

Efficacy of Acupuncture-Related Therapy for Migraine: A Systematic Review and Network Meta-Analysis

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Objective: Migraine is a common neurological disorder, which resulting in significant societal and personal burdens. Acupuncture has attracted widespread attention in migraine prophylaxis and treatment in recent years. Although some studies have confirmed the effectiveness of acupuncture therapy in treating migraines, there is still a lack of comprehensive evaluation regarding the comparison between different types of migraines and various acupuncture therapies. Furthermore, certain special acupuncture methods have not received sufficient attention and research. Therefore, the objective of this study is to summarize and expand upon previous research, update existing evidence, and compare the efficacy of different acupuncture therapies for migraine. We aim to provide stronger evidence-based support for clinical practice through this study, thereby promoting wider application of acupuncture therapy in migraine treatment.

Methods: A exhaustive and methodical search was conducted across the nine databases: PubMed, EMBASE, Web of Science, Scopus, the Cochrane Library, CBM, CNKI, WANFANG and VIP Data. The Visual Analog Scale (VAS) scores, migraine attack frequency, duration, days of attack and adverse effects were observation indicators.

Results: This study included 34 studies involving a total of 3365 migraineurs. The results of the study demonstrated that acupuncture therapy reduced VAS scores of migraine patients better compared to medication (MD=-1.29, 95% CI=[-1.67,-0.92]) and exhibited greater efficacy in reducing the frequency of migraine attacks (MD=-1.95, 95% CI=[-3.06,-0.85]), the duration of attacks (MD=-3.29, 95% CI=[-4.65,-1.93]), and days of attack (MD=-1.02, 95% CI=[-1.58,-0.47]). Significant heterogeneity suggested that different acupuncture therapies had varying effects, and that the efficacy of the same therapy may also vary in different migraine types. In the context of network meta-analysis, the SUCRA of acupuncture therapies for reducing VAS scores was ranked as special acupuncture method (98.3%), acupuncture plus medicine (71.9%), and acupuncture (54.5%). Blood-letting and cupping was the most effective treatment for lowering the frequency of migraine attacks. The most effective treatment for shortening the duration of migraine was acupuncture plus medication (81.2%). When it comes to decreasing the days of migraine, acupuncture (80.3%) came out on top. 14 studies reported the occurrence of adverse effects, of which 4 studies had no adverse effects in the test group.

Conclusion: Initial findings indicate that acupuncture-related therapy exhibits superior effectiveness in the treatment of migraine and clinical decision-making should be patient-specific.

Keywords: acupuncture, migraine, systematic review, network meta-analysis

Introduction

Migraine, one of a disabling primary headache illness, which typically characterised by recurrent moderate or severe unilateral pulsatile headaches, but can also be seen bilaterally.¹ It's usually lasts from a few hours to several days, can be accompanied by nausea and vomiting, and physical activity, light, sound or odor stimulation can aggravate the headache. It is the second most common of the neurological disorders in causing disability-adjusted life-years (DALYs; the sum of years of life lost (YLLs) and years lived with disability (YLDs)) and second only to stroke.² Besides, migraine usually

affects patients during the ages of 15–49 years, with a peak in prevalence between ages 35 and 39 years.³ Migraine not only presents headache symptoms, but is also a potential risk factor for ischemic stroke, and is prone to concomitant mental disorders such as anxiety and depression.⁴

In the International Classification of Headache Disorders, 3rd edition, ICHD-3, migraine is categorized into six types: migraine without aura, migraine with aura, chronic migraine, migraine complications, probable migraine, and cyclical syndromes that may be associated with migraines, of which the most common is migraine without aura. In addition, the ICHD-3 appendix includes other migraine types that have yet to be further studied and validated, such as vestibular migraine (VM) and menstrual migraine (MM).⁵

Migraine affects approximately 1.04 billion people globally, with a lifetime prevalence of approximately 10% in males and 22% in females.^{6,7} This high incidence and disability rate of migraine result in significant health burden, reduced quality of life, and productivity losses, thereby imposing substantial negative impacts on patients, their families, and society as a whole. However, the etiology of migraine remains elusive and may involve genetic factors, dysregulation of brain neuronal excitability, endocrine metabolism, environmental influences, dietary factors, psychosocial factors, and sleep disorders. Research suggests that the pathogenesis of migraine may involve dysfunction of the nervous system, central sensitization of the cerebral cortex,⁸ abnormal vasodilation, neurogenic inflammatory response,⁹ genetic factors and so on.

At present, the main goals of treatment are to reduce or terminate headache attacks, relieve accompanying symptoms, and prevent headache recurrence. Treatment consists of both pharmacologic and non-pharmacologic treatments. Currently, the treatment of migraine is mainly based on drug therapy. In clinical practice, non-steroidal painkillers, sedatives, anti-anxiety and depressive drugs and calcium channel blockers, β -blockers and so on are mostly used, supplemented by behavioral interventions, psychological guidance and other non-pharmacological treatments. However, oral western medicine is easily accompanied by certain side effects, such as gastrointestinal discomfort, rash, drowsiness, fatigue, etc., resulting in many migraine patients' poor adherence to medication,¹⁰ which affects the efficacy of treatment, and also causes dependence on and abuse of medication if used frequently over a long period of time.

Compared to conventional drug therapies, the use of traditional Chinese medicine (TCM) in migraine management is becoming more widespread. According to Chinese medicine, migraine is caused by six external evils, emotional disorders, dietary disorders, and dysfunctions of internal organs, etc., which lead to poor qi and blood circulation, impassable veins and channels, and ultimately triggers headache. Treatment is mainly aimed at regulating qi and blood, and balancing the functions of the internal organs to relieve symptoms. Commonly used therapies include acupuncture, Chinese herbal tonics, massage, etc., which can often achieve good results. As a green therapy, acupuncture has been widely used in the treatment of migraine because of its convenience, safety, fewer consumables, inexpensive, long-lasting effect and non-dependence.¹¹ Many clinical studies have shown that acupuncture is effective in reducing the number and duration of migraine attacks, reducing pain, preventing headache recurrence, having fewer adverse effects, and has been recognized internationally.^{12,13} Commonly used acupuncture therapies include conventional acupuncture, acupressure, auricular pressure bean, blood-letting and cupping, electroacupuncture, scalp acupuncture, etc., which are widely used in the clinical treatment of migraine. Beside traditional acupuncture, there are also some special acupuncture therapies, which either use special acupuncture instruments or special acupuncture techniques and acupuncture theories, and these therapies can often achieve good therapeutic effects in clinical applications.

Based on the literature search, there are a number of systematic evaluation articles that have analyzed and compared the efficacy and safety of acupuncture therapy for the prevention or treatment of migraine accordingly. But integrated assessment of different acupuncture therapies for multiple migraine types and evaluation of the efficacy of specific acupuncture therapies is still absent. This article will provide a comprehensive and systematic summary.

With the increasing understanding of migraine and the accumulation of experience in non-pharmacological management, non-pharmacological treatment strategies, mainly acupuncture, have gradually become mainstream in the management of migraine. Therefore, by summarizing the randomized controlled trials of different acupuncture therapies for the prevention and treatment of different types of migraine, we can provide more objective and intuitive ideas and experiences on the treatment of migraine, and thus improve the clinical efficacy. Therefore, in order to provide

comprehensive and objective information, and the basis for the development of reliable clinical strategies for migraine patients, we posed the following research questions:

- 1.the research trends of acupuncture therapy in the prevention and treatment of migraine, as well as the greater concern is which type of migraine;
- 2.in terms of treatment options, which were the acupuncture therapies used for the prevention and treatment of different types of migraine, and the choice of acupuncture points;
- 3.effectiveness and safety of different acupuncture treatments compared to conventional therapeutic drugs in the treatment and prevention of migraine.

Materials and Methods

The present investigation adhered to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).¹⁴ The protocol has been previously registered on PROSEPERO (ID: CRD42023475425).

Data Sources and Search Strategy

We searched PubMed, Web of Science, EMBASE, Scopus, the Cochrane Library, China Biology Medicine Disc (CBMdisc), China National Knowledge Infrastructure (CNKI), WANFANG Database, and VIP Data from their creation dates until August 25th, 2023. This search was limited to articles written in either Chinese or English. The following keywords combined with Medical Subject Headings (MeSH) terms were used for searching: “acupuncture”, “needle”, “acupoint”, “electroacupuncture”, “moxibustion”, “migraine”, “status migrainosus”, “sick headache”, “medicine”, and “Standard Pharmacological Therapy” and other related phrases were utilised in the search process. The complete search strategy for each database is provided in the [Supplementary Information 1](#).

Inclusion Criteria

(1) Type of study: The study should be structured as a RCT to investigate the efficacy of acupuncture as a therapy for migraine, each group should consist of a minimum of 30 participants, and the literature included in the study should be in either Chinese or English. (2) Type of patients: Patients can be of any age, gender, or disease duration as long as they have been diagnosed with migraine (with or without aura) or another any kind of migraine. The diagnostic criteria, as well as the inclusion and exclusion criteria, must be well-defined. (3) Type of interventions: Patients in the test group received acupuncture-related therapies (including conventional acupuncture, blood-letting and cupping, electroacupuncture, etc.) with or without drug therapy, and the specific acupoints used were noted; the control group used conventional drug therapy only; and the medications used were those recommended by the clinical guidelines for migraine. (4) Type of outcomes: The evaluation should encompass one of the effectiveness outcomes and safety endpoints listed below: VAS score, the number of days of migraine, migraine duration, migraine attack frequency, and adverse events.

Exclusion Criteria

(1) Type of study: Non-RCTs, as well as literature reviews, animal experiments, conference papers, systematic reviews, and meta-analyses; sample sizes of less than 30 individuals per group; literature in other languages. (2) Type of patients: Secondary headaches, such as migraines secondary to cerebral hemorrhage, cerebral thrombosis, hypertension, and atherosclerosis; lack of diagnostic criteria, inclusion criteria, or exclusion criteria. (3) Type of interventions: In the test group, the interventions combined with other therapies in addition to medication; the medications combined with the interventions were Chinese herbs or proprietary Chinese medicines; the specific acupoints used were not indicated. In the control group, participants received any form of pharmacological therapy were be excluded if the specific medications used were not mentioned, or if the medications used were not recommended in the clinical guidelines. (4) Type of outcomes: The evaluation findings were unclear or inconsistent.

Study Selection

The literature retrieved based on the search terms was imported into the Zotero 6.0 software. Firstly, the literature function of the software was used to automatically remove duplicate documents. Then, a manual check was conducted to confirm the absence of any duplicate literature. All participating researchers underwent professional training. Two researchers (WY and WZY) adopted a cross-checking approach to read the de-duplicated articles, focusing solely on the titles and abstracts, and performed a preliminary screening based on predetermined inclusion and exclusion criteria to eliminate irrelevant studies. Subsequently, a further full-text reading was conducted to carry out a more rigorous screening to determine the eligibility of the studies. After obtaining preliminary results, the two researchers exchanged and cross-checked their findings. If there were any disagreements, they would first discuss the issue to seek consensus. However, if the disagreement remained unresolved after the discussion, a third researcher (DX) would be involved to make an assessment.

Data Extraction

Two researchers (MCH and HY) extracted data from the included trials and constructed a comprehensive table, encompassing the following primary components: 1. Basic information of the included studies, including title, authors, publication date, country, sample size, patient age and gender, and migraine type; 2. Specific details regarding acupuncture interventions, comprising acupuncture technique, acupoint names, retention time, treatment frequency, and duration; 3. Drug names, dosage, and frequency of administration; 4. Outcome measures and adverse events, encompassing VAS scores, migraine days, migraine duration, attack frequency, and adverse events such as dizziness, bleeding, and hematoma. For those studies where complete data could not be obtained, we made every effort to follow up with the original authors via phone and email.

Quality Assessment

The risk of bias for the included studies was assessed separately by two researchers (HY and WZY) using the evaluation procedures outlined in the Cochrane Risk of Bias 2.0 tool for Randomised Controlled Trials (RCTs) handbook.¹⁵ The assessment covered various aspects of study quality and placed particular emphasis on five main domains: 1) formation of random sequences, 2) allocation concealment, 3) blinding of participants and personnel, 4) blinding of outcome assessment, 5) completeness of outcome data, 6) selective outcome reporting, and 7) other sources of bias. The researchers categorized the study results as “low risk”, “high risk”, or “unclear risk” based on the risk of bias assessment tool, thereby determining the quality of the studies. To guarantee the credibility of the assessment findings, contact with a third researcher (referred to as MCH) was sought in instances where inconsistencies arose. Graphs were generated and visualized using Review Manager 5.4.

Statistical Analysis

Stata 17.0 software was used to analyze the data in this study. The data used were continuous variables and the effect indicators were chosen as mean difference (MD) and 95% confidence interval (95% CI). In order to identify and measure the heterogeneity of the statistics, the I^2 test was utilized for the analysis. When the I^2 value was less than 50%, it indicated that there was no significant heterogeneity, and therefore a fixed-effects model was selected for data analysis; whereas, when the I^2 value was greater than 50%, it indicated that there was significant heterogeneity, and a random-effects model was selected, then subgroup analyses or meta-regression analyses were performed to further explore the source of heterogeneity. Sensitivity analyses were conducted to assess the stability and reliability of the effect values. Subsequently, indirect observational comparisons of the effectiveness of individual acupuncture treatments were performed using network meta-analysis. Mean differences and 95% CIs were similarly analyzed as effect observations, and network relationship evidence maps were developed to describe the relationships between individual acupuncture therapies. Inconsistency tests were performed using node splitting to assess the consistency of the results of direct and indirect comparisons.¹⁶ Two-by-two comparisons of acupuncture therapies were performed using league tables to observe differences in efficacy between acupuncture therapies. The surface under the cumulative ranking area (SUCRA) was calculated for ranking the efficacy of different acupuncture therapies; the higher SUCRA scores and larger areas under the curve indicated better efficacy. Funnel plots were used to assess the publication bias of the included studies. Review Manager 5.4 was used for forest mapping and corresponding descriptions.

Results

According to the previously determined search terms, a preliminary search was conducted in various databases. In this search, a total of 2,981 potentially relevant articles were found, of which 1,108 articles were duplicates. After merging and removing duplicates, 1,867 articles remained. 337 relevant articles were preliminarily selected after reading the titles and abstracts of these 1,867 articles. Subsequently, the full texts of these 337 articles were read. Among them, 26 articles were found to be inaccessible in full text. Among the remaining articles with accessible full text, further selection was conducted according to the screening criteria, resulting in the inclusion of 34 articles that met the criteria. 277 articles were excluded for the following reasons: 1. No strict randomization was conducted (n=21); 2. Lack of clear diagnostic criteria, inclusion criteria, or exclusion criteria (n=41); 3. TCM or Chinese patent medicine was used as an intervention, or combined with acupuncture therapy (n=67); 4. Sample size in each group was less than 30 people (n=17); 5. Inconsistency or ambiguity in outcome measures (n=118); 6. Specific acupoints used were not specified (n=6); 7. Specific drugs used were not specified, or the drugs used were not recommended in the clinical guidelines for migraines (n=4); 8. Literature was non-Chinese or non-English (n=3). Agreement between investigators for trial eligibility was excellent (Kappa statistic=0.88). (Figure 1) And the PRISMA Checklist is shown in [Supplementary Appendix 1](#).

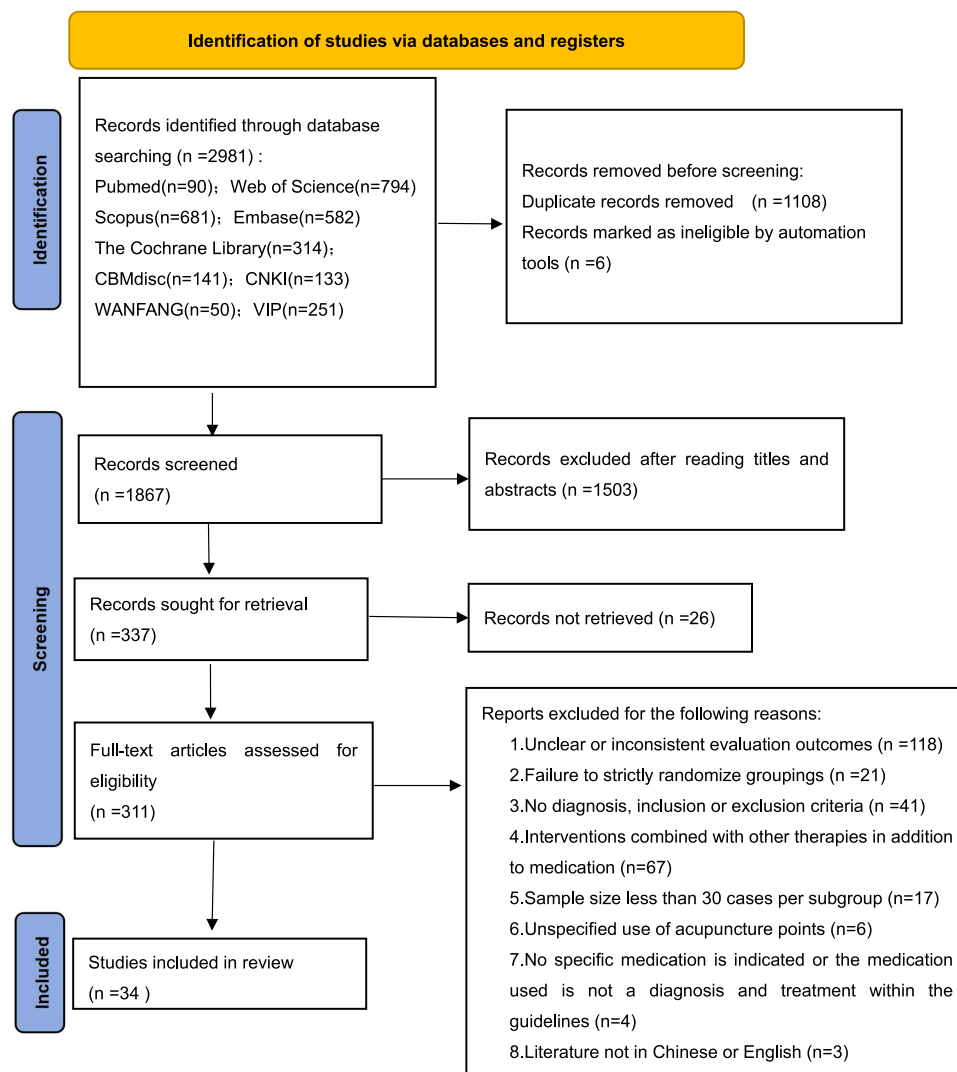


Figure 1 Selection of included studies.

Risk of Bias Assessment

The 34 included articles were assessed for risk according to the Cochrane Risk of Bias 2.0 Tool as follows: In terms of randomized sequence generation, 2 studies^{17,18} were judged to be at high risk due to their randomized sequence generation being unreasonable, such as “randomly allocated in the order of attendance”. In addition, 7 studies^{19–25} were judged to be of uncertain risk because they only mentioned that study subgroups were generated under randomized conditions without providing specific methods or relevant information on random sequence generation. The remaining studies were judged to be of low risk, with a reasonably reliable process of random sequence generation. In terms of allocation concealment, only 10 studies^{26–35} were rated as low risk, while the others did not mention specific methods of allocation concealment and were therefore considered to be of uncertain risk. In terms of blinding, 7 studies^{26,27,31,34–37} used double-blind methods and were at low risk of bias for both “blinding of subjects and intervention providers” and “blinding of outcome evaluators”. The remaining studies did not provide information on blinding and the risk was considered uncertain. Regarding the completeness of outcome data, 10 studies^{21,26,27,29,31–33,38–40} reported missing data. However, only 1²⁶ of the 10 studies stated the reasons for incomplete data, whether there were differences in missing data between groups, whether missing data would have an impact on the outcome of the intervention in the whole study, and how the missing data would be handled, and was therefore judged to be at low risk, whereas the rest studies were judged to be at indeterminate risk. In addition, 3^{21,27,29} of these 10 studies did not provide specific reasons for incomplete data at the same time. In terms of selective outcome reporting and other sources of bias, all 34 studies were rated as low risk and their final reported outcomes were consistent with the evaluation results listed in the study protocols, and there were no other sources of bias, too. Only 3^{26,34,35} of the total studies were rated as low risk for all risks of bias, making these studies highly accurate and reliable. (Figure 2 and 3)

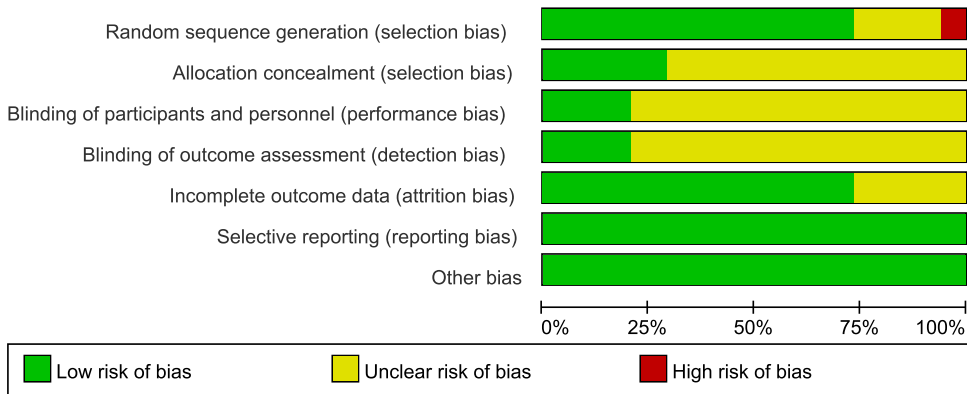


Figure 2 Risk of bias graph.

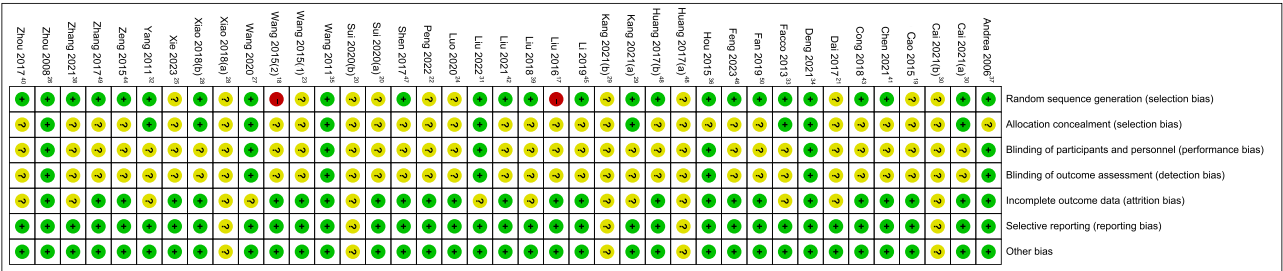


Figure 3 Risk of Bias summary. The three-arm study was equally divided into two groups-a and b. (1) and (2): Wang (1), Wang (2), Same author and year, but different studies.

Research Trends in Acupuncture Therapy for Migraine

Among the 34 articles included, the earliest publication was in 2006, with the highest number of published articles being 6 in 2021, followed by 5 in 2015 and 2017, respectively. The countries involved in the study were China (31), Taiwan (1),³² Germany (1),³⁷ and Italy (1).³³ The 34 RCTs included 3,365 patients, and according to the available information provided in the text, the minimum age of the participants was 13 years old and the maximum age was 68 years old, with a mean age of 38.57 years in the trial group and 39 years in the control group. The average percentage of females was 68.20%. The differences in general information such as age and gender between the test group and the control group were not statistically significant compared to each other and were comparable. (Table 1)

Regarding the type of migraine suffered by the included patients, a total of 12 studies^{20,25,28,30,32,39,42–44,48–50} did not specify the type of migraine, followed by 8 studies^{17,21,26,34,37,40,41,46} on migraine without aura or with aura, 6

Table 1 Basic Information of the Studies

| Author, Year | Country | Sample Size (Treatment Group/ Control Group) | Sex(F%) | Age |
|----------------------------------|--------------|---|---------|-------------------------------------|
| Cao et al 2015 ¹⁹ | China | 31/30 | 78.7 | 41/40 |
| Zhang et al 2021 ³⁸ | China | 43/42 | 70 | 36.12±9.45/34.93±6.57 |
| Liu et al 2016 ¹⁷ | China | 30/30 | 63.3 | 41.47±13.51/34.27±13.60 |
| Zhou et al 2008 ²⁶ | China | 146/140 | 65.7 | 41.9±12.3/43.1±12.7 |
| Wang et al 2020 ²⁷ | China | 67/65 | 67.4 | 38.7±10.4/40.6±11.0 |
| Xiao et al 2018 ²⁸ | China | 30/30/30 | 59.2 | 30.77±11.19/34.63±11.95/33.90±11.18 |
| Sui et al 2020 ²⁰ | China | 30/30/30 | 61.1 | 45.5±1.7/45.4±1.5/46.0±1.2 |
| Kang et al 2021 ²⁹ | China | 34/34/35 | 72.8 | 36.29±9.23/35.64±8.68/35.02±9.47 |
| Dai et al 2017 ²¹ | China | 35/34/45 | 65.8 | 42.09±9.67/42.15±9.67/44.04±11.13 |
| Peng et al 2022 ²² | China | 36/36 | 100 | 34.42±5.34/35.18±6.04 |
| Shen et al 2017 ⁴¹ | China | 32/32 | 54.7 | 39.8±10.1/38.4±11.4 |
| Chen et al 2021 ⁴² | China | 44/44 | 53.4 | 26.7±11.5/27.5±10.9 |
| Wang et al 2015(1) ²³ | China | 34/34 | 100 | 31.6±9.6/32.6±8.9 |
| Luo et al 2020 ²⁴ | China | 30/30 | 41.7 | 48.23±5.32/48.47±5.24 |
| Xie et al 2023 ²⁵ | China | 60/60 | 72.5 | 35.9±4.9/36.4±5.1 |
| Liu et al 2021 ⁴³ | China | 45/45 | 47.8 | 37.46±5.83/37.15±5.64 |
| Cong et al 2018 ⁴⁴ | China | 60/60 | 55.8 | 43.5±2.53/42.3±2.58 |
| Fan et al 2019 ⁴⁵ | China | 52/52 | 64.4 | 39.87±4.51/39.84±4.53 |
| Huang et al 2017 ⁴⁶ | China | 40/40/40 | 55.8 | 35.7±8.3/34.7±7.5/35.4±8.7 |
| Liu et al 2018 ³⁹ | China | 45/44 | 84.7 | 18.2±4.6/17.4±4.5 |
| Zhang et al 2017 ⁴⁷ | China | 40/40 | 46.3 | 42.31±11.84/41.87±10.19 |
| Zeng et al 2015 ⁴⁸ | China | 34/34 | 48.5 | 39.89±12.78/40.13±12.27 |
| Cai et al 2021 ³⁰ | China | 30/30/30 | 60 | 39±3.58/42±4.55/45±3.61 |
| Zhou et al 2017 ⁴⁰ | China | 35/35 | 55.7 | 38.4±10.3/40.2±11.8 |
| Hou et al 2015 ³⁶ | China | 42/41/19 | 82.4 | 41.0±9.1/39.8±9.2/41.7±8.8 |
| Liu et al 2022 ³¹ | China | 86/84 | 100 | 36.44±6.74/35.15±6.73 |
| Yang et al 2011 ³² | China Taiwan | 33/33 | 89.3 | 47.6±7.4/48.1±6.4 |
| Facco et al 2013 ³³ | Italy | 41/41 | 68.3 | 40/34 |
| Li et al 2019 ⁴⁹ | China | 39/39 | 53.8 | 41.6±4.9/43.8±5.7 |
| Feng et al 2023 ⁵⁰ | China | 38/38 | 52.7 | 42.73±8.92/43.82 ± 9.63 |
| Deng et al 2021 ³⁴ | China | 57/54 | 57.5 | 47±12/48±12 |
| Andrea et al 2006 ³⁷ | Germany | 57/37 | 87.7 | 40.0±11.4/40.3±10.7 |
| Wang et al 2011 ³⁵ | China | 61/59 | 85 | 39.2±10.9/39.9±13.1 |
| Wang et al 2015(2) ¹⁸ | China | 32/32 | 100 | 31±10/33±9 |

Notes: (1) and (2): Wang (1), Wang (2), Same author and year, but different studies.

studies^{19,27,29,33,35,38} on migraine without aura, 4 studies^{18,22,23,31} on MM, 2 studies^{24,47} on VM, 1 study⁴⁵ on chronic migraine, and 1 study³⁶ that included patients with episodic migraine and chronic migraine. Regarding the period of migraine treatment, 4 studies^{38,43,44,48} described the inclusion of patients with acute attacks of migraine, 5 studies^{17,21,26,28–30} with episodic migraine, 4 studies^{20,32,33,37} with prophylactic treatment of migraine, and 1 study²⁹ with remission of migraine; the remaining 20 studies did not mention the specific period of migraine suffered by the included patients.(Table 2)

Interventions

Acupuncture Therapy

Therapies involved in this study were acupuncture, electroacupuncture, blood-letting and cupping therapy, special acupuncture method. The most used of these therapies was acupuncture (11), special acupuncture method (6), then electroacupuncture (3) and blood-letting and cupping (2).

In terms of migraine staging, except for studies that did not specify the migraine attack period, in the acute migraine attack period, the interventions involved were acupuncture (2) and acupuncture plus conventional medicine (2). In the migraine attack period, acupuncture (2), electroacupuncture (2), bloodletting and cupping therapy (1) and special acupuncture method (3) were applied. In the migraine relief period, the intervention used was acupuncture, and in prophylaxis, the main interventions used were acupuncture (3) and acupuncture plus conventional medicine (1).

Acupoint

Generally, the same kind of acupuncture treatment, the selected points were more or less the same, ie, according to the site of pain and the meridian to which the pain site belongs, eg, points on the Shaoyang, Yangming, and Taiyang meridians were often selected, such as the Shuaigu, Jiaosun, Toulinqi, Touwei, Baihui, Yuzhen, Tianzhu and so on. Different acupuncture therapies will choose different treatment points depending on their mode of intervention. For example, Taiyang is often chosen for bloodletting and cupping.^{17,42} In addition, menstrual migraine is a special type of migraine, which is related to the liver, spleen and kidney, and the cause of its onset is more related to emotional depression, the deficiency of qi and blood, and poor functioning, etc. Therefore, the acupoints on the meridians of the liver, spleen and kidney will be selected more often in the identification of the cause of menstrual migraine. Vestibular migraine is also a special type of migraine, which is mostly attributed to vertigo, but is still characterized by deficiency of the liver and kidney, qi and blood as the pathomechanism, and acupoints are identified in this way. There are also some studies based on unique therapeutic theories, such as the theory of treating both the root and the symptoms, Tiaoshen theory, Distant-proximal point theory, and so on, which select unique acupoints or sites for the treatment of acupoints, such as Yintang, Laogong, Yongquan, Renzhong, and so on.^{29,43}

Effects of Interventions

A total of 34 studies reported on the VAS, of which 6^{20,21,28–30,46} were three-armed studies analyzed in a meta-analysis using a “control group split evenly and compared with the intervention group in 2 pairs”, where the sample size of the conventional medicine group was halved and the mean and standard deviation were kept constant. And one group labeled as a and one group labeled as b. There were a total of 12 studies reported frequency of migraine attacks, 9 studies reported duration of migraine, 6 studies reported duration of migraine, and all were two-arm studies.

Meta-Analysis

VAS Scores

Heterogeneity between studies was significant ($I^2=98\%$, $P<0.01$), and using a random-effects model, the results showed that the efficacy of acupuncture therapies was superior to conventional medicine in reducing VAS scores in migraine (MD=−1.31, 95% CI=[−1.69, −0.94]). To further investigate the differences in efficacy between different acupuncture interventions and control measures, subgroup analyses were implemented according to the type of acupuncture, of which 8 were acupuncture, 11 were acupuncture plus conventional medicine, 9 were special acupuncture method, 3 were electroacupuncture, and 2 were blood-letting and cupping. The results showed that acupuncture (MD=−1.07, 95% CI=[−1.80, −0.33]), special acupuncture method (MD=−1.86, 95% CI=[−2.49, −1.23]), acupuncture plus conventional medicine

Table 2 Summary of the Selected Studies

| Author, Year | Intervention | | Acupoint | Type of migraine | Period | Outcomes |
|---------------------------------|-----------------|--|---|------------------------------------|------------------------------|--|
| | Treatment Group | Control Group | | | | |
| Zhang et al 2021 ³⁸ | A | Flunarizine, 5 mg, qn | Main acupoint: Fengchi, Taiyang, Shuaigu, Zulinqi, Qiuxu, Zuqiaoyin, Ashi; auxiliary acupoint: Lieque, Fengmen, Quchi, Dazhui, Yinlingquan, Xingjian, Taixi, Fenglong, Xuehai, Gesu, Qihai, Zusanli, Shenshu | Migraine without aura | Acute migraine attack period | VAS scores, adverse events |
| Peng et al 2022 ²² | A | Flunarizine, 5 mg, qn | Bilateral: Lieque, Hegu, Taiyang, Toulinqi, Sizhukong, Sanyinjiao. Lieque: for unilateral headache, select acupoints on the healthy side (non-painful side); for bilateral or predominantly top-of-head headaches, select acupoints bilaterally | Migraine without aura or with aura | Migraine attack period | VAS scores |
| Luo et al 2020 ²⁴ | A | Flunarizine, 5 mg, qn | Main acupoint: Yintang, Shangxing penetrating through Baihui, Sanyinjiao; auxiliary acupoint: Fengchi, Wangu, Tianzhu Taiyang, Taichong; selecting acupoints based on syndrome differentiation: Xingjian, Xiaxi, Zusanli, Guanyuan, Taixi, Yinlingquan, Fenglong, Shenmen | Vestibular migraine | - | Frequency of attacks, duration, adverse events |
| Liu et al 2018 ³⁹ | A | Flunarizine, 5 mg, qn, and Nimodipine, 30 mg, tid | Qubin, Fengchi, Wangu, Toulinqi, Shuaigu, Sizhukong, Waiguan, Zhongzhu, Tongtian, Kunlun; auxiliary acupoint: Taichong or Xingjian, Taixi, Sanyinjiao, Xiaxi, Ashi | - | - | VAS scores, adverse events |
| Zeng et al 2015 ⁴⁸ | A | Flunarizine, 5 mg, qd | bilateral: Touwei, Neiting, Hegu, Quchi, Taichong, Sanyinjiao, Tongziliao, Yangbai, Fengchi, Dazhui, Baihui, Yintang, Taiyang, Shenmen | - | Acute migraine attack period | VAS scores, frequency of attacks, duration |
| Zhou et al 2017 ⁴⁰ | A | Flunarizine, 10 mg, qn | Baihui, bilateral: Fengchi, Touwei, Sanyinjiao, Taichong, Taixi, Neiguan; acute migraine attack period: plus Shenting, Sishencong, Ashi, Naokong (affected side) | Migraine without aura or with aura | - | Days of attacks, adverse events |
| Yang et al 2011 ³² | A | Topiramate, oral and titration | Yintang, bilateral: Cuanzhu, Fengchi, Taiyang | - | Prophylaxis | Duration, days of attacks |
| Facco et al 2013 ³³ | A | Valproic acid, 600 mg. All the patients were allowed to take Rizatriptan to treat the attacks: a 10 mg Rizatriptan wafer was allowed as needed and a second dose was allowed after 2 hours if pain persisted | Fengchi, Touwei, Taiyang, Fengshi, Fengmen, Kunlun, Shuiquan, Dazhui, Fenglong, Sanyinjiao, Zhongwan, Yangbai, Taichong, Zhongfeng, Yinlingquan, Shenting, Baihui, Wangu, Tianzhu, Shenshu, Taixi, Xuehai, Ashi | Migraine without aura | Prophylaxis | Duration, adverse events |
| Andrea et al 2006 ³⁷ | A | Metoprolol, 100–200 mg, a day | Fengchi, Qiuxu, Zuqiaoyin, Diwuhui, Baihui, Taichong, Zhongzhu, Waiguan, Taiyang and additional points based on traditional Chinese syndrome diagnosis | Migraine without aura or with aura | Prophylaxis | Frequency of attacks, days of attacks |

(Continued)

Table 2 (Continued).

| Author, Year | Intervention | | Acupoint | Type of migraine | Period | Outcomes |
|--------------------------------|-----------------|---|--|------------------------------------|------------------------------|--|
| | Treatment Group | Control Group | | | | |
| Zhou et al 2008 ²⁶ | B | Ergotamine caffeine, 2 tablets, qd | Taiyang of both sides | Migraine without aura or with aura | Migraine attack period | VAS scores |
| Wang et al 2020 ²⁷ | B | Flunarizine, 10 mg, qd | Affected side: Fengchi, Shuaigu, Touwei, Taiyang; auxiliary acupoint: Yanglingquan, Xingjian, Fenglong, Yinlingquan, Waiguan, Quchi, Taichong, Xuehai, Sanyinjiao, Taixi | Migraine without aura | - | VAS scores, adverse events, days of attacks |
| Liu et al 2016 ¹⁷ | C | Diclofenac sodium, 75 mg, take immediately during an attack | Affected side or both sides of Taiyang and nearby cutaneous superficial veins | Migraine without aura or with aura | Migraine attack period | VAS scores, adverse events |
| Chen et al 2021 ⁴² | C | Nimodipine, 40mg, tid | Affected or bilateral: Taiyang | - | - | VAS scores, frequency of attacks, duration, adverse events |
| Cao et al 2015 ¹⁹ | D | Rizatriptan benzoate, 10 mg, qd | Affected side: Fengchi, Shuaigu, Waiguan, Hegu, Yinlingquan, Taichong | Migraine without aura | - | VAS scores, frequency of attacks, days of attacks |
| Xie et al 2023 ²⁵ | D | Flunarizine, 5 mg, qn | Main acupoint: Fengchi, Taiyang, Shuaigu, Lieque, Neiguan, Zulinqi, Qiuxu, Zuqiaoyin, Ashi; auxiliary acupoint: Fengmen, Quchi, Dazhui, Yinlingquan, Xingjian, Taixi, Fenglong, Xuehai, Geshu, Qihai | - | - | VAS scores, frequency of attacks, duration |
| Liu et al 2021 ⁴³ | D | Nimodipine, 40 mg, tid | Affected side: Sizhukong, Shuaigu, Taiyang, Jiaosun, Zulinqi, Zhongzhu | - | Acute migraine attack period | VAS scores |
| Cong et al 2018 ⁴⁴ | D | Flunarizine, 5 mg, qn, and Nimodipine, 30 mg, tid | Baihui, Taiyang, Shuaigu, Xuanlu, Touwei, Fengchi, Waiguan, Taichong, Zulinqi, Hegu, Sanyinjiao | - | Acute migraine attack period | VAS scores, frequency of attacks, duration, adverse events |
| Fan et al 2019 ⁴⁵ | D | Flunarizine, 10 mg, qn | Baihui, bilateral: Touwei, Fengchi, Taixi, Neiguan, Sanyinjiao, Taichong | Chronic migraine | - | VAS scores, adverse events |
| Zhang et al 2017 ⁴⁷ | D | Flunarizine, 10 mg, qd | Main acupoint: Fengchi, Taiyang, Taichong; selecting acupoints based on syndrome differentiation: Xingjian, Xiaxi, Zusanli, Guanyuan, Sanyinjiao, Taixi, Tinlingquan, Fenglong, Anmian, Shenmen, Neiguan | Vestibular migraine | - | VAS scores, adverse events |

| | | | | | | |
|----------------------------------|-----|--|--|------------------------------------|------------------------|---|
| Liu et al 2022 ³¹ | D | Naproxen, 500 mg, qd | Preventive treatment: Baihui, Shenting, Benshen, Shuaigu, Jiaosun, Fengchi, Waiguan, Yanglingquan, Hegu, Neiting, Kunlun, Houxi, Taichong, Qiuxu, Neiguan; premenstrual conditioning treatment: Dahe, Zhongji, Guilai | Menstrual migraine | - | VAS scores, days of attacks |
| Li et al 2019 ⁴⁹ | D | Flunarizine, 5 mg, qd | Shuaigu, Fengchi, Neiguan, Yongquan, Taichong | - | - | Adverse events |
| Deng et al 2021 ³⁴ | D | Flunarizine, 10 mg, qn | Affected side or bilateral: Sizhukong, Shuaigu, Taiyang, Fengchi, Yanglingquan, Zulinqi, Hegu, Taichong, Waiguan | Migraine without aura or with aura | - | VAS scores |
| Wang et al 2011 ³⁵ | D | Flunarizine, 10 mg, qn (10 mg in the first 2 weeks and 5 mg in the next 2 weeks) | Baihui, Shenting, Benshen, Shuaigu, Fengchi; additional points were chosen individually depending on different syndromes: Waiguan, Yanglingquan, Hegu, Neiting, Kunlun, Houxi, Taichong, Qiuxu, Taichong; sham acupuncture: located 3 mm apart from these selected acupoints | Migraine without aura | - | VAS scores, days of attacks, adverse events |
| Feng et al 2023 ⁵⁰ | E | Flunarizine, 10 mg, qn | Affected side: Sizhukong, Toulinqi, Shuaigu, Xuanlu, Fengchi, Waiguan, Zulinqi | - | - | VAS scores |
| Shen et al 2017 ⁴¹ | E | Amitriptyline, 12.5 mg, qn; after 5 days, changed to 25 mg; after 10 days, change to 50 mg | Shuitu, affected side: Zhongzhu, Zulinqi | Migraine without aura or with aura | - | VAS scores, frequency of attacks |
| Wang et al 2015(1) ²³ | E | Flunarizine, 2.5 mg, qn | Naohui, Shuaigu, Baihui, Touwei | Menstrual migraine | - | VAS scores, frequency of attacks, duration |
| Hou et al 2015 ³⁶ | E | Fixed (muscle)-site injections of BoNT, every dose was 2.5 U/ 0.1 mL | Yintang, Taiyang, Baihui, Shuaigu, Fengchi, Tianzhu | Episodic and chronic migraine | - | VAS scores, frequency of attacks, duration |
| Wang et al 2015(2) ¹⁸ | E | Flunarizine, 2.5 mg, qn | Naohu, Luoque, Naokong, Shuaigu; Baihui, Chengling, Yuzhen, Touwei | Menstrual migraine | - | VAS scores, frequency of attacks, duration |
| Kang et al 2021 ²⁹ | A/A | Flunarizine, 5 mg, qd | Treatment group: Shuigou, bilateral: Laogong, Yongquan; control group 1: Taiyang, Shuaigu, Xuanlu, Touwei, Fegnchi, Waiguan, Taichong, Zulinqi; control group 2: Sanyangluo, Zhigou, Shangjuxu, Xiajuxu, Tisokou (all open 0.5 cm to the outside) | Migraine without aura | Migraine relief period | VAS scores, adverse events |

(Continued)

Table 2 (Continued).

| Author, Year | Intervention | | Acupoint | Type of migraine | Period | Outcomes |
|--------------------------------|-----------------|---|--|------------------------------------|------------------------|------------|
| | Treatment Group | Control Group | | | | |
| Huang et al 2017 ⁴⁶ | A/D | Gabapentin, 100 mg, tid | Bilateral: proximal: affected side: Fengchi, Taiyang, Jiaosun, Shuaigu; distant: Hegu, Xingjian, Zulinqi. Acupoint selection based on syndrome differentiation: Yanglingquan, Zhongfeng, Zhongwan, Fenglong, Zusanli, Taibai, Geshu, Xuehai, Taichong, Taixi, Sanyinjiao. Treatment based on meridian differentiation: the pain is primarily located in the forehead: Toulinqi, Touwei, Hegu, Jiexi, Neiting; The pain is predominantly located on the side of the head: Fengchi, Taiyang, Shuaigu, Zulinqi, Xiashi; the pain is mainly concentrated in the back of the head and neck: Tianzhu, Yuzhen, Fengchi, Naohu, Houxi, Zhiyin; the pain is primarily focused on the vertex (top) of the head: Baihui, Qinding, Houding, Tongtian, Taichong | Migraine without aura or with aura | - | VAS scores |
| Dai et al 2017 ²¹ | A/E | Dihydroergotomine, 2.5 mg, bid or Nicergoline, 10 mg, tid or Nimodipine, 40 mg, tid | Bone Edge needling group: Sanjian, Fengchi, Baihui, Shuaigu, Taiyang, Touwei; ordinary acupuncture group: Hegu, Fengchi, Baihui, Shuaigu, Taiyang, Touwei | Migraine without aura or with aura | Migraine attack period | VAS scores |
| Xiao et al 2018 ²⁸ | B/E | Diclofenac sodium enteric-coated tablets, 50 mg, bid | Projection zone group: Tianzhu to Yuzhen (affected side); ordinary acupuncture group: Taiyang, Shuaigu, Xuanlu, Touwei, Fengchi, Waiguan, Taichong, Zulinqiaxiliary acupoint: Waiguan, Xiashi, Hege, Neiting, Houxi, Shenmai, Neiguan, Taichong(bilateral) | - | Migraine attack period | VAS scores |
| Sui et al 2020 ²⁰ | D/D | Flunarizine, 5 mg, bid | Tiaoshen group: main acupoint: Neiguan, Renzhong, Baihui, Yintang; axiliary acupoint: Taiyang, Xuanlu, Fengchi, Shuaigu; Tiaogan group: Taiyang, Shuaigu, Fengchi, Jiaosun, Yanglingquan; comfort group: 3 inches away from the acupoint: Xiajuxu, Tiaokou, Zhigou, Sanyangluo, Shangjuxu | - | Prophylaxis | VAS scores |
| Cai et al 2021 ³⁰ | E/E | Flunarizine, 20 mg, qd | Medicated thread: Shikui, Zhongkui, Wukui, Fengchi, Taiyang, Shuaigu; moxibustion with seed-sized moxa cone: Danshu, Zusanli, Qihai, Guanyuan, | - | Migraine attack period | VAS scores |

Notes: (1) and (2): Wang (1), Wang (2), Same author and year, but different studies. A: acupuncture; B: electroacupuncture; C: blood-letting and cupping; D: acupuncture plus conventional medicine; E: special acupuncture method.

(MD=-1.37, 95% CI=[-1.89, -0.86]) were superior to conventional medicine in terms of efficacy in reducing VAS scores, while electroacupuncture (MD=-0.59, 95% CI=[-1.22, -0.03]), and blood-letting and cupping (MD=-0.70, 95% CI=[-3.23, 1.83]) did not show any statistical difference in efficacy in reducing VAS scores when compared to conventional medicine. (Figure 4)

Based on the classification of migraine types, separate subgroup analyses of studies applying acupuncture, special acupuncture method, and acupuncture plus medicine interventions were conducted. The results showed that there was heterogeneity in the effectiveness of interventions for different types of migraine under these three different interventions, suggesting that differences in migraine type may be one of the potential factors contributing to the heterogeneity. (Supplementary Information 2, Figures S1-S3)

Frequency of Migraine Attacks

Heterogeneity between studies was significant ($I^2=100\%$, $P<0.01$), so a random-effects model was used. The results showed that acupuncture therapy was superior to conventional medicine in reducing the frequency of migraine attacks (MD=-1.95, 95% CI=[-3.06, -0.85]). To further investigate the differences in efficacy between the different acupuncture interventions and the control measures, subgroup analyses were also implemented according to the type of acupuncture, of which four were acupuncture, one was blood-letting and cupping, four were special acupuncture method, and three were acupuncture plus conventional medicine. The results showed that acupuncture (MD=-0.97, 95% CI=[-1.27, -0.68]), blood-letting and cupping (MD=-7.98, 95% CI=[-8.30, -7.66]), special acupuncture method (MD=-2.28, 95% CI=[-2.97, -1.60]), and acupuncture plus conventional medicine (MD=-0.63, 95% CI=[-0.91, -0.35]) were all superior to conventional medicine in terms of efficacy in reducing frequency. (Figure 5)

Duration of Migraine

Heterogeneity between studies was significant ($I^2=100\%$, $P<0.01$), so a random-effects model was used, the results showed that acupuncture therapy was superior to conventional medicine in reducing the duration of migraine (MD=-3.29, 95% CI=[-4.65, -1.93]). To further investigate the differences in efficacy between acupuncture interventions and the control measures, subgroup analyses were also implemented according to the type of acupuncture, three for acupuncture, one for blood-letting and cupping, three for special acupuncture method, and two for acupuncture plus conventional medicine. The results showed that blood-letting and cupping (MD=-4.88, 95% CI=[-5.12, -4.64]), special acupuncture method (MD=-3.71, 95% CI=[-6.14, -1.28]) were superior in efficacy to reduce migraine duration than conventional medicine, but acupuncture (MD=-0.68, 95% CI=[-3.57, 2.22]), and acupuncture plus conventional medicine (MD=-5.94, 95% CI=[-16.05, 4.16]) compared to medicine did not show better efficacy. (Figure 6)

Days of Migraine

Heterogeneity between studies was significant ($I^2=100\%$, $P<0.01$), and using a random-effects model, the results showed that acupuncture therapy was superior to conventional medicine in reducing the number of days of migraine attacks (MD=-1.02, 95% CI=[-1.58, -0.47]). In order to further investigate the differences in efficacy between different acupuncture interventions and control measures, implementing the type of acupuncture as subgroup, two for acupuncture, one for electroacupuncture, and three for acupuncture plus conventional medicine. And the results showed that electroacupuncture (MD=-1.00, 95% CI=[-1.03, -0.97]) showed better efficacy in reducing the number of days of migraine attacks than conventional medicine treatment, but acupuncture (MD=-1.52, 95% CI=[-3.27, 0.24]), acupuncture plus conventional medicine (MD=-0.92, 95% CI=[-1.94, 0.10]) did not show better efficacy compared to medicine treatment. (Figure 7)

Sensitivity Analyses

In the sensitivity analyses of the outcome indicators of VAS scores, migraine attack frequency, duration, and attack days in this study, none of the effect estimates exceeded the range of their respective combined effect sizes, suggesting that the results of the data obtained in the study were reasonably stable and reliable. (Supplementary Information 3, Figures S4-S7)

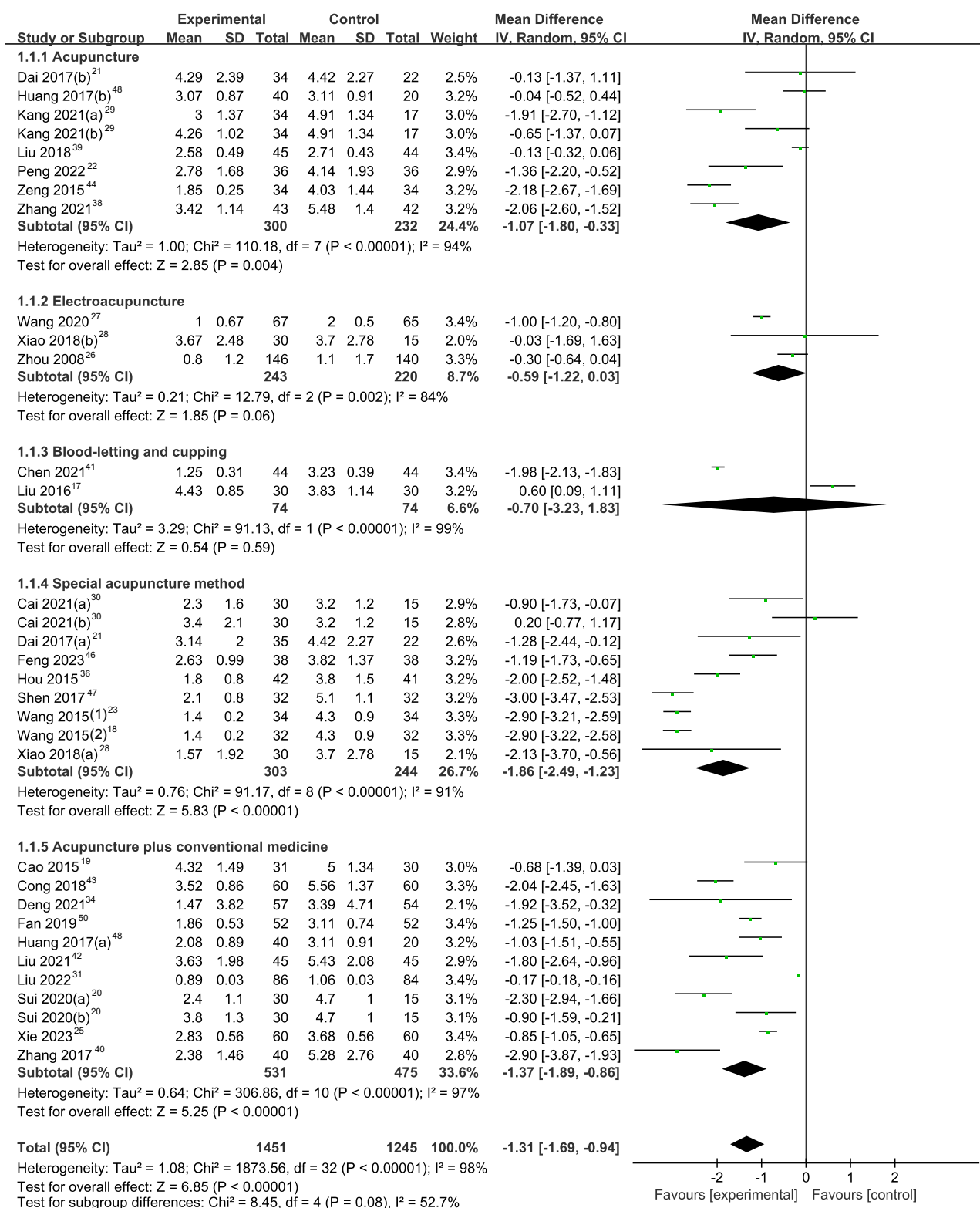


Figure 4 The forest plot of VAS scores of migraine attacks after treatment for acupuncture, electroacupuncture, blood-letting and cupping, special acupuncture method and acupuncture plus conventional medicine versus conventional medicine of different migraine types. The three-arm study was equally divided into two groups-a and b. (1) and (2): Wang (1), Wang (2), Same author and year, but different studies.

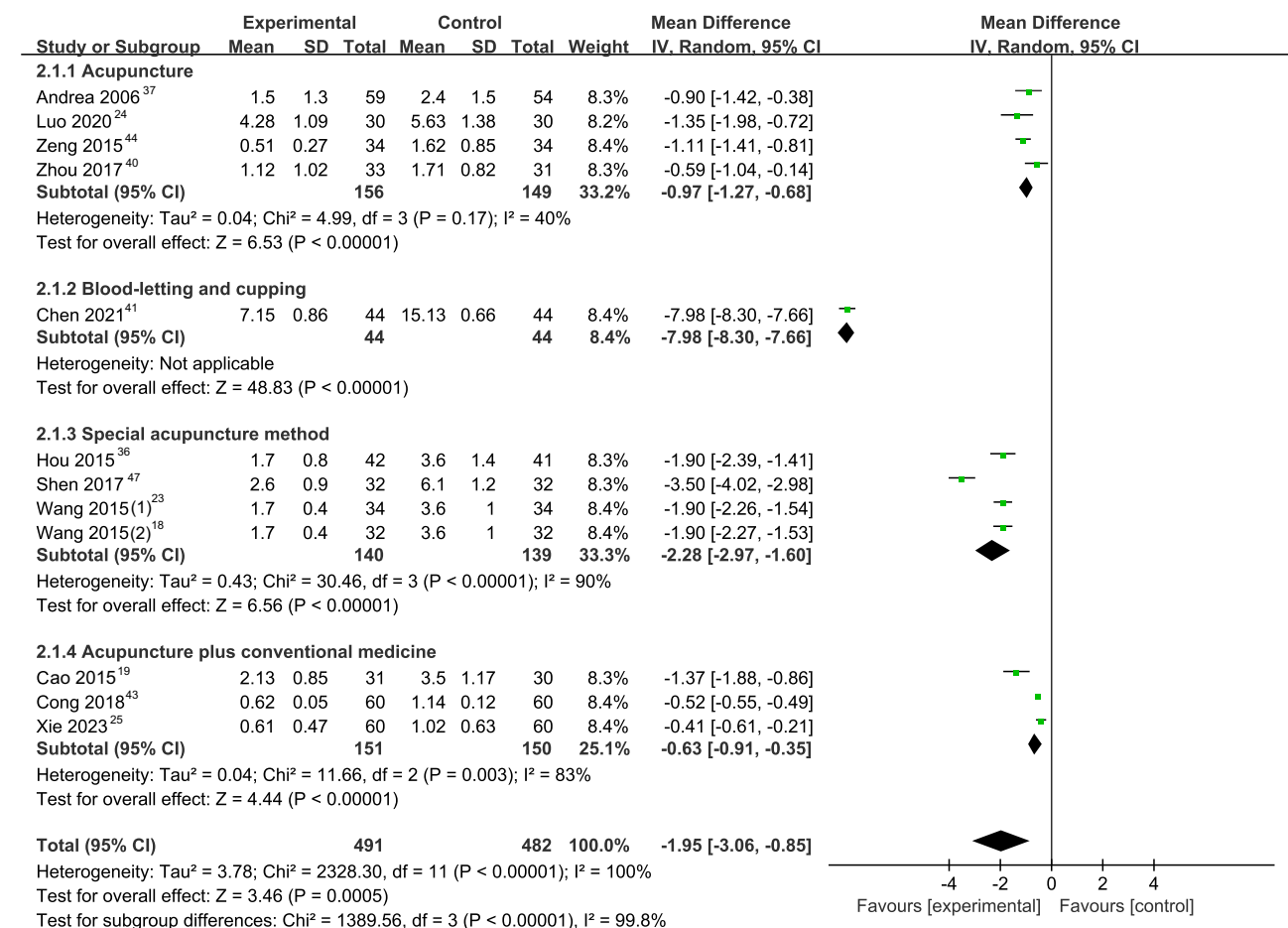


Figure 5 The forest plot of frequency of migraine attacks after treatment for acupuncture, blood-letting and cupping, special acupuncture method and acupuncture plus conventional medicine versus conventional medicine of different migraine types. (1) and (2): Wang (1), Wang (2), Same author and year, but different studies.

Network Meta-Analysis

Network Evidence Map

The web of relationships between the interventions is shown in the figure and is generally reflected in the centre of conventional medicine. A star-like structure of seven intervention nodes formed three triangular closed loops in this indicator of VAS scores: acupuncture-special acupuncture method-conventional medicine, electroacupuncture-special acupuncture method-conventional medicine, acupuncture-blood-letting and cupping-conventional medicine. But no closed loops were formed for migraine attack frequency, duration, or days of attack. (Figure 8)

Consistency Test

In the inconsistency model test, the results of VAS scores, migraine duration, and days of attack were $P > 0.05$, indicating good agreement between direct and indirect comparisons, and therefore all were reticulated meta-analyses using the consistency model. However, the results of migraine attack frequency with $P < 0.05$ indicated inconsistency between direct and indirect comparisons, and therefore the inconsistency model was used for reticulated meta-analysis. Local inconsistency tests were performed using the node splitting method, and the results all showed $P > 0.05$, indicating that the difference between direct and indirect comparisons was not statistically significant, and that the results remained consistent between direct and indirect comparisons. (Table 3–6)

Two-by-Two Comparisons

Two-by-two comparisons between individual acupuncture treatments were performed based on a consistency model. The

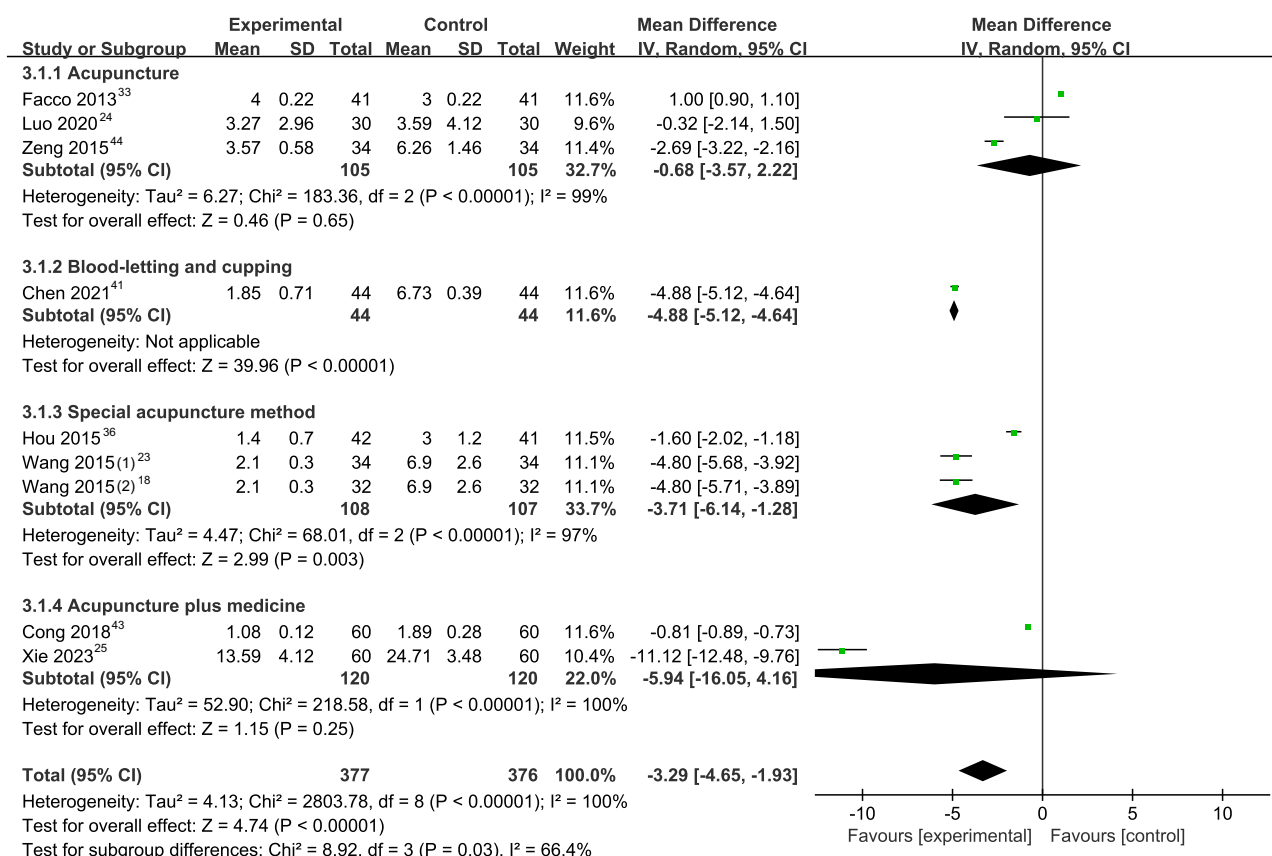


Figure 6 The forest plot of duration of migraine after treatment for acupuncture, blood-letting and cupping, special acupuncture method and acupuncture plus conventional medicine versus conventional medicine of different migraine types. (1) and (2): Wang (1), Wang (2), Same author and year, but different studies.

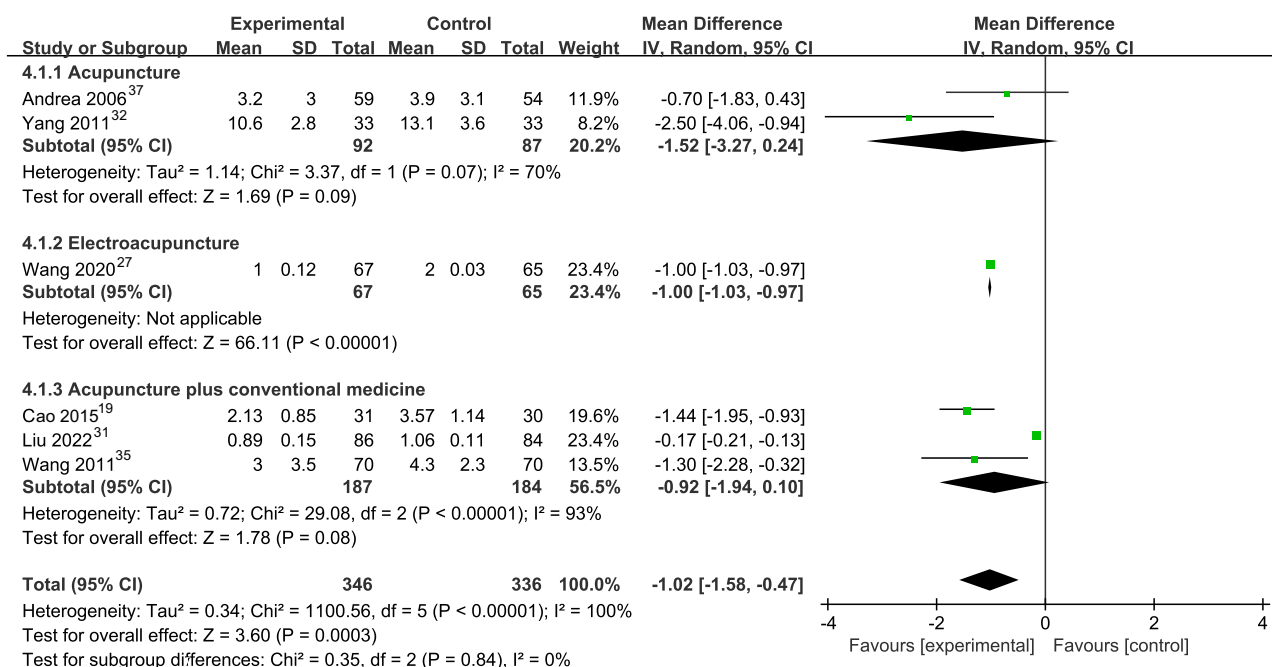


Figure 7 The forest plot of days of migraine after treatment for acupuncture, electroacupuncture and acupuncture plus conventional medicine versus conventional medicine of different migraine types.

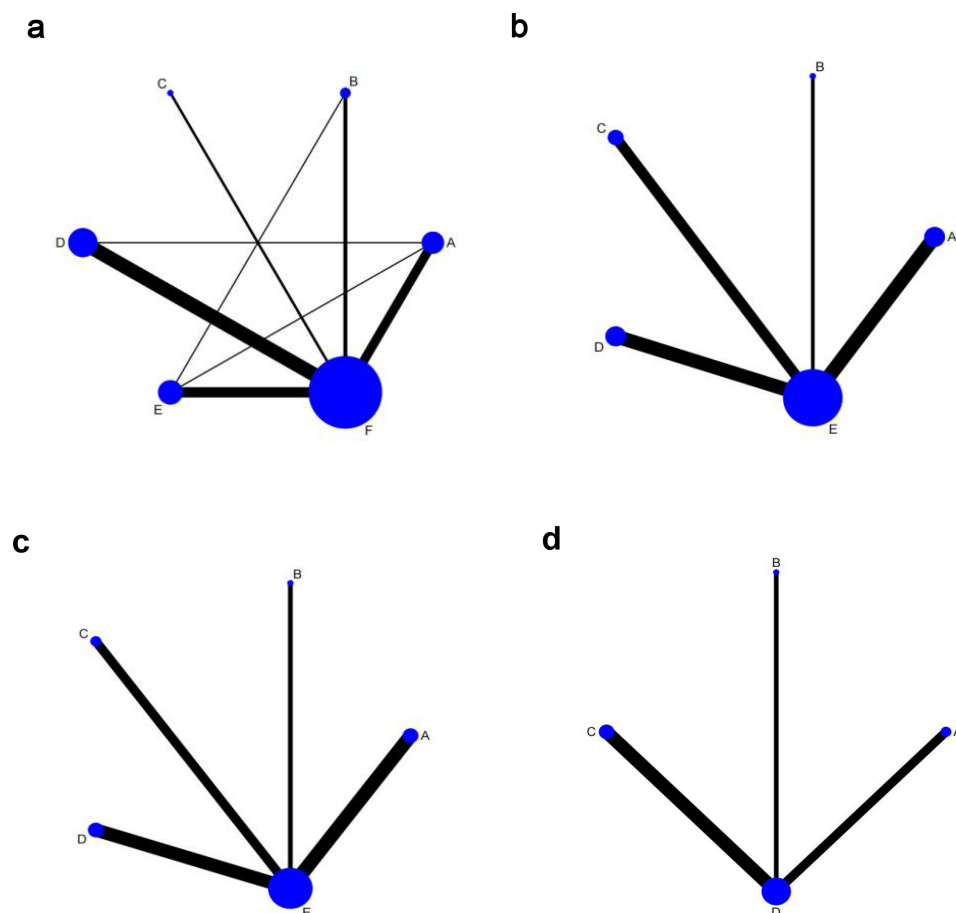


Figure 8 Network evidence map. (a) VAS scores: A: acupuncture; B: electroacupuncture; C: blood-letting and cupping; D: acupuncture plus conventional medicine; E: special acupuncture method; F: conventional medicine. (b) Frequency of migraine attacks: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (c) Duration of migraine: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (d) The number of migraine days: A: acupuncture; B: electroacupuncture; C: acupuncture plus conventional medicine; D: conventional medicine.

results showed that in reducing VAS scores, special acupuncture method was superior to acupuncture (MD=−1.03, 95% CI=[−1.90, −0.16]), while acupuncture was superior to conventional medicine (MD=−1.04, 95% CI=[−1.70, −0.39]), special acupuncture method was superior to electroacupuncture (MD=−1.62, 95% CI=[−2.75, −0.49]), acupuncture plus medicine was superior to conventional medicine (MD=−1.37, 95% CI=[−1.91, −0.83]), special acupuncture method was superior to conventional medicine (MD=−2.07, 95% CI=[−2.69, −1.45]).

Table 3 Test of Local Inconsistency of VAS Scores

| Side | | Direct | | Indirect | | Difference | | P> z | |
|------|---|--------|----------|----------|----------|------------|----------|-------|-------|
| | | Coef. | Std.Err. | Coef. | Std.Err. | Coef. | Std.Err. | | |
| A | D | −0.991 | 0.889 | −0.146 | 0.474 | −0.845 | 1.007 | 0.402 | 0.867 |
| A | E | −1.120 | 1.027 | −1.006 | 0.504 | −0.114 | 1.144 | 0.921 | 0.879 |
| A | F | 1.030 | 0.353 | 1.197 | 1.242 | −0.168 | 1.289 | 0.896 | 0.881 |
| B | E | −2.090 | 1.045 | −1.411 | 0.701 | −0.679 | 1.254 | 0.588 | 0.875 |
| B | F | 0.503 | 0.547 | −0.190 | 1.931 | 0.693 | 2.013 | 0.731 | 0.877 |
| C | F | 0.741 | 0.625 | 2.081 | 208.809 | −1.340 | 208.810 | 0.995 | 0.863 |
| D | F | 1.317 | 0.276 | 3.415 | 1.676 | −2.098 | 1.699 | 0.217 | 0.851 |
| E | F | 2.004 | 0.328 | 3.325 | 1.456 | −1.321 | 1.496 | 0.377 | 0.868 |

Notes: A: acupuncture; B: electroacupuncture; C: blood-letting and cupping; D: acupuncture plus conventional medicine; E: special acupuncture method; F: conventional medicine.

Table 4 Test of Local Inconsistency of Frequency of Migraine Attacks

| Side | | Direct | | Indirect | | Difference | | $P> z $ | tau |
|------|---|--------|----------|----------|----------|------------|----------|---------|-------|
| | | Coef. | Std.Err. | Coef. | Std.Err. | Coef. | Std.Err. | | |
| A | E | 0.980 | 0.291 | 0.446 | 25.775 | 0.533 | 25.777 | 0.983 | 0.527 |
| B | E | 7.980 | 0.552 | 1.959 | 480.145 | 6.021 | 480.145 | 0.990 | 0.527 |
| C | E | 0.740 | 0.314 | 1.949 | 52.889 | -1.209 | 52.890 | 0.982 | 0.527 |
| D | E | 2.277 | 0.287 | 1.940 | 262.914 | 0.337 | 262.914 | 0.999 | 0.527 |

Notes: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine.

Table 5 Test of Local Inconsistency of Duration of Migraine

| Side | | Direct | | Indirect | | Difference | | $P> z $ | tau |
|------|---|--------|----------|----------|----------|------------|----------|---------|-------|
| | | Coef. | Std.Err. | Coef. | Std.Err. | Coef. | Std.Err. | | |
| A | E | 0.674 | 2.129 | 2.812 | 57.384 | -2.138 | 57.424 | 0.970 | 3.646 |
| B | E | 4.880 | 3.647 | 1.352 | 347.940 | 3.528 | 347.960 | 0.992 | 3.645 |
| C | E | 5.873 | 2.602 | 1.347 | 126.546 | 4.526 | 126.573 | 0.971 | 3.647 |
| D | E | 3.791 | 2.117 | 1.348 | 439.940 | 2.443 | 439.945 | 0.996 | 3.645 |

Notes: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine.

Table 6 Test of Local Inconsistency of the Number of Migraine Days

| Side | | Direct | | Indirect | | Difference | | $P> z $ | tau |
|------|---|--------|----------|----------|----------|------------|----------|---------|-------|
| | | Coef. | Std.Err. | Coef. | Std.Err. | Coef. | Std.Err. | | |
| A | D | 1.474 | 0.729 | 0.495 | 20.651 | 0.979 | 20.664 | 0.962 | 0.77 |
| B | D | 1.000 | 0.77 | 2.933 | 47.906 | -1.933 | 47.912 | 0.968 | 0.77 |
| C | D | 0.914 | 0.48 | 2.945 | 81.626 | -2.03 | 81.627 | 0.98 | 0.769 |

Notes: A: acupuncture; B: electroacupuncture; C: acupuncture plus conventional medicine; D: conventional medicine.

As for frequency of migraine attacks, the results showed that blood-letting and cupping was superior to acupuncture (MD=-7.00, 95% CI=[-8.22, -5.78]), acupuncture plus medicine (MD=-7.24, 95% CI=[-8.48, -6.00]), special acupuncture method (MD=-5.70, 95% CI=[-6.92, -4.48]), and conventional medicine (MD=-7.98, 95% CI=[-9.06, -6.90]), special acupuncture method was superior to acupuncture (MD=-1.30, 95% CI=[-2.10, -0.50]), acupuncture plus medicine (MD=-1.54, 95% CI=[-2.37, -0.70]), and conventional medicine (MD=-2.28, 95% CI=[-2.84, -1.72]), acupuncture was superior to conventional medicine (MD=-0.98, 95% CI=[-1.55, -0.41]), acupuncture plus medicine was superior to conventional medicine (MD=-0.74, 95% CI=[-1.36, -0.12]). There was no statistically significant difference between the two-by-two comparisons for the remaining acupuncture treatments. Due to the inclusion of a single study pertaining to blood-letting and cupping therapy, the overall number of studies available for analysis was limited, thus diminishing the statistical power and generalizability of the findings.

Only acupuncture plus medicine was superior to conventional medicine in reducing duration of migraine (MD=-5.87, 95% CI=[-10.97, -0.77]), and acupuncture was superior to conventional medicine in reducing the number of days of migraine (MD=-1.47, 95% CI=[-2.90, -0.05]). The remaining two-by-two comparisons of acupuncture therapies were not statistically significant. (Figure 9)

Order of the Surface Under the Cumulative Ranking Area

The SUCRA ranking of different acupuncture treatments to reduce migraine VAS scores was special acupuncture method (98.3%), acupuncture plus medicine (71.9%), acupuncture (54.5%), blood-letting and cupping (40.6%), electroacupuncture

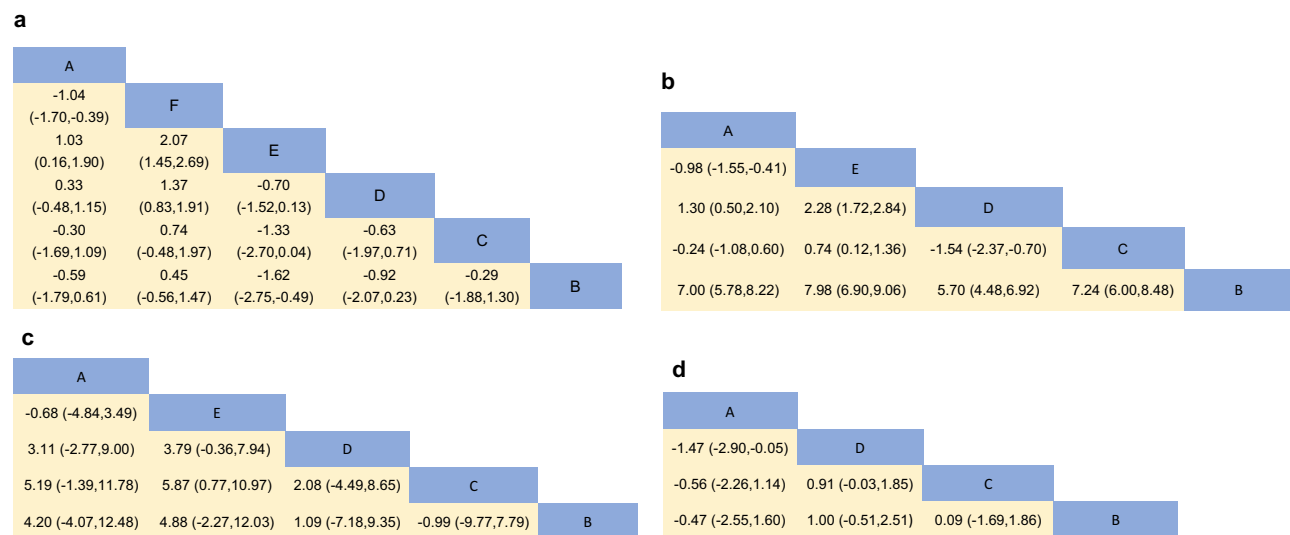


Figure 9 Two-by-two comparisons. (a) VAS scores: A: acupuncture; B: electroacupuncture; C: blood-letting and cupping; D: acupuncture plus conventional medicine; E: special acupuncture method; F: conventional medicine. (b) Frequency of migraine attacks: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (c) Duration of migraine: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (d) The number of migraine days: A: acupuncture; B: electroacupuncture; C: acupuncture plus conventional medicine; D: conventional medicine.

(28.5%), conventional medicine(6.2%), showed that special acupuncture method was the most efficacious in reducing VAS scores. As for the ranking of different acupuncture treatments to reduce the frequency of migraine attacks was blood-letting and cupping (100%), special acupuncture method (75.0%), acupuncture (42.9%), acupuncture plus medicine (31.9%), and conventional medicine (0.3%), which demonstrated that blood-letting and cupping had the best efficacy in reducing the frequency of migraine attacks.

The SUCRA ranking of different acupuncture therapies to reduce the duration of migraine attacks was acupuncture plus medicine (81.2%), blood-letting and cupping (69.3%), special acupuncture method (62.0%), acupuncture (24.9%), conventional medicine (12.6%). It showed that acupuncture plus medicine was the most effective in reducing the duration of migraine.

The SUCRA ranking of different acupuncture treatments to reduce the frequency of migraine attacks was acupuncture (80.3%), electroacupuncture (58.4%), acupuncture plus medicine (56.1%), and conventional medicine (5.1%), which showed that acupuncture had a best efficacy in reducing days of migraine attacks. (Figure 10)

Publication of Bias

The funnel plot demonstrated an asymmetrical distribution of the study points, with a few studies located outside the lines on either side of the funnel, suggesting the potential presence of publication bias. (Figure 11)

Adverse Events

A total of 14 studies included have reported the occurrence of adverse reactions, 41.2% of total studies. Out of these, four studies had no adverse reactions were observed in the test group. The incidence of adverse reactions in the test group was $6.72 \pm 7.60\%$, whereas the incidence of adverse reactions in the control group was $21.84 \pm 18.79\%$. The use of acupuncture therapy in the studies where adverse events occurred was acupuncture plus medicine in 5 studies, acupuncture in 2 studies, blood-letting and cupping in 2 studies, and special acupuncture method in 1 study. In the treatment of the test group, dizziness was mentioned in 3 studies, drowsiness, gastrointestinal discomfort, subcutaneous haematoma, malaise and weakness were mentioned in 2 studies respectively, and nausea and/or vomiting, rash and itchy skin were reported in 1 study respectively. In the control treatment group, nausea and/or vomiting was mentioned in 6 studies, dizziness in 6 studies, somnolence in 5 studies, gastrointestinal discomfort in 3 studies, both 2 studies reported

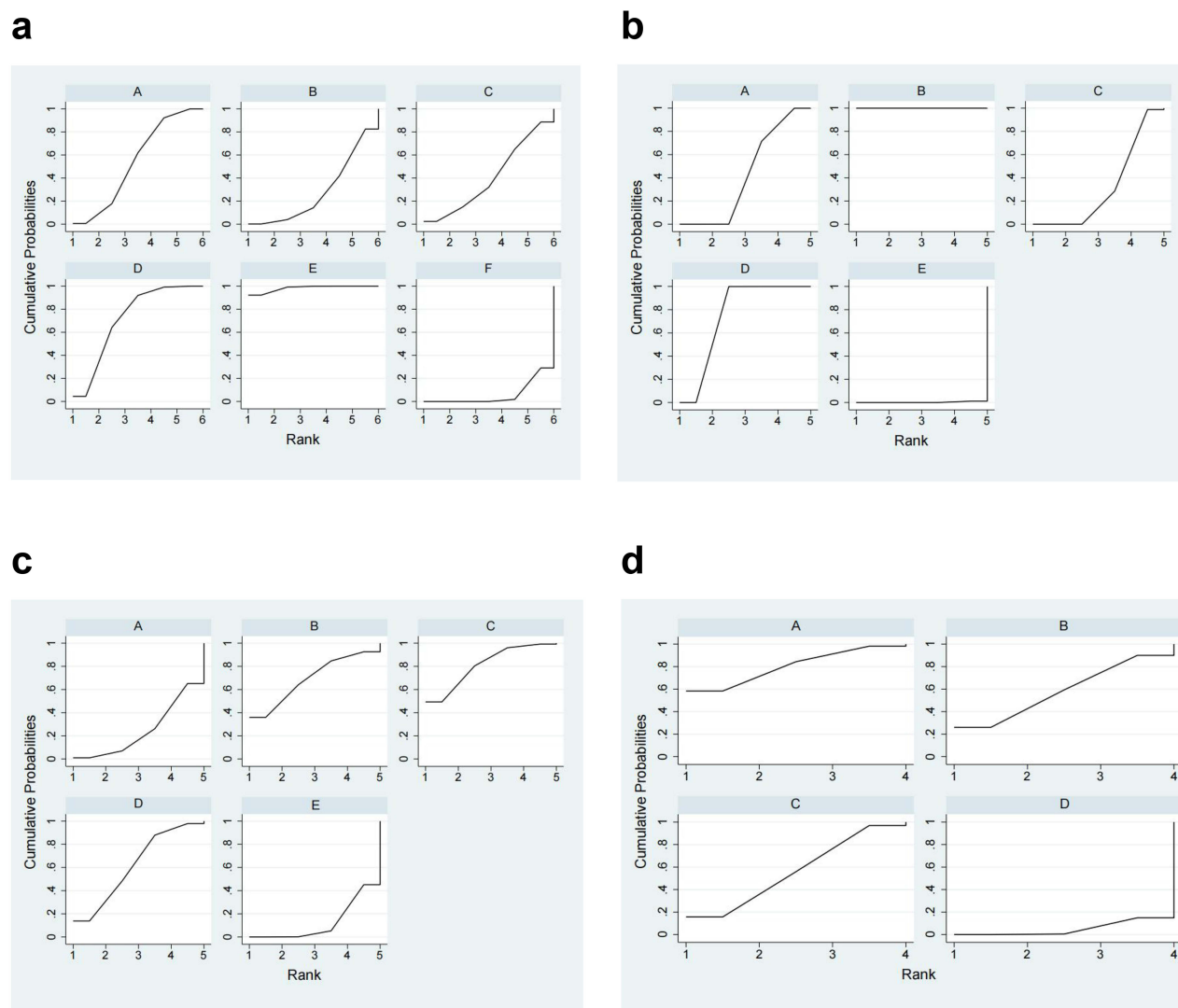


Figure 10 Order of the surface under the cumulative ranking area. (a) VAS scores: A: acupuncture; B: electroacupuncture; C: blood-letting and cupping; D: acupuncture plus conventional medicine; E: special acupuncture method; F: conventional medicine. (b) Frequency of migraine attacks: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (c) Duration of migraine: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (d) The number of migraine days: A: acupuncture; B: electroacupuncture; C: acupuncture plus conventional medicine; D: conventional medicine.

itchy skin, cardiac arrhythmia, weakness and malaise, weight gain and abdominal pain, and the occurrence of rash, insomnia, constipation, and involuntary movements in 1 other study. (Figure 12)

Discussion

Migraine is a common neurological disorder that is classified as a primary headache. In the treatment of migraine, acupuncture therapy has a clear and safe efficacy, and it is currently a commonly used non-pharmacological therapy in migraine clinics, and migraine has been listed as one of the dominant diseases treated by acupuncture.⁵¹ The purpose of this study was to conduct a systematic review and network meta-analysis to directly and indirectly compare the included RCTs and evaluate the effectiveness of different acupuncture-related therapies in the prevention and treatment of various types of migraines.

This systematic evaluation and meta-analysis demonstrated that acupuncture-related therapies were more effective in treating migraine than drug therapies alone in terms of VAS, migraine attack frequency, migraine duration, and migraine attack days. These therapies included acupuncture, electroacupuncture, blood-letting and cupping, and special

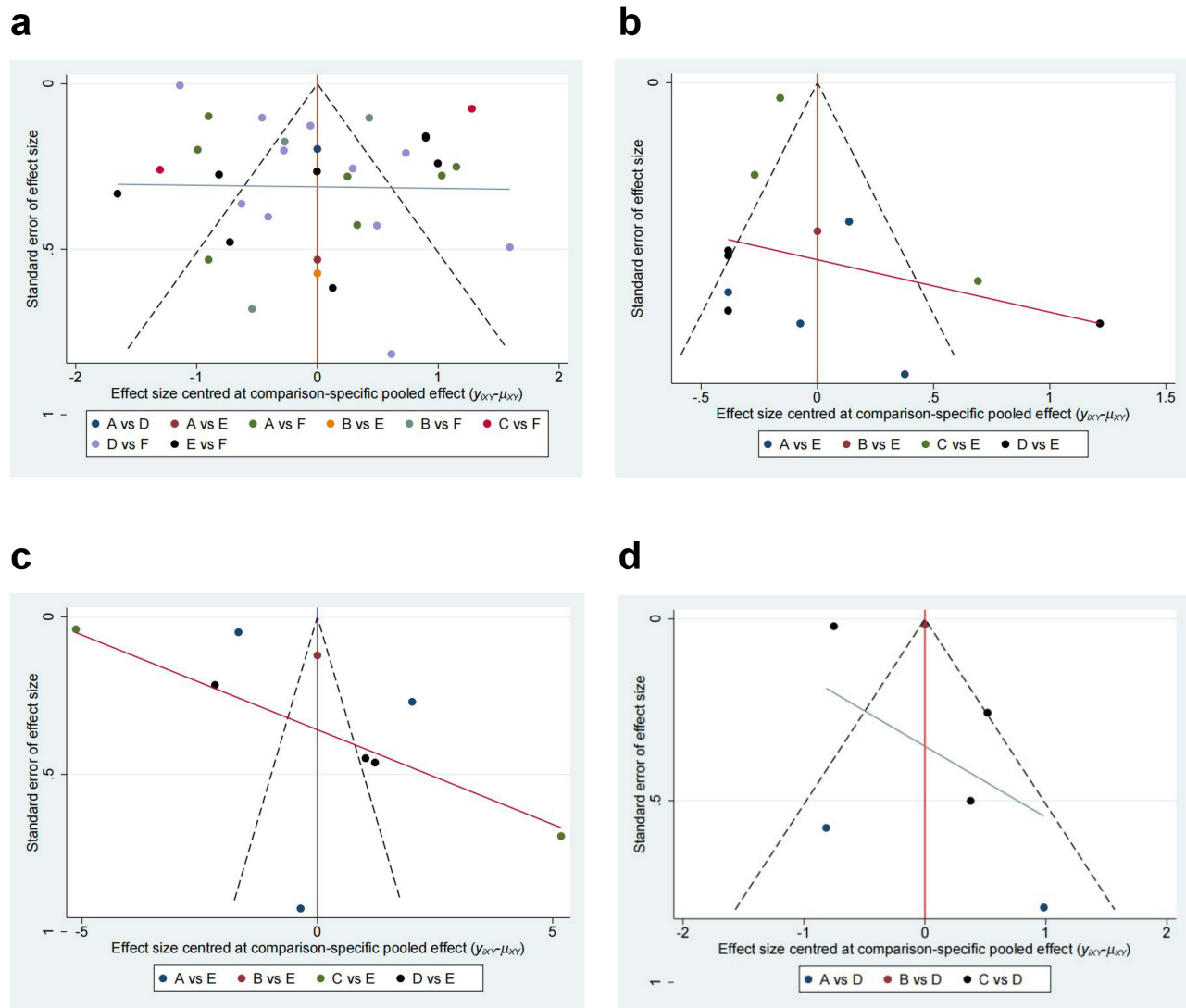


Figure 11 Funnel plot of network meta-analysis. (a) VAS scores: A: acupuncture; B: electroacupuncture; C: blood-letting and cupping; D: acupuncture plus conventional medicine; E: special acupuncture method; F: conventional medicine. (b) Frequency of migraine attacks: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (c) Duration of migraine: A: acupuncture; B: blood-letting and cupping; C: acupuncture plus conventional medicine; D: special acupuncture method; E: conventional medicine. (d) The number of migraine days: A: acupuncture; B: electroacupuncture; C: acupuncture plus conventional medicine; D: conventional medicine.

acupuncture therapies. Additionally, we also compared the combination of acupuncture and drug therapy as an intervention measure. The results of the meta-analysis showed that special acupuncture method, acupuncture plus medicine, and acupuncture showed better efficacy in improving VAS scores compared with medication alone. Subgroup analyses of different acupuncture therapies and different migraine types separately revealed significant heterogeneity between therapies, suggesting that different acupuncture therapies have different effects on the improvement of VAS scores in migraine, and that the efficacy of the same therapy may also differ in different migraine types. In the network meta-analysis, VAS scores of the SUCRA rank of different acupuncture therapies was special acupuncture method > acupuncture plus medicine > acupuncture > blood-letting and cupping > electroacupuncture > drug therapy, suggesting that special acupuncture method has the best efficacy in improving VAS scores. The results of this analysis suggest that the application of special acupuncture method in clinical practice may bring better results for the treatment of migraine than traditional acupuncture.

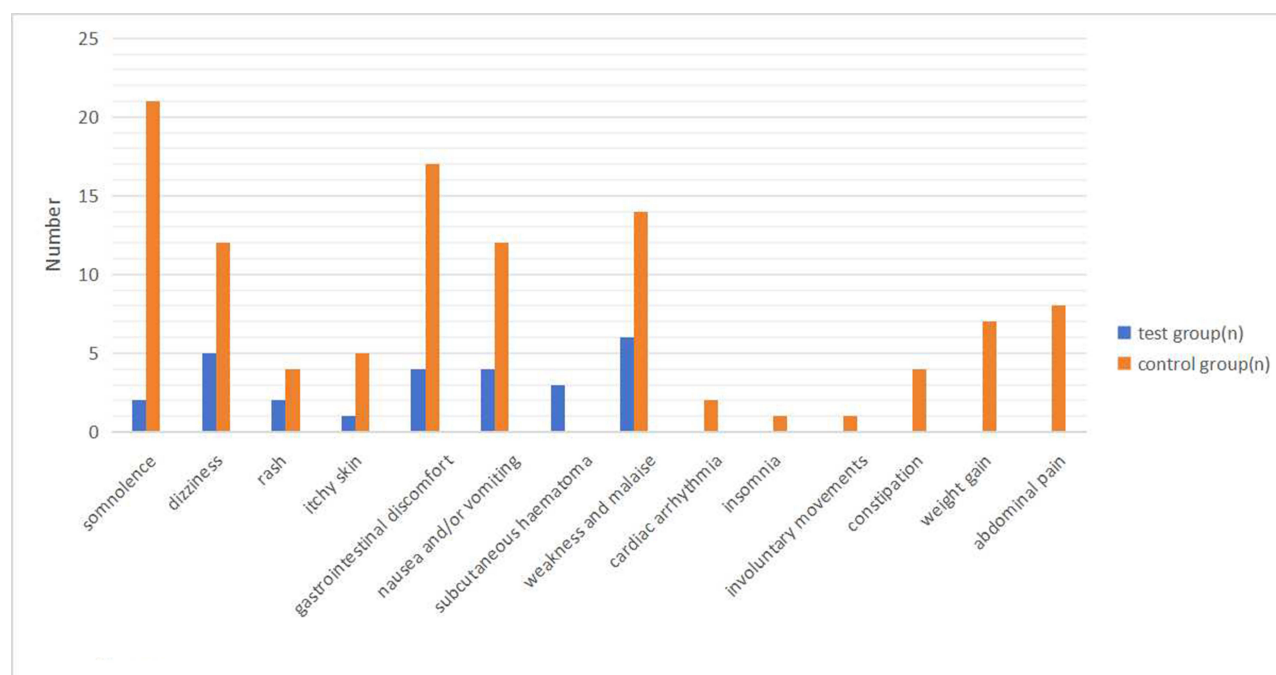


Figure 12 Adverse events of interventions.

In the analysis of reducing the frequency of migraine attacks, blood-letting and cupping therapy showed superior effectiveness, followed by special acupuncture method and traditional acupuncture. However, the limited number of studies on bloodletting therapy may introduce bias in the evaluation results. As for reducing the duration of migraine, acupuncture plus medicine therapy showed the best effect, followed by blood-letting and cupping and special acupuncture method. And in the analysis of reducing the number of days of migraine attacks, acupuncture had a significant advantage over electroacupuncture, acupuncture combined with medication, and medication alone. In adverse reactions, a total of 14 studies reported the occurrence of adverse reactions, accounting for 41.2% of the total studies. The incidence of adverse reactions for each acupuncture-related therapy was generally lower than that of pharmacological treatments. Taken together, the three therapies, special acupuncture method therapy, acupuncture plus medicine therapy, and acupuncture, showed better therapeutic effects, significantly improved VAS scores, and reduced the frequency, duration, and number of days of migraine attacks. Previous studies that have been systematically evaluated and meta-analysed concluded that acupuncture and acupoint injections may be the most effective acupuncture therapies for improving migraine, which is more consistent with the results obtained in our study. In addition, because of the small number of included studies on blood-letting and cupping and electroacupuncture, it is difficult to have a more accurate comparison and analysis of the efficacy of these two therapies. However, based on the results obtained earlier, we speculate that different acupuncture therapies have their own therapeutic advantages, and therefore more multicentre clinical studies are needed to verify the therapeutic efficacy of the respective therapies.

34 randomised controlled trials including 3,365 migraineurs were included in this study. The included studies mainly focused on migraine without aura types, suggesting that acupuncture therapy is more widely used in the treatment of this specific migraine type. This also reflects the fact that migraine without aura is more commonly observed in clinical practice. Additionally, only a small portion of the included studies in this research focused on VM and MM. Surveys have shown that the incidence of VM is relatively low.^{52,53} Furthermore, VM exhibits a wide range of clinical manifestations, with diverse characteristics of dizziness. Its symptoms often overlap with other causes of dizziness, particularly Meniere's Disease (MD) and benign paroxysmal positional vertigo (BPPV), which makes diagnosis challenging.⁵⁴ MM is specifically related to the menstrual cycle in women, and its occurrence is limited to females. Moreover, the incidence of migraines tends to decrease with age.⁵⁵ Therefore, it is speculated that due to the

aforementioned reasons, the limited number of trials included in this study focused on special types of migraines such as VM and MM, resulting in relatively limited clinical evidence regarding the effectiveness of acupuncture therapy for their treatment. Therefore, in the design of future clinical studies, the type of migraine in patients should be clarified and studies on specific types of migraine should be increased to more accurately assess the efficacy of acupuncture therapy in the treatment of migraine and its specific types.

This study adopted special acupuncture therapy as a classification of acupuncture-related therapies, which mainly covers unique acupuncture tools, acupuncture techniques and theories. Special acupuncture instruments include acupoint injections and electrical stimulation of body surface acupoints, etc. Most of these instruments are products of the recent modern development of acupuncture therapy and are applied under the guidance of the mutual integration of Chinese and Western medical theories, which can be used to deal with specific diseases or symptoms, thus expanding the field of application of acupuncture therapy. Special needling techniques include the use of shallow and multi-twist needling, digit-end needling and bone edge needling, etc. These needling techniques are unique techniques developed by clinicians based on ancient acupuncture texts and years of clinical experience, and usually achieve significant therapeutic effects. For example, Feng et al used the shallow multi-twist acupuncture technique to treat migraine and found that it was superior to the use of flunarizine hydrochloride in improving the clinical symptoms of migraine, and was more effective in reducing the VAS scores and the migraine composite score, as well as increasing the serum levels of 5-hydroxytryptamine and β -endorphin in patients with migraine.⁵⁰ Chen Lei, a famous traditional Chinese medicine practitioner in Zhejiang Province, concluded this unique therapy based on the theory of skin area in *Huangdi's Internal Classics* and his rich experience in treating migraine headache for many years.⁵⁶ The therapy is gentle and comfortable with reliable efficacy and has the unique advantages of Chinese medicine in treating migraine.⁵⁷ The results of this analysis suggest that the application of special acupuncture method in clinical practice may bring better results for the treatment of migraine than traditional acupuncture. There are various theories in special acupuncture techniques, such as the “symptom and root cause” theory, Tiaoshen acupuncture, acupuncture for restoring consciousness and inducing resuscitation, and the theory of distant and nearby acupoints combination. These acupuncture theories are the result of clinical doctors integrating years of practical experience and skillfully applying TCM theories to the treatment of migraines, which can often achieve good therapeutic effects.

This study found that in acupuncture therapy, most of the studies followed a similar idea in selecting acupuncture points, ie, according to the site of pain and the meridian to which the pain site belongs, eg, points on the Shaoyang, Yangming, and Taiyang meridians were often selected. On top of that, points were also chosen according to the patient's condition, for example, when there was a deficiency of Qi and Blood, such as Zusanli and Zhongwan, and when there was a deficiency of the Liver and Kidney, such as Taixi and Sanyinjiao would be selected. Different acupuncture therapies selected different treatment points according to their mode of intervention. For example, the Taiyang point was usually chosen for the blood-letting and cupping therapy, the Fengchi point was mostly chosen for the acupoint injection method in special acupuncture therapy, and the area from Yuzhen to Tianzhu points were chosen for electroacupuncture of the vertebral region. These findings indicate that the selection of acupoints for different acupuncture therapies has its own rules and characteristics, suggesting that we should rationally select the correct acupoints according to different acupuncture therapies in clinical practice applications. Each acupuncture therapy has its own guidelines and principles for choosing acupoints. Therefore, it is crucial for practitioners to consider factors such as the patient's condition, symptoms, and treatment objectives in order to determine the most suitable acupoints for a particular acupuncture therapy. By doing so, we can maximize the effectiveness of acupuncture treatments and enhance clinical outcomes. Overall, it is essential to make informed and strategic acupoint choices while applying different acupuncture therapies in clinical practice.

The aim of this study was to compare the use of different acupuncture therapies for migraine, and to consider the differences in efficacy between acupuncture therapies and pharmacological treatments for different migraine types. Furthermore, the application and efficacy of special acupuncture instruments, special acupuncture methods, and acupuncture methods guided by unique acupuncture theories in the treatment of migraine were examined, which is innovative. This study also provided a comprehensive comparison of the differences in efficacy between acupuncture

combined with drug therapy and acupuncture therapy alone. In summary, this study more comprehensively and systematically evaluated the efficacy of multiple acupuncture-related therapies for different migraine types.

However, there are some limitations on this study: 1. Due to the small number and sample size of the included studies, the data are relatively homogeneous, resulting in the inability to make more adequate comparisons, and there may be a bias or a small sample size effect in the present analysis, such as the small number of studies in which the blood-letting and cupping therapy and electroacupuncture were responded to, and their rank ordering needs to be further verified still in the future; 2. There is significant heterogeneity among the included studies. Although subgroup analysis was conducted for different migraine types, the limited number of studies within each category resulted in low-quality evidence and limited generalizability of the obtained results. Therefore, the results cannot be extrapolated; 3. There is a relative lack of evidence for direct comparisons between acupuncture therapies, and the precision and statistical efficacy of the analysed results are limited, and direct comparative studies between a variety of acupuncture therapies still need to be further developed.

Therefore, more relevant clinical studies need to be conducted in the future to investigate the efficacy and safety of acupuncture therapy in the prevention and remission treatment of migraine; the efficacy and safety of acupuncture therapy in different types of migraine, especially specific types of migraine; and the use of acupuncture therapy in adolescent migraine patients needs to be studied in depth. In addition, the effectiveness of different acupuncture therapies in migraine treatment needs to be investigated. In order to improve the quality of research evidence, the design, conduct and analysis of clinical trials should be operated in strict accordance with standards to better assess the effectiveness and safety of treatments.

Conclusion

Based on the available evidence, it is known that acupuncture therapy is primarily used in the prevention and treatment of migraine, particularly for migraine without aura. There are various acupuncture techniques involved in the treatment. Additionally, different acupuncture therapies have their own characteristics and patterns when it comes to acupoint selection. In terms of efficacy, acupuncture, electroacupuncture, blood-letting and cupping, and special acupuncture method have shown better performance compared to drug therapy in reducing migraine VAS scores, decreasing migraine frequency, duration, and number of migraine days. Furthermore, combining acupuncture with drug therapy has demonstrated superior efficacy compared to using medication alone for the treatment of migraine. Therefore, it can be argued that acupuncture therapy possesses efficacy as a viable therapeutic option for those suffering from migraines. In the context of professional practise, it is important to carefully choose suitable treatment options based on the individual circumstances of the patient. However, due to the limitations of the number and quality of the existing studies, the above conclusions still need to be further validated and supplemented by large-sample, multicentre and high-quality clinical trials, with a view to providing stronger evidence support for acupuncture therapy for migraine.

Abbreviations

VAS, Visual Analog Scale; GBD, The Global Burden of Diseases; DALYs, disability-adjusted life-years; YLLs, the sum of years of life lost; YLDs, years lived with disability; VM, vestibular migraine; MM, menstrual migraine; TCM, traditional Chinese medicine; RCT, randomized clinical trial; PRISMA, the Preferred Reporting Items for Systematic Reviews and Meta-Analysis; PROSPERO, the International Prospective Register of Systematic Reviews; CBMdisc, China Biology Medicine disc; CNKI, the China National Knowledge Infrastructure; WANFANG, WANFANG Database; VIP, CQVIP; MeSH, Medical Subject Headings; MD, mean difference; 95% CI, 95% confidence interval; SUCRA, surface under the cumulative ranking area; MD, Meniere's Disease; BPPV, benign paroxysmal positional vertigo.

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