Scientific Research Publishing

Journal of Biosciences and Medicines, 2026, 14(4), 465-487
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Efficacy and Safety of Tonifying Qi and Circulating Blood Chinese Herbal Medicines in Post-Stroke Cognitive Impairment: A Systematic Review and Network Meta-Analysis

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How to cite this paper: Chen, J.X., Gao, K., Li, N., Zhang, Z.J., Jing, M., Wang, F. and Li, J. (2026) Efficacy and Safety of Tonifying Qi and Circulating Blood Chinese Herbal Medicines in Post-Stroke Cognitive Impairment: A Systematic Review and Network Meta-Analysis. *Journal of Biosciences and Medicines*, **14**, 465-487.
https://doi.org/10.4236/jbm.2026.144033

Received: March 16, 2026
Accepted: April 27, 2026
Published: April 30, 2026

Abstract

Background: Post-stroke cognitive impairment (PSCI) significantly aggravates the burden of stroke. Current conventional Western medical treatments have limited efficacy, tonifying qi and circulating blood Chinese herbal medicine which is based on the theory of traditional Chinese medicine to target the core pathogenesis of PSCI, emerge as potential candidates for PSCI management. **Methods:** We systematically searched PubMed, Cochrane Library, Web of Science, Embase, CNKI, Wanfang, VIP and China Biology Medicine disc for randomized controlled trials. The primary outcomes included clinical efficacy rate, Mini-Mental State Examination (MMSE) score, Montreal Cognitive Assessment (MoCA) score, National Institutes of Health Stroke Scale (NIHSS) score, and adverse event incidence. Both direct and indirect evidence were integrated through meta-analysis to evaluate the relative efficacy and safety of different tonifying qi and circulating blood Chinese herbal medicine using the Surface Under the Cumulative Ranking Curve. **Results:** A total of 49 studies involving 4260 participants were included. The systematic review showed that Chinese herbal medicine for tonifying qi and circulating blood with conventional Western medicines increased the clinical efficacy rate more significantly

than conventional Western medicine alone (RR: 1.23, 95% CI: 1.19 to 1.27), improved cognitive function by MMSE score (MD: 3.13, 95% CI: 2.54 to 3.73), MoCA score (MD: 2.76, 95% CI: 2.19 to 3.32), and reduced NIHSS score (MD: 2.78, 95% CI: 1.76 to 3.80). Network meta-analysis results showed that Buyang Huanwu decoction and its modified formulations demonstrated particularly prominent efficacy in improving cognitive and neurological functions in PSCI patients. No serious adverse reactions were reported. **Conclusion:** This study provides preliminary evidence that tonifying qi and circulating blood Chinese herbal medicines are beneficial for PSCI, indicating that Buyang Huanwu decoction and its modified formulations may be potential safe and effective adjunctive therapeutic options for PSCI.

Keywords

Tonifying Qi and Circulating Blood, Chinese Herbal Medicines, Post-Stroke Cognitive Impairment, Systematic Review, Network Meta-Analysis

1. Introduction

Post-stroke cognitive impairment (PSCI) is a clinical syndrome characterized by persistent cognitive deficits that occur after a stroke event and last for at least six months [1]-[3]. The 2024 Global Burden of Disease Study estimated that approximately one-third of the global population is affected by stroke [4]. In China, nearly one-third of stroke survivors develop PSCI [5], which severely affects cognitive function and quality of life, and significantly contributes to the increasing burden of stroke-related diseases [6]. Currently, there are no disease-modifying therapies for PSCI, and clinical management is limited to mitigating vascular risk factors (e.g., hypertension control and lipid regulation) and providing symptomatic treatment (e.g., cholinesterase inhibitors and memantine). According to traditional Chinese medicine (TCM) theory, as articulated in Zhang Zhongjing's Jin Gui Yao Lue, the pathogenesis of stroke involves dual deficiency of qi and blood, with blood stasis due to qi deficiency being a key causative factor [7]. Contemporary evidence further indicates that the syndrome patterns characterized by deficiency of qi and blood in the orifices of the brain, complicated by blood stasis due to qi stagnation, are the predominant TCM syndrome types underlying PSCI [8]. Consequently, therapeutic strategies focusing on tonifying qi and circulating blood have become cornerstone interventions in TCM-based management of PSCI [9]. In recent years, numerous randomized controlled trials have demonstrated that tonifying qi and circulating blood Chinese herbal medicines with conventional Western medicines may have beneficial effects on improving PSCI.

However, the overall efficacy and safety profile of these herbal interventions have not been systematically evaluated and summarized. Furthermore, the wide variety of tonifying qi and circulating blood Chinese herbal medicines used in clinical practice may lead to differences in efficacy and safety. In recent years, sev-

eral systematic reviews have explored the efficacy of TCM for PSCI, but most focused on mixed TCM therapeutic principles without targeting the core pathogenesis of qi deficiency and blood stasis alone. This study aims to supply the evidence for tonifying qi and circulating blood Chinese herbal medicines, which is a key TCM intervention for PSCI and quantitatively compare the efficacy of different formulations through network meta-analysis.

2. Methods

This systematic review and network meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10]. The research protocol was registered in PROSPERO with registration number CRD42024566449.

2.1. Inclusion and Exclusion Criteria

The criteria for inclusion of the studies include: 1) Study design: randomized controlled trials. 2) Population: Patients should be diagnosed with PSCI, defined by a definite temporal association between cognitive impairment and stroke, including post-stroke vascular dementia and mild cognitive impairment [1]. 3) Interventions: The trial group received tonifying qi and circulating blood Chinese herbal medicines with conventional Western medicines (CWM). The control group received CWM alone. Conventional Western medicine was defined as the standard therapeutic protocol recommended by the Experts Consensus on Post-stroke Cognitive Impairment Management 2021 [1]. 4) studies reporting at least one internationally recognized cognitive assessment scale, including the Montreal Cognitive Assessment (MoCA) and Mini-Mental State Examination (MMSE).

The criteria for exclusion of the studies include: 1) Which were non-randomized controlled trials, case reports or reviews. 2) Incomplete or unavailable outcome metrics. 3) Duplicate publications. 4) The trial intervention did not tonifying qi and circulating blood Chinese herbal medicines, the control intervention did not conventional Western medications or incorporated adjunctive non-pharmacological therapies (e.g., acupuncture, therapeutic massage, and cognitive training).

2.2. Literature Search

We searched eight databases including PubMed, EMBASE, Cochrane Library, Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang Data, China Science and Technology Journal Database (VIP), and China Biology Medicine disc (CBM) from inception until October 2025. Search strategies were tailored to each database using a combination of controlled vocabulary and free-text keywords related to: 1) stroke. 2) cognitive impairment or dementia. 3) tonifying qi and circulating blood Chinese herbal medicines. 4) randomized controlled trials.

2.3. Study Selection and Data Extraction

Literature search results were imported into EndNote X9 for duplicate removal. The study selection process consisted of two steps: 1) initial screening of titles and abstracts based on the predefined inclusion and exclusion criteria. 2) rigorous full-text assessment of potentially eligible studies to determine final inclusion. Two researchers independently extracted data forms included studies. If disagreements arose between the two researchers, a third researcher was consulted to resolve the disputes. The following data were extracted: title, first author, publication year, sample size, mean age, intervention, dosage, treatment duration, Mean and standard deviation for MMSE score, MoCA score, NIHSS score, clinical effective rate and adverse events.

2.4. Risk of Bias Assessment

Systematic reviews and network meta-analyses were conducted using Stata 18.0 software. Clinical efficacy rate was assessed using risk ratios (RR), while MMSE score, MoCA score and NIHSS score were using mean differences (MD) combined with effect sizes, with 95% Confidence Intervals (95%CI) calculated. Heterogeneity among studies was quantified using the Cochran Q test and I^2 statistic. If significant heterogeneity was detected ($P < 0.05$ and $I^2 > 50\%$), a random-effects model was employed for meta-analysis. Otherwise, a fixed-effects model was used. In addition, subgroup and sensitivity analyses were performed for outcome measures with high heterogeneity to preliminarily explore the sources of heterogeneity and the stability of results. Given the small sample sizes in most trials, Egger regression tests were conducted to statistically assess potential publication bias. A statistically significant intercept ($P < 0.05$) indicated potential publication bias, while $P \geq 0.05$ supported funnel plot symmetry. Network meta-analysis ranked intervention efficacy using the Surface Under the Cumulative Ranking Curve (SUCRA), with SUCRA values ranging from 0% to 100%, where higher values indicated greater likelihood of representing the optimal intervention.

3. Results

3.1. Study Selection

Initial searches across the eight databases identified 4433 studies. After removing 1884 duplicates, 2549 unique publications were subjected to title/abstract screening, excluding 2120 records. The full-text assessment of the remaining 429 studies excluded 380 protocol deviations or insufficient data, resulting in 49 studies eligible for quantitative synthesis. The flow diagram of study selection and identification is described in **Figure 1**.

3.2. Characteristics of Included Studies

A total of 49 studies involving 4260 participants were included, with 2139 subjects in the trial group and 2121 in the control group. Baseline data were balanced be-

tween all trial and control group. These studies evaluated 26 distinct tonifying qi and circulating blood Chinese herbal medicines, including 14 proprietary Chinese medicines and 12 decoction formulas. Thirty-eight studies [11]-[47] reported MMSE score, twenty-four studies [14]-[16] [21] [23] [24] [26]-[28] [38] [43]-[54] reported MoCA score, thirty-five studies [11] [13] [15] [16] [18] [21]-[27] [29]-[31] [33]-[40] [42]-[46] [50]-[53] [55] [56] reported clinical efficacy rate, ten studies [15] [21]-[24] [29] [44] [48] [53] [56] reported NIHSS score. All included studies occurred in China. Detailed baseline characteristics of included studies were shown in Table 1.

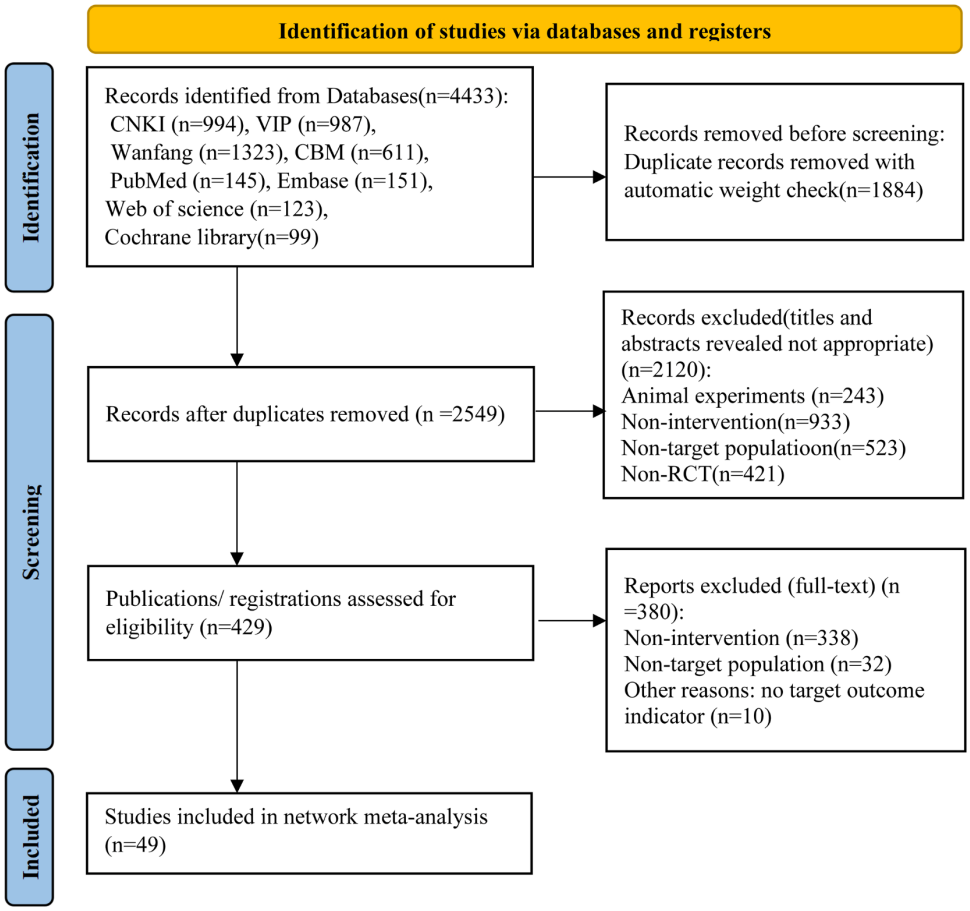

Figure 1. Flow diagram of study selection and identification.

Table 1. Basic characteristics of included studies.

Study	n/case		Age/year		Treatment measures		Treatments /Days
	T	C	T	C	T	C	
Huang LW 1999 [11]	30	29	63.56 ± 6.2	64.6 ± 5.8	FZ + CWM	CWM	60
Cai XY 2014 [12]	40	40	64 ± 6.6	64 ± 6.6	BYHX + CWM	CWM	90
Jiang Y 2014 [13]	32	32	60.38 ± 2.54	60.56 ± 2.34	NXT + CWM	CWM	56
Zhang K 2024 [48]	40	40	65.16 ± 5.12	65.26 ± 5.25	NXT + CWM	CWM	30

Continued

Li W 2017 [14]	45	45	65.7 ± 6.4	65.6 ± 6.9	NXT + CWM	CWM	180
Huang D 2019 [15]	47	47	63.56 ± 2.24	63.21 ± 2.19	NXT + CWM	CWM	90
Niu HH 2025 [44]	50	50	60.68 ± 4.39	60.57 ± 4.34	NXT + CWM	CWM	90
Xiao Y 2025 [43]	61	59	66.57 ± 2.21	66.54 ± 2.20	NXT + CWM	CWM	84
Chen ZX 2015 [16]	34	33	63.97 ± 8.28	64.84 ± 8.79	TXL + CWM	CWM	84
Chen N 2014 [17]	34	34	61.5 ± 11.2	62.2 ± 12.7	TXL + CWM	CWM	120
Yang P 2016 [18]	40	40	61.5 ± 14.2	62.2 ± 12.7	TXL + CWM	CWM	90
Yu XQ 2011 [19]	40	28	/	/	TXL + CWM	CWM	90
Song QY 2018 [49]	34	32	65.2 ± 3.6	66.1 ± 3.6	DZSM + CWM	CWM	180
Rong XT 2025 [56]	40	40	60.58 ± 4.78	61.88 ± 5.57	DZSM + CWM	CWM	90
Wang L 2018 [20]	30	30	62.73 ± 9.40	59.53 ± 9.90	QLYZ + CWM	CWM	180
Wang YW 2020 [21]	37	37	60.54 ± 11.99	62.54 ± 11.49	ZFXN + CWM	CWM	21
Bao JQ 2021 [22]	100	100	52.45 ± 8.29	52.36 ± 8.46	YQTL + CWM	CWM	168
Shi HM 2023 [23]	65	65	58 ± 5	58 ± 5	YQTL + CWM	CWM	180
Han ZY 2022 [57]	43	43	72.8 ± 4.35	70.1 ± 5.2	DYNT + CWM	CWM	84
Chen DY 2023 [54]	55	55	69.45 ± 10.25	72.18 ± 9.92	YNK + CWM	CWM	180
Wu Y 2023 [24]	38	38	63.11 ± 10.55	67.18±7.82	QSHW + CWM	CWM	84
Sun Y 2024 [25]	45	45	65.69 ± 7.36	66.44 ± 6.41	SWYZ + CWM	CWM	90
Guo C 2025 [47]	45	45	/	/	SWYZ + CWM	CWM	28
Gao LN 2024 [26]	30	31	61.09 ± 7.59	61.59 ± 6.83	BN + CWM	CWM	30
Wei Jw 2024 [45]	93	93	61.74 ± 3.66	62.35± 2.17	QL + CWM	CWM	60
Pan JW 2015 [50]	37	37	68.7 ± 7.1	69.1 ± 7.4	BYHW + CWM	CWM	28
Chen XR 2020 [27]	40	40	65.52 ± 3.94	65.59 ± 3.91	BYHW + CWM	CWM	28
Chen J 2023 [28]	42	42	62.38 ± 9.59	61.89 ± 8.72	BYHW + CWM	CWM	84
Liu LM 2015 [51]	42	42	69.9 ± 7.2	70.5 ± 7.0	BYHW + CWM	CWM	14
Wang Z 2022 [29]	43	43	60.9 ± 2.8	58.3 ± 2.5	BYHW + CWM	CWM	84
Shao R 2013 [55]	36	36	68.7 ± 7.5	68.1 ± 7.5	BYHW + CWM	CWM	58
Wang JS 2016 [30]	49	49	61.4 ± 6.9	62.6 ± 6.67	BYHW + CWM	CWM	/
Yang YC 2019 [31]	44	44	68.02 ± 8.57	67.79 ± 8.46	BYHW + CWM	CWM	30
Fang HM 2014 [32]	40	40	67.1 ± 7.4	66.5 ± 6.9	YZHX + CWM	CWM	28
Li GC 2016 [33]	28	28	58.6 ± 3.2	56.8 ± 5.2	YZHX + CWM	CWM	84
Liu JY 2012 [34]	30	30	59.50 ± 7.51	60.30 ± 6.92	YZHX + CWM	CWM	84
Chen L 2009 [35]	30	30	59.4 ± 9.3	60.1 ± 9.5	GBHX + CWM	CWM	84
Zhang Y 2014 [36]	20	20	64.5 ± 0.7	64.5 ± 0.7	GBHX + CWM	CWM	60
Li XG 2018 [37]	51	51	61.52 ± 7.34	62.67 ± 7.51	GBHX + CWM	CWM	84
Lu JZ 2019 [38]	39	39	71.09 ± 4.46	71.12 ± 4.44	GBHX + CWM	CWM	90
Liu SF 2005 [42]	60	60	70.8	68.2	YQHXTL + CWM	CWM	30

Continued

You YY 2020 [52]	30	30	63.47 ± 8.21	63.60 ± 7.75	YQSXTM + CWM	CWM	90
Qing XL 2022 [53]	30	30	62.03 ± 6.48	61.53 ± 6.76	YQHXHT + CWM	CWM	84
Cheng J 2020 [39]	30	30	63.36 ± 1.63	63.43 ± 1.54	YQHX + CWM	CWM	60
You ZJ 2010 [40]	30	30	67.7 ± 8.5	66.8 ± 7.7	BQYX + CWM	CWM	56
Gao L 2014 [58]	62	63	63.71 ± 10.66	63.58 ± 10.92	QSTL + CWM	CWM	21
Run JW 2023 [59]	60	60	70.34 ± 2.19	70.39 ± 2.11	GP&XFZY + CWM	CWM	60
Huang PL 2019 [41]	60	60	59.36 ± 5.74	61.98 ± 4.95	BZ + CWM	CWM	21
Cheng L 2025 [46]	56	56	59.56 ± 4.79	60.14 ± 5.23	WSXN + CWM	CWM	84

Abbreviation: T, Trial group. C, Control group. WMT, Western medicine treatment. FZ, Fuzheng Capsule. BYHX, Buyi Huoxue pill. NXT, Naoxintong capsule. TXL, Tongxinluo capsule. DZSM, Dengzhan Shengmai capsule. QLYZ, Qilong Yizhi granule. ZFXN, Zhong feng xing nao liquid. YQTL, Yiqitongluo granule. DYNT, Dengyin Naotong capsule. YNK, Yinaokang capsule. QSHW, Qishen Huanwu capsule. SWYZ, Shenwu Yizhi capsule. BN, Bunao cream. QL, Qinglong capsule. BYHW, Buyang Huanwu decoction. YZHX, Yizhi Huoxue decoction. GBHX, Guben Huoxue decoction. YQHXTL, Yiqi Huoxue Tonglou decoction. YQSXTM, Yiqi Shuxue Tongmai prescription. YQHXHT, Yiqi Huoxue Huatan decoction. YQHX, Yiqi Huoxue decoction. BQHX, Buqi Huoxue decoction. QSTL, Qishen Tongluo Zengzhi decoction. GP&XFZY, Guipi decoction with xuefu zhuyu decoction. BZ, Bazhen decoction. WSXN, Wushen Xingnao decoction.

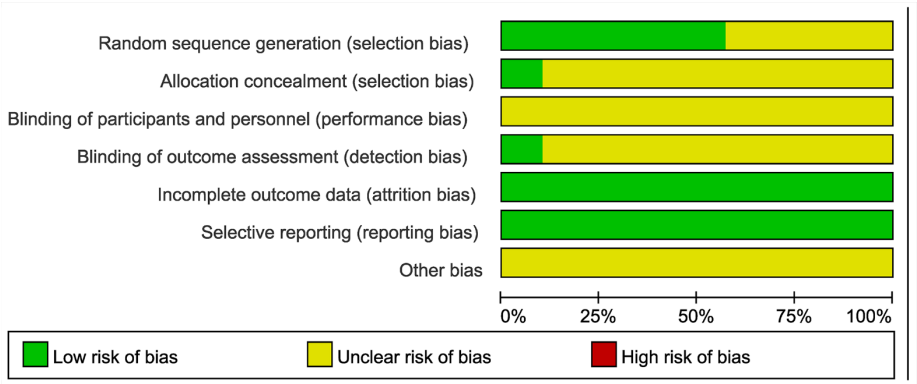

Figure 2. Results of the risk of bias evaluation.

3.3. Assessment of the Risk of Bias

Twenty-seven studies [13] [15] [18] [20]-[22] [24]-[26] [28] [32] [37] [41] [43]-[48] [50] [52]-[54] [56] provided detailed descriptions of randomization procedures using random-number tables and were judged to be low risk. The remaining 22 studies The remaining 22 studies only mentioned randomization without specifying the relevant method, leading to an unclear risk. For allocation concealment, five studies [21] [24] [52] [53] employed sealed opaque envelopes or centralized computerized randomization systems and were rated as low risk. while the other included studies did not describe any allocation concealment measures. Concerning blinding, three studies [52] [54] [58] explicitly reported blinding of outcome assessors and were assessed as low risk. The other studies did not mention blinding of participants or personnel, have being rated as unclear risk. In terms of outcome completeness and selective reporting, all studies demonstrated complete outcome data with no evidence of selective reporting, and were assigned low risk.

Based on full-text review, other potential sources of bias could not be identified, so this domain was rated as unclear risk. The results of the risk of bias assessment are presented in Figure 2.

3.4. Outcome Measures

3.4.1. Network Diagram

In the network evidence diagram, each node represents a different intervention. Node size is proportional to the total sample size of the included studies, and the lines between nodes indicate direct comparisons between interventions. The network diagram presented a star-shaped structure with no closed loops among all intervention nodes, making inconsistency testing unfeasible in this network meta-analysis. Thus, all efficacy rankings of interventions were based exclusively on indirect evidence, as illustrated in Figure 3. Notably, Naoxintong capsule, Tongxinluo capsule, Yiqi Tongluo granule, Buyang Huanwu decoction, Guben Huoxue decoction and Yizhi Huoxue decoction are the most extensively investigated tonifying qi and circulating blood Chinese herbal medicine in the treatment of PSCI.

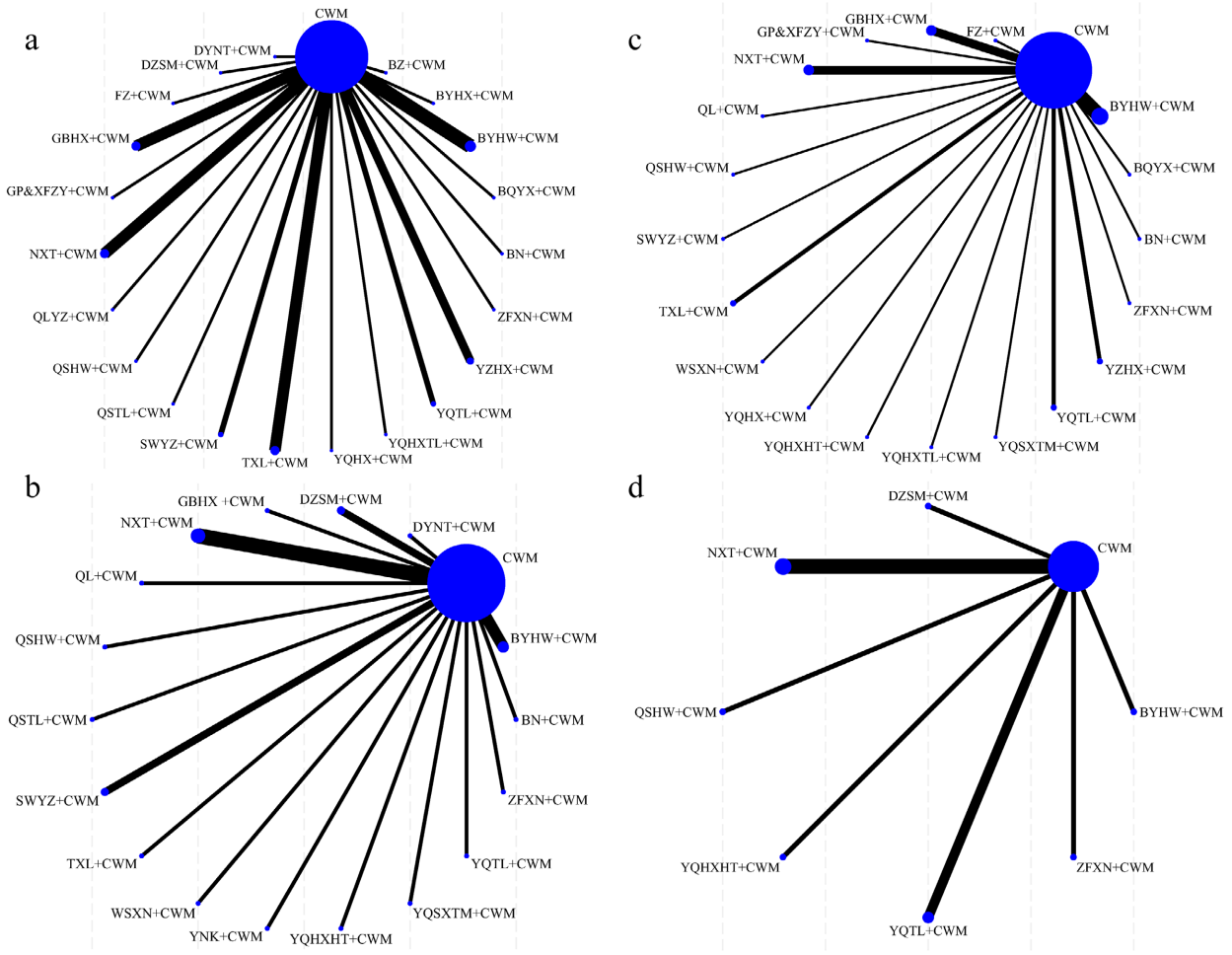

Figure 3. Network diagram of outcomes. (a) MMSE score, (b)MoCA score, (c) clinical efficacy rate, (d) NIHSS score.

3.4.2. MMSE Score

Thirty-eight studies [11]-[47] reported MMSE score, involving a total of 3222 participants, including 1619 in trial group and 1603 in control group. Heterogeneity analysis showed substantial between-study heterogeneity (I^2 = 92.6%, P = 0.00), a random-effects model was used to pool effect sizes. Meta-analysis demonstrated that tonifying qi and circulating blood Chinese herbal medicines with conventional Western medication were significantly superior to conventional Western medication alone in improving MMSE score (MD: 3.13, 95% CI: 2.54 - 3.73). The forest plot is presented in **Figure 4**. The network meta-analysis results demonstrated that the top five interventions with conventional Western medicines for enhancing MMSE score ranked by SUCRA were: Guipi decoction with Xuefu Zhuyu decoction (99.2%), Yiqi Huoxue decoction (88.0%), Buyang Huanwu decoction (82.1%), Naoxintong capsules (78.6%), and Buyi Huoxue pills (73.9%), as illustrated in **Figure 5**.

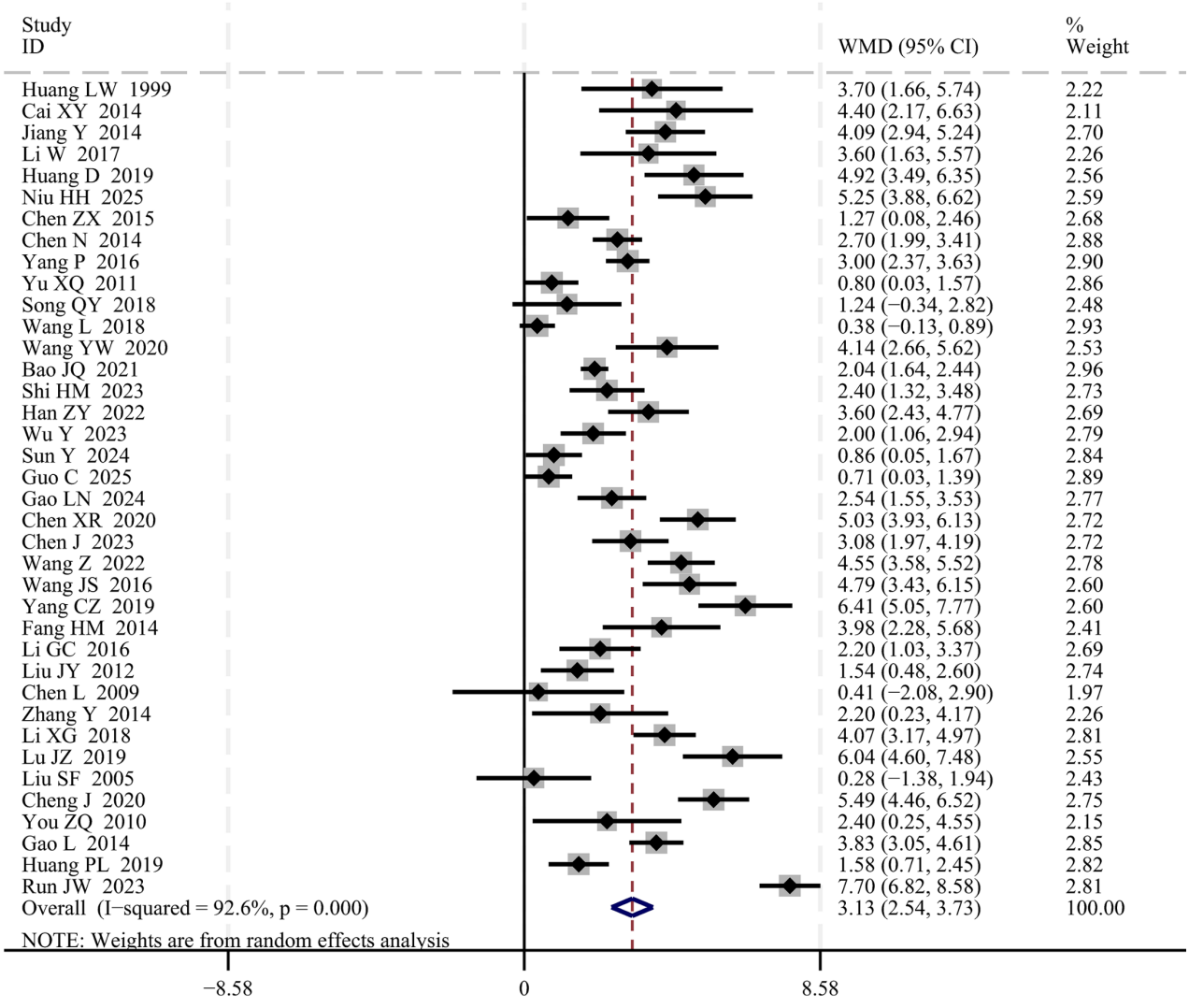

Figure 4. Forest plot of MMSE score.

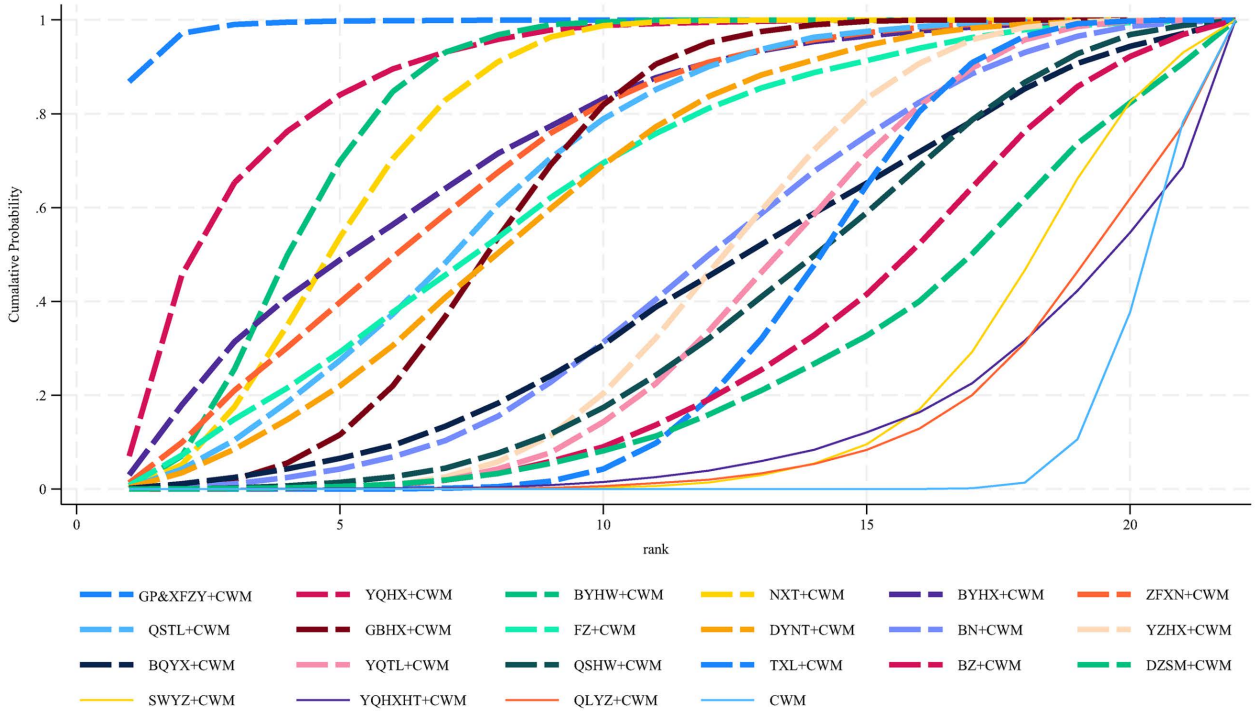

Figure 5. SUCRA Results of MMSE score.

3.4.3. MoCA Score

Twenty-four studies [14]-[16] [21] [23] [24] [26]-[28] [38] [43]-[54] reported MoCA score, involving a total of 2154 participants, with 1077 in trial and control group. Heterogeneity analysis indicated substantial study-to-study variation (I^2 = 84.5%, P = 0.000), prompting the use of a random-effects model for meta-analysis. Meta-analysis results showed that tonifying qi and circulating blood Chinese herbal medicines with conventional Western medication demonstrated superiority over conventional Western medication alone in improving MoCA scores (MD: 2.76, 95% CI: 2.19 - 3.32), the forest plot is presented in **Figure 6**. The network meta-analysis results demonstrated that the top five interventions with conventional Western medicines for enhancing MoCA score ranked by SUCRA were: Yiqi Tongluo granules (92.8%), Naoxintong capsules (91.7%), Guben Huoxue decoction (88.2%), Qishen Tongluo Zhengzhi decoction (86.1%), and Buyang Huanwu decoction (81.2%), as shown in **Figure 7**.

3.4.4. Clinical Effective Rate

The clinical efficacy rate was defined as the proportion of patients with improved cognitive function after treatment. It was designated as an exploratory outcome in this study. A total of 35 studies [12] [14] [16] [17] [19] [22]-[28] [30]-[32] [34]-[41] [43]-[47] [51]-[54] [56] [57] reported this outcome, with a total of 2973 participants (1489 in the trial group and 1484 in the control group). Heterogeneity analysis showed low inter-study heterogeneity (I^2 = 0%, P = 0.917), allowing the use of a fixed-effect model for effect size pooling. Meta-analysis results demonstrated that tonifying qi and circulating blood Chinese herbal medicines combined

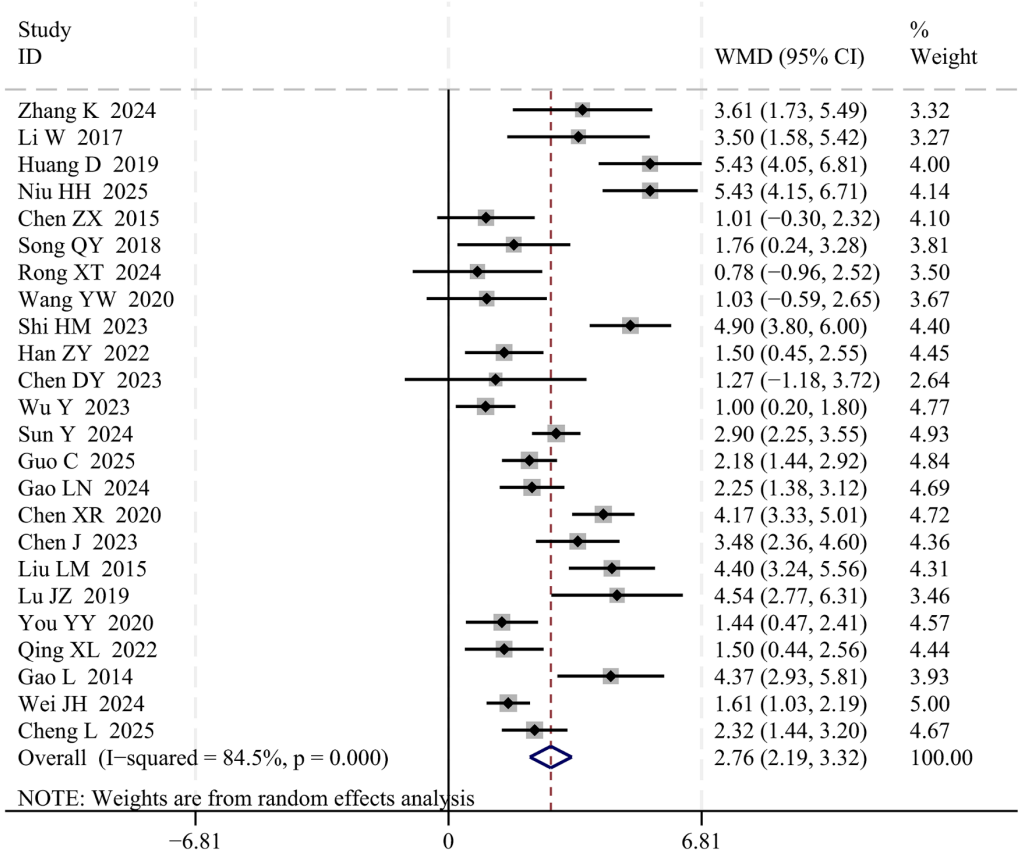

Figure 6. Forest Plot of MoCA score.

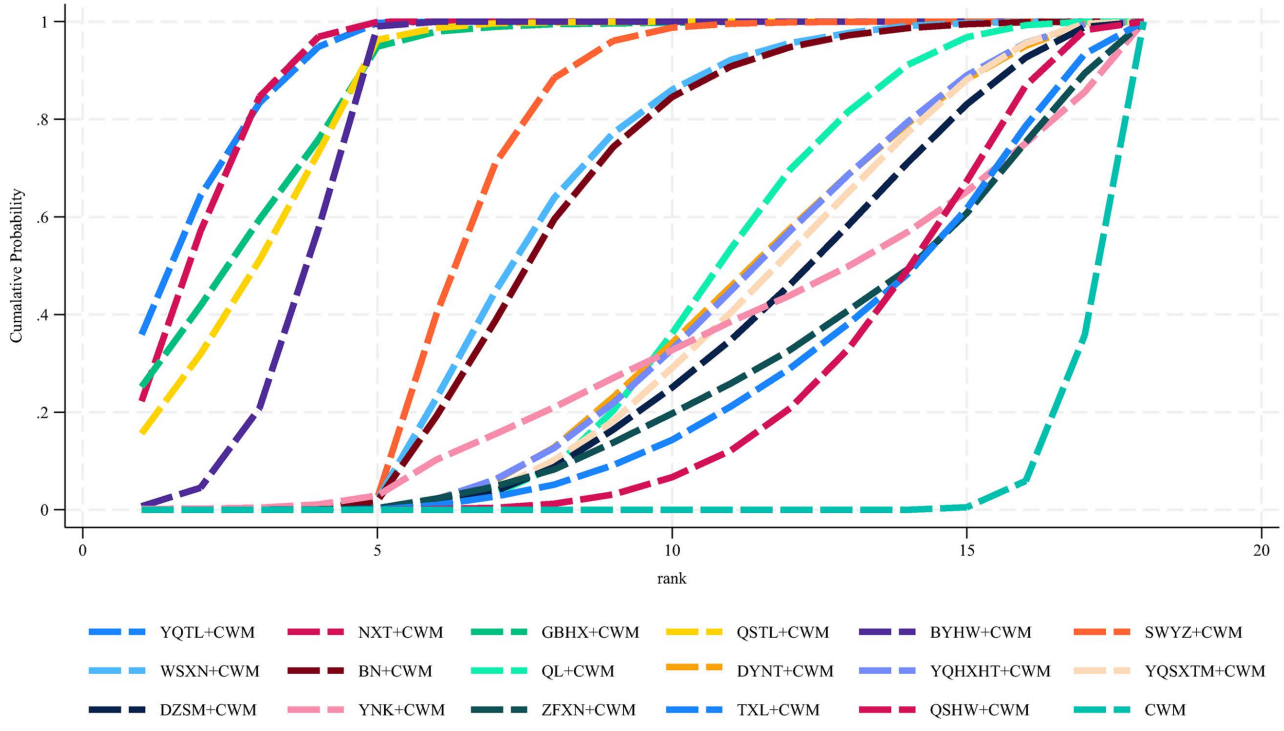

Figure 7. SUCRA Results of MoCA score.

with conventional Western medication significantly improved the clinical effective rate compared with conventional Western medication alone (RR: 1.23, 95% CI: 1.19 - 1.27), with statistical significance. The forest plot is shown in Figure 8. In the network meta-analysis, interventions were ranked based on the SUCRA. The top five interventions with conventional Western medicines for enhancing clinical efficacy rate were: Qishen Huanwu capsules (90.2%), Fuzheng capsules (83.5%), Yizhi Huoxue decoction (71.6%), Guben Huoxue decoction (68.9%), Shenwu Yizhi capsules (67.3%), as shown in Figure 9.

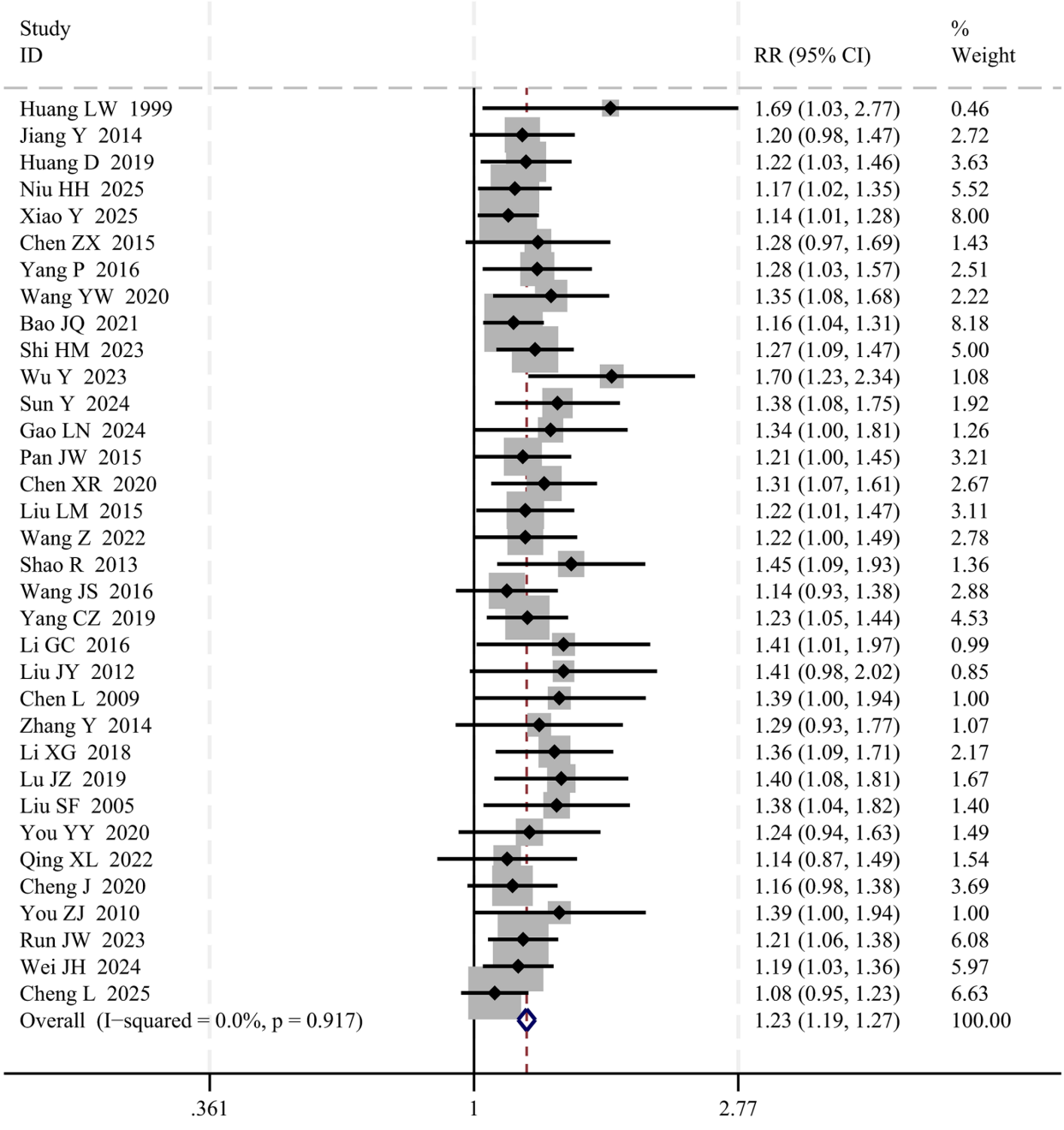

Figure 8. Forest Plot of clinical effective rate.

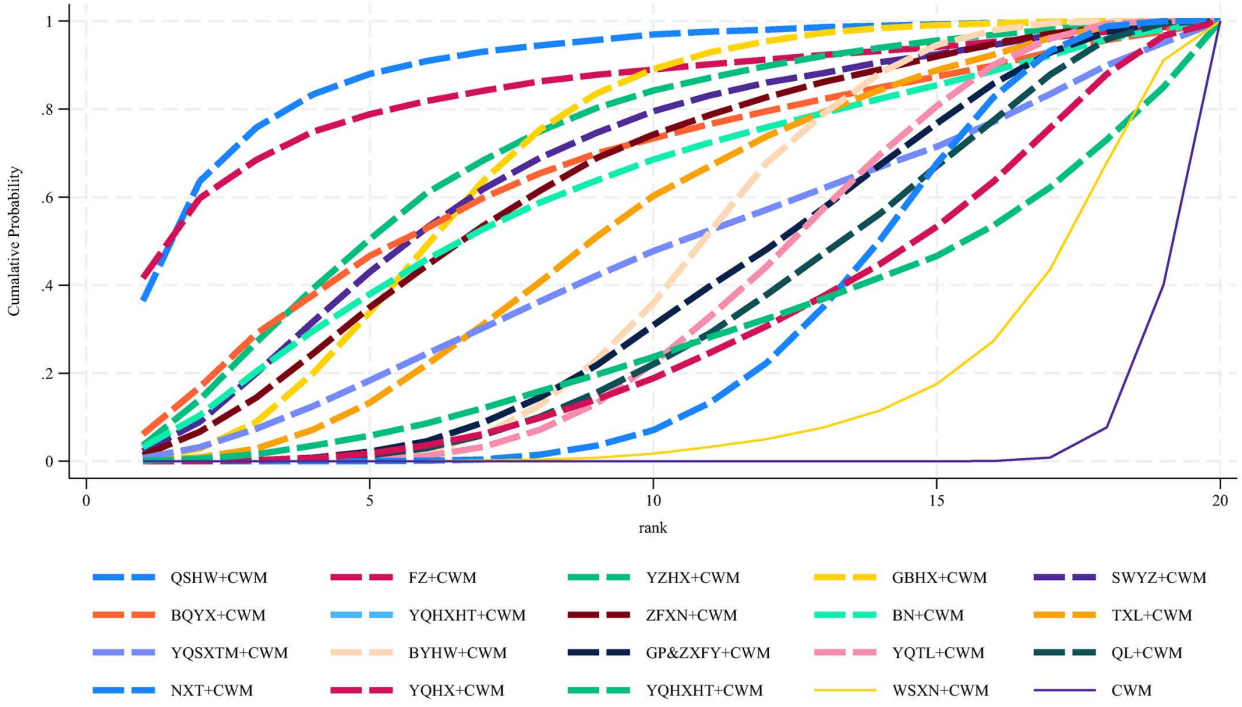

Figure 9. SUCRA Result of Clinical effective rate.

3.4.5. NIHSS Score

Ten studies [15] [21]-[24] [29] [48] [53] reported NIHSS scores, involving a total of 980 participants, with 490 in trial and control group. Heterogeneity analysis revealed substantial inter-study heterogeneity (I^2 = 91.0%, P = 0.000), necessitating the use of a random-effects model for effect sizes. Meta-analysis results indicated that tonifying qi and circulating blood Chinese herbal medicines with conventional Western medication significantly outperformed conventional Western medication alone in reducing NIHSS score (MD: 2.78, 95%CI: 1.76 - 3.80), the forest plot is shown in **Figure 10**. The network meta-analysis results demonstrated that the top five interventions with conventional Western medicine for reducing NIHSS score ranked by SUCRA were: Nao Xintong capsules (99.6%), Buyang Huanwu decoction (82.1%), Qishen Huanwu capsules (61.8%), Yiqi Tongluo granules (57.2%), Yiqi Huoxue Huatan decoction (46.3%), as shown in **Figure 11**.

3.4.6. Subgroup and Sensitivity Analyses

Given the high heterogeneity observed in MMSE, MoCA and NIHSS score outcomes, subgroup analyses were further performed in this study stratified by treatment course, dosage form and conventional western medicine type. The results showed that high heterogeneity still existed in all subgroups (I^2 > 50%, P < 0.05), indicating that treatment course, dosage form and conventional western medicine type were not the sources of heterogeneity. Meanwhile, sensitivity analysis was conducted using the leave-one-out method. The results showed that omitting any individual trial did not shift the overall effect estimate outside the 95% confidence interval, which verified the stability of the meta-analysis findings.

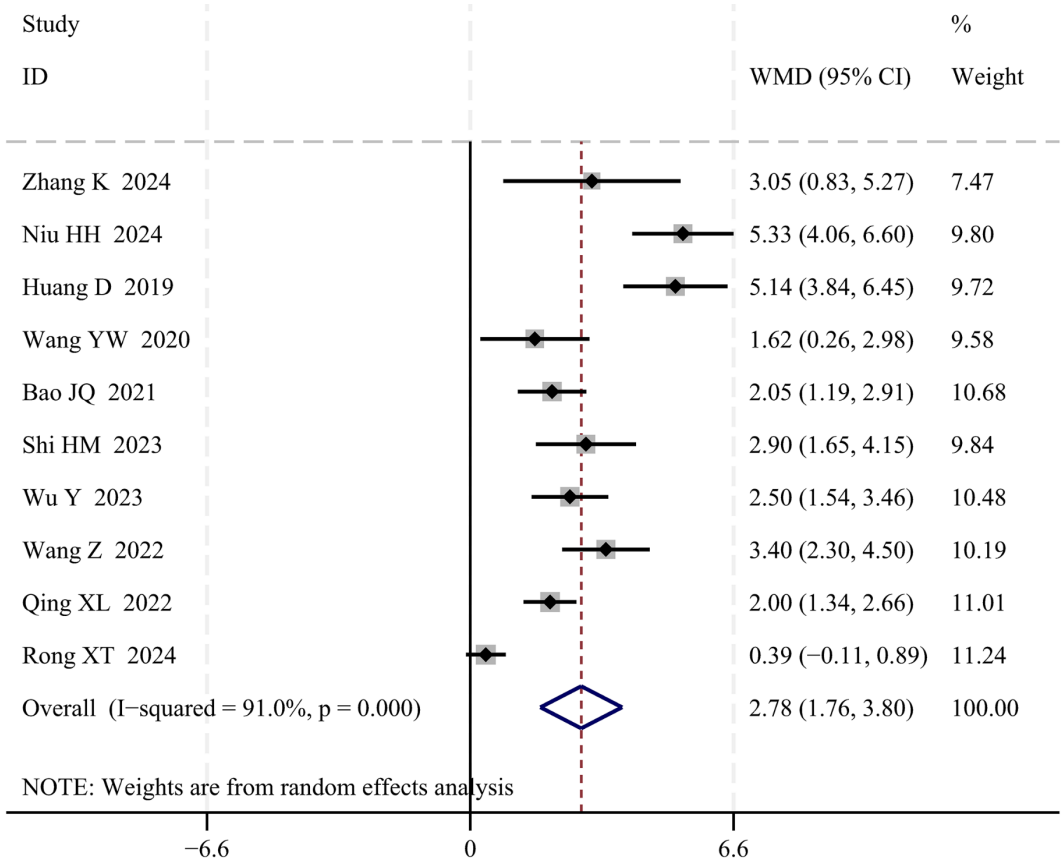

Figure 10. Forest plot of NIHSS score.

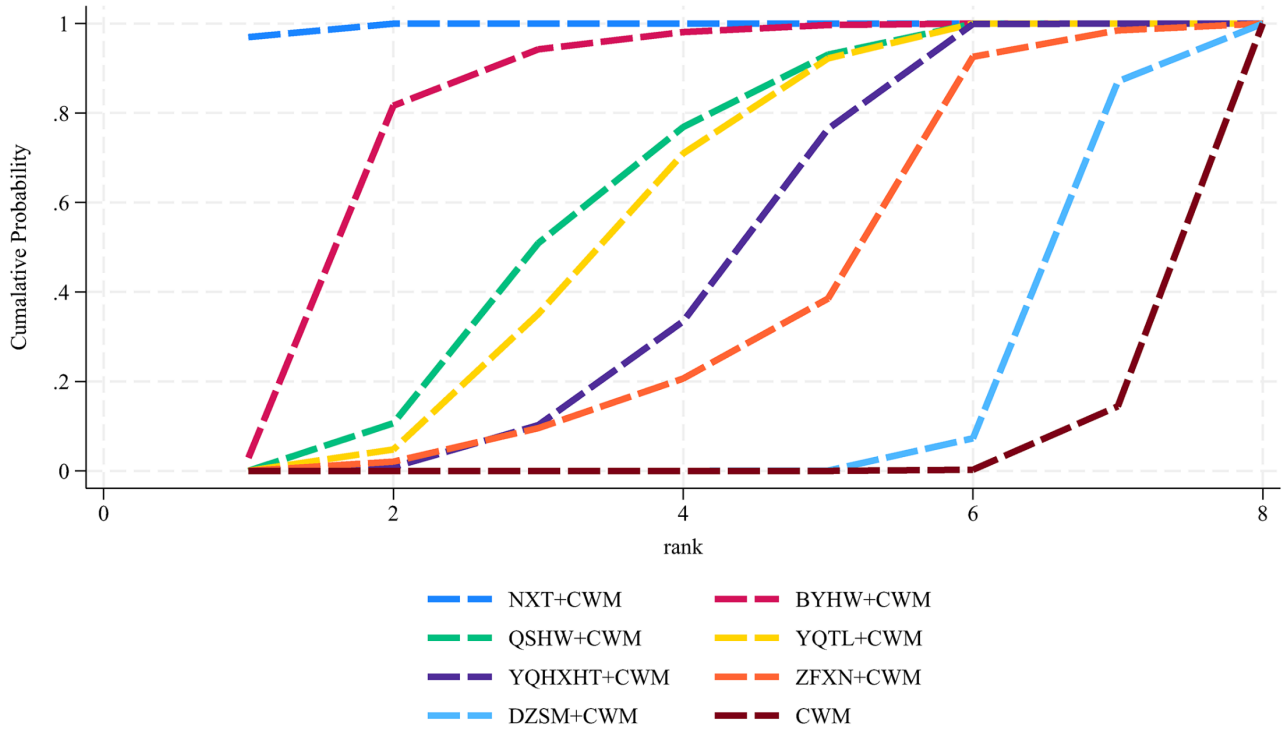

Figure 11. SUCRA result of NIHSS score.

3.4.7. Safety

Among the 49 studies, 27 studies [11] [15]-[18] [20]-[22] [24]-[27] [29] [32] [35]-[37] [40] [43]-[48] [52]-[54] reported adverse reactions. Thirteen studies [15] [17] [18] [22] [27] [32] [43]-[46] [48] [52] [54] documented adverse reactions, mainly including gastrointestinal disturbances and neurological symptoms. The remaining 14 studies reported no adverse reactions. In these 13 studies reports [15] [17] [18] [22] [27] [32] [43]-[46] [48] [52] [54] demonstrated no statistically significant difference in the incidence of adverse events between the trial and control groups ($P > 0.05$). Given that no significant between-group differences were observed in the overall incidence of adverse events, only a descriptive analysis was performed in the present study. Detailed information on adverse events is presented in **Table 2**.

Table 2. Detailed information of adverse events.

Study	Intervention measures	Adverse events	
		Trial group	Control group
Zhang K 2024 [48]	NXT + CWM	2 cases diarrhea, 1 case decreased appetite	1 case dizziness, 2 cases diarrhea, 1 case decreased appetite
Huang D 2019 [15]	NXT + CWM	1 case dizziness, 2 cases gastrointestinal reaction	2 cases dizziness, 1 case gastrointestinal reaction, 1 case Skin Itching
Niu HH 2025 [44]	NXT + CWM	2 cases fatigue, 2 cases diarrhea, 1 case loss of appetite	1 cases fatigue, 2 cases diarrhea
Xiao Y 2025 [43]	NXT + CWM	4 cases gastrointestinal discomfort, 1 case muscle cramps, 1cases insomnia	2 cases gastrointestinal discomfort, 2 cases muscle cramps, 1 case insomnia
Chen N 2014 [17]	TXL + CWM	3 cases stomach pain, 2 cases nausea	3 cases nausea and gastric discomfort
Yang P 2016 [18]	TXL + CWM	3 cases stomach pain, 2 cases nausea	3 cases gastric discomfort
Bao JQ 2021 [22]	YQTL + CWM	1 case odizziness, 1 case diarrhoea, 3 cases nausea and vomiting, 2 cases abdominal distension, 1 case rash	2 cases odizziness, 1 case diarrhoea, 2 cases nausea and vomiting, 1 case abdominal distension
Chen DY 2023 [54]	YNK + CWM	1 case insomnia	1 cases insomnia
Chen XR 2020 [27]	BYHW + CWM	1 case dizziness, 1 case somnolence, 1 case constipation, 1 case dry mouth	1 case Somnolence, 1 case constipation, 1 case dry mouth
Fang HM 2014 [32]	YZHX + CWM	2 cases nausea, 2 cases abdominal discomfort	1 case nausea, 1 case abdominal discomfort
You YY 2020 [52]	YQSXTM + CWM	1 case nausea	1 case nasal congestion
Wei JH 2024 [45]	QL + CWM	14 cases nausea, 7 cases headache, 9 cases abnormal liver function	13 cases nausea, 6 cases headache, 8 cases abnormal liver function
Cheng L 2025 [46]	WSXN + CWM	1 case mildly elevated transaminases, 2 cases nausea and vomiting, 1 case fatigue	2 cases mildly elevated transaminases, 2 cases abdominal pain, 1 case fatigue

3.4.8. Publication Bias

This study assessed potential publication bias quantitatively using Egger's regression test. The results showed that the P-values for the intercept tests of MMSE scores and clinical response rates were 0.037 and 0.000 ($P < 0.05$), indicating pos-

sible presence of publication bias, which may be related to the relatively limited sample sizes of the included studies. In contrast, the P-values for the intercepts of MoCA scores and NIHSS scores were 0.229 and 0.142 ($P > 0.05$), indicating that no significant publication bias was observed for these two outcome measures, as shown in Table 3.

Table 3. Result of Egger's P-value.

Outcome measure	Egger's P-values
MMSE score	0.037
MoCA score	0.229
NIHSS score	0.142
Clinical efficacy rate	0.000

4. Discussion

PSCI is a disabling clinical syndrome secondary to cerebrovascular events, characterized by domain-specific cognitive deficits or global cognitive deterioration. The clinical treatment of PSCI remains challenging owing to the lack of targeted pharmacological interventions [60]. According to traditional Chinese medicine theory, PSCI is categorized under TCM syndromes including "amnesia", "memory loss" and "cognitive retardation". Its pathogenesis is considered to be centered on cerebral dysfunction and visceral disharmony, with core pathological changes involving phlegm-dampness retention, blood stasis, qi stagnation and kidney essence insufficiency. Notably, the formation of phlegm and blood stasis is frequently induced by qi deficiency and qi stagnation, and cerebral dysfunction is further aggravated by inadequate qi and blood nourishment to the brain [7] [8] [61]. Growing evidence has identified tonifying qi and circulating blood therapies as the fundamental therapeutic principles of TCM for PSCI [9].

4.1. Major Findings

This study is the first systematic review and network meta-analysis to specifically investigate the efficacy and safety of tonifying qi and circulating blood Chinese herbal medicine as adjunctive therapy with conventional Western medicine for PSCI. The core finding is that this combined therapeutic strategy exerts a significant positive effect on improving cognitive and neurological functions in PSCI patients, which verifies the clinical applicability of the TCM therapeutic principle of tonifying qi and activating blood circulation for PSCI targeting the core pathogenesis of qi deficiency and blood stasis. Notably, Buyang Huanwu Decoction and its modified formulations (Naoxintong capsules, Yiqi Tongluo granules, Qishen Huanwu capsules, Fuzheng capsules) show consistent superiority across multiple cognitive and neurological outcome assessments. This result is not accidental but highly consistent with the TCM pathological understanding of PSCI, as these formulations are precisely designed to tonify qi and resolve blood stasis, directly ad-

dressing the key pathological link of cerebral orifice malnourishment due to qi and blood deficiency in PSCI.

4.2. Pharmacological Mechanism

Buyang Huanwu Decoction, a classical TCM formula for qi deficiency and blood stasis syndrome in stroke, is composed of Astragali Radix as the monarch herb to tonify primordial qi, combined with blood-activating and stasis-resolving herbs such as Chuanxiong Rhizoma, Carthami Flos and Pheretima. Its core efficacy of tonifying qi and activating blood circulation aligns with the core pathogenesis of PSCI, laying a theoretical foundation for its clinical efficacy. Based on the core mechanism of action, its modified formulations further optimize their pharmacological effects to adapt to the complex pathological characteristics of PSCI. Naoxintong capsule, grounded in the "concurrent treatment of brain and heart" theory, enhances Buyang Huanwu decoction by integrating additional circulate blood and transform stasis herbs [62]. This study confirms its optimal efficacy in reducing the National Institutes of Health Stroke Scale (NIHSS) score, which is consistent with previous findings that "Naoxintong Capsules can improve neurological deficits in patients with acute ischemic stroke." Animal studies have also verified its ability to regulate inflammatory cytokines and improve memory in mice [63] [64]. Yiqi Tongluo granule, composed of Astragalus membranaceus, Salvia miltiorrhiza, Lumbricus, Ligusticum chuanxiong, and Carthamus tinctorius, can regulate ROS/ATP metabolism to alleviate mitochondrial damage, enhance the viability of hypoxic neurons, and promote cerebral angiogenesis, thereby improving neurological function in rats with cerebral infarction [65] [66]. It exhibits excellent efficacy in improving cognitive function, as reflected by MoCA score. Fuzheng Capsules are mainly formulated based on the qi-tonifying and blood-activating principles of Buyang Huanwu Decoction, supplemented with kidney-tonifying and phlegm-resolving herbs. They have been proven to significantly improve cognitive function and protect against free radical damage. Furthermore, multiple meta-analyses have confirmed the remarkable efficacy of Buyang Huanwu Decoction in the treatment of stroke and its recovery phase, which is likely mediated by the activation of the AMPK/mTOR and PI3K-AKT signaling pathways [67] [68]. This further substantiates the efficacy and mechanistic rationality of Buyang Huanwu Decoction and its modified formulations.

4.3. Strengths and Limitations

The principal strength of this study lies in its focus on the core pathogenesis of "qi deficiency and blood stasis" in PSCI. This study represents the first dedicated analysis of traditional Chinese medicines with the effects of tonifying qi and circulating blood. This research approach retains and emphasizes the unique therapeutic characteristics of this specific therapeutic principle. Methodologically, this study first verified via systematic review that herbs for tonifying qi and circulating blood circulation are superior to conventional Western medicines. Subsequently, a net-

work meta-analysis was adopted to integrate direct and indirect evidence for the quantitative comparison of diverse interventions, thereby improving the reliability of the research results.

Despite the valuable insights obtained, this study has several unavoidable limitations. First, the inclusion of only Chinese-language published studies may lead to potential language bias. Second, the methodological quality of the included trials was generally suboptimal, especially in terms of the inadequate reporting of allocation concealment and blinding measures in most studies. Although the difficulty in blinding complex herbal decoctions is an inherent challenge, this does not negate the existence of the aforementioned limitation. Finally, the underreporting of adverse events in nearly half of the included studies compromises the robustness of the safety evaluation.

5. Conclusion

In conclusion, this systematic review and network meta-analysis is the first to integrate evidence on the efficacy of tonifying qi and circulating blood Chinese herbal medicine with conventional Western medicine for PSCI and provides preliminary evidence for this combined therapy. Results indicate that these Chinese herbal medicines may hold potential for improving cognitive and neurological functions in patients with PSCI, particularly Buyang Huanwu decoction and its modified formulations. These preliminary findings need to be confirmed by large-sample, multicenter, double-blind randomized controlled trials with standardized study protocols before clinical recommendation.

Funding

This work was supported by grants from the Science and Technology Planning Project of Guangdong Province (2024A1515012818), the Guangzhou Key R&D Program Project (2023B03J1343, 2024B01J1232), the Fundamental Research Funds for the Central Universities (21623114), as well as the Scientific Research Fund Project of Yunnan Provincial Department of Education (2025J0183).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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