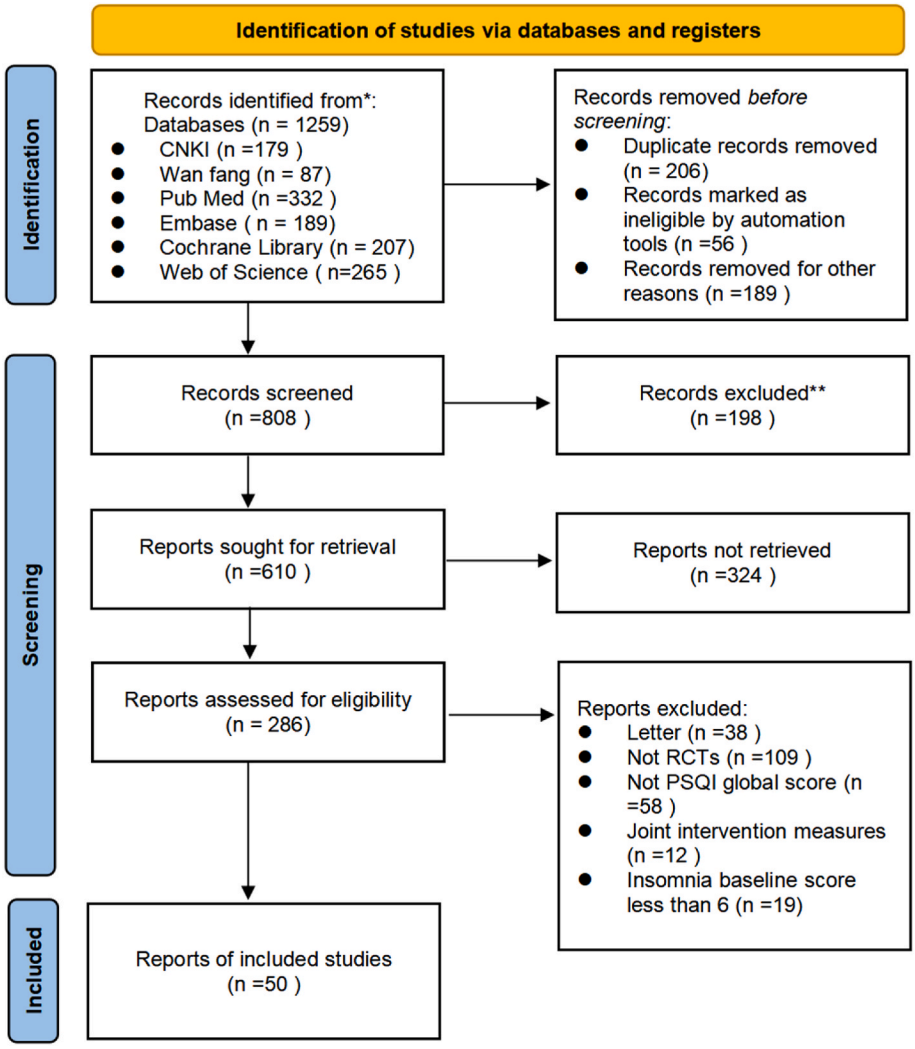

Fig. 1. Literature search process.

as the outcome index to explore the clinical effects of TCM exercises and to provide a reference for future research.

2. Method

2.1. Search strategy

This study followed PICOS guidelines with strict literature inclusion and exclusion criteria, and was registered on the Prospero platform (ID: CRD42024542106).

We searched the China National Knowledge Infrastructure, Wanfang, PubMed, Embase, Cochrane Library, and Web of Science for articles published from the period of database establishment to April 2024. A search term was developed as follows: ("Chi, Tai" OR "Tai Ji Quan" "Qi Gong" OR "Ch'i Kung" OR "baduanjin" OR "wuqinxi" OR "liuzijue " OR "yijinjing") AND ("Sleeplessness" OR "sleep" OR "Insomnias" OR "Chronic Insomnia" OR "Primary Insomnia"). We included literature published in English and Chinese.

2.2. Inclusion and exclusion criteria

The inclusion criteria for the studies were as follows: (1) study participants aged ≥18 years, (2) patients with insomnia having a baseline Pittsburgh sleep quality index (PSQI) Global Sleep score ≥6, (3) utilized yijinjing, wuqinxi, liuzijue, baduanjin, and taijiquan as interventions, (4) utilized a randomized controlled trial study design, and (5) used PSQI global scores as an outcome variable.

Exclusion criteria included: (1) case-control studies, cross-sectional studies, and other descriptive studies, (2) abstracts, reviews, commentaries, and other non-RCTs, (3) studies which did not use the interventions, outcome indicators, and sample populations mentioned above, and (4) articles with incomplete data provision or inaccessible full texts.

2.3. Data collection

First, initial screening was performed by two investigators (LL and JL) who independently assessed the title and abstract for each publication. After excluding irrelevant literature and literature with inaccessible full texts, the full texts were read to eliminate literature that did not meet the criteria. A uniform data extraction form was used to extract information from the included literature, including the country, first author's name, year of publication, interventions, outcome indicators, etc. When disagreements occurred between the two investigators, final decisions were made based on a joint discussion and the opinion of a third researcher if needed.

2.4. Estimation of quality

The quality of the included literature was assessed by two

Table 1
Basic characteristics of the included studies.

Study Authors (Year)	Country	Sample Size (T/C)	Age	Interventions	Control group	Outcome indicators	Intervention cycle
Yao et al., 2022	China	36/36	46.9 ± 8.3	taijiquan	Usual care	PSQI	8 weeks, 2time/week
Siu et al., 2021	China	105/110	67.3 ± 6.8	taijiquan	Usual care	PSQI	12 weeks, >3time/week
Nguyen and Kruse, 2012	Vietnam	39/34	69.2 ± 5.3	taijiquan	Usual care	PSQI	24 weeks, 2times/week
Li et al., 2004	Usa	62/56	>60	taijiquan	Usual care	PSQI	24 weeks,3 times/week
Irwin et al., 2008	Usa	30/22	69.6 ± 6.3	taijiquan	Health education	PSQI	16 weeks, 3 times/week
Pu (2014)	China	30/30	–	taijiquan	Health education	PSQI	16 weeks, 3 times/week
Zhang (2014)	China	30/30	48.9 ± 7.4	taijiquan	Health education	PSQI	2 weeks,1times/day
Guoqing et al. (2022)	China	46/49	54.8 ± 10.3	taijiquan	Usual care	PSQI	24 weeks, 3 times/week
Wang et al., 2021	China	40/40	41.97 ± 5.51	taijiquan	Health education	PSQI	8 weeks, 2–3 times/week
Wang et al., 2024	China	40/40	56.35 ± 3.35	taijiquan	Usual care	PSQI	8 weeks, 5 times/week
Rao et al., 2021	China	15/15	53.91 ± 4.65	taijiquan	Usual care	PSQI	8 weeks, 5 times/week
Rao and Ni, 2018	China	30/30	54.91 ± 4.65	taijiquan	Health education	PSQI	8 weeks, 5 times/week
Luo (2021)	China	157/158	18.58 ± 2.25	taijiquan	Usual care	PSQI	16 weeks, 3 times/week
Ru et al. (2022)	China	49/49	69.51 ± 5.73	taijiquan	Usual care	PSQI	24 weeks, 2 times/day
Fang (2020)	China	30/30	62.55 ± 4.57	taijiquan	Usual care	PSQI	12 weeks, 5 times/week
Fan et al., 2016	China	34/37	51.23 ± 12.41	taijiquan	Usual care	PSQI	12 weeks, 3–4 times/week
Fan et al., 2020	China	67/72	71.6 ± 6.3	baduanjin	Usual care	PSQI	24 weeks, 5 times/week
Chen et al., 2012	Taiwan	27/28	71.75 ± 8.13	baduanjin	Usual care	PSQI	12 weeks, 3 times/week
Carcelén-Fraile et al., 2022	China	57/60	69.73 ± 6.44	baduanjin	Health education	PSQI	12 weeks, 2 times/week
Hong et al. (2023)	China	19/19	20.47 ± 1.47	baduanjin	Health education	PSQI	10 weeks, 4 times/week
Zhu (2019)	China	30/30	42.25 ± 5.27	baduanjin	Usual care	PSQI	12 weeks
Liwei et al. (2021)	China	34/34	70.88 ± 5.56	baduanjin	Health education	PSQI	12 weeks, 5 times/week
Ying et al., 2019	China	37/37	72.63 ± 3.05	baduanjin	Usual care	PSQI	12 weeks, 5 times/week
Dihui et al. (2020)	China	32/36	33.5 ± 6.7	baduanjin	Usual care	PSQI	3 weeks, 6 times/week
Xiong et al., 2018	China	84/84	59.75 ± 6.34	baduanjin	Usual care	PSQI	12 weeks, 5 times/week
Xie et al., 2021	China	16/15	–	baduanjin	Usual care	PSQI	4 weeks, 4 times/week
Xiang et al., 2023	China	32/32	48.84 ± 17.64	baduanjin	Usual care	PSQI	4 weeks, 2/day
Wang et al., 2019	China	45/44	71.50 ± 8.59	baduanjin	Health education	PSQI	12 weeks, 4 times/week
Tian et al., 2022	China	27/22	48.23 ± 9.41	baduanjin	Health education	PSQI	12 weeks, 3 times/week
Tang and Liu, 2022	China	44/43	55.78 ± 9.78	baduanjin	Usual care	PSQI	12 weeks
Tan et al., 2022	China	42/42	68.95 ± 7.21	baduanjin	Usual care	PSQI	12 weeks, 5 times/week
Liu et al., 2018	China	57/55	44.17 ± 10.18	baduanjin	Usual care	PSQI	12 weeks, 1 time/day
Fu et al., 2021	China	86/88	54.23 ± 14.46	baduanjin	Usual care	PSQI	24 weeks, 3 times/week
Zhu and peace, 2022	China	65/64	45.36 ± 5.21	liuzijue	Health education	PSQI	12 weeks, 3 times/day
Xu et al., 2019	China	40/40	77.06 ± 23.21	liuzijue	Usual care	PSQI	4 weeks, 1 time/day
Yi and Lan (2023)	China	35/35	64.71 ± 6.05	liuzijue	Usual care	PSQI	4 weeks, 2 times/day
Liu et al., 2014	China	20/20	63.37 ± 9.41	liuzijue	Usual care	PSQI	16 weeks, 2 times/day
Li et al. (2018)	China	51/52	20~65	liuzijue	Usual care	PSQI	2 times/day
Zhou et al., 2014	China	30/30	–	wuqinxi	Usual care	PSQI	12 weeks, 2 times/day
Yang et al., 2020	China	40/40	37.84 ± 8.29	wuqinxi	Usual care	PSQI	12 weeks, 5 times/week
Wang et al., 2020	China	30/30	–	wuqinxi	Usual care	PSQI	24 weeks, 40min/day
Ma et al., 2023	China	39/38	67.12 ± 5.87	wuqinxi	Usual care	PSQI	12 weeks, 5 times/week
Gu et al., 2024	China	34/34	≥60	wuqinxi	Usual care	PSQI	8 weeks, 3 times/week
Zhang et al. (2020)	China	25/25	57.88 ± 13.83	yijinjing	Usual care	PSQI	4 weeks, 3 times/week/
Zhang et al., 2021	China	64/63	67.01 ± 3.22	yijinjing	Usual care	PSQI	4 weeks
Song et al., 2011	China	19/21	–	yijinjing	Usual care	PSQI	8 weeks, 4 times/week
Qian et al., 2016	China	30/30	36.35 ± 8.41	yijinjing	Usual care	PSQI	8 weeks, 3 times/week
Fang et al., 2018	China	30/30	49.40 ± 3.21	yijinjing	Usual care	PSQI	12 weeks, 5 times/week
Cheng et al. (2018)	China	23/23	77.43 ± 3.06	yijinjing	Health education	PSQI	12 weeks, 3 times/week
Cai et al., 2022	China	30/30	43.5 ± 17.5	yijinjing	Usual care	PSQI	2 weeks, 1 time/day

investigators (LL and JL) using the Cochrane Risk of Bias Assessment Tool, which is based on a discussion of the sources of bias in seven dimensions as recommended by the Cochrane Handbook, i.e., selection bias, implementation bias, measurement bias, follow-up bias, reporting bias, and other bias. The risk of bias was assessed as low, high, or unclear for each category of bias.

2.5. Statistical analysis

Data were analyzed using Stata 18 software for network meta-analysis based on a frequency-based framework through a random effects model with 95% confidence intervals, with $p < 0.05$ being considered as statistically significant. The results of the network meta-analysis were summarized based on all possible pairwise comparisons, both direct and indirect. Therefore, local and global tests of inconsistency were performed when a closed-loop structure was formed between the interventions. The effect of different interventions on insomnia was estimated based on the area under Surface Under the Cumulative Ranking Curve (SUCRA). Smaller SUCRA values indicated lower treatment effectiveness. Finally, funnel plots were drawn to assess the publication bias of the outcome indicators.

3. Results

3.1. Characteristics of the included studies

An initial search through six databases yielded 1259 papers, and after excluding those that did not meet the inclusion criteria, 50 randomized controlled trials were finally included and analyzed. This included 42 Chinese manuscripts and 8 English manuscripts. A schematic of the search process is shown in Fig. 1.

Fifty papers(Cai et al., 2022; Dihui et al., 2020; Chen et al., 2012; Cheng et al., 2018; Fan et al., 2016; Fan et al., 2020; Fang et al., 2018; Fang, 2020; Liwei et al., 2021; Fu et al., 2021; Gu et al., 2024; Irwin et al., 2008; Li et al., 2004; Liu et al., 2014; Liu et al., 2018; Luo, 2021; Ma et al., 2023; Nguyen and Kruse, 2012; Qian et al., 2016; Song et al., 2011; Rao et al., 2021; Rao and Ni, 2018; Siu et al., 2021; Tan et al., 2022; Tang and Liu, 2022; Tian et al., 2022; Wang et al., 2019; Wang

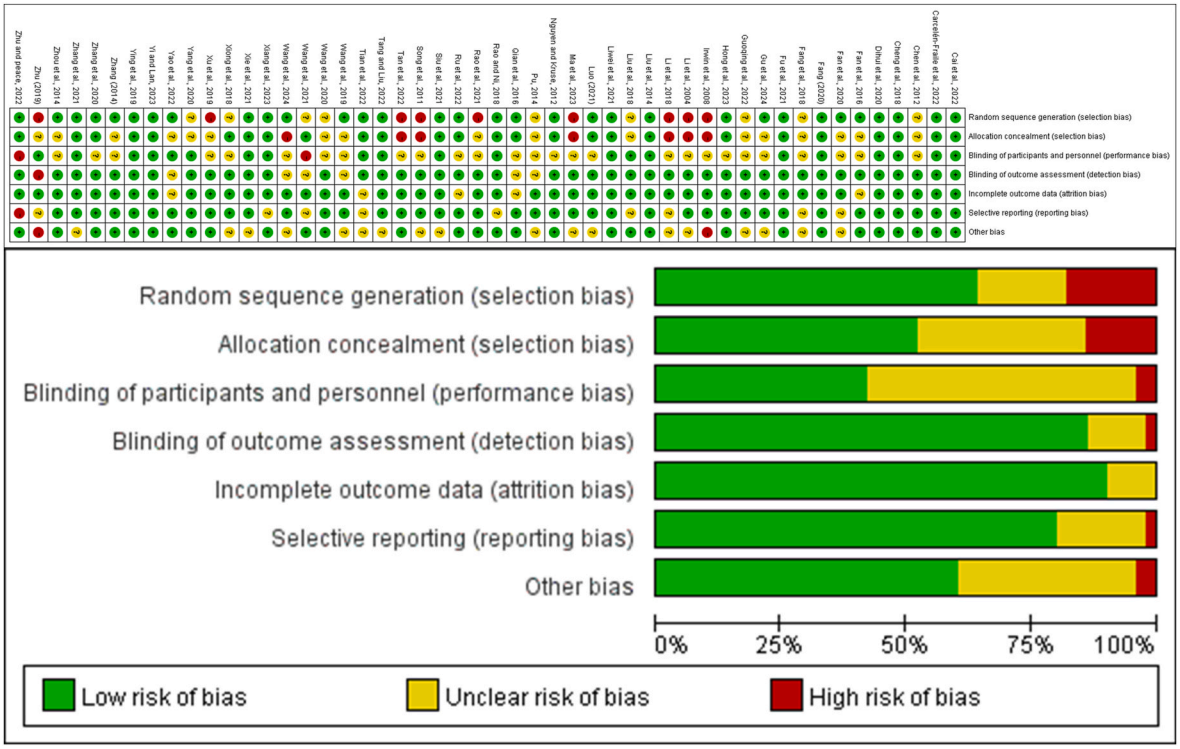

Fig. 2. Literature bias map.

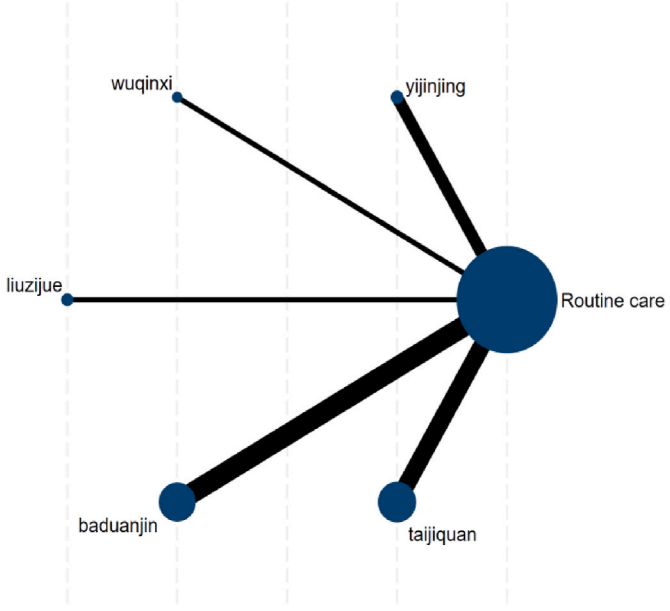

Fig. 3. Network evidence map. The node size represents the number of included studies, whereas the line thickness represents the number of studies directly compared between the interventions.

et al., 2020; Wang et al., 2021; Wang et al., 2024; Xiang et al., 2023; Xie et al., 2021; Xiong et al., 2018; Xu et al., 2019; Guoqing et al., 2022; Yang et al., 2020; Yao et al., 2022; Ying et al., 2019; Hong et al., 2023; Zhang, 2014; Zhang et al., 2020; Zhang et al., 2021; Li et al., 2018; Yi and Lan, 2023; Zhou et al., 2014; Zhu, 2019; Carcelén-Fraile et al., 2022; Pu, 2014; Ru et al., 2022; Zhu and peace, 2022) were included and published between 2004 and 2024, with a total of 4226 insomnia patients. Most of the randomized controlled trials were conducted in China. The TCM exercise interventions included yijinjing, wuqinxi, liuzijue, baduanjin, and taijiquan. The essential characteristics of the included literature are shown in Table 1.

3.2. Risk assessment of bias

Fig. 2 illustrates the distribution of bias for the 50 papers. Some of the studies did not report the specific randomization method, allocation concealment method, and/or blinding method, so were assessed as unclear risk. Therefore, the quality of the literature included in this study was low. The detailed bias evaluation is shown in Fig. 2.

3.3. Network meta-analysis

3.3.1. Network evidence map

Fig. 3 illustrates a network relationship graph of five TCM exercise interventions for insomnia, including yijinjing, wuqinxi, liuzijue, baduanjin, and taijiquan. The size of the nodes in the graph represents the number of included studies. In contrast, the thickness of the node connecting lines indicates the number of studies between the interventions that were directly compared. Seventeen studies evaluated the effect of baduanjin on insomnia, 16 studies evaluated the effect of taijiquan on insomnia, 7 studies evaluated the effect of yijinjing on insomnia, 5 studies evaluated wuqinxi on insomnia, and 5 studies evaluated the effect of liuzijue on insomnia.

3.3.2. Comparison of the network analysis results

Fig. 4 demonstrates the direct and indirect comparative network meta-forest plots of the effects of the five TCM exercises on insomnia. The combined values of the interventions intersecting the vertical line of the 0-axis in the graph were not statistically significant. The comparison between the five TCM exercises and usual care was statistically significant ($p < 0.05$). Among the comparisons between the five TCM exercises, the comparisons between liuzijue and wuqinxi ($p < 0.05$), and liuzijue and taijiquan were significantly different ($p < 0.05$). The specific analysis of Fig. 4 is displayed in Table 2.

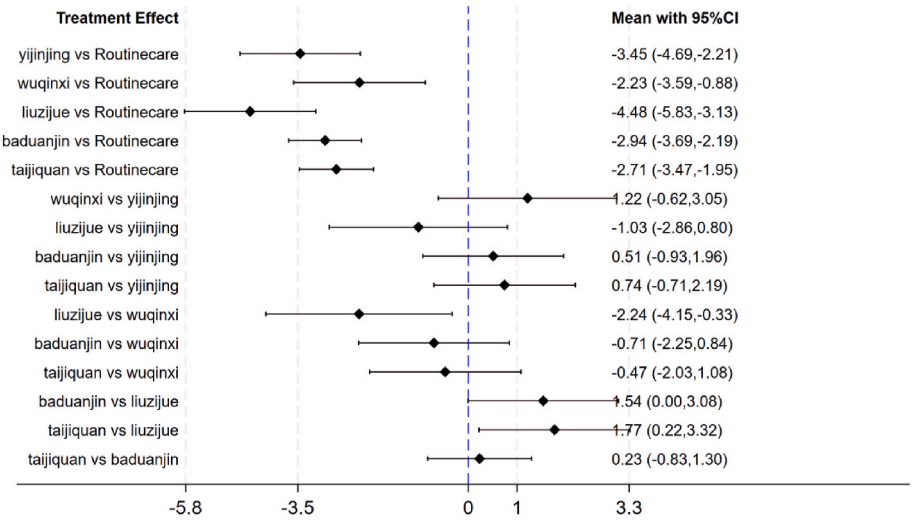

Fig. 4. Network evidence map comparing the effects of five traditional Chinese medicine exercise interventions on insomnia.

Table 2
Effects of five traditional Chinese medicine exercises on insomnia.

yijinjing					
−1.22 (−3.05,0.62)	**wuqinxi**				
1.03 (−0.80,2.86)	**2.24 (0.33,4.15)**[a]	**liuzijue**			
−0.51 (−1.96,0.93)	0.71 (−0.84,2.25)	−1.54 (−3.08,0.00)	**baduanjin**		
−0.74 (−2.19,0.71)	0.47 (−1.08,2.03)	**−1.77 (-3.32,-0.22)**[a]	−0.23 (−1.30,0.83)	**taijiquan**	
−3.45 (-4.69,-2.21)[a]	**−2.23 (-3.59,-0.88)**[a]	**−4.48 (-5.83,-3.13)**[a]	**−2.94 (-3.69,-2.19)**[a]	**−2.71 (-3.47,-1.95)**[a]	**routine care**

[a] $p < 0.05$.

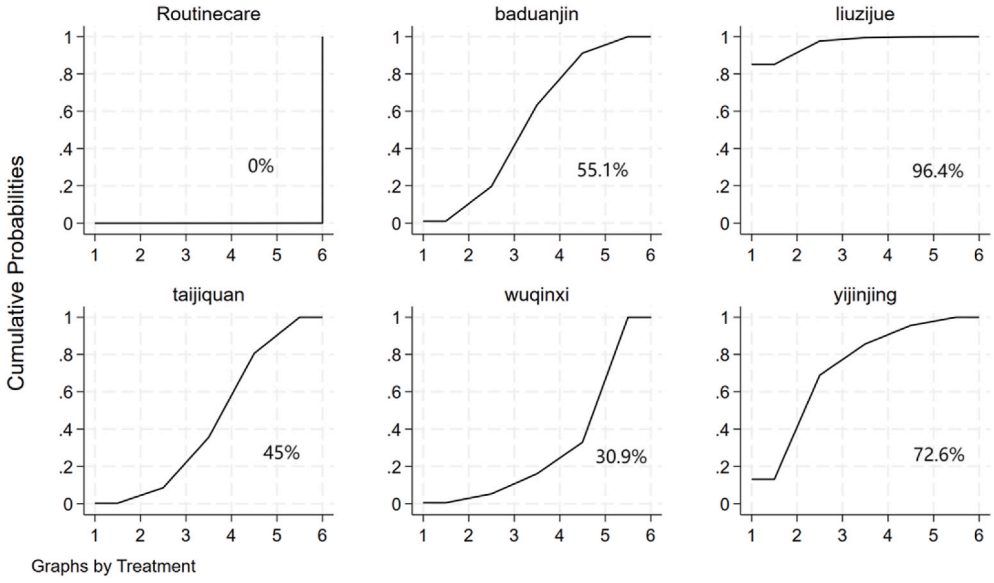

Fig. 5. Surface under the cumulative ranking curve rankings for each traditional Chinese medicine exercise for treating insomnia.

3.3.3. *Quality measures ranking*

The surface under the cumulative ranking curve (SUCRA) metric was used to rank the effectiveness of each TCM exercise modality and determine the best treatment modality. liuzijue (SUCRA = 96.4%) > yijinjing (SUCRA = 72.6%) > baduanjin (SUCRA = 55.1%) > taijiquan (45%) > wuqinxi (SUCRA = 30.9%). The SUCRA rankings are shown in Fig. 5.

3.3.4. *Published bias analysis*

The bias of the included literature was analyzed by funnel plot. Fig. 6 shows the funnel plot of five TCM exercises for insomnia. The scatters in the figure basically show left-right symmetry, indicating that the literature may not have publication bias. However, some scatters in the figure fall outside the funnel plot range, suggesting that there may be heterogeneity among the literature or a small sample effect. It may be related to the baseline insomnia scores of patients included in the literature.

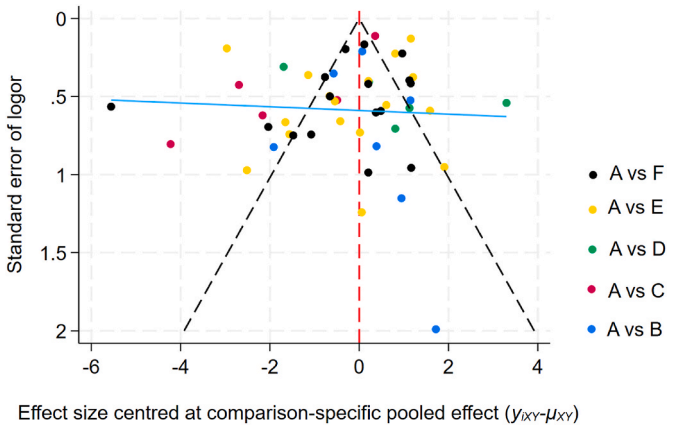

Fig. 6. Funnel plot detailing the risk of bias related to the effects of each traditional Chinese medicine exercise on insomnia. A: routine care; B: yijinjing; C: wuqinxi; D: liuzijue; E: baduanjin; and F: taijiquan.

4. Discussion

In this web-based meta-analysis, we evaluated 50 randomized controlled trials which included 4226 patients, with the aim of comparing the efficacy of five TCM exercises on insomnia. Our analysis showed that all five TCM exercises were able to improve the sleep quality of insomnia patients compared with usual care. However, in an indirect comparison of the five TCM exercises, liuzijue was significantly more effective than wuqinxi and taijiquan. The order of effectiveness of the five TCM exercises for treating insomnia was determined by SUCRA as follows: liuzijue (SUCRA = 96.4%) > yijinjing (SUCRA = 72.6%) > baduanjin (SUCRA = 55.1%) > taijiquan (45%) > wuqinxi (SUCRA = 30.9%).

The effect of TCM exercises on insomnia has been reported for many years; in 2004, Li et al. first showed in a randomized controlled trial that tai chi improved sleep quality in older adults with sleep disorders (Li et al., 2004). Yeh et al. tested the ability of tai chi to enhance sleep stability in patients with chronic heart failure based on electrocardiography. They identified significant effects on blood pressure and heart rate (Yeh et al., 2008). It has been shown that the effect of qigong on sleep quality is mediated through regulation of the patient's psychoemotional state (Manzaneque et al., 2009). However, some studies have also reported that baduanjin has a significant effect on the improvement of sleep in community-dwelling older adults (Chen et al., 2012). One study confirmed the ability of taijiquan to improve sleep quality in healthy adults and patients with chronic diseases through direct meta-analysis (Raman et al., 2013). In a recent randomized controlled comparative study, it was stated that taijiquan was more effective than aerobic exercise in improving sleep quality in patients with advanced lung cancer (Takemura et al., 2024). Various other studies have also confirmed the positive clinical effects of TCM exercise on insomnia (Li et al., 2004; Irwin et al., 2008).

The pathogenesis of insomnia stems from abnormalities in brain regulation (Jansen et al., 2019). People encounter psychological stress reactions, such as tension, depression, excitement, restlessness, etc. These psychological stresses produce continuous alterations in various bodily functions, which leads to abnormalities of the neurotransmitter, endocrine, and other systems, resulting in brain dysfunction and transient insomnia (Zhao et al., 2021). If transient insomnia is not treated in a timely manner, excessive mental stress and enhanced cerebral cortical excitation can lead to long-term insomnia. TCM exercises for insomnia can promote the cerebral cortex to play a protective role (Siu et al., 2021). By controlling the brain's consciousness, TCM exercises inhibits the cerebral cortex. This synchronizes brain cell activity, which is conducive to the repair of the brain cells, corrects the flocculation of the nervous system, and coordinates the cerebral cortex and subcortical centers (Yu et al., 2018; Wang et al., 2022). TCM exercises can coordinate breathing, the limbs, and consciousness to improve insomnia.

Liuzijue the most effective ways to treat insomnia with TCM exercises. Liuzijue is one of the exercises of TCM and is also a breathing and exhaling therapy. A total of six characters need to be learned in liuzijue, and the corresponding internal organs, meridians, qi, and blood in the chest cavity are implicated through the pronunciation of the six characters, shape of the mouth, and movement of the lips and tongue (Xiao and Zhuang, 2015). Through breathing alternation, liuzijue can regulate insomnia patients' emotions, divert their attention, and enable them to enter a state of relaxation. This is also the difference between liuzijue and the other four TCM exercise. Thus, long-term practice can improve the quality of sleep and reduce the occurrence of insomnia (Tang et al., 2021; Zhang et al., 2023).

TCM exercise is an exercise modality that aids in the treatment of insomnia and can be used as a complementary therapy to insomnia treatment. This study is the first to compare the efficacy of five TCM exercises on insomnia. Although we implemented a rigorous experimental design, the following limitations exist: (1) We only searched Chinese and English databases for literature, and likely omitted studies in other languages, leading to bias in the inclusion of literature. (2) Our criterion for inclusion of insomnia was a PSQI global score >6. The degree of insomnia of the included patients varied, resulting in scattered points in the funnel plot. (3) In the Risk assessment of bias, the quality of the original literature included was not high, so the results of the analysis in this study are for reference only. Future randomized controlled experimental studies with higher quality and large sample sizes are needed.

5. Conclusion

The results of this network meta-analysis indicated that five types of TCM exercises, including yijinjing, wuqinxi, liuzijue, baduanjin, and taijiuqna, were able to treat insomnia and improve the sleep quality of insomnia patients. Liuzijue was the most effective way of treating insomnia of the five TCM exercises.

CRediT authorship contribution statement

Liang Li: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Data curation. **Jiuzhu Liang:** Software, Resources, Project administration, Methodology, Data curation, Conceptualization. **Tonggang Fan:** Writing – review & editing, Visualization, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of generative AI in scientific writing

The authors did not use the AI and AI-assisted techniques in this study.

Funding

This work was supported by the 2023 Shanghai Philosophy and Social Science Planning Project [grant number 2023BTY002].

Declaration of competing interest

The authors declare that there are no conflict of interests, we do not have any possible conflicts of interest.

Acknowledgments

This work was supported by Shanghai University of Sport.

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