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Systematic Review

Effect of Acupuncture on Reducing Migraine Pain and Medication Use: A Meta-Analysis

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ABSTRACT

Background: *Migraine is a common neurological disorder that significantly affects quality of life and daily functioning. Despite this, the existing evidence remains inconsistent and requires further clarification through comprehensive analysis. The aim of this study was to analyze and estimate the effectiveness of acupuncture in reducing migraine pain score and medication use.*

Methods: *This is a systematic review and meta-analysis of twelve Randomized Control Trial studies. The data used for this study sourced from following database: PubMed, ScienceDirect, and Google Scholar between 2015-2024. The data selection was carried out using PRISMA flowchart. The statistical analysis was conducted with Review Manager 5.4.1. Effect sizes were pooled using a random-effects model to account for heterogeneity across studies.*

Results: *Result of meta-analysis showed that acupuncture can reduce migraine pain intensity (SMD= -1.05; 95% CI= -1.73 to -0.37; p=0.002) and medication use (SMD= -1.61; 95% CI= -2.99 to -0.23; p=0.02).*

Conclusion: *Acupuncture is effective in reducing both migraine pain intensity and medication use, indicating its potential as a non-pharmacological treatment option for migraine management. Acupuncture may be considered as an adjunct therapy in clinical practice for migraine patients, and further high-quality randomized controlled trials are recommended to strengthen the evidence base.*

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KEYWORDS
acupuncture therapy; meta-analysis; migraine disorders; pain intensity; medication use

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INTRODUCTION

Migraine is common neurovascular disorders characterized by periodic headache, throbbing sensation, feel in one side of the head, and cause other manifestation such as sensitive of light and sound. It estimates 14% of the population in the world suffering migraine and significantly causes disability and eliminates productivity. This condition also leads to a decline in patients' quality of life, both physically and psychologically. Furthermore, the economic burden caused by migraines is considerable, due to rising treatment costs and lost working days (Ličina et al., 2026).

For more than three decade, the global burden of migraine was raised around 58.15% (Dong et al., 2025). The incidence of migraine increased in 2023. For every 100.000 people, 14.053 suffer from migraine. This figure is higher than incidence rate in 1990, which was 13,817 in the worldwide (Steinmetz et al., 2023). In Southeast Asia, the incidence of migraine is quite high compared to the global burden or other regions. This indicates that the population in Southeast Asia is more susceptible to suffering migraine (Ge & Chang, 2023). This indicates that the burden of migraine continues to rise both globally and regionally, necessitating serious attention to ensure more effective prevention and management.

The lack of information about migraine prevalence in Indonesia make it difficult to knowing precise estimation. Publication in 2023 suggest prevalence migraine in Indonesia at 44.254.184 with number incidences 3.546 per 100.000 (Ge & Chang, 2023). In Indonesia, about 42% patients with neurological disorders reporting headaches and it is the common grievance among neurology patients (Dave et al., 2022). This situation suggests that the actual burden of migraine may be greater but has not yet been fully identified due to a lack of accurate epidemiological data at national level.

Several pharmacological treatments can help to treat migrain. The treatment focuses on acute and prophylactic treatment. For prophylactic migraine pharmacology such as Monoamine oxidase inhibitors (MAOIs) and Topiramate. This medication focus to reduce migraine occurrence (Nguyen et al., 2022). For acute treatment, medication is used when attack once started. The example such as Nonsteroidalanti-Inflammatory Drugs (NSAIDs) and acetaminophen (Toufic et al., 2025). All pharmaceuticals are often having the side effects. For example, Topiramate can cause adverse effect on nerveous and digestive system. It has been reported have potential in psychiatric disorders (Naghdi et al., 2024). This situation highlights the need for safer, long-term non-pharmacological treatment options in the management of migraine.

This side effects open the possibilities for other treatments as alternatives treatments. Acupuncture is one of the other choices as complementer therapy. Compared to pharmacological therapy, the use acupuncture in treating migraine was becoming widespread and accepted (Liu et al., 2022). Clinical results demonstrated acupuncture's efficacy in pain relief and functional improvement (Zhang et al., 2026). The previous study of meta-analysis has shown that acupuncture could be alternative therapy for migraine. Acupuncture significantly reducing pain intensity and migraine relapse (Song et al., 2022). Another meta analysis of Randomized Control Trial study reported that acupuncture improve migraine frequency (Zheng, 2025). Acupuncture affect neuro activity in brain (Qi et al., 2025). However, this study offers a novel approach by synthesising the latest evidence to evaluate the effectiveness of acupuncture on migraine pain intensity and medication use in a more comprehensive manner.

Compared to medications, acupuncture has no side effects or only minor side effects. These side effects may reduce without intervention (Fan, 2025). This highlights the potential of acupuncture as a safer therapy. However, recommendations for the use of acupuncture must be based on evidence based. The evidence supporting acupuncture has not yet been fully explored (Stephen, 2022). Further high-quality research is therefore needed to strengthen clinical evidence and support the wider use of acupuncture in the management of migraine.

The side effects of medications have long been known, while the studies of the effectiveness of acupuncture in migraine especially reducing medication use was limited. It lacks the newest study and difficult to found. The aim of this study was to analyze and

estimate the effectiveness of acupuncture in reducing migraine pain score and medication use. This study is a meta-analysis of the latest Randomised Controlled Trials (RCTs), which is expected to provide stronger and more comprehensive scientific evidence to support the development of evidence-based complementary therapies for migraine.

MATERIALS AND METHOD

Research Design

This study used a systematic review and meta-analysis method. The process of selecting and reviewing articles is carried out using the PRISMA flowchart. The process involved searching, collecting, identifying, and selecting data from primary studies with RCT design. This method is used to enhance the validity of the findings by combining the results of various RCTs that have a high level of evidence.

Eligibility Criteria

Study applied by determining Population, Intervention, Comparison, and Outcome (PICO). The following PICO:

P (Population)	:	People who suffer from migraine report migraine attacks at least 12 months, and do not have acupuncture.
I (Intervention)	:	Patients receive acupuncture treatment especially manual acupuncture, auricular acupuncture, and laser acupuncture
C (Comparison)	:	Non acupuncture therapy includes sham acupuncture, medication, and prophylaxis treatment.
O (Outcome)	:	Migraine pain score and medication use.
S (Study Design)	:	Randomized Control Trial.

Inclusion and exclusion criteria were established to ensure that the studies analysed were consistent with the research objectives. This process also aims to safeguard the quality and validity of the evidence derived from the article selection process. Consequently, only relevant studies that meet methodological standards will be included in the final analysis.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication year	Articles published within the last 10 years (2015 2025)	Articles published more than 10 years ago (<2015)
Study design	Experimental studies such as randomized controlled trials, quasi-experimental studies, or pretest-posttest designs	Non-experimental studies such as cross-sectional studies, observational studies, qualitative studies, case reports, or literature reviews
Type of intervention	Studies using aerobic exercise as the main intervention, either as a single intervention or combined with other non-	Studies that did not use aerobic exercise interventions

Criteria	Inclusion	Exclusion
	pharmacological interventions	
Study population	Women in the perimenopause, menopause, or postmenopause phase	Populations other than perimenopausal, menopausal, or postmenopausal women
Outcome	Dynamic balance or related indicators (postural balance, functional balance, gait, fall risk, mobility)	Studies that did not assess balance or only evaluated other outcomes such as bone density, cardiovascular outcomes, or hormonal outcomes
Article language	Articles written in Indonesian or English	Articles written in languages other than Indonesian and English
Article access	Articles available in full text	Articles that could not be accessed in full text

Information Sources and Search Strategy

We are searching for an article published between March 2015 until August 2024, across three major electronic databases: PubMed, ScienceDirect, and Google Scholar. The following keywords couple with Medical Subject Headings (MeSH) we used: "Acupuncture Therapy" AND "Migraine Disorder" AND "Pain Intensity" AND "Medication Use" AND “Randomized Control Trial” AND “Mean” OR “Standard Deviation”. Moreover, this strategy was designed to enhance both the sensitivity and specificity of the search process, thereby ensuring the comprehensiveness and relevance of the retrieved studies.

Study Selection Process

First, the two authors independently screened the articles based on the titles. If the title matched with keyword, the two authors then reviewed the abstract of the article. Once an article was deemed eligible, both authors read the full text to identify the participants, the intervention and comparison groups, or the inclusion and exclusion criteria. Disagreement between the two authors arose when determining whether the intervention involved manual acupuncture alone or with other methods. This issue was resolved by agreeing that the intervention used in this study was acupuncture using various methods, such as manual acupuncture, auricular acupuncture, and laser acupuncture.

Data Analysis

Data analysis was performed using Review Manager software version 5-4.1. Publication bias was evaluated through multiple complementary approaches using Funnel Plot Visual Inspection. Visual examination of funnel plots (effect size plotted against standard error) to assess asymmetry, with asymmetry suggesting potential small-study effects or publication bias. The analysis was carried out by looking heterogeneity consistency value I^2 (values: 0–25% minimal, 25–50% moderate, 50–75% substantial, >75% considerable). Fixed effect model is used when the heterogenity is lower than 50%.

The random effect is used when the heterogenity is higher than 50%. The publication bias was evaluated with RoB 2 tool revised to assess Risk of Bias in Randomized Control Trial 2023 published by JBI Global.

RESULTS

The articles for this study were sourced from several databases, including Scholar, ScienceDirect, PubMed. The article review process is detailed in the search flow diagram presented in Figure 1.

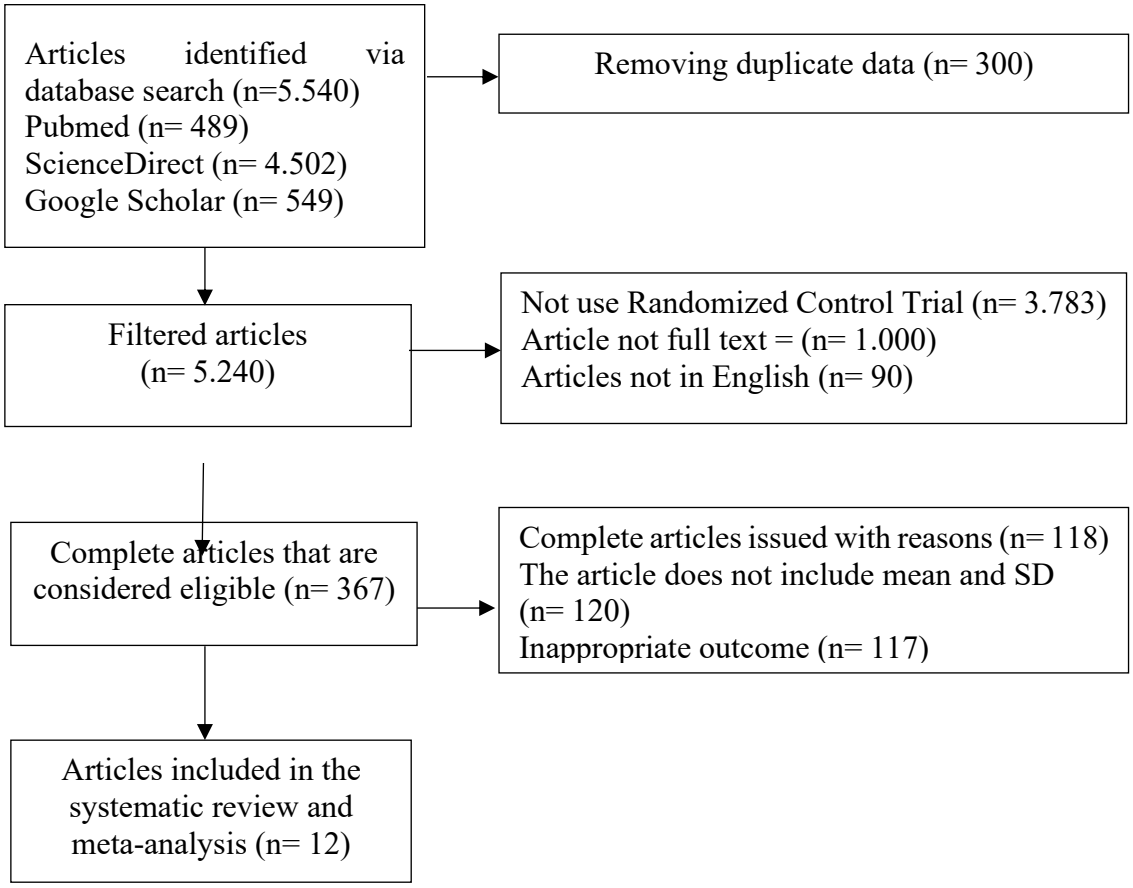


Figure 1. PRISMA Flow Diagram

Electronic database searches identified 5.540 articles; after removal of 300 duplicate records, 5.240 unique records underwent title and abstract screening. This process identified 3.783 articles do not use Randomized Control Trials, 1000 articles not available in full text, 90 articles published not in English. Articles were considered eligible to use is 367. After reviewing, 355 articles were removed because issued, not including mean and Standard Deviation, and inappropriate outcome.

The Risk of Bias (RoB) was conducted in the assesment critical appraisal for Randomized Control Trial. Author used RoB 2 tool revised to assess Risk of Bias in Randomized Control Trial. The research quality assesment are showed in table 1 followed by question. This assessment was carried out to ensure the internal validity of the studies included in the meta-analysis.

Table 2. Critical Appraisal for Assesment of Risk of Bias Randomized Control Trial

Study Name	Question												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
Akinci. (2022)	1	0	0	1	1	1	1	1	1	0	1	1	9
Xu. (2020)	1	0	0	1	1	1	1	1	1	0	1	1	9
Naderinabi et al. (2017)	1	0	0	1	1	1	1	1	1	0	1	1	9
Wang et al. (2015)	1	0	0	1	1	1	1	1	1	0	1	1	9
Mayrink et al. (2018)	1	0	0	1	1	1	1	0	1	1	1	1	9
Giannini et al. (2021)	1	0	0	1	1	1	1	1	1	0	1	1	9
Habibabadi et al. (2021)	1	0	0	1	1	0	1	1	1	1	1	1	9
Biçer et al. (2017)	1	0	0	1	1	1	1	1	1	1	1	1	10
Zhao. (2017)	1	0	0	1	1	1	1	1	1	1	1	1	10
Yu et al. (2024)	1	0	0	1	1	1	1	1	1	1	1	1	10
Wang. (2017)	1	0	0	1	1	1	1	1	1	1	1	1	10
Wu et al. (2024)	1	0	0	1	1	0	1	1	1	1	1	1	9

Note:

Description of the question:

1. Was randomization used for assigment?
2. Was allocation to treatment group concealed?
3. Were treatment groups similar at baseline?
4. Were participants blind to treatment assigment?
5. Were those delivering the treatment blind to treatment assigment?
6. Were treatment group treated identically with interest?
7. Were outcome assesor blind to treatment assigment?
8. Was outcome measured in the same way for treatment group?
9. Was outcome measured in a reliable way?
10. Was follow up complete?
11. Was appropiate statistical analysis used?
12. Was the trial design appropiate and any Standard Deviation?

Description of the answer:

0. No
1. Yes

The results of the critical appraisal indicate that the majority of the RCTs analysed were of good methodological quality, with total scores ranging from 9 to 10. In general, all studies met key criteria such as randomisation, consistency in outcome measurement, reliability of instruments, and the use of appropriate statistical analyses. However, the most consistent weakness was found in the aspect of blinding, particularly regarding participants, intervention providers, and outcome assessors, which was largely not implemented. Nevertheless, all studies indicated that follow-up and study design were adequate; consequently, the overall risk of bias can be categorised as low to moderate, and the studies remain suitable for inclusion in a meta-analysis.

Table 3. Summary of Articles in the Meta-Analysis with Each PICO

Author (Year)	Country	Sample	P	I	C	O
Akinci. (2022)	Finlad	80	Migraine Patients	Acupuncture	Non-Acupuncture	Migraine Pain
Xu. (2020)	China	51	Migraine Patients	Acupuncture	Non-Acupuncture	Migraine Pain

Author (Year)	Country	Sample	P	I	C	O
Naderinabi et al. (2017)	Iran	100	Migraine Patients	Acupuncture	Non-Acupuncture	Medication Usage
Wang et al. (2015)	Australia	50	Migraine Patients	Acupuncture	Non-Acupuncture	Migraine Pain
Mayrink et al. (2018)	Brazil	34	Migraine Patients	Acupuncture	Non-Acupuncture	Medication Usage Migraine Pain
Giannini et al. (2021)	Italy	137	Migraine Patients	Acupuncture	Non-Acupuncture	Medication Usage
Habibabadi et al. (2021)	Iran	80	Migraine Patients	Auricular Acupuncture	Non-Acupuncture	Migraine Pain
Wu et al. (2024)	China	60	Migraine Patients	Laser Acupuncture	Non-Acupuncture	Medication Usage
Biçer et al. (2017)	Turkey	54	Migraine Patients	Acupuncture	Non-Acupuncture	Medication Usage Migraine Pain
Zhao. (2017)	China	163	Migraine Patients	Acupuncture	Non-Acupuncture	Migraine Pain
Yu et al. (2024)	China	51	Migraine Patients	Acupuncture	Non-Acupuncture	Migraine Pain
Wang. (2017)	China	38	Migraine Patients	Acupuncture	Non-Acupuncture	Migraine Pain

Table 3 explains the summary of articles used in this study. The years range in this study ranged between 2015-2024. The locations covered in this study span four continents Asia, Europe, America, Australia and include the following countries: China, Australia, Brazil, Iran, and Turkey. The total sample was 965 people who diagnosed migraine. Acupuncture and laser acupuncture are used as intervention. For comparison non acupuncture includes sham acupuncture, pharmacological, and others.

Table 4. Effect estimate (Mean SD) Acupuncture of Migrain Pain Intensity

Author (Year)	Acupuncture		Non-Acupuncture	
	Mean	SD	Mean	SD
Akinci. (2022)	3.9	1.5	4.4	2.4
Xu. (2020)	−2.2	2.5	−0.9	1.9

Author (Year)	Acupuncture		Non-Acupuncture	
	Mean	SD	Mean	SD
Wang et al. (2015)	3.9	1.0	3.60	1.9
Mayrink et al. (2018)	3.76	1.98	5.88	1.11
Habibabadi et al. (2021)	4.55	2.49	6.32	2.55
Biçer et al. (2017)	5.75	2.03	4.64	2.56
Zhao. (2017)	3.4	2.3	4.2	1.9
Yu et al. (2024)	3.62	1.94	4.84	1.99
Wang. (2017)	3.56	1.24	5.57	1.40

Table 5. Effect estimate (Mean SD) Acupuncture in Change of Medication Use

Author (Year)	Acupuncture		Non-Acupuncture	
	Mean	SD	Mean	SD
Giannini et al. (2021)	6.34	4.9	6.31	4.54
Mayrink et al. (2018)	1.47	0.79	2.47	1.46
Wang et al. (2015)	3.9	1.0	3.60	1.9
Mayrink et al. (2018)	3.76	1.98	5.88	1.11
Naderinabi et al. (2017)	3.34	3.96	7.04	4.32
Biçer et al. (2017)	0.39	0.96	0.48	1.3
Wu et al. (2024)	-3.9	3.8	0	2.7

Table 4 and 5 explain there are 12 articles used with RCT to estimate the effect of acupuncture on reducing migraine pain intensity and medication use. The highest reduction of pain exposed in the Akinci (2022) study (Mean= 3.9; SD= 1.5) and the lower reduction in Wang et al (2015) study (Mean= 3.9; SD= 1.0). The change of medication usage showed in table 3. The highest reduction was in Wu et al (2024).

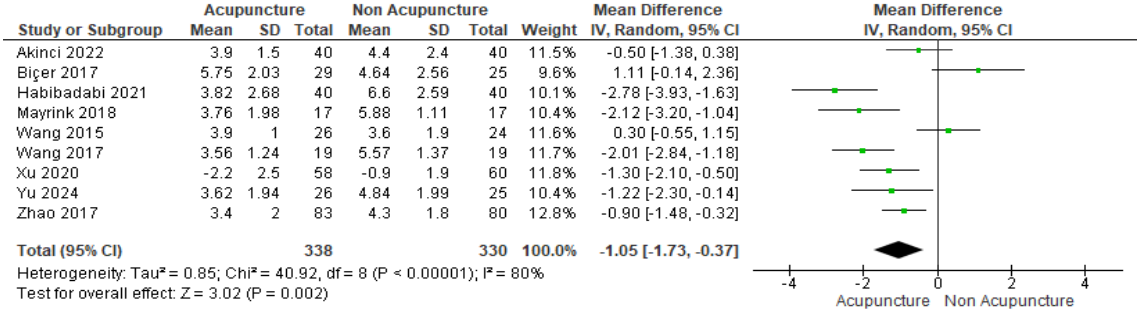


Figure 2. Forest Plot of Effect Acupuncture on Reducing Migraine Pain

The forest plot in Figure 2 shows the effect of acupuncture therapy on reducing migraine pain, and this effect is statistically significant. Patients with migraine received acupuncture treatment experienced reducing migraine pain 1.05 than who did not receive acupuncture treatment (SMD= -1.05; 95% CI= -1.73 to -0.37; p= 0.002). The forest plot showed high heterogenity in effect estimate between study (I^2= 80%; p<0.001). The calculation of the average effect estimate uses the random effect model.

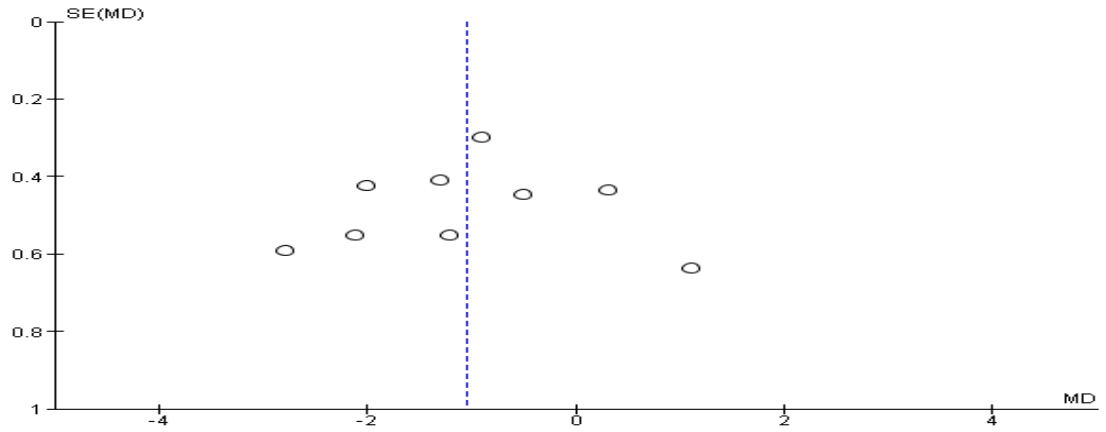


Figure 3. Funnel Plot the Effect of Acupuncture on Reducing Migraine Pain

The funnel plot explains inequitable distribution of effect estimate with the distribution on the left side is greater than the right side. The asymmetry indicates publication bias. Furthermore, because the effect estimates shown as a diamond in the forest plot left side—it is likely that publication bias has led to an overestimation of the true effect.

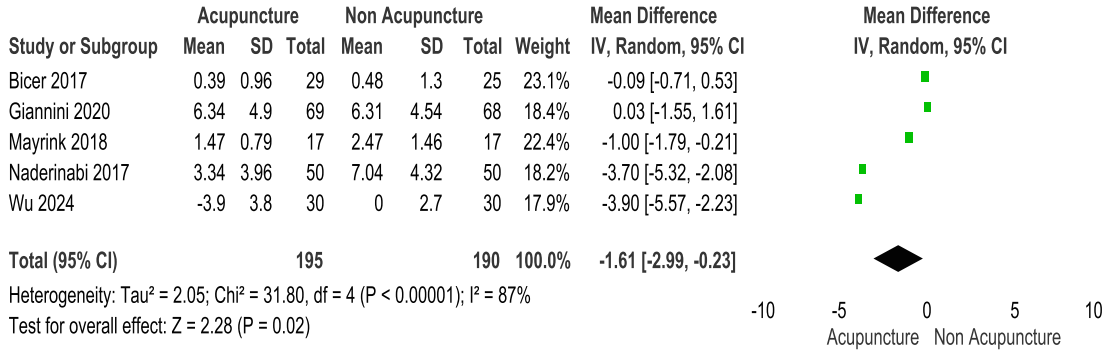


Figure 4. Forest Plot of Effect Acupuncture on Reducing Medication Usage

The forest plot in Figure 4 shows the effect of acupuncture therapy on reducing medication usage, and this effect is statistically significant. Patients with migraine who received acupuncture treatment experienced reducing on medication usage 1.61 than who did not receive acupuncture treatment (SMD= -1.61; 95% CI= -2.99 to -0.23; p= 0.02). The forest plot showed high heterogenity in effect estimate between study (I^2= 87%; p<0.001). The calculation of the average effect estimate uses the random effect model.

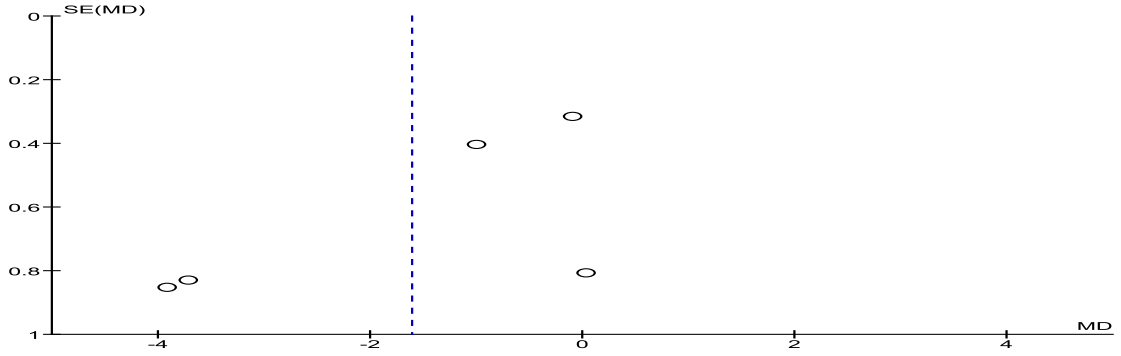


Figure 5. Funnel Plot the Effect of Acupuncture on Reducing Medication Usage

The funnel plot explains equitable distribution of effect estimate with the distribution on the right side and the left side. The symmetry indicates no publication bias. Furthermore, the even distribution of data points indicates that no small studies significantly distorted the results of the analysis. This reinforces the validity of the findings of the meta-analysis.

DISCUSSION

This meta-analysis includes twelve RCTs study to estimate acupuncture effect on pain and medication usage in migraine patients. This study found that patients with migraine who received acupuncture treatment experienced reducing on migraine pain 1.05 than who did not receive acupuncture treatment (SMD= -1.05; 95% CI= -1.73 to -0.37; p= 0.002). These findings are consistent with previous research showing that acupuncture significantly reduces the intensity of pain in cases of headaches (Jin et al., 2025). Furthermore, acupuncture treatment reduced patient medication usage by 1.61 than who did not receive acupuncture treatment (SMD= -1.61; 95% CI= -2.99 to -0.23; p= 0.02). The heterogenity was reported to be higher than 50%. It means the size effect may vary around study. The meaning becomes less useful because effect size falls near the meaning, so the meaning is not representative of the real population. The random effect model was used in this condition to estimate the effect size (Borenstein, 2023).

Acupuncture has shown the great effect for headache such as lowering pain intensity and medication use (He et al., 2024). It consistent with previous meta analysis that acupuncture reducing pain score and rise therapeutic effect (Ou et al., 2020). The brain activity can explain the mechanism of acupuncture (Liu et al., 2021). Such related brain regions as amygdala and hippocampus play an important role in multidimensional regulation of acupuncture analgesia (Sci et al., 2022). This is consistent with previous research that the limbic regions, particularly the insula, are important components of the pain matrix include circuits specific to pain perception. The amygdala plays a key role in emotion processing and the emotion affective dimension of pain (X. Wang et al., 2024).

Acupuncture can reduce medication use and serve as a relatively safe alternative for treating migraines (Naguit et al., 2022). Another studied reported significantly fewer acute medication requirements (Anggraini & Albana, 2022). This reduction is clinically relevant as it may mitigate the risk of medication overuse headache, a well-recognized complication of conventional therapy. This suggests that acupuncture has the potential to be an important strategy in reducing medication dependence on migraine patients.

A meta-analysis of various studies indicates that acupuncture reduces pain and medication use (Lu et al., 2025). The implication of this study provides further concrete

evidence based on the effectiveness of acupuncture in cases of migraine, especially medication consumption. This therapy reduce dependence on pharmacological drugs that carry the riskof long-term side effects (Amiroh et al., 2023). Acupuncture can therefore be considered a safer and more sustainable complementary therapeutic approach in the management of migraines.

The findings of this meta-analysis have important clinical implications, suggesting that acupuncture may be considered an effective complementary therapy in the management of migraines, particularly in reducing pain intensity and decreasing medication use. These results support the integration of non-pharmacological approaches into clinical practice to reduce patients' reliance on medications that may cause long-term side effects. Furthermore, these findings may also serve as a basis for the development of evidence-based clinical guidelines for a more holistic approach to migraine management that prioritises patient safety.

The main strength of this study lies in the use of systematic review and meta-analysis design based on RCTs with a high level of evidence. Furthermore, the use of the PRISMA method in the study selection process, alongside statistical analysis using a random-effects model, enhances the validity and reliability of the data synthesis results. This study also integrates various recent studies, thereby providing a more comprehensive overview of the effectiveness of acupuncture in the management of migraines across a broader population.

This study has several limitations, including the database, language, and number of study subjects. Other limitations are high heterogeneity and bias potential which introduces considerable complexity into research, particularly during the synthesis of data. In meta-analysis, high levels of heterogeneity can undermine the validity of pooled results, suggesting that the combined estimate may not accurately represent individual study outcomes (Migliavaca & Colpani, 2022). In this study the heterogenity and bias publication resulted because of different baseline data, various intervention, and different instrument measuer which needed further study to validate the findings.

CONCLUSION

This study demonstrates that acupuncture therapy can reduce the severity of migraine pain and decrease medication use. These findings may emphasize the effect of acupuncture on pain case and may be used as compelentary therapy. Overall, acupuncture shows consistent potential as an evidence-based adjunct intervention in migraine management. It can therefore be considered a promising non-pharmacological option to support standard migraine treatment. Additional variables or other experimental measures may be added in the future study to reinforce effect acupuncture on related cases.

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DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

AI tools were used solely for grammar and language editing. The authors take full responsibility for the content and integrity of the manuscript.

CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest that could have affected the results or interpretation of this study.

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