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A PRISMA-Based Qualitative Review of Acupuncture Protocols in Autism Spectrum Disorder

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ABSTRACT

Background: Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental condition that often requires individualized and multimodal therapeutic strategies. In the absence of curative treatments and given the limitations of pharmacological management, interest has grown in non-pharmacological interventions, including acupuncture.

Methods: A PRISMA-guided qualitative review was conducted using PubMed, VIP, Scopus, and Embase, covering studies from inception to December 2025. Human studies published in English or Chinese that clearly reported acupuncture methodology and acupoint selection were included. Eighteen studies-comprising randomized controlled trials, non-randomized studies, and case reports-were retained. Data extraction focused on acupuncture modality, session duration, treatment dosage, acupoint and meridian selection, theoretical rationale, and control conditions. Risk of bias in randomized controlled trials was assessed using the Cochrane Risk of Bias 2.0 tool.

Results: Manual acupuncture was the most frequently investigated modality (10 studies, 55.56%). Session durations of 20–30 minutes were most common (9 studies, 50.00%). Treatment intensity most frequently involved 21–40 sessions per cycle (8 studies, 44.44%), followed by moderate-intensity regimens of 41–90 sessions (5 studies, 27.78%). Frequently reported acupoints (≥4 studies) included Sishencong (EX-HN1), Baihui (GV20), Naohu (GV17), Zusanli (ST36), Neiguan (PC6), Sanyinjiao (SP6), Shenting (GV24), Yintang (EX-HN3), and Benshen (GB13). Meridian-level analysis showed predominance of the Governing Vessel (66.67%).

Conclusion: This review highlights substantial methodological heterogeneity in acupuncture studies for ASD, alongside recurring patterns in treatment parameters and acupoint selection. Cranial midline and Governing Vessel-related acupoints were commonly emphasized, often combined with distal limb points. This overview may help inform future clinical trial design.

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Keywords: Acupuncture, Autism Spectrum Disorder, Integrative Medicine, Sun Simiao, Electroacupuncture

Abbreviations:

ASD: Autism spectrum disorder

ADHD: Attention-Deficit/Hyperactivity Disorder

SSRIs: Serotonin Reuptake Inhibitors

RCTs: Randomized-Controlled Trials

TCM: Traditional Chinese Medicine,

EA: Electroacupuncture

WHO: World Health Organization

TMS: Transcranial magnetic stimulation

Highlights

- Comprehensive PRISMA-guided qualitative review of acupuncture protocols for autism spectrum disorder (ASD).
- Manual acupuncture was the most frequently investigated modality, with typical session durations of 20–30 minutes and 21–90 sessions per treatment cycle.
- Cranial acupoints (e.g., GV20, EX-HN1, GV24) and distal limb acupoints (e.g., ST36, PC6, SP6) were most consistently reported across studies.
- Substantial heterogeneity in study design, acupoint selection, and theoretical rationale underscores the need for improved methodological standardization in ASD acupuncture research.

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition that profoundly affects social interaction and constitutes a significant educational barrier to learning. Its etiology is complex and multifactorial, involving genetic factors (including rare mutations, single-gene disorders, copy number variations, single nucleotide polymorphisms, and epigenetic mechanisms such as DNA methylation, chromatin remodeling, and non-coding RNAs), environmental influences (prenatal exposures including altered maternal microbiota, microbial metabolites, toxins, and medications such as valproic acid, as well as postnatal factors such as birth mode, stress, feeding practices, and lifestyle), and immune or metabolic dysfunctions. Together, these factors disrupt neuronal development and connectivity, leading to structural and functional brain alterations that manifest as the core features of ASD, including deficits in social communication, repetitive behaviors, restricted interests, and other neurodevelopmental manifestations [1].

In 2021, ASD was estimated to affect 61.8 million individuals worldwide, corresponding to approximately one in every 127 people. Among individuals aged 5–39 years, prevalence ranged from 1,100 to 1,200 cases per 100,000 population. Geographically, the highest prevalence rates were reported in Japan and in high-income regions, including Australasia, Asia-Pacific, North America, Southern Latin America, and Western Europe. Overall, ASD exerts a greater developmental impact on males than on females [2].

Available therapeutic strategies address a wide range of associated symptoms, including sleep disturbances, depression, mood instability, irritability, and attention-deficit/hyperactivity disorder (ADHD). Consistent with the principle that “one size does not fit all,” current guidelines recommend cautious use of pharmacological treatments, with careful adjustment of drug selection and dosage based on individual patient characteristics. For sleep disturbances, first-line non-invasive approaches may include melatonin, followed by agents such as clonidine or trazodone; hydroxyzine may be used to facilitate sleep onset, while guanfacine may support sleep maintenance [3,4]. Zolpidem can also be considered in selected cases.

For attention and concentration difficulties, clonidine, atomoxetine, viloxazine, and guanfacine may be employed, particularly when anxiety, sleep disturbances, or tics coexist [5]. Alternatively, methylphenidate, amphetamine salts, or lisdexamfetamine may be prescribed for ADHD management in the absence of behavioral or emotional dysregulation [6]. Anxiety symptoms may require benzodiazepines such as lorazepam, second-generation antidepressants such as mirtazapine, or selective serotonin reuptake inhibitors (SSRIs), including duloxetine, depending on symptom acuity and the presence of comorbid depression, sleep disturbances, or ADHD [7]. Depression without sleep disturbances may be treated with duloxetine, mirtazapine, or other SSRIs, whereas duloxetine and/or mirtazapine may be preferred when sleep symptoms coexist.

Pharmacological interventions present several limitations, including adverse effects such as increased irritability or suicidal ideation associated with anti-ADHD medications, as well as gastrointestinal disturbances such as diarrhea, nausea, and constipation [8]. Additional challenges include poor treatment adherence, particularly in young children, and difficulties with pill ingestion during long-term therapies [9]. Moreover, these

interventions primarily target associated symptoms and provide limited improvement in core ASD features, such as cognition and social functioning.

In contrast, comprehensive rehabilitation programs, sound stimulation, and olfactory training, together with specialized educational support, have demonstrated benefits for individuals with ASD. These approaches aim to enhance communication abilities, social interaction, quality of life, and academic performance. However, despite their effectiveness, they do not address the underlying pathophysiology of ASD, which remains incompletely understood [10–12]. This persistent therapeutic gap underscores the need for complementary approaches that may extend beyond symptomatic management.

Given its holistic perspective on health and disease, interest in acupuncture has increased, particularly because of its non-pharmacological nature. Several reviews and meta-analyses have reported potential benefits of acupuncture approaches, including improvements in autistic behaviors, language abilities, social interaction, and self-care skills [13,14]. These effects may be related to modulation of neural networks or neurochemical pathways, offering a potential complement to the incompletely understood pathophysiology of ASD. Nevertheless, further high-quality studies are required due to the substantial heterogeneity across existing investigations. To address this gap and support future research, we conducted a qualitative analysis of acupuncture methods applied to ASD, following a classical PRISMA workflow to ensure methodological rigor [15].

Material and Methods

PRISMA Screening

A PRISMA-guided literature search was conducted using PubMed, VIP, Scopus, and Embase, covering studies published from database inception to December 2025. The search strategy employed the keywords “acupuncture” AND “autism,” with corresponding Chinese terms (“Acupuncture” AND “Autism”) applied for the VIP database. Study screening and selection were performed by a single reviewer, consistent with the qualitative focus of this analysis. A qualitative assessment of methodological characteristics was conducted to contextualize findings, including study design, randomization, blinding, outcome reporting, and clarity of acupuncture protocol description. No studies were excluded based on this assessment, as the primary objective was to analyze acupuncture methods rather than clinical efficacy [16]. Inclusion Criteria:

- Human studies (randomized controlled trials, observational studies, case reports);
- Participants diagnosed with ASD;
- Published in English or Chinese;
- Studies clearly reporting acupuncture methodology and acupoint selection.

Exclusion Criteria:

- Animal studies;
- Acupuncture combined with Chinese herbal medicine;
- Acupuncture as the sole intervention compared with multimodal or complex interventions in controls;
- Narrative reviews, ongoing trials, protocols, meta-analyses, or systematic reviews without acupoint reporting;
- Articles not open access or without author response to requests;
- Publications in languages other than English or Chinese;
- Conference proceedings or book chapters;
- Studies including participants with specific comorbidities;

- Studies with unequal baseline treatments between control and intervention groups.

Study Selection Process

Following duplicate removal, titles and abstracts were screened, followed by full-text assessment for eligibility according to the predefined inclusion and exclusion criteria. Study selection was performed by a single reviewer, and reasons for exclusion at the full-text stage were recorded. The process and the number of studies at each stage are summarized in the PRISMA flow diagram (Figure 1).

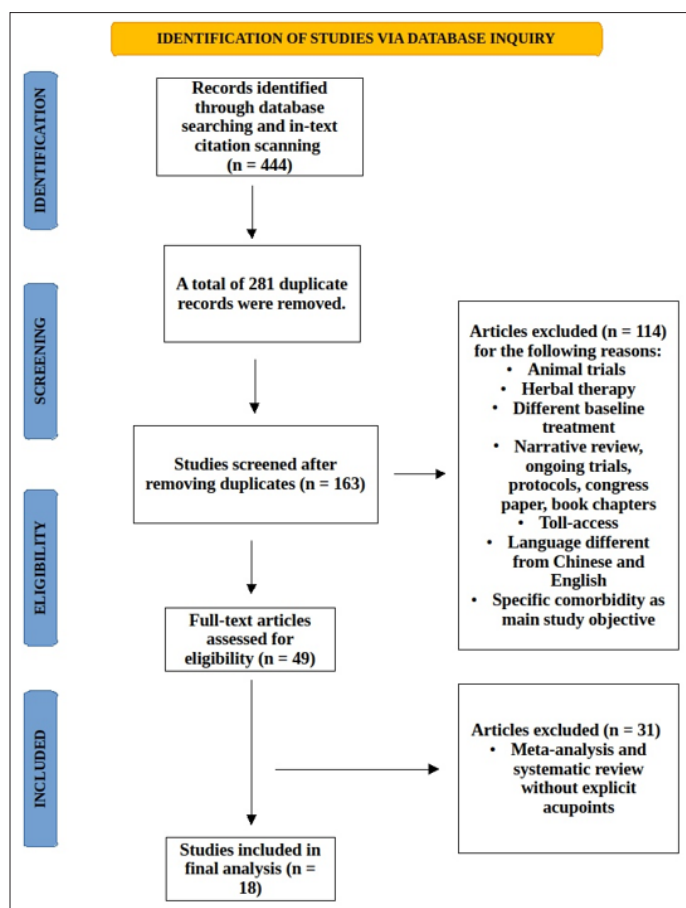


Figure 1: PRISMA Flowchart

Data Extraction and Qualitative Analysis

Data were extracted using a standardized form, including publication details, study design, participant characteristics, ASD diagnostic criteria, acupuncture modality, acupoint selection, treatment frequency and duration, stimulation parameters, outcome measures, and reported effects [17].

A narrative synthesis was applied to analyze acupuncture methodologies rather than clinical efficacy. Protocols were compared to identify common treatment principles, frequently used acupoints, stimulation techniques, and treatment patterns. Variability in approaches was examined relative to study design and context.

To provide an integrated overview, key intervention characteristics were summarized across five domains: Modality, Retention time, Sessions per cycle, Meridian, and Technique. Proportions of studies reporting each feature were calculated, and the summary was visualized using a faceted horizontal bar plot, with features color-coded by category [18].

Risk of Bias Assessment

Risk of bias for included randomized controlled trials was evaluated using the Cochrane ROB 2.0 tool, covering six domains: randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, selection of reported results, and overall risk. Assessments were conducted in R version 4.3.3 (“Angel Food Cake”, 2024-02-29) using the robvis package to generate traffic light plots [19].

Non-randomized studies were appraised qualitatively, focusing on study design, clarity of acupuncture protocol, outcome measure reporting, and methodological limitations.

Results

PRISMA Screening Results

A total of 444 papers were identified from database inception to December 2025 (PubMed: 85; VIP: 57; Scopus: 181; Embase: 121). After removing 281 duplicates, 163 records were screened by title and abstract, yielding 50 full-text articles for further evaluation. Following the exclusion of systematic reviews and meta-analyses that did not report a specific list of acupoints for each study, 18 papers were included in the qualitative analysis of acupuncture methodology (Supplementary Table 1S). The study selection process is summarized in the PRISMA flow diagram (Figure 1).

Risk of Bias: Randomized Controlled Trials (RCTs)

The risk of bias for the 11 randomized controlled trials included in this review was assessed using the Cochrane ROB 2.0 tool. Results are summarized in the traffic light plot (Figure 2). Across the six domains, several studies were rated as “some concerns,” primarily due to incomplete reporting or methodological limitations:

- Domain 1 (Randomization): While randomization was reported in some studies, the specific methods were not described in detail.
- Domain 2 (Deviations from intended interventions): Concerns arose because control groups often received only baseline treatment, without an alternative acupuncture intervention.
- Domain 4 (Measurement of outcomes): The blinding status of outcome assessors was unclear in several studies.

All other domains were generally rated as low risk. According to ROB 2.0 rules, the overall risk of bias for each study was considered “some concerns” if at least one domain received that rating. The traffic light plot (Figure 2) provides a visual summary of domain-level and overall risk, highlighting areas where methodological reporting could be improved [20].

Risk of Bias: Non-Randomized Studies

The remaining seven studies—including single-arm studies, case reports, and double-arm non-randomized trials—were appraised using a qualitative assessment of methodological characteristics (Table 1). The appraisal focused on study design, clarity of the acupuncture protocol, outcome measure reporting, and key methodological limitations. A “some concerns” rating for acupuncture protocol clarity was assigned when intervention details were incomplete or ambiguous, such as unclear needle retention time, session duration, or inconsistencies in protocol description. Outcome measure reporting was evaluated for completeness and precision, with “some concerns” assigned when numerical data were limited or scoring strategies were not clearly reported [21].

Overall, the qualitative assessment highlighted substantial variability in study design and reporting. Many studies lacked randomization or control groups, although acupuncture protocols were generally well described. Table 1 summarizes the methodological characteristics and key limitations of each non-randomized study, providing context for interpreting acupuncture approaches across these investigations [22].

Acupuncture Modalities

Across the 18 included studies, comprising a total of 894 participants, five distinct categories of acupuncture-based interventions were identified. Manual acupuncture was the most frequently investigated modality, reported in 10 studies (55.56%). Electroacupuncture (EA) was reported in 4 studies (22.22%). Scalp acupuncture was used in 2 studies (11.11%), while combined approaches—defined as protocols integrating EA with additional techniques such as manual acupuncture or wet acupuncture—were reported in 1 study (5.56%). Laser acupuncture was also reported in 1 study (5.56%).

The study-level analysis demonstrated a predominance of manual acupuncture interventions, whereas electroacupuncture accounted for approximately one quarter of the included evidence base [23].

Retention Time

Session duration varied substantially across the 18 included studies. Retention time ranged from ultra-short stimulation lasting 12–15 seconds to extended protocols with needles retained for 60 minutes or longer. Short-duration sessions of 20–30 minutes were the most commonly reported, occurring in 9 studies (50.00%). Extended-duration sessions (≥ 60 minutes) were reported in 4 studies (22.22%), primarily in electroacupuncture and scalp acupuncture protocols, including one study with needles retained for approximately four hours per session. Intermediate session durations of 40–50 minutes were reported in 2 studies (11.11%), while ultra-short sessions (≤ 15 seconds) were reported in 2 studies (11.11%), exclusively associated with laser and tongue acupuncture protocols. One study (5.56%) adopted an age-dependent approach, applying shorter sessions in younger children and longer sessions in older participants [24].

Overall, the study-level analysis indicates marked heterogeneity in session duration across the included trials. This variability appears closely related to the acupuncture technique employed: non-invasive or highly localized approaches favored shorter stimulation times, whereas electroacupuncture and scalp-based protocols typically adopted longer treatment sessions.

Treatment Intensity (Sessions per Cycle)

All studies reported treatment dosage using heterogeneous descriptors, including weeks, months, courses, or individual sessions. For quantitative synthesis, the primary metric was standardized as the total number of sessions per complete treatment cycle, derived from the reported frequency and duration. When necessary, conservative assumptions were applied and explicitly noted. Total treatment sessions were calculated using the following hierarchy:

- When explicit session counts were provided, these values were used directly.
- For studies reporting frequency and duration (e.g., “x sessions/week for y weeks”; one month = 4.345 weeks), total sessions were calculated by multiplication.
- For studies with ambiguous or contradictory scheduling descriptions, reasonable interpretations were applied based

on clinical practice patterns (e.g., “daily with weekly pause” interpreted as six sessions per week).

- When multiple treatment courses were described, session counts were summed across all courses; treatment intervals between courses were not subtracted from the total treatment duration.

Across the 18 included studies, treatment intensity demonstrated considerable heterogeneity. The most common regimen comprised 21–40 sessions per cycle (8 studies, 44.44%). Moderate-intensity regimens of 41–90 sessions were employed in 5 studies (27.78%). Shorter (≤ 20 sessions) and longer (> 90 sessions) protocols were used in approximately 11.11% and 16.67% of studies, respectively. Interpretation of these results warrants caution, as total session numbers in several studies were derived from reported treatment frequencies and durations rather than being directly reported.

Acupoints

All reported acupoints were standardized using English nomenclature with international alphanumeric codes according to World Health Organization (WHO) standards. Chinese-only terms, functional scalp zones, and named point groups (e.g., Four-Shen points, Brain Three Needles, Tongue Tri-Points) were translated and harmonized [25].

For frequency analyses, named acupoint groups and functional systems (e.g., Brain Three Needles, Tongue Tri-Points, scalp functional zones) were counted as single composite features per study, rather than being disaggregated into individual points, in order to reflect protocol-level intervention patterns. Scalp functional areas (e.g., speech area, emotional zone) and tongue-based points were recorded explicitly and analyzed as distinct categories, rather than being merged with classical meridian points.

The complete list of acupoints and functional areas extracted from the 18 included studies prior to frequency calculation is provided in the supplementary material (Table 2S), with each item classified as a classical meridian point, extra point, scalp functional area, or tongue-based point. Table 2 summarizes each acupoint’s Chinese name (e.g., Baihui), WHO code (e.g., GV20), the number of studies reporting its use, and the corresponding percentage of studies. Only acupoints reported in four or more studies are included in Table 2; all remaining points, reported in three or fewer studies, are retained in the comprehensive extraction table (Supplementary Material).

Across the included studies, acupoint selection showed a strong convergence toward midline cranial points and extra points associated with cognitive function and Shen regulation. Baihui (GV20) and Sishencong (EX-HN1) were the most frequently used points, appearing in over half of the included trials. A substantial proportion of studies also incorporated scalp functional zones related to speech, emotion, and cognition, as well as tongue-based points, reflecting technique-specific adaptations within pediatric autism populations [26].

It should be noted that studies in which acupoint prescriptions were partially individualized based on traditional Chinese medicine pattern differentiation could result in the conditional inclusion of additional points. Consequently, frequency estimates reflect reported point usage at the study level and may slightly overestimate exposure to points applied only to specific diagnostic subgroups.

Meridian-Level Analysis

Meridian-level analysis was performed using all extracted acupoints. Each meridian was counted once per study, even if multiple points from the same meridian were applied. Percentages represent the proportion of studies in which each meridian was used.

Across the 18 included studies, the most frequently used meridians were the Governing Vessel (GV, 66.67%), Gallbladder (44.44%), Stomach (38.89%), Spleen (38.89%), Pericardium (38.89%), and Large Intestine (16.67%). Other meridians included Heart (27.78%) and Conception Vessel (22.22%).

Control Interventions

Control interventions varied widely across the included studies, with some combining multiple approaches (e.g., rehabilitation + language therapy, rehabilitation + Tuina) as the baseline for both groups. Six studies provided no treatment or did not report control interventions, including case reports and single-arm studies, encompassing a total of 10 participants [27].

Six studies employed behavioral or rehabilitative therapies, one study used occupational therapy, one study used language therapy, and one study implemented training sessions with various approaches, collectively involving 255 participants. One study employed sham electroacupuncture (25 participants), and two studies used repetitive transcranial magnetic stimulation (TMS; 74 participants).

In two-arm studies, baseline treatments were often applied in both groups, with acupuncture added to the intervention group. Table 3 summarizes the control type, number of studies, and total participants.

Theoretical Rationale

Among the 18 included studies, 14 studies (77.78%) explicitly reported a theoretical rationale grounded in Traditional Chinese Medicine (TCM) to justify acupuncture point selection, whereas 4 studies (22.22%) did not provide a stated theoretical framework. The reported rationales were heterogeneous in both content and placement within the articles [28].

Several studies conceptualized ASD as involving disturbances or insufficiencies of the brain and mind (Shen), often associated with congenital deficiencies and dysfunction of the Heart, Kidney, Liver, Spleen, and Pericardium. A prominent theme was the emphasis on head- and Governing Vessel-related acupoints, cited for their traditional association with brain function and consciousness. Classical or historical TCM doctrines were also referenced, including Sun Simiao’s Thirteen Ghost Acupoints and disease analogies such as “Five Delays.”

Some studies combined traditional meridian theory with modern or hybrid explanations, linking scalp or tongue acupuncture to cortical projection areas, neural networks, cerebral perfusion, or functional reinnervation [29].

Overall, while the majority of studies provided some theoretical justification for acupuncture point selection, the depth, terminology, and theoretical consistency varied substantially across trials. No standardized framework was applied across the full study set. Key details of each study’s theoretical framework, including the specific doctrines cited and core concepts informing acupuncture point selection, are summarized in Table 4.

TCM Diagnosis

None of the included studies explicitly reported the TCM diagnosis for individual patients, nor did they summarize major observed trends. Studies 14 and 18 reported additional points based on TCM pattern differentiation; however, no clear statements specifying the TCM diagnosis for each participant were provided [30].

Table 1: Methodological Characteristics, Acupuncture Protocol Clarity, Outcome Reporting, And Key Limitations of Non-Randomized Studies Included in This Review

Study ID	Design	Clarity of acupuncture protocol	Outcome measure reporting	Total sample size	Key limitations
1	Double-arm study	Clear	Complete	20	Small sample, lack of control
7	Pilot study of 2 cases	Clear	Complete	2	Two patients
8	Single-arm study	Some concerns	Complete	55	Unclear protocol and session timing, lack of control
9	Single-arm study	Some concerns	Some concerns	32	Scoring strategy, two acupuncture protocols
12	Single-arm study	Clear	Complete	68	Lack of control
13	Case report	Clear	Some concerns	1	Result reporting lacks precise numerical data
16	Double-arm study	Clear	Complete	48	Not randomized

Table 2: Frequently reported acupoints in included studies, with corresponding WHO codes, number of studies reporting each point, and percentage of studies

Acupoint (standardized)	WHO Code	Number of studies (n)	Percentage of studies
Baihui	GV20	9	50.00
Sishencong	EX-HN1	10	55.56
Shenting	GV24	6	33.33
Naohu	GV17	7	38.89
Benshen	GB13	5	27.78
Yintang	EX-HN3	6	33.33
Zusanli	ST36	6	33.33
Neiguan	PC6	6	33.33
Sanyinjiao	SP6	6	33.33
Shenmen	HT7	5	27.78
Fengchi	GB20	5	27.78
Taichong	LR3	4	22.22
Tongue-related points (any)	EX-HN / TAC	5	27.78
Scalp functional areas (any)	Functional	8	44.44

Table 3: Types Of Control Interventions Used in Included Studies, With the Number of Studies Reporting Each Type and the Total Number of Participants in Each Control Group

Control type	Number of studies	Total participants
Not present/ NA /Not reported	6	10
Behavioral therapy	1	30
Rehabilitation therapy	5	165
Occupational therapy	1	36
Language therapy	1	15
Training (various and combined)	1	9
Sham EA	1	25
TMS (repetitive transcranial magnetic stimulation)	2	74

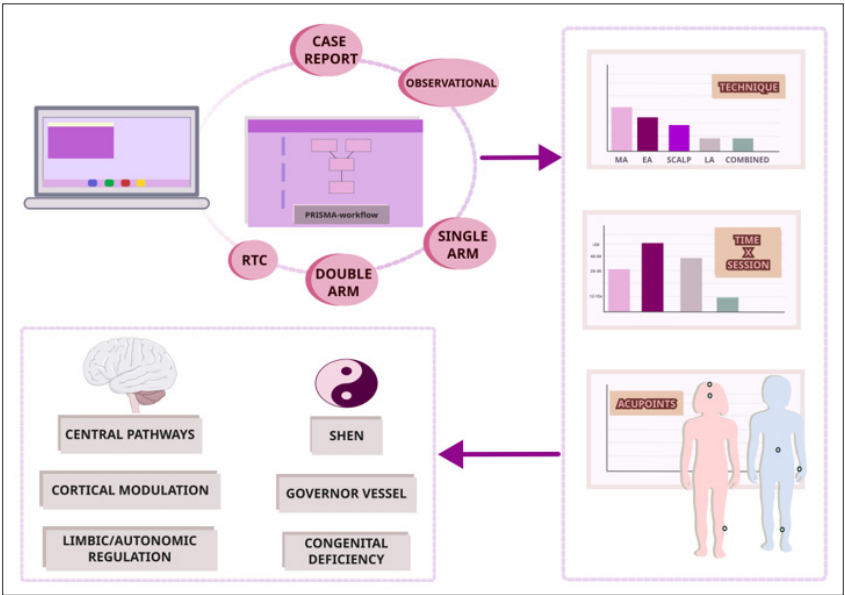
Table 4: Doctrines Cited and the Core Concepts Informing Acupuncture Point Selection

Study ID	Theoretical framework cited	Core concepts informing point selection
2	Traditional Chinese Medicine (TCM); meridian theory; neurophysiological hypotheses	ASD-related symptoms attributed to Shen (Spirit) disturbance; regulation of mind via Governor Vessel, Heart/Pericardium meridians; scalp acupuncture linked to cortical projections; electroacupuncture proposed to enhance cerebral perfusion and metabolism
3	Classical TCM; historical doctrine (Sun Si-miao)	“Thirteen Ghost Acupoints” for psychiatric disorders; regulation of Governor and Conception Vessels; balancing yin–yang; opening orifices and dredging meridians
4	TCM syndrome differentiation	Congenital deficiency affecting brain, heart, spleen, liver, kidney; imbalance of Zang–Fu and Five Spirits; treatment principle of “calming the heart, strengthening spleen, and tranquilizing the spirit”
5	TCM holistic theory	Congenital deficiency with lesion site in the brain; involvement of heart, liver, kidney; selection of scalp points corresponding to frontal, temporal, and parietal lobes
7	TCM meridian and organ theory	Regulation of Heart, Pericardium, Liver, Spleen, Kidney; calming and awakening the mind; strengthening vital function
9	TCM experiential school	Autism classified as developmental retardation due to liver–kidney deficiency; use of “three experienced acupoints” and “opening the orifice, elevating wisdom” technique
10	TCM organ–meridian theory with neurofunctional interpretation	Yin–yang imbalance of Heart, Kidney, Liver; tongue acupuncture linked to neural networks and cortical reinnervation
11	TCM disease categorization	Brain–mind insufficiency; involvement of Heart, Liver, Spleen, Kidney; primary selection of head and auricular points to awaken and calm the mind
13	TCM developmental concepts	Congenital deficiency and inadequate brain nourishment linked to developmental delay
14	TCM syndrome differentiation	Liver stagnation, heart orifice obstruction, kidney essence deficiency; individualized treatment based on pattern differentiation
15	TCM head-acupuncture theory	Autism categorized as heart–mind disorder; head and tongue points used to awaken brain, regulate meridians, and enhance cortical function
16	TCM head-acupuncture theory	Similar rationale to Study 16, emphasizing head, tongue, and Governor Vessel points for brain function restoration
17	TCM disease analogy	ASD likened to “Dian disorder” and “Five Delays”; congenital deficiency and kidney essence depletion with brain involvement
18	TCM heart–mind disorder framework	Heart–mind disturbance, kidney essence deficiency; acupuncture effects described as opening orifices, calming spirit, regulating meridians

Table 5: Most Frequently Reported Acupoints, Anatomical Location, Peripheral Innervation, And Putative Central Neural Pathways

Acupoint	Location	Likely peripheral innervation	Putative central pathway / cortical target	TCM rationale
GV20 (Baihui)	Top of the head	Branches of trigeminal nerve (supratrochlear nerve - V1) & greater occipital nerve (C2)	Somatosensory cortex (S1), frontal cortex, corpus callosum possibly (sensory/motor integration)	Shen regulation, mind, cognitive function
EX-HN1 (Sishencong)	Scalp, surrounding GV20	Primarily supratrochlear (V1) & auriculotemporal (V3) nerve branches	Frontal and parietal cortex	Memory, attention, cognitive enhancement
GV24 (Shenting)	Midline forehead, anterior to hairline	Supratrochlear nerve (trigeminal V1)	Prefrontal cortex	Calm mind, improve cognition
GV17 (Naohu)	Midline posterior head	Greater occipital nerve	Greater occipital nerve (C2) → trigeminocervical complex (C1-C3/brainstem) → higher centers (limbic, thalamus)	Calm spirit, brain function
GB13 (Benshen)	Lateral frontal head	Primarily the auriculotemporal nerve (from trigeminal V3)	Frontal cortex	Mental regulation
EX-HN3 (Yintang)	Between eyebrows	Supratrochlear / supraorbital nerves	Prefrontal cortex, limbic connections	Calm mind, reduce anxiety
ST36 (Zusanli)	Lateral leg, below tibial head	Deep peroneal nerve	Spinal cord → brainstem → hypothalamus	Digestive support, overall energy, systemic regulation
PC6 (Neiguan)	Medial forearm, 3 cun above wrist crease	Median nerve	Spinal cord → brainstem → autonomic centers	Heart–mind regulation, calm spirit
SP6 (Sanyinjiao)	Medial lower leg, 3 cun above medial malleolus	Tibial nerve (primary), potential contribution from saphenous nerve	Spinal cord → hypothalamus / limbic system	Spleen, kidney, yin regulation, sedation
HT7 (Shenmen)	Wrist crease, ulnar side	Ulnar nerve	Spinal cord → brainstem → limbic system	Calm mind, emotional regulation
GB20 (Fengchi)	Lateral occiput	Greater occipital nerve (C2), lesser occipital nerve (C2), great auricular nerve (C2-C3) Brainstem (notably medulla), cerebellum, occipital cortex	Brainstem, cerebellum	Calm wind, improve cognition
LR3 (Taichong)	Dorsal foot, between 1st & 2nd metatarsal	Deep peroneal nerve	Spinal cord → brainstem → prefrontal & limbic cortical modulation	Liver Qi regulation, emotional balance

Graphical Abstract



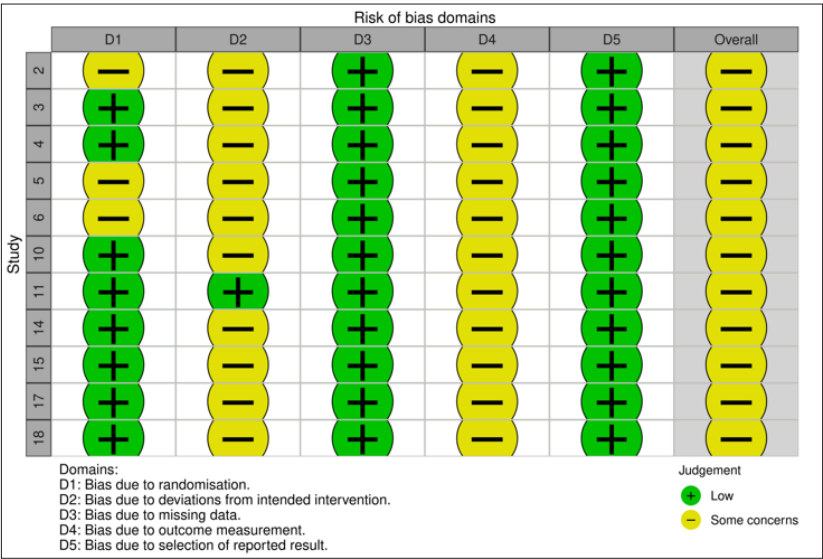


Figure 2: Risk-of-Bias Assessment of Included Randomized Controlled Trials (RCTs) only, Visualized Using the Robvis Traffic Light Plot. Each Domain Represents a Specific Aspect of Trial Quality, and the Overall Risk is Indicated for Each Rct.

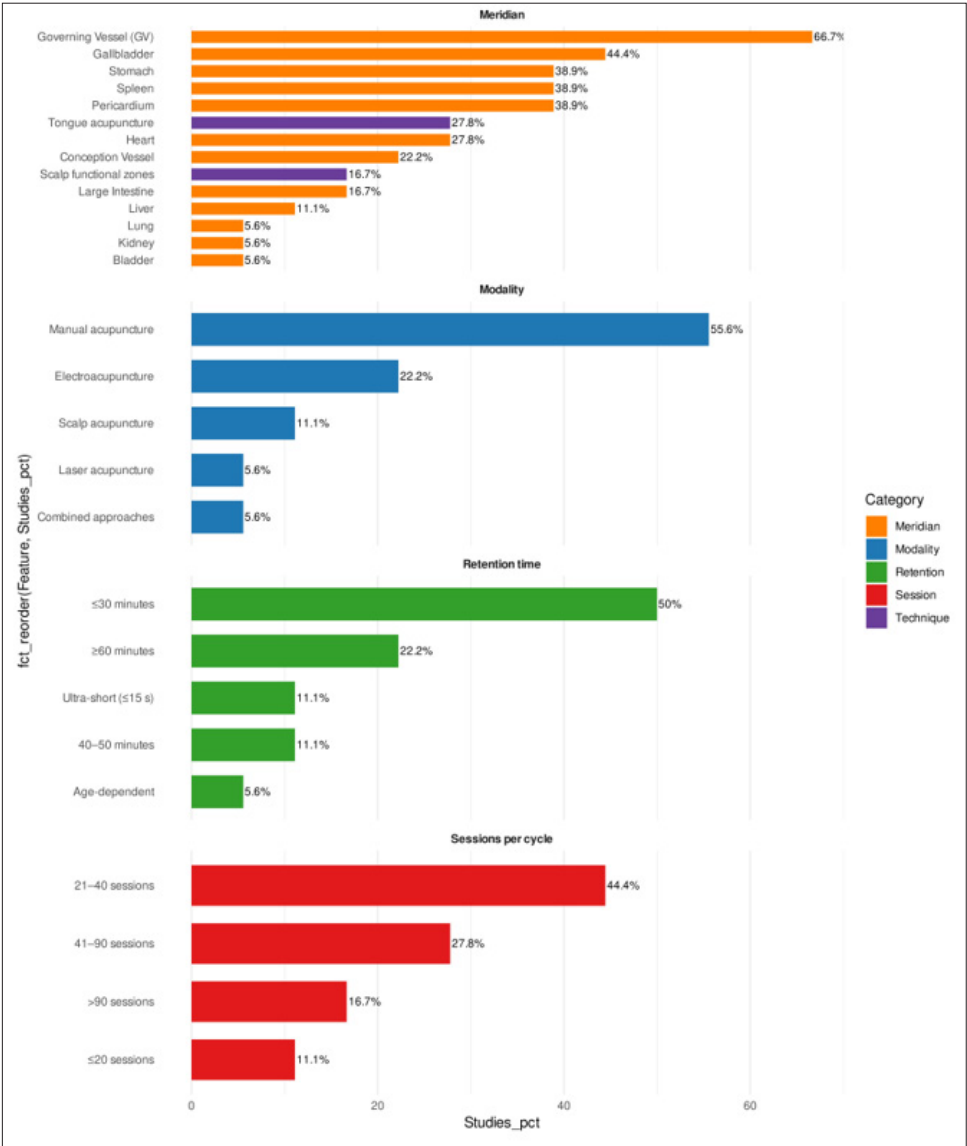


Figure 3: Summary of Key Characteristics of Acupuncture Interventions Across Included Studies. The Faceted Horizontal Bar Chart Shows the Distribution of Meridians, Modality, Session Retention Time, and Total Sessions Per Cycle, Providing an Integrated Overview of Intervention Patterns

Summary

Figure 3 provides a visual overview of the main characteristics of acupuncture interventions across the included studies. The selected domains (Meridian, Modality, Retention time, Sessions per cycle) offer a structured yet comprehensive summary of intervention characteristics, focusing on aspects most relevant to clinical practice and replicability while avoiding overcomplication from rarely reported or study-specific features.

Manual acupuncture was the most frequently reported modality, followed by electroacupuncture, with scalp and tongue techniques represented alongside classical meridian points. Session duration and total number of treatment sessions per cycle varied substantially, reflecting heterogeneity in treatment intensity. At the meridian level, the Governing Vessel, Spleen, Stomach, and Gallbladder meridians were most commonly used [31].

This summary highlights both the convergence of frequently applied intervention components and the variability in less commonly reported features, providing an integrated view of acupuncture practices in ASD studies.

Discussion

Autism is a complex neurodevelopmental condition that requires multimodal therapeutic approaches and individualized interventions, reflecting the heterogeneous nature of the disorder. Due to the absence of a definitive treatment, interest has grown in non-pharmacological strategies, including acupuncture. The safety and potential efficacy of acupuncture across various clinical settings have prompted several meta-analyses. Although the available data are promising, comprehensive evaluations incorporating appropriate control conditions and standardized sham acupuncture protocols remain necessary [32,33].

Using a PRISMA-guided approach, we conducted a qualitative assessment of the methodological aspects of acupuncture protocols to inform future investigations. After screening, 18 studies were included, comprising single-arm studies, double-arm studies, randomized controlled trials, and case reports. Manual acupuncture was the most frequently employed modality, consistent with previous evidence highlighting the good tolerability and applicability of dry needling in pediatric populations, an important consideration for children with ASD [34,35]. Across study designs, a retention time of 20–30 minutes was most commonly applied, with treatment courses ranging from 21 to 90 sessions.

Acupoints reported in four or more studies included both cranial and distal regions. Cranial points such as GV20, EX-HN1, GV24, GV17, GB13, and EX-HN3 are densely innervated by branches of the trigeminal and cervical nerves, potentially conveying sensory signals to frontal, parietal, and occipital cortical areas. To provide an integrated interpretative framework, Table 5 summarizes the most frequently reported acupoints, detailing their anatomical location, likely peripheral innervation, putative central neural pathways, and corresponding TCM rationales.

Baihui (GV20), particularly when stimulated with penetrating techniques, has been associated with reduced neuronal apoptosis and oxidative stress via upregulation of SIRT1 and FOXO1, leading to improvements in neurological deficits in animal models [36]. It has been speculated that SIRT1 activation may ameliorate ASD-related behaviors, a hypothesis supported by data on SIRT1 activators [37]. EX-HN1, consisting of four needling sites symmetrically distributed around GV20, has been reported to increase nitric oxide synthase activity and nitric oxide levels

in the brains of mice, improving insomnia and sleep disturbances [38]. This may be particularly relevant for children with ASD who experience sleep problems and may not benefit from pharmacological interventions.

In a rat model of Alzheimer's disease, acupuncture at GV24 was shown to improve learning and memory, possibly through increased cerebral glucose metabolism in the brainstem, hypothalamus, and thalamus [39]. These findings align with studies suggesting that cerebral glucose hypometabolism is associated with autistic behaviors and poorer performance on neuropsychological tests [40].

Naohu (GV17), traditionally described as the “brain's door,” is identified in classical texts as a key point related to “bone marrow,” which in TCM governs mental function by providing nourishment and vitality [41]. GV17 may increase cerebral microcirculation, potentially benefiting patients by enhancing glymphatic clearance, a process often impaired in children with ASD and possibly contributing to secondary metabolic, cardiovascular, and sleep disturbances [42,43]. GB13, often used in combination with GV24, has been indicated for vascular dementia and cognitive impairment [44]. In murine models of Alzheimer's disease, electroacupuncture and three-needle acupuncture at these points improved spatial learning and memory, with neuroimaging studies demonstrating enhanced limbic system activity and reduced amyloid- β deposition [45].

EX-HN3 (Yintang) has been shown to reduce anxiety in surgical patients [46]. In healthy subjects, stimulation of this point increased activity in the left superior temporal lobe and cerebellum while decreasing activity in the left inferior parietal lobule, right precuneus, and middle occipital gyrus, suggesting potential regulatory effects on mood, emotional control, perception, and self-monitoring [47].

Distal limb points, including ST36, PC6, SP6, HT7, and LR3, are innervated by peripheral nerves of the upper and lower limbs and may influence central neural circuits via ascending spinal pathways to the brainstem, thalamus, and limbic structures [48–50]. While these neurophysiological connections remain largely theoretical, this framework provides plausible mechanisms through which peripheral acupuncture stimulation could interact with central networks involved in cognitive, emotional, and autonomic regulation.

These central regulatory processes are closely linked to clinically relevant symptom domains characterized by dysregulation of autonomic and affective systems, including pain, sleep disturbance, fatigue, and vasomotor instability [51,52].

As the primary aim of this review was to characterize acupuncture methodologies rather than evaluate clinical efficacy, the observed methodological limitations should be interpreted in this context and do not undermine the descriptive findings; however, they do warrant caution when considering broader interpretation and generalizability. The included studies exhibited substantial heterogeneity in study design, sample size, acupuncture modality, session duration, stimulation parameters, and acupoint selection, which precluded quantitative synthesis and limited cross-study comparability. In addition, reporting of TCM diagnoses, theoretical rationales, and control or sham conditions was often incomplete or inconsistent, reducing reproducibility. Many studies were single-arm investigations or small case reports, further limiting external validity.

These limitations highlight the need for cautious interpretation of broader implications and underscore the importance of methodological rigor in future investigations. Future research should aim to standardize key aspects of acupuncture protocols, including session duration, total number of sessions, and acupoint selection, particularly for pediatric ASD populations. Transparent and detailed reporting of TCM diagnoses, theoretical rationales, and stimulation parameters is essential to enhance reproducibility. The implementation of well-designed control or sham acupuncture conditions will further strengthen trial validity. Integrating mechanistic studies, such as neuroimaging or biomarker assessments, could help clarify the neural and physiological effects of acupuncture and support hypothesis-driven protocol development. Collectively, these strategies will facilitate more rigorous, reproducible, and clinically informative acupuncture trials in ASD.

Conclusion

This PRISMA-based qualitative review summarizes the methodological characteristics of acupuncture interventions used in autism spectrum disorder (ASD) across 18 studies. Although substantial heterogeneity was observed in study design, treatment intensity, and control conditions, several consistent patterns emerged. Manual acupuncture was the most frequently employed modality, typically delivered in 20–30minute sessions over moderate-to-high intensity treatment cycles. Acupoint selection showed marked convergence toward cranial midline points-particularly Governing Vessel-related and extra points associated with cognitive function and Shen regulation-often combined with distal limb points traditionally linked to emotional and autonomic modulation.

Risk-of-bias assessment revealed recurring methodological limitations, including incomplete reporting of randomization and blinding procedures, heterogeneous comparator interventions, and inconsistent descriptions of acupuncture protocols. Additionally, Traditional Chinese Medicine diagnostic frameworks and theoretical rationales were variably reported, limiting reproducibility and cross-study comparability.

Rather than evaluating clinical efficacy, this review provides a structured overview of how acupuncture has been applied in ASD research to date. The findings highlight the need for greater methodological standardization, transparent protocol reporting, and harmonized control designs to strengthen future research and support the development of reproducible and clinically meaningful acupuncture trials in ASD.

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AI Declaration

During the preparation of this work, the author(s) used ChatGPT (OpenAI) solely to correct grammar and improve language clarity. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

Ethical Statement: Ethical approval was not required for this study. The work is a PRISMA-guided qualitative review based exclusively on previously published literature and publicly available data. No human participants or animals were directly involved.

Data Availability

All data generated or analyzed during this study are included in this published article and its references.

Supplementary

Supplementary Table 1S. Comprehensive summary of all included studies, including first author, study ID, publication year, study type, session duration (minutes), total sessions per treatment cycle, number of participants in the treatment group, acupuncture intervention type (ACU = manual acupuncture, EA = electroacupuncture), number of participants in the control group, acupoints used, and reference number.

First Author	Study ID	Year	Type	Min per session	Sessions per total cycle	Treatment (N)	Acupuncture treatment in the intervention Treatment (N)	Control (N)	Treatment in the control	Points	Reference number
Xu et al.	1	2025	Single study	30 min	12 weeks, 3 times/week	10	ACU	10	No treatment (not specified)	Baihui (GV20), Sishencong (EX-HN1), Yintang (EX-HN3), Tianshu (ST25), Zusanli (ST36), Shangjuxu (ST37)	16
Wang et al.	2	2010	Single study	50 min	4 months, 2 months per course, 5 sessions/ week	30	EA	30	Behavioral therapy	Baihui (GV20), Sishencong (EX-HN1), Shenting (GV24), Benshen (GB13), Yintang (EX-HN3), Naohu (GV17), Naokong (GB19), Neiguan (PC6); Scalp Speech Areas by Jiao Shun-fa (first, second, third)	17
Li et al.	3	2017	Single study	15 min (<4y), 30 min (>4y)	Three courses; 1 course = 30 sessions, 3 times/ week, 20-day break after 10 sessions	45	ACU	45	Rehabilitative training	Thirteen Ghost Points (Sun Si-miao[4]): Shuigou (GV26), Fengfu (GV16), Chengjiang (CV24), Jiache (ST6), Shaoshang (LU11), Daling (PC7), Yinbai (SP1), Haiquan (EX-HN11), Laogong (PC8), Shenmai (BL62), Shangxing (GV23), Huiyin (CV1), Quchi (LI11)	18
Wang et al.	4	2024	Single study	30 min	36 sessions (6/ week for 12 weeks, 30 min retention per session)	36	ACU	36	Occupational therapy	Shenmen (HT7), Neiguan (PC6), Sanyinjiao (SP6), Zusanli (ST36); scalp points: Three-needle cognition, Four-Shen points, Brain three points, Ding Shen points	19

Kong et al.	5	2018	Single study	30 min	4 months, 1 session/day (10 min stim per session), 1 pause/week	30	ACU	30	Rehabilitative therapy	Brain tripoints, Four-Shen points, Temple tri-points, Hand tri-points, Shou-Zhi points, Tongue tri-points, Foot tri-points, Zu-Zhi points, Fengchi (GB20), Yamen (GV15)	20
Elsheikh et al.	6	2023	Single study	12 sec	2 sessions/week, total 12 sessions	15	Laser acupuncture (LASER ACU)	15	No laser acupuncture (language stimulation)	GV20 (Baihui), EX-HN1 (Sishencong), GV24 (Shenting), GB20 (Fengchi), GV26 (Shuigou), EX-HN3 (Yintang), LI4 (bilateral Hegu), ST36 (bilateral Zusanli), SP6 (bilateral Sanyinjiao), scalp speech area	21
Chen et al.	7	2008	Pilot study (2 cases)	30 min	24 sessions, 3 sessions/week on alternate days over 8 weeks	2	ACU	0	NA	Acupoint set A: Sishencong (EX-HN1), Yintang (EX-HN3), Neiguan (PC6), Ernaodian (AT3), Zusanli (ST36), Taichong (LR3); Acupoint set B: Sishencong (EX-HN1), Yintang (EX-HN3), Shenmen (HT7), Shounaodian, Sanyinjiao (SP6)	22
Zhao et al.	8	2014	Single study	2 h (30 min per limb)	Twice daily, 12–24 months	55	EA	0	NA	Hegu (LI4)-Quchi (LI11) bilateral upper limbs, Zusanli (ST36)-Sanyinjiao (SP6) bilateral lower limbs	23
Xi et al.	9	2010	Single study	30 min	Daily, 4 times/week, 3 months = 1 course	32	EA + Bleeding + ACU	0	NA	Group 1: Nape points (GV15 Yamen, GB20 Fengchi, GB12 Wangu), Hand points (PC6 Neiguan, HT7 Shenmen, PC8 Laogong), Temple points (GB8 Shuaigu), Head points (GV12 Shenzhu, GB13 Benshen), Baihui (GV20); Group 2: Tongue points (EX-HN12 Jinjin, EX-HN13 Yuye, CV23 Lianquan), Foot points (KI1 Yongquan), Brain points (GV17 Naohu), Mind points (EX-HN1 Sishencong); groups used alternately	24
Wong et al.	10	2014	RCT	<15 sec	40 daily sessions, 5/week over 8 weeks	12	Tongue acupuncture	9	Scheduled training/education	Tongue surface: TAC#1 Z Run Ze, TAC#2 Z Guan Zhu; Tongue base: TAC#3 Z Tian Men, TAC#4, TAC#5 Z Di You	25
Wong et al.	11	2010	RCT	30 min	3 sessions/week, 4 weeks	30	EA	25	Sham acupuncture + conventional/educational program	Sishencong (EX-HN1), Yintang (EX-HN3), Neiguan (PC6), Shenmen (HT7), Taichong (LR3), Ear Naodian (AT3), Ear Shenmen (TF4), Sanyinjiao (SP6)	26
Yau et al.	12	2018	Single study	1 h	Twice weekly, total 30 sessions	68	Scalp acupuncture	0	NA	Baihui (GV20), Sishencong (EX-HN1), midline forehead, lateral line 2 forehead, posterior lateral vertex, primary auditory cortex, auditory speech area	27
Liu et al.	13	2024	Case report	4 h	One puncture daily, 10 punctures per session, 15-day break between sessions, 30 sessions/course	1	Scalp acupuncture	0	NA	Hiqi, emotional zone, Language areas 1/2/3, Ding Shen, Brain three, Jin Jing Yu Ye	28
Zheng et al.	14	2022	Single study	60 min	5 days/week, 2-week course, 2-day break, total 6 months	41	ACU	41	Rehabilitation + Tuina	Laogong (PC8), Neiguan (PC6), Shenmen (HT7), Naohu (GV17), Touwei (ST8), Benshen (GB13), Shenting (GV24), Sishencong (EX-HN1); plus motor, speech, emotion areas; additional points based on TCM pattern diagnosis	29
Chen et al.	15	2020	Single study	30 min	Once daily, 2 weeks/course, 2 courses	25	ACU	25	Comprehensive rehabilitation	Baihui (GV20), Naohu (GV17), Naokong (GB19), Benshen (GB13), Shenting (GV24), Sishencong (EX-HN1)	30
Wang et al.	16	2019	Single study	40 min	Daily, 1 month/course	24	ACU	24	Rehabilitation	Benshen (GB13), Tongue tri-points (EX-HN12, EX-HN13, CV23), Naokong (GB19), Sishencong (EX-HN1), Naohu (GV17), Shenting (GV24), Baihui (GV20)	31

Zhu et al.	17	2024	Single study	20 min	Daily, 90 days	21	ACU	21	Rehabilitation + rTMS	Baihui (GV20), Shenting (GV24), Naohu (GV17), Sishencong (EX-HN1), Naokong (GB19), Tongue tri-points (EX-HN12, EX-HN13, CV23)	32
Shi et al.	18	2024	Single study	30 min	1 course = 20 sessions, 3 courses total, 10-day interval between courses	53	ACU	53	TMS	Baihui (GV20), Sishencong (primary) (EX-HN1); additional points: Ding Shen, Hand wisdom points, Brain Hu, Sanyinjiao (SP6); TCM pattern-based additions depending on liver/heart/ kidney deficiency or phlegm obstruction	33

Supplementary Table 2S. Complete list of acupoints extracted from all included studies, including Chinese name, WHO code/system, and category (e.g., Governing Vessel, extra points, meridian-specific points such as Stomach channel).

Acupoint/Area	WHO Code/System	Category
Shenzhu	GV12	Governing Vessel
Naohu	GV17	Governing Vessel
Fengfu	GV16	Governing Vessel
Shangxing	GV23	Governing Vessel
Yamen	GV15	Governing Vessel
Shuigou	GV26	Governing Vessel
Baihui	GV20	Governing Vessel
Shenting	GV24	Governing Vessel
Sishencong	EX-HN1	Extra point
Yintang	EX-HN3	Extra point
Haiquan	EX-HN11	Extra point
Jinjin	EX-HN12	Extra point
Yuye	EX-HN13	Extra point
Benshen	GB13	Gallbladder
Naokong	GB19	Gallbladder
Fengchi	GB20	Gallbladder
Wangu	GB12	Gallbladder
Shuaigu	GB8	Gallbladder
Xuanzhong	GB39	Gallbladder
Jiache	ST6	Stomach
Touwei	ST8	Stomach
Tianshu	ST25	Stomach
Zusanli	ST36	Stomach
Shangjuxu	ST37	Stomach
Jiache	ST6	Stomach
Sanyinjiao	SP6	Spleen
Yinbai	SP1	Spleen
Gongsun	SP4	Spleen
Shenmen	HT7	Heart
Neiguan	PC6	Pericardium
Daling	PC7	Pericardium
Laogong	PC8	Pericardium
Zhongchong	PC9	Pericardium
Shaoshang	LU11	Lung
Taichong	LR3	Liver
Yongquan	KI1	Kidney
Taixi	KI3	Kidney

Shenmai	BL62	Bladder
Feishu	BL13	Bladder
Xinshu	BL15	Bladder
Ganshu	BL18	Bladder
Pishu	BL20	Bladder
Shenshu	BL23	Bladder
Chengjiang	CV24	Conception Vessel
Huiyin	CV1	Conception Vessel
Lianquan	CV23	Conception Vessel
Guanyuan	CV4	Conception Vessel
Hegu	LI4	Large Intestine
Quchi	LI11	Large Intestine
Zhizheng	SJ7	Sanjiao
Scalp speech / language areas	Functional	Scalp functional
Emotional zone	Functional	Scalp functional
Auditory cortex / speech area	Functional	Scalp functional
Brain three needles / tripoints	Functional	Scalp functional
Four-Shen points	Functional	Scalp functional
Tongue tri-points / TAC points	Functional	Tongue system

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