



# The efficacy of acupuncture for attention deficit hyperactivity disorder (ADHD): An overview of systematic reviews and meta-analyses

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## ABSTRACT

**Background:** Attention deficit hyperactivity disorder (ADHD) is one of the most common neurological and mental developmental disorders in children. Published systematic reviews (SRs) and meta-analyses (MAs) concerning the use of acupuncture for ADHD have compared the efficacy of acupuncture treatment to that of drug therapies. However, the quality of these articles has not been evaluated and the evidence varies widely.

**Objective:** To summarize and assess the efficacy of acupuncture for ADHD based on existing SRs and MAs.

**Methods:** A systematic search of the literature was conducted from inception until September 16 2021, using seven electronic databases. The AMSTAR-2 tool was used to evaluate the quality of SRs and MAs, and the GRADE system was used to assess the quality of evidence.

**Results:** There are a total of five SRs and MAs included in this overview. Using the AMSTAR-2, three articles were rated as having 'Low' quality, while two were rated as having of 'Critically Low' quality. The GRADE system was used to measure the quality of evidence for ten outcomes (five response rate outcomes, three Conners' Index of Hyperactivity (CIH) score outcomes, one Conners' rating scale score outcome, and one Chinese medicine syndrome outcome) across the five included MAs. Four of the ten outcomes demonstrated 'moderate' quality, four demonstrated 'low' quality, and two demonstrated 'very low' quality. The risk of bias and inconsistency accounted for most downgrading factors in the included reviews.

**Conclusion:** It is still debatable whether acupuncture is efficacious in improving the CIH score and the Response rate. Considering the heterogeneity of clinical trials and the fact that this study did not search and evaluate the relevant data of each randomized controlled trial, large-sample and high-quality randomized controlled trials are still needed to draw reliable conclusions regarding acupuncture's role in treating ADHD. Due to the poor quality of existing available evidence, little inference can be drawn from the included studies.

## 1. Introduction

Attention deficit hyperactivity disorder (ADHD), characterized by abnormal inattention, hyperactive behavior, and impulsivity is one of the most common neurological and mental developmental disorders observed in children.<sup>1</sup> According to recent studies,<sup>2,3</sup> the prevalence of

ADHD in China is roughly 5.6 % and the estimated global prevalence in children is between 8 % and 12 %. The prevalence of ADHD is increasing alongside the development of society, and the disorder is potentially burdensome for the individuals suffering from it, as well as their families and communities.<sup>4</sup> Strategies for treating ADHD should be individualized, integrated, and multimodal, incorporating both

**Abbreviations:** ADHD, Attention deficit hyperactivity disorder; CM, Chinese Medicine; SRs, systematic reviews; MAs, meta-analyses; CBM, Chinese Biomedical Databases; CNKI, China National Knowledge Infrastructure; RCTs, randomized controlled trials; AT, acupuncture therapy; EA, electro-acupuncture; AA, auricular acupuncture; BT, behavior treatment; DT, drug therapy; SI, sensory intergration; CIH, the Conners' Index of Hyperactivity; ROB, the Cochrane risk of bias criteria; AMSTAR-2, the Assessment of Multiple Systematic Reviews; GRADE, Grading of Recommendations Assessment, Development and Evaluation; STRICTA, the Standards for Reporting Interventions in Clinical Trials of Acupuncture.

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non-pharmacological therapies (e.g., cognitive training and evidence-based behavioral therapies) and pharmacological therapies (e.g., psychostimulants).<sup>5</sup> In China, Chinese medicine (CM) offers complementary and alternative therapies for ADHD in addition to pharmaceutical therapies.<sup>5</sup> Although stimulants are the most effective therapeutic medications for treating the symptoms of ADHD, non-stimulants are also useful management tools.<sup>5</sup> Notably, drug treatments may entail adverse side effects such as insomnia, abdominal pain, headache, dry mouth, nausea, and others.<sup>7</sup>

Traditional therapies based on the theory of Chinese Medicine (CM) have been practiced and developed for centuries. Acupuncture is a wonderful mode of CM. Based on the theory of the differentiation of CM syndromes, acupuncture plays an important role in the correction of *Qi* (i.e., vital energy), blood imbalances, *Yin-Yang* imbalances, and so on.<sup>8</sup> Acupuncture therapy includes manual acupuncture, electroacupuncture, auricular acupuncture, scalp acupuncture, etc. From the perspective of CM, ADHD is a disease related to pathological congenital insufficiency and a lack of postnatal nourishment.<sup>6</sup> The CM theory of meridians and collaterals has guided the clinical practice of Chinese medicine for thousands of years and provides the theoretical basis for acupuncture. Acupuncture induces a unique feeling known as 'needle sensation,' which is a manifestation of its therapeutic effect. The stimulation of specific acupoints regulates the function of *Qi*, blood, and immunological function.<sup>6</sup>

To date, several articles about the use of acupuncture for ADHD have compared the efficacy of acupuncture treatment with that of drug therapy.<sup>9,10</sup> However, these articles' quality has not been assessed. Evidence supporting the use of acupuncture for ADHD remains unclear or inconclusive due to small sample sizes and methodological flaws. We performed an overview intending to help fill the gaps in this field of research. To this end, using the AMSTAR-2 tool and the GRADE system, we investigated the selected systematic reviews' general characteristics and assessed their methodological quality and the reliability of their conclusions on the use of acupuncture for ADHD. Finally, we summarized and evaluated the information to aid physicians in making clinical decisions.

## 2. Methods

This overview of SRs/MAs was performed as per the guidelines recommended by the Cochrane Collaboration.<sup>11</sup>

### 2.1. Literature search

We searched the PubMed, EMBASE, Web of Science, Chinese Biomedical Databases (CBM), VIP, WanFang, China National Knowledge Infrastructure (CNKI) databases up until September 16, 2021, without publication time and language restrictions. The search terms and basic search strategy were as follows: ("Attention Deficit Disorders with Hyperactivity" OR "ADHD" OR "Attention Deficit Hyperactivity Disorder" OR "Hyperkinetic Syndrome" OR "Attention Deficit Disorder" OR "Minimal Brain Dysfunction") combined with ("meta-analysis" OR "systematic review") combined with ("Acupuncture Treatment" OR "Acupuncture" OR "Pharmacopuncture Therapy" OR "Pharmacopuncture" OR "Acupuncture, Ear" OR "Electroacupuncture").

### 2.2. Inclusion criteria

Articles that met the PICOS principle (P: population, I: intervention, C: comparator, O: outcome, S: study design) were selected for inclusion.<sup>1</sup> Population: Children diagnosed with ADHD using standard diagnostic criteria such as the Diagnostic and Statistical Manual of Mental Disorders, the Chinese Classification of Mental Disorders, or the International Classification of Diseases. There were no restrictions on gender, race, onset time and source of cases.<sup>2</sup> Intervention: Acupuncture therapies (e.g., acupuncture, electroacupuncture, pharmacopuncture) or

acupuncture combined with other therapies.<sup>3</sup> Comparator: Comfort therapies (i.e., placebo, pseudoacupuncture, or blank control) and other therapies (i.e., Western medicine, traditional Chinese medicine, and other non-drug therapies).<sup>4</sup> Outcome: The outcome measures included at least one type of quantitative outcome data point. These outcomes comprised the Conners' Index of Hyperactivity (CIH) score, the Conners' rating scale of ADHD, and the Conners' Parental Rating Scale (CPRS) since these scales are the most commonly used scales for the evaluation of ADHD motor impairment; the total effective rate (TER), defined as the percentage of patients who showed improvement of their symptoms during treatment; quality-of-life and activities of daily living scales (if these were relevant to the assessment of ADHD symptoms); and adverse event frequency.<sup>5</sup> Study design: SRs or MAs of randomized controlled trials concerning the use of acupuncture for the treatment of ADHD.

### 2.3. Exclusion criteria

The exclusion criteria were as follows: studies involving patients with secondary ADHD or those with severe complications; literature on the non-major intervention of acupuncture in the treatment group or acupuncture as an intervention in the control group; non-RCT SRs/MAs; retrospective studies; duplicate publications; commentaries; conference abstracts; and studies from which data could not be extracted.

### 2.4. Literature screening and data extraction

The study selection and data extraction were performed independently by two investigators before being cross-checked. In the event of disagreements, the two investigators held a discussion and reached a joint decision. The retrieved articles were imported into *EndNote X7* and any duplicate publications were excluded. The full-text articles were then independently reviewed for eligibility based on the inclusion and exclusion criteria. The basic characteristic tables of the standard articles were formulated based on the selected articles' characteristics. Information on the name of the first author, publication year, country, study design, sample size, interventions, control measures, quality assessment methods, conclusions, and funding information was extracted from each article included in this overview.

### 2.5. Quality assessment

The methodological quality of the included SRs/MAs were appraised using the Assessment of Multiple Systematic Reviews (AMSTAR-2) tool.<sup>12</sup> Whereas the original version of the AMSTAR consists of 11 domains, the AMSTAR-2 retains 10 domains from the original version and was modified and expanded to include 16 domains. The evaluation options are reduced to three, namely, 'Yes,' 'Partially Yes,' and 'No.' In addition, the AMSTAR-2 classifies review results' overall confidence into four levels, namely, 'high,' 'moderate,' 'low,' and 'critically low.'<sup>13, 14</sup>

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) is a specialized tool for grading the quality of evidence of SRs. For each outcome, four points were awarded as these outcomes were based on randomized trials. The evidence can be considered degraded for the following five reasons: risk of bias, inconsistency, indirectness, imprecision, and publication bias.<sup>15,16</sup> The quality of evidence was classified into four categories based on the overall GRADE scores of each comparison, namely, 'high,' 'moderate,' 'low,' and 'very low.'

The quality of the included studies was independently assessed by two investigators according to the corresponding standards. Disagreements were resolved by consensus or in discussion with a third investigator.

### 3. Results

#### 3.1. Literature selection

Based on the search strategy outlined above, a total of 49 reviews were acquired from the digital search and 28 duplicate articles were

identified and excluded. After screening the titles and abstracts, 16 articles were excluded for the following reasons: five were not SRs or MAs, eight were not related to ADHD, two reviews' interventions were not related to acupuncture, and one did not have the full text available. Finally, five SRs/MAs were included in this overview.<sup>9,10,17-19</sup> A flow-chart detailing the screening process is shown in Fig. 1.

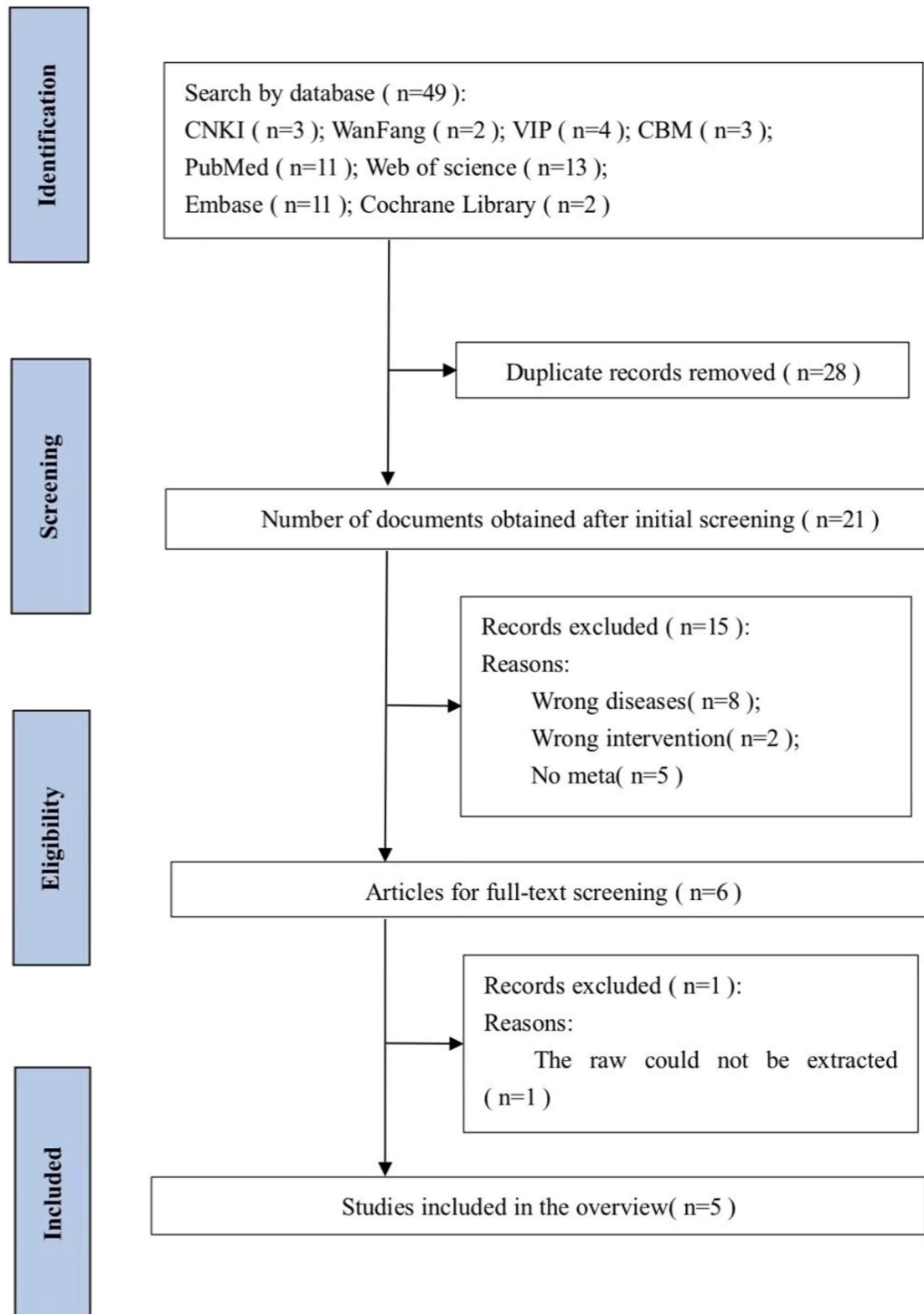


Fig. 1. Flow diagram of detailed search strategies(based on PRISMA 2009).

### 3.2. Study characteristics

The main characteristics of the included reviews are shown in [Table 1](#). The included articles were published between 2011 and 2021, including four articles from China and one from Korea. The quality assessment scales of the original studies varied across the included systematic reviews. Two used the Cochrane risk of bias criteria (ROB), two used a modified Jadad scale, and one used both ROB and the Jadad scale. The intervention measures mainly included acupuncture therapy (AT), electro-acupuncture (EA), auricular acupuncture (AA), AT plus drug therapy, AT plus behavioral treatment (BT), or AT plus psychological treatment in the treatment group. The interventions in the control group included drug therapy, sham AT, traditional Chinese medicine, and sensory integration therapy.

### 3.3. Assessment of methodological quality and quality of evidence

#### 3.3.1. Methodological quality of the included reviews

The results of the AMSTAR-2 assessment are shown in [Table 2](#). According to the AMSTAR-2 evaluation criteria, all the MAs were of low quality because they had at least one critical flaw (items 2, 4, 7, 9, 11, 13, and 15). One article was deemed of 'Low' quality, while four were deemed to be of 'Critically Low' quality. Four of the five articles did not register a study protocol. In terms of critical flaw, none of the included articles met item 2, that is, no review protocol was provided. The failure to provide a list of excluded studies (40 %) and to use a comprehensive literature search strategy (100 %), as well as the failure to report funding sources or potential conflicts of interest (60 %) were also major reasons this degraded quality. Regarding the research details of the included studies, three of the five articles<sup>9,17,18</sup> were not fully collected, such as the dose of drugs, the research institute, and the participant

characteristics.

#### 3.3.2. Quality of evidence

We used the GRADE system to assess the quality of evidence associated with the included MA's specific outcomes. The quality of evidence for ten outcomes in the five included MAs are shown in [Table 3](#). There were five response rate outcomes, three outcomes of the Conners' Index of Hyperactivity (CIH) score, one Conners' rating scale score outcome and one Chinese medicine syndrome outcome. Of these ten outcomes, four provided moderate-quality evidence, four provided low-quality evidence, and two provided very low-quality evidence. Risk of bias (100 %) and inconsistency (40 %) were the most common factors that degraded the quality of evidence in the included reviews, followed by imprecision (30 %) and publication bias (10 %).

#### 3.4. Outcome measures of acupuncture for the treatment of ADHD

The five MAs included 69 RCTS with 6234 participants.

##### 3.4.1. Response rate of acupuncture for the treatment of ADHD

All five of the included articles took response rate as an outcome measure. Regarding acupuncture treatment versus drug treatment, two articles<sup>9,10</sup> suggested that acupuncture had better efficacy and less heterogeneity. However, these two results were of low quality grade. Among them, due to the limited number of included studies, Myeong's study<sup>9</sup> did not produce high-quality evidence. Tian and Ni's study<sup>10,17</sup> suggested that the results were not statistically significant regarding acupuncture versus other treatments. In contrast, Zhang's<sup>19</sup> study suggested that acupuncture had better efficacy than other treatment methods with low heterogeneity. In summary, the treatment group was superior to the control group, but most included studies were low

**Table 1**  
Characteristics of the included systematic reviews.

First author (year) (Ref.)	Country	Number of RCTs (No, of participants)	Treatment intervention	Control intervention	Quality assessment tool	Outcome measures	Overall conclusion (quote)
Myeong Soo Lee (2011) <sup>9</sup>	South Korea	3(308)	EA, AT, AA	Sham EA, DT	ROB	response rate	Our systematic review provides limited evidence for the effectiveness of acupuncture as a symptomatic treatment of ADHD. Future rigorous RCTs are therefore warranted.
Yi-Chen Chen (2021) <sup>10</sup>	China	10(876)	AT, DT	DT, psychiatric treatment	ROB	response rate, post-treatment hyperactivity scores, adverse events	This study suggests the AT may be more beneficial than MPH therapy for ADHD patients. However, the evidence may be highly limited, especially considering the outcome of hyperactivity scores with the high risk of bias, risk of bias, very low GRADE, and small number of studies.
Ni Xin-qiang (2015) <sup>17</sup>	China	13(1304)	EA, BT, AT, AA, DT	BT, DT	Jadad score	response rate, CIH score reduction rate; Conners' rating scale of ADHD, Chinese medicine syndrome of children with ADHD	Acupuncture is an effective and safety therapy in treating ADHD, combined administration of acupuncture and pharmacotherapy or behavior therapy is more effective than the pharmacotherapy or behavioral therapy alone.
Tian Yong (2019) <sup>18</sup>	China	18(1580)	EA, AT, AA, BT, DT, SI	BT, DT, Sham EA, SI	Jadad score	response rate, adverse events	Acupuncture treatment of ADHD can improve the efficacy and reduce the CIH, However, more rigorously designed and high-quality RCTs are needed to confirm the above conclusion.
Zhang Shan-yu (2020) <sup>19</sup>	China	25(2166)	EA, BT, AT, AA, DT	DT, Sham EA, BT, SI	ROB, Jadad score	response rate	Acupuncture alone or combined with conventional pharmacotherapy or behavioural therapy has efficacy superiority for ADHD compared with conventional pharmacotherapy alone or combined with behavioral therapy, and is worth of promotion.

\*ADHD = Attention deficit hyperactivity disorder, CM = Chinese Medicine, SRs = systematic reviews, MAs = meta-analyses, RCTs = randomized controlled trials, AT = acupuncture therapy, EA = electro-acupuncture, AA = auricular acupuncture, BT = behavior treatment, DT: drug therapy; SI: sensory intergration, CIH = the Conners' Index of Hyperactivity, ROB = the Cochrane risk of bias criteria.

**Table 2**  
Results of the AMSTAR-2 assessment.

Included studies (first author (year) (Ref.))	AMSTAR-2																Overall quality
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	
Myeong SL (2011) <sup>9</sup>	Y	N	Y	PY	Y	Y	Y	PY	Y	N	Y	Y	Y	Y	N	Y	L
Yi CC (2020) <sup>10</sup>	Y	N	Y	PY	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	CL
Ni XQ (2015) <sup>17</sup>	Y	N	Y	PY	Y	Y	N	PY	PY	N	Y	Y	Y	Y	Y	N	CL
Tian Y (2019) <sup>18</sup>	Y	N	Y	PY	N	N	N	PY	PY	N	Y	Y	Y	N	Y	N	CL
Zhang SY (2020) <sup>19</sup>	Y	N	Y	PY	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	CL

Y: Yes; PY: Partial yes; N: No; L: Low; CL: Critically low.

Q1: Did the research questions and inclusion criteria for the review include the components of PICO?

Q2: Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?

Q3: Did the review authors explain their selection of the study designs for inclusion in the review?

Q4: Did the review authors use a comprehensive literature search strategy?

Q5: Did the review authors perform study selection in duplicate?

Q6: Did the review authors perform data extraction in duplicate?

Q7: Did the review authors provide a list of excluded studies and justify the exclusions?

Q8: Did the review authors describe the included studies in adequate detail?

Q9: Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?

Q10: Did the review authors report on the sources of funding for the studies included in the review?

Q11: If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?

Q12: If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?

Q13: Did the review authors account for RoB in individual studies when interpreting/discussing the results of the review?

Q14: Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?

Q15: If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?

Q16: Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?

**Table 3**  
Results of GRADE assessment.

Author (year) [Ref.]	Intervention VS Control	Outcomes	Effect estimate 95 % CI	RCTs (patients)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Quality
Myeong (2011) <sup>9</sup>	Acupuncture VS Drug	Response Rate	RR:1.15 [1.02,1.31]	2(116)	-1	0	0	0	-1	L
Yi (2020) <sup>10</sup>	Acupuncture VS Drug	Response Rate	OR:2.24 [1.44,3.49]	8(716)	-1	0	0	-1	0	L
Ni (2015) <sup>17</sup>	Acupuncture VS Drug	CIH score	SMD:- 0.88 [- 1.30,- 0.47]	3(232)	-1	-1	0	-1	0	VL
	Acupuncture VS Drug treatment	Response Rate	OR:2.22 [1.65,3.00]	13(1304)	-1	0	0	0	0	M
	Acupuncture VS Drug treatment	CIH score	SMD:- 0.94 [- 1.41,- 0.47]	6(443)	-1	-1	0	0	0	L
Tian (2019) <sup>18</sup>	Acupuncture VS Drug treatment	Conners' rating scale scores	SMD:- 7.28 [- 8.32,- 6.23]	2(114)	-1	0	0	0	0	M
	Acupuncture VS Drug treatment	Chinese medicine syndrome	SMD:- 1.14 [- 2.53,0.25]	2(171)	-1	-1	0	-1	0	VL
	Acupuncture VS Other treatments	Response Rate	OR:2.98 [2.24,3.96]	18(1580)	-1	0	0	0	0	M
Zhang (2020) <sup>19</sup>	Acupuncture VS Other treatments	CIH score	SMD:3.89 [2.48,5.31]	7(537)	-1	-1	0	0	0	L
	Acupuncture VS other treatments	Response Rate	RR:1.16 [1.12,1.21]	25(2126)	-1	0	0	0	0	M

GRADE: Grading of Recommendations Assessment, Development and Evaluation; CIH = the Conners' Index of Hyperactivity; OR: odds ratio; RR: relative risk; SMD: Std.mean difference; CI: confidence interval; VL: very low; L: low; M: moderate; H: high.

quality.

### 3.4.2. CIH score reduction rate Conners' rating scale of ADHD

Two articles reported CIH score reduction rates, both showing that the therapeutic effect of the acupuncture treatment group was superior to that of the drug treatment group. Ni and Tian's study<sup>17,18</sup> showed statistically significant difference between acupuncture plus BT and BT alone, but the heterogeneity of the studies was high. The GRADE suggested a low quality of evidence.

Only one included study<sup>17</sup> compared acupuncture treatment to drug treatment alone. Only one RCT was included in the meta-analysis, although acupuncture was found to be more effective than drug treatment in lowering the Conners' rating scale of ADHD, the results suggested no statistical significance. GRADE suggested a moderate quality of evidence.

### 3.4.3. Change in Chinese medicine syndrome of children with ADHD

Ni's study included two SRs/MAs and showed no significant

difference between patients treated with acupuncture versus drugs alone in the Chinese medicine syndrome of children with ADHD, and GRADE suggested a very low quality of evidence.

#### 3.4.4. Post-treatment hyperactivity scores

One MA<sup>10</sup> reported the results of acupuncture treatment versus drug treatment alone with three RCTs included in the SRs/MAs. The results showed that acupuncture treatment proved superior to drug treatment alone in terms of post-treatment hyperactivity scores. GRADE suggested a moderate quality of evidence.

## 4. Discussion

This overview synthesized the existing SR and MA literature to assess the efficacy and safety of acupuncture in treating ADHD. All five included articles were published in Asia between 2011 and 2021, with four of them conducted in China. The majority of outcome measures used in these articles are generally recognized as valid.<sup>20,21</sup> Before 2011, Cochrane published an article<sup>6</sup> on acupuncture therapy for ADHD, but no literature met the specified inclusion criteria. In this study, similar criteria were applied to screen articles, and five articles conducted over the last decade were selected.

### 4.1. Summary of the main results

Based on the findings from the included MAs, the most frequently utilized medications for ADHD treatment in China and South Korea are Methylphenidate (Ritalin), Haloperidol, and sustained-release Methylphenidate tablets (Zhuanzhuda). However, it has been observed that ADHD symptoms tend to relapse after drug withdrawal, and there are certain side effects associated with its usage. In recent years, acupuncture has emerged as a complementary approach for ADHD, displaying promising therapeutic effects.

Our study revealed that it is still debatable whether acupuncture can improve response rate and CIH score in children with ADHD, as the results of some of the included MAs were not statistically significant, and the evidence level was low. These variations in results are attributable to heterogeneity and discrepancies in the literature included in the MAs. Some studies were conducted earlier, resulting in a smaller pool of eligible articles. As SRs increase over time, including more articles in newly published studies may lead to varied outcomes. Two sMAs<sup>9,18</sup> reported adverse events regarding safety. One of the five articles in Tian's meta-analysis reported dizziness in some patients, although this condition gradually resolved without affecting the ongoing treatment. The remaining four articles agreed that acupuncture significantly reduced adverse events related to the digestive system (e.g., reduced appetite, nausea, constipation) and nervous system (e.g., dry mouth, headache, insomnia) when compared to the drug treatment group.<sup>18,22</sup> Other studies obtained similar results, with consistent findings and discussions.<sup>23</sup> Some systematic analyses<sup>10,19</sup> collected data on patients' ages and comorbidities, but no subgroup analysis was conducted. Consequently, the effect of acupuncture treatment on adults and preschoolers and its efficacy for children with comorbidities remains unclear. Moreover, future research requires more high-quality studies using efficacy and safety as outcome measures.

### 4.2. Methodological quality and quality of evidence

High-quality systematic evaluations provide reliable evidence for physicians to make decisions in clinical diagnosis and treatment. In this paper, the AMSTAR-2 was used to evaluate the quality of the methods adopted in the five included MAs. One articles were rated as 'low' quality and four as 'critically low' quality. All articles did not report their study protocols. It is also important to register studies in advance to improve research transparency and reduce methodological bias.<sup>24,25</sup> In terms of literature database construction, none of the MAs retrieved

information from multi-faceted perspectives such as research-related registries, reference lists, and bibliographies. These oversights may have given rise to retrieval bias. Two MAs<sup>17,18</sup> did not provide a list of excluded studies, which made it difficult to guarantee the repeatability of the results. Three articles<sup>9,10,17</sup> did not provide detailed descriptions of experimental information (e.g., study sites, follow-up periods, and experimental or control measures). Furthermore, in addition to the information required by AMSTAR-2, it is essential to gather additional information concerning acupuncture treatment, such as the type of acupuncture used, the acupoint selection process, treatment duration, and treatment frequency. These factors may contribute to an increase in subgroup analysis heterogeneity. The control group also received sham acupuncture in half of the acupuncture trials. The merits of the specific implementation methods of sham acupuncture remain highly debatable.<sup>26,27</sup> Nonetheless, it was discovered that sham acupuncture is effective for disease treatment and affective disorders.<sup>28</sup> That makes it useful for designing clinical trials that compare the clinical efficacy of control groups by implementing a multi-arm experiment.

According to GRADE, we assessed ten outcomes from the included articles, four outcomes provided moderate-quality evidence. Among them, two of the results suggested that acupuncture was more effective than drug treatments in improving response rates, and the differences were statistically significant in the meta-analysis. The main reasons for the downgraded quality of evidence was the lack of clear descriptions of randomization, allocation concealment, and blinding in most of the included MAs. Additionally, small sample size or limited number of studies may lead to considerable publication bias, which is also a reason for downgrading the evidence quality. We found that grouping different studies, such as acupuncture versus drug or acupuncture plus drug versus drug, could not be unified. Due to the limited number of studies and cases in each group, a subsequent combined analysis for categorization and summary is not conducive. Large principle grouping criteria can be developed to facilitate future research based on subsequent evidence. In addition to the lack of a review protocol and the list of studies excluded from the main studies also reduced confidence in the results.

Only two articles contained no conflicts of interest and disclosed their funding sources. Disclosure of funding sources is crucial for avoiding publication bias. Nevertheless, acupuncture research is mainly supported by state or university funding, making it less prone to publication bias than drug research. Since all included articles were conducted in Asia, the work may contain a cultural or regional bias. Thus, it would be helpful to include more studies from other regions and cultures.

Future clinical trials should comply with the Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA)<sup>29</sup> to obtain more high-quality RCTs. Reporting SRs according to the AMSTAR-2 scale and the GRADE system is essential to obtain high-quality clinical evidence.

### 4.3. Strengths and limitations

In this paper, strict inclusion criteria were adopted to search the literature database comprehensively. Unqualified descriptive reviews and reviews containing non-randomized controlled trials or cohort studies were excluded. The data from the included articles were categorized and their methodological and evidential quality were evaluated.

There are still certain limitations to this study. First, Chinese and English are the only two publication languages of the selected literature. Therefore, potential language restriction biases should be considered. Second, most of the included MAs did not provide high-quality initial RCTs, therefore yielding unsatisfactory evidence. Our study did not search for articles with initial RCTs, nor did we reorganize and evaluate the relevant data. Researchers should be circumspect of the conclusions drawn from these MAs. In addition, this study was not registered in advance and the research protocol was not published in advance.

## 5. Conclusion

According to the evidence of the five SRs/MAs involved in this overview, acupuncture as an alternative therapy for ADHD may be therapeutically effective and improve ADHD scale scores. However, because of methodological flaws in the included studies, conclusive evidence is still lacking. Large-sample and high-quality randomized controlled trials are still needed to draw reliable conclusions about the value of acupuncture in the treatment of ADHD.

## CRedit authorship contribution statement

LZ and XC were responsible for the study conceptualization and design, LZ and CH were responsible for drafting and critical revision of the article. SD, JY and BH were responsible for the approval of the article. All the authors contributed to the article and approved the final submitted version.

## Data sharing statement

The outcome measure Microsoft Excel spreadsheet and Table 1 will be attached hereto as supplemental data. Detailed data on the literature screening process will be shared upon request.

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## Declaration of Competing Interest

We declare that we have no conflicts of interest.

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