

## Acupuncture for Pediatric Conditions: A Narrative Review

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### ABSTRACT

**Background:** The use of acupuncture for common pediatric conditions continues to grow. Three previous overviews have summarized the research literature.

**Objective:** The aim of this article is to provide an updated narrative review of the literature on the use of acupuncture within the pediatric population.

**Methods:** A systematic search was performed to identify clinical trials and reviews published through July 2015. Trials were excluded if they were *not*: (1) acupuncture-specific; (2) limited to pediatric patients; (3) published in English. The literature was assessed and synthesized into a narrative review and commentary.

**Results:** Seventy-one publications were identified (59 clinical trials and 12 reviews) that represented 20 conditions. Since the prior overviews, 36 new publications (33 clinical trials) were identified and represented nine countries; the top three were China, Norway, and the United States. The top five areas of research at that timepoint were autism spectrum disorder, cerebral palsy, colic, pain, and nausea and vomiting.

**Conclusions:** Clinical trials in pediatric acupuncture ( $n=59$ ) represent a small subset of acupuncture research. Data are promising for conditions such as pain and amblyopia; however, conclusions cannot be made due to limited number of trials and heterogeneity of treatment approaches. Specifically, caution is warranted, as acupuncture needling of a single acupoint in clinical research may not be equivalent to acupuncture treatment in clinical practice. Further research on the use of acupuncture for pediatric conditions is warranted. The current authors posit that the early phase research model, with pragmatic treatment approaches, should be employed to all areas of study. The conditions with promising evidence may represent key areas of focus for future research.

**Key Words:** Acupuncture, Acupuncture Therapy, Pediatrics, Review, Narrative Review

### INTRODUCTION

ACUPUNCTURE, AN INTEGRAL COMPONENT of Traditional East Asian Medicine, has been used within the pediatric population for centuries. As an example, *Shonishin*, a pediatric-specific style of acupuncture dates back to seventeenth-century Japan.<sup>1</sup> As acceptance of acupuncture in Western countries continues to grow, U.S. data indicate

that acupuncture was the most frequently used Complementary and Integrative Medicine (CIM) modality in children, accounting for 70% of visits.<sup>2</sup> Three reviews suggested that acupuncture is a safe intervention within the pediatric population.<sup>3-5</sup> Yet, a survey from Germany found that only 36% of pediatricians were receptive to the use of CIM therapies (including acupuncture).<sup>6</sup> Clearly, there is a need to assess the literature to provide guidance for clinicians

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on the safety and appropriate use of acupuncture within the pediatric population, as well as to guide future research.

The pediatric acupuncture literature has been summarized within three previous overviews, two of these included clinical trials of acupuncture and acupuncture-like modalities.<sup>5,7</sup> These reviews, highlighting the benefit of acupuncture for an array of conditions, included the suggestion that future research should be conducted to, “guide pediatricians and other health professionals. . . .”<sup>7</sup> The most recent overview assessed the efficacy and safety of acupuncture by summarizing systematic reviews through 2014.<sup>8</sup> Since the publication of these three overviews, several clinical trials have been published. An update of literature is warranted; yet, in contrast to the prior reviews, other acupuncture-like modalities (e.g., acupressure or laser acupuncture) are excluded from the current review. The aim of this article is to provide a narrative review of the literature (clinical trials and reviews) published on the use of acupuncture for pediatric conditions.

## METHODS

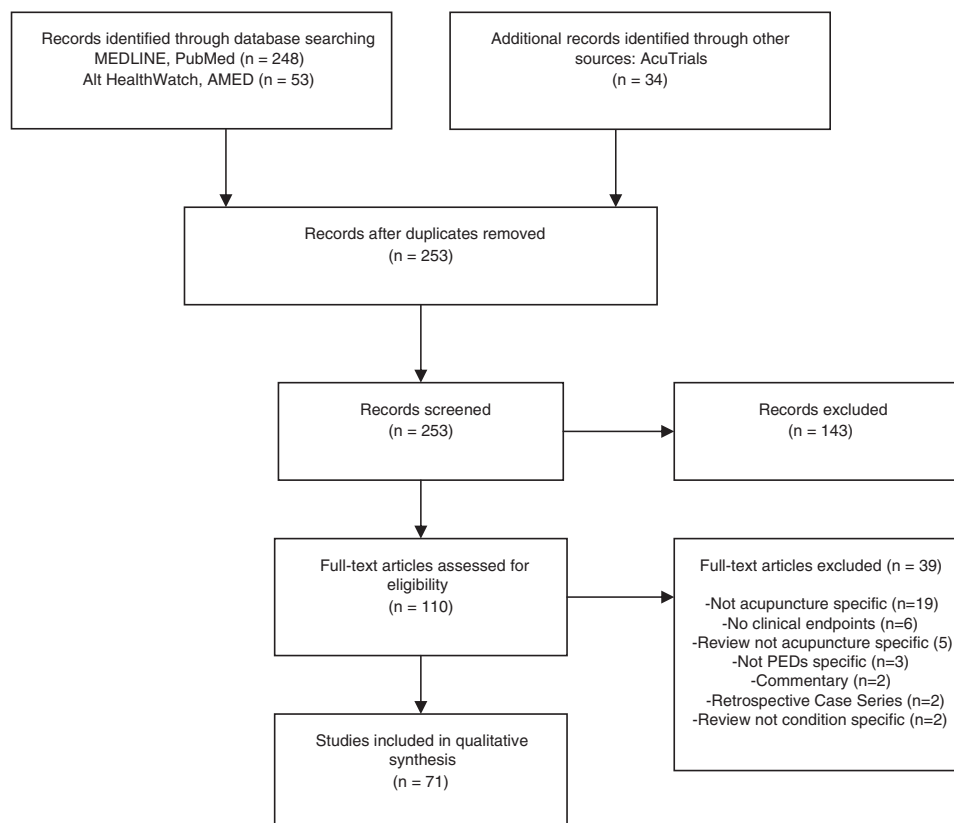
A systematic search was performed for English-language publications of clinical trials and reviews of acupuncture

within the pediatric population (<18 years). Trials on all forms of classical acupuncture were included, and trials on non-acupuncture methods (e.g., acupressure) were excluded. Reviews that were not limited to acupuncture or that were not condition-specific were excluded. Predefined algorithms were used in searching four databases: MEDLINE® (PubMed), Alt HealthWatch, AMED [Allied and complementary *Medicine Database*], and AcuTrials through July 31, 2015.

Although the search strategy was systematic in nature, it was not intended to assess methodological quality or to pool data for meta-analysis. Articles were hand-screened and publications that met inclusion criteria for this review were synthesized into a narrative review and synopsis. Articles that were included within the three prior overviews of the pediatric acupuncture literature<sup>5,7,8</sup> are not summarized in this article.

## RESULTS

The search identified a total of 335 articles. After removal of duplicates and screening titles and abstracts, 110 publications were included for review; of these, 39 were excluded for various reasons (Fig. 1). The remaining 71 articles



**FIG 1.** Flow diagram of the literature screening process. AMED, Allied and complementary *Medicine Database*.

fulfilled the predefined inclusion criteria and are included in this narrative review.

Research (published in English) on use of acupuncture within the pediatric population dates to 1973.<sup>9</sup> The majority of publications (83%; 59/71) were clinical trials, while the remaining 17% were reviews. Most of the clinical trials were small-scale, as 81% (48/59) had  $n \leq 100$  and 48% (28/59) had  $n \leq 50$ .

A total of 20 condition categories were investigated (See Table 1). The top five (based on clinical trials) were: (1) nausea and vomiting; (2) cerebral palsy; (3) digestive complaints (e.g., colic); (4) pain; (5) autism spectrum disorder (ASD) and respiratory-tract diseases (same ranking). Each of these top conditions categories had  $\geq$  five publications and accounted for 73% (43/59) of the published literature. The 59 clinical trial publications represented 14 countries (Table 2); the top three, China, the United States, and Hong Kong, account for 59% (35/59) of the publications.

TABLE 1. RANK ORDER OF CLINICAL TRIALS BY CONDITION CATEGORY

<i>Conditions</i>	<i>Clinical trials</i>	<i>Rank order</i>	<i>Total articles (including reviews)</i>
Nausea & vomiting (postoperative, chemotherapy-induced)	10	1	10
Cerebral palsy	9	2	9
Digestive complaints (colic, constipation, diarrhea)	8	3	8
Pain (acute, chronic)	6	4	6
Autism spectrum disorder	5	5	8
Respiratory-tract diseases (allergic rhinitis, asthma, pharyngitis)	5	5	6
Nocturnal enuresis	3	6	6
Vision disorders (amblyopia, central & peripheral disorders, myopia)	3	6	4
ADHD	2	7	3
Extubation	2	7	2
Intellectual disability	2	7	2
Brachial plexus neuropathies	1	8	1
Hearing loss (sensorineural)	1	8	1
Obesity	1	8	1
Sialorrhea	1	8	1
Epilepsy	0	9	1
Hypoxia—ischemic encephalopathy	0	9	1
Mumps	0	9	1
<b>Total</b>			<b>71</b>

ADHD, attention-deficit hyperactivity disorder.

TABLE 2. RANK ORDER OF CLINICAL TRIALS BY COUNTRY OF ORIGIN

<i>Country</i>	<i>Clinical trials</i>	<i>Rank</i>
China	14	1
United States	11	2
Hong Kong	10	3
Norway	5	4
Germany	3	5
Israel	3	5
Sweden	3	5
Canada	2	6
Egypt	2	6
Turkey	2	6
Denmark	1	7
Iran	1	7
Japan	1	7
Taiwan	1	7

### SUMMARY OF NEWER PUBLISHED CLINICAL TRIALS AND REVIEWS

Thirty-six articles (33 clinical trials and three systematic reviews) not included in the previous overviews<sup>5,7,8</sup> accounted for half of all publications (51%; 36/71). The trend of small-scale clinical trials continued; 82% (27/33) of studies had  $n \leq 100$  and 42% (14/33) had  $n \leq 50$ .

The top five condition categories are: autism spectrum disorder, cerebral palsy, colic, pain, and nausea and vomiting (Table 3). These studies represented 9 countries

TABLE 3. RANK ORDER OF CLINICAL TRIALS ( $\geq 2007$ ) BY CONDITION CATEGORY

<i>Conditions</i>	<i>Clinical trials</i>	<i>Rank order</i>	<i>Total articles (including reviews)</i>
Autism spectrum disorder	5	1	5
Cerebral palsy	5	1	5
Colic	5	1	5
Pain (acute)	4	2	4
Nausea & vomiting (postoperative, chemotherapy-induced)	4	2	4
Asthma	2	3	3
ADHD	2	3	2
Amblyopia	2	3	2
Nocturnal enuresis	1	4	2
Intellectual disability	1	4	1
Brachial plexus neuropathies	1	4	1
Obesity	1	4	1
Mumps	0	5	1
<b>Total</b>			<b>36</b>

ADHD, attention-deficit hyperactivity disorder.

TABLE 4. RANK ORDER OF CLINICAL TRIALS (≥ 2007) BY COUNTRY OF ORIGIN

Country	# of references	Rank
China	10	1
Norway	5	2
United States	5	2
Hong Kong	4	3
Sweden	3	4
Egypt	2	5
Germany	2	5
Denmark	1	6
Turkey	1	6

(Table 4) with the top three countries, China, Norway, and the United States, accounting for 61% (20/33) of recent publications. Condition summaries are presented in rank order, based on number of new articles (i.e., those not included within the prior overviews).

### Autism Spectrum Disorder

New publications included five clinical trials and one review (Table 5). The most recent systematic review identified 27 publications (3 in English) and concluded that well designed trials are needed.<sup>15</sup> The authors stated that all of the articles report high tolerability to acupuncture and “improvements in children who received a form of acupuncture.”

A pilot study from Egypt assessed the effects of scalp acupuncture adjunctive to language therapy.<sup>10</sup> Positive effects were observed for several parameters of language tests, leading the authors to conclude that adjunctive treatment was feasible, accepted, and may offer benefits.

A trial from Hong Kong assessed the effects of dermal acupuncture treatment, (7-Star needle) at a standardized set of acupuncture meridians (not acupoints).<sup>12</sup> Results sug-

gested positive effects in language and social interaction but not in stereotyped behaviors or motor functions.

Another group from Hong Kong published articles about a series of trials. The first, an outcomes-based pilot study, provided (Traditional Chinese Medicine (TCM)–style electroacupuncture (EA) to participants.<sup>11</sup> These positive findings led to a larger trial that compared EA to sham EA.<sup>13</sup> Participants received EA treatment at a standardized set of acupoints or sham EA at areas 4 mm away from the acupoints. Overall, mixed results were reported with positive effects within subscales of each of the primary outcomes (i.e., language comprehension and self-care). The third trial, also a pilot study, assessed the effects of a newly developed Tongue Acupuncture (TAC) treatment approach.<sup>14</sup> Participants received TAC or sham TAC, which involved lightly pressing the same acupoints with the handle of the acupuncture needle. Based on the acceptance and feasibility, the authors suggested that additional studies are warranted.

*Synopsis.* Of the new trials, three were pilots, while the other two suggested positive effects from different treatment approaches. The current authors agree with the prior overview by Yang et al., which concluded: “*The efficacy of acupuncture for autism spectrum disorder is unclear.*”<sup>8</sup>

### Cerebral Palsy

Five new clinical studies have been published (Table 6) and there have been no recent reviews. A pilot study from the United States assessed the effects of acupuncture compared to osteopathic manipulation (OT); a third group served as a wait-list control group.<sup>16</sup> All groups continued to receive usual care. The authors found the design feasible and suggested that adjunctive OT could be effective but not acupuncture.

A trial from China assessed frequency of cerebral palsy–related seizures in children.<sup>17</sup> Results of this crossover

TABLE 5. NEW CLINICAL TRIALS FOR AUTISM SPECTRUM DISORDER (N=8; 6 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu Style</i>	<i>Acupoint protocol</i>	<i># Txs</i>	<i>Outcome measure</i>	<i>Results</i>
Allam, 2008 <sup>10</sup>	Egypt	Range: 4–7 yrs n=20	Acu+UC vs. UC	Scalp	Standardized	72: 2×/wk	Pilot: Language tests	Feasible; might be useful
Chen, 2008 <sup>11</sup>	Hong Kong	Mean: 11.5 yrs n=2	Outcomes-based	TCM	Standardized	24: 3×/wk	Pilot: QoL & function scales	Feasible; might be useful
Chan, 2009 <sup>12</sup>	Hong Kong	Mean: 6.8 yrs n=32	Acu vs. wait-list	7-star	Standardized	30: 5×/wk	Pt diary	Mixed
Wong, 2010 <sup>13</sup>	Hong Kong	Range: 3–18 yrs n=59	Acu+UC vs. Sham+UC	TCM	Standardized	12: 3×/wk	4 QoL & function scales	Mixed
Wong, 2010 <sup>14</sup>	Hong Kong	Range: 3–11 yrs n=50	Acu+UC vs. Sham+UC	Tongue	Standardized	40: 5×/wk	Pilot: QoL & function scales	Feasible; might be useful

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews). One new article was a systematic review and is not shown in this table.

Acu, acupuncture; Tx, treatment; yrs, years; UC, usual care; TCM, Traditional Chinese Medicine; wk, week; QoL, quality of life; Pt, patient.

TABLE 6. NEW CLINICAL TRIALS FOR CEREBRAL PALSY (N=9; 5 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Tx</i>	<i>Outcome measure</i>	<i>Results</i>
Duncan 2008 <sup>16</sup>	United States	<i>Range:</i> 20 mo–12 yrs <i>n</i> = 55	Acu+UC vs. OT+UC vs. UC alone	TCM	Individualized	30: > 6 mo	<i>Pilot:</i> multiple outcomes	No Acu effect; OT = +
Wu 2008 <sup>17</sup>	China	<i>Range:</i> 1–6 yrs <i>n</i> = 116	Acu+UC vs. UC	TCM & Scalp	Individualized	60: 5×/wk	Seizure frequency	No increased risk
Duncan 2012 <sup>18</sup>	China	<i>Range:</i> 12–72 mo <i>n</i> = 75	Acu+UC vs. UC	TCM	Individualized	60: 5×/wk	GMFM & disability	No effect
Wang 2013 <sup>19</sup>	China	<i>Mean:</i> 32.5 mo <i>n</i> = 74	Individualized Acu vs. standardized Acu	Scalp & TCM	Semi-individualized	42: Every other day	GMFM & Spasticity	No difference
Liu 2013 <sup>20</sup>	China	<i>Range:</i> 1–7 yrs <i>n</i> = 200	Acu+UC vs. UC	TCM	Standardized	30: Every 3 days	GMFM & GDS	Acu = +

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; mo, months; yrs, years; UC, usual care; OT, osteopathic manipulation; TCM, Traditional Chinese Medicine; GMFM, Gross Motor Function Measure; GDS, Gesell Development Scale.

feasibility study suggested that there was no increased risk from the addition of body and scalp acupuncture to rehabilitative therapy.

A collaborative trial (United States and China) compared the effects of acupuncture adjunctive to rehabilitation therapy to rehabilitation therapy alone (a crossover group).<sup>18</sup> Results suggested no difference between groups at the end of treatment. At the end of the treatment period the rehabilitation-only group received acupuncture and trends of improvement were observed.

A trial from China compared use of a standardized set of acupoints to individualized acupuncture; both groups continued to receive usual care.<sup>19</sup> Although no differences be-

tween groups were observed, a secondary analysis of infants with spastic cerebral palsy suggested that individualized treatment was better.

The largest trial to date also assessed the effect of acupuncture adjunctive to rehabilitative therapy.<sup>20</sup> The results suggested that adjunctive acupuncture treatment was significantly better than rehabilitation training alone.

*Synopsis:* Clinical trials reported mixed effects from TCM styles of acupuncture treatment, all of which provided an intensive course of therapy (30–60 treatments). Results of the largest trial were positive, and the current authors agree with the conclusion of the prior overview by Yang et al.: “*The efficacy of acupuncture for cerebral palsy is promising.*”<sup>8</sup>

TABLE 7. NEW CLINICAL TRIALS FOR COLIC (N=5; 5 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Tx</i>	<i>Outcome measure</i>	<i>Results</i>
Reinthal 2008 <sup>21</sup>	Sweden	<i>Mean:</i> 6 wks <i>n</i> = 40	Acu vs. no Tx	Single acupoint (LI 4)	Standardized	4: 2×/wk	<i>Pt diary:</i> Crying & pain	Acu = +
Landgren 2010 <sup>22</sup>	Sweden	<i>Range:</i> 2–8 wks <i>n</i> = 90	Acu vs. no Tx	Single acupoint (LI 4)	Standardized	6: 2×/wk	<i>Pt diary:</i> Crying	Acu = +
Landgren 2011 <sup>23</sup>	Sweden	<i>Range:</i> 2–8 wks <i>n</i> = 90	Acu vs. no Tx	Single acupoint (LI 4)	Standardized	6: 2×/wk	<i>Pt diary:</i> Feeding, stool & sleep	No effect
Skjeie 2011 <sup>24</sup>	Norway	<i>Mean:</i> 7 wks <i>n</i> = 9	Acu vs. no Tx	Single acupoint (ST 36)	Standardized	3: Daily	<i>Pilot, Pt diary:</i> Crying	Feasible; might be useful
Skjeie 2013 <sup>25</sup>	Norway	<i>Range:</i> 3–13 wks <i>n</i> = 90	Acu vs. no Tx	Single acupoint (ST 36)	Standardized	3: Daily	<i>Pt diary:</i> Crying	No effect

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; wks, weeks; Pt, patient.

## Colic

There were five new articles (4 were clinical trials) but no reviews on the effects of acupuncture for the treatment of colic (Table 7). A trial from Sweden assessed the effects of acupuncture needling at a single acupoint (bilateral LI 4).<sup>21</sup> Needles were retained for 20 seconds with “light” stimulation, and data suggested that the treatment was effective for alleviating colic (crying and pain).

Another trial from Sweden also assessed the effects of acupuncture needling at LI 4 on crying for infants with colic.<sup>22</sup> Needling was applied superficially (2-mm depth) for 2 seconds to the acupoint LI 4 (unilateral). Results suggested that minimal needling can reduce the intensity and duration of crying. A second publication generated from the same trial reported that acupuncture needling had no major effect on feeding, stooling, and sleep.<sup>23</sup>

A pilot trial from Norway assessed the effect on crying of acupuncture needling at ST 36 for infants with colic.<sup>24</sup> Based on the positive findings, a larger multisite trial was conducted.<sup>25</sup> Infants received 20 seconds of acupuncture needling at ST 36 (bilateral), with no statistically significant or clinically relevant effect.

*Synopsis:* The clinical trials assessed similar treatment approaches, including brief acupuncture needling to a single acupoint—either LI 4 or ST 36. The trials on LI 4 reported benefit for mitigating crying, while those on ST 36 did not.

## Nausea and Vomiting

Articles on four new clinical studies, but no new reviews, were published on the effects of acupuncture for the treatment of nausea and vomiting (Table 8). A multicenter study assessed the antiemetic effects of acupuncture as adjunctive care in patients undergoing chemotherapy.<sup>26</sup> Results suggested that acupuncture treatment can reduce the incidence of nausea and vomiting and the need for antiemetic drugs.

A group from Norway published a series of articles on the effectiveness of a single session of acupuncture needling at a single acupoint (PC 6) for postoperative nausea and vomiting (PONV). Positive effects were observed in a feasibility study on children undergoing tonsillectomy or adenoidectomy.<sup>27</sup> This led to a clinical trial to assess the effects of acupuncture needling as an adjunct to usual care.<sup>28</sup> PC 6 needling and acupressure at PC 6 as adjunctives to usual care (medications) demonstrated positive effects in reducing PONV. The final study was a multicenter trial that provided acupuncture needling at PC 6 (no acupressure) as an adjunctive to usual care.<sup>29</sup> The trial was designed to control for placebo effects that could have resulted from parents' expectations. All parents believed that their children would receive acupuncture. The results demonstrated no significant difference between the groups.

*Synopsis:* A series of clinical trials assessed PC 6 acupuncture for PONV. One trial suggested that needling combined with acupressure was effective<sup>28</sup>; yet, researchers who conducted the largest trial concluded that, when controlling for possible placebo effects, needling alone (no acupressure) was not effective.<sup>29</sup> The current authors agree with the prior overview by Yang et al.<sup>8</sup> and suggest that the efficacy of PC 6 needling for PONV is unclear. Limited trials have been conducted on the effects of acupuncture for chemotherapy-induced nausea and vomiting; no conclusions can be drawn.

## Pain

Articles on four new clinical studies, and no new reviews, were published on the effects of acupuncture for the treatment of acute pain (Table 9). An outcomes-based feasibility study provided acupuncture treatments to critically ill children in the postoperative setting.<sup>30</sup> Results suggested that 1–2 acupuncture treatments were feasible within this population. In addition, for patients <2 years old, *Shonishin* (noninsertion needling) was performed and also found to be effective.

TABLE 8. NEW CLINICAL TRIALS FOR NAUSEA AND VOMITING (N=10; 4 New<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Tx</i>	<i>Outcome measure</i>	<i>Results</i>
Gottschling 2008 <sup>26</sup>	Germany	Range: 6–18 yrs n=23	Acu+UC vs. UC	TCM	Individualized	≤ 6 per Pt discretion	Antiemetic use w/chemo	Acu=+
Norheim 2010 <sup>27</sup>	Norway	Range: 2–8 yrs n=20	Acu vs. No Tx	Single acupoint (PC 6)	Standardized	1	<i>Pilot, Pt diary:</i> PONV	Feasible; might be useful
Liodden 2011 <sup>28</sup>	Norway	Range: 1–11 yrs n=154	Acu+UC vs. UC	Single acupoint (PC 6)	Standardized	1	<i>Pt diary, 24-hr:</i> PONV	Acu=+
Liodden 2015 <sup>29</sup>	Norway	Range: 1–11 yrs n=282	Acu+UC vs. UC	Single acupoint (PC 6)	Standardized	1	<i>Pt diary, 24-hr:</i> PONV	No difference

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; yrs, years; UC, usual care; TCM, Traditional Chinese Medicine; Pt, patient; chemo, chemotherapy; PONV, postoperative nausea and vomiting.

TABLE 9. NEW CLINICAL TRIALS FOR PAIN (N=6; 4 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Tx</i>	<i>Outcome measure</i>	<i>Results</i>
Wu 2009 <sup>30</sup>	United States	Range: 6 mo–18 yrs n=23	Outcomes-based	Japanese-style	Semi-individualized	2: 2 days apart	Pilot: Pain scales & symptoms	Feasible; might be useful
Lin 2009 <sup>31</sup>	United States	Range: 1–6 yrs n=60	Acu vs. no Tx	2 acupoints (LI 4, HT 7)	Standardized	1	Pain & agitation scales	Acu = +
Ecevit 2011 <sup>32</sup>	Turkey	Mean: 30 wks n=10	Acu vs. no Tx	Single acupoint ( <i>Yintang</i> )	Standardized	1	Crying & pain scale	Acu = +
Nager 2015 <sup>33</sup>	United States	Mean: 15 yrs n=6	Outcomes-based	Japanese-style ( <i>Kiiko</i> )	Individualized	1	Pilot: 3 Pain scales	Feasible; might be useful

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; mo, months; yrs, years; wks, weeks.

A trial from the U.S. assessed the effects of acupuncture needling at two acupoints (HT 7 and LI 4) to reduce post-operative pain in children undergoing tympanostomy-tube placement.<sup>31</sup> Results suggested that a single session of acupuncture needling can reduce pain and emergence agitation.

A trial from Turkey assessed the effects of acupuncture needling at a single acupoint (*Yintang*) on reducing pain in preterm neonates who required a heel prick for blood-gas analysis.<sup>32</sup> Results suggested that needling this acupoint was an effective method to reduce pain and duration of crying.

An outcomes-based pilot study assessed the effects of Japanese-style acupuncture treatments to reduce pain in pediatric patients diagnosed with acute appendicitis.<sup>33</sup> Results suggested that *Kiiko*-style acupuncture was feasible in this population and might decrease pain and inflammation.

*Synopsis:* Four clinical trials reported positive effects achieved by using various styles of acupuncture treatment for differing pain conditions. All trials provided a brief intervention (1 or 2 sessions) within a hospital setting. The

current authors agree with the overview by Yang et al., which concluded: “*The efficacy of acupuncture for pain reduction is promising.*”<sup>8</sup>

## Asthma

Articles on two new clinical trials and one new review were published (Table 10).

A trial from Germany assessed the immediate effects of adjunctive acupuncture treatment for children with bronchial asthma.<sup>34</sup> Results were mixed, with improvements in peak expiratory flow (PEF) variability and anxiety, but no differences were seen in lung-function tests and quality of life.

A trial from Denmark assessed the effects of acupuncture needling at a single acupoint (LR 2) combined with acupressure in children with asthma.<sup>35</sup> The results of patient diaries indicated that acupuncture was effective at the end of treatment; however, no effect was observed at the primary endpoint (8-month follow-up).

TABLE 10. NEW CLINICAL TRIALS FOR ASTHMA (N=4; 3 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Tx</i>	<i>Outcome measure</i>	<i>Results</i>
Scheewe 2011 <sup>34</sup>	Germany	Range: 12–17 yrs n=93	Acu+UC vs. UC	TCM	Semi-individualized	12: 3×/wk	Lung function, PEF, QoL, anxiety	Mixed
Karlsen 2013 <sup>35</sup>	Denmark	Range: 6 mo–6 yrs n=122	Acu vs. no Tx	Single acupoint (LR 2)	Standardized	10: 2 days–2 wks	Pt diary at 12 mo	No effect

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews). One article was a systematic review and is not included in this table.

Acu, acupuncture; Tx, treatment; yrs, years; mo, months; UC, usual care; TCM, Traditional Chinese Medicine; wk, week; PEF, peak expiratory flow; QoL, quality of life; Pt, patient.

TABLE 11. NEW CLINICAL TRIALS FOR AMBLYOPIA (N=2; 2 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Txs</i>	<i>Outcome measure</i>	<i>Results</i>
Zhao 2010 <sup>37</sup>	China	Range: 7–12 yrs n=88	Acu vs. UC	TCM	Standardized	75: 5×/wk for 15 wks	BCVA	Acu = +
Lam, 2011 <sup>38</sup>	China	Range: 3–7 yrs n=83	Acu+UC vs. UC	TCM	Standardized	45: 5×/wk for 15 wks	BCVA	Acu = +

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; yrs, years; UC, usual care; TCM, Traditional Chinese Medicine; wk, week; BCVA, best-corrected visual acuity.

The review identified seven clinical trials, including both newly published trials; no meta-analysis was performed. The researchers concluded that “acupuncture may have a beneficial effect on peak expiratory flow (PEF) or PEF variability.”<sup>36</sup>

*Synopsis:* Two clinical trials reported mixed effects, each with a different treatment approach. Both trials were included within the recent systematic review, which suggested a beneficial effect of acupuncture on PEF.<sup>36</sup> The current authors agree with the prior overview by Yang et al., which concluded: “*The efficacy of acupuncture for asthma is unclear.*”<sup>8</sup>

## Amblyopia

Articles on two new clinical studies, and no new reviews, were published on the effects of acupuncture for the treatment of amblyopia (Table 11). A group from China conducted both studies. The first study compared the effects of acupuncture treatment to daily eye patching.<sup>37</sup> Both groups received optical correction and performed eye exercises. Results suggested that acupuncture was as effective as eye patching. The second study assessed the effects of the same acupuncture treatment, this time adjunctive to refractive correction.<sup>38</sup> Results of this trial suggested that adjunctive acupuncture was beneficial for anisometropic amblyopia and that treatment effects were maintained at a 1-year follow-up.

*Synopsis:* Two clinical trials (same acupoint protocol) reported positive effects on amblyopia. Both trials are included

in the recent overview by Yang et al., which concluded: “*The efficacy of acupuncture for amblyopia is promising.*”<sup>8</sup>

## Attention-Deficit Hyperactivity Disorder

Articles on two new clinical trials were published (Table 12) on attention-deficit hyperactivity disorder (ADHD), and there were no new reviews. A trial compared two forms of Korean-style hand acupuncture treatment.<sup>39</sup> The authors suggest that the newly developed 3-phase hand acupuncture system was clinically superior to the traditional system of Korean-style hand acupuncture.

A trial from China compared the effects of EA treatment to sham EA.<sup>40</sup> Both groups received acupuncture at the same set of acupoints, but the control group did not receive *Deqi* stimulation or an EA current. The results suggested that adjunctive EA treatment can have positive effects in reducing symptoms of ADHD.

*Synopsis:* Two clinical trials, each with a different treatment approach, reported positive effects. The current authors agree with the prior overview by Yang et al., which concluded: “*The efficacy of acupuncture for ADHD is unclear.*”<sup>8</sup>

## Nocturnal Enuresis

One new clinical study and one new review have been published on the effects of acupuncture for the treatment of nocturnal enuresis (Table 13). The review identified 21 clinical trials from which it pooled data for meta-analysis.<sup>42</sup>

TABLE 12. NEW CLINICAL TRIALS FOR ATTENTION-DEFICIT HYPERACTIVITY DISORDER (N=3; 2 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Txs</i>	<i>Outcome measure</i>	<i>Results</i>
Soliman 2007 <sup>39</sup>	United States	Range: 10–15 yrs n=40	Acu vs. Acu (2 different forms)	Korean Hand	Semi-individualized	20: 1/wk	Pt diary	New style more effective
Li 2010 <sup>40</sup>	China	Range: 4–6 yrs n=180	Acu+UC vs. sham+UC	TCM	Standardized	72: 6×/wk	Curative effect	Acu = +

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; yrs, years; UC, usual care; TCM, Traditional Chinese Medicine; wk, week; Pt, patient.



TABLE 13. NEW CLINICAL TRIALS FOR NOCTURNAL ENURESIS (N=6; 2 NEW<sup>a</sup>)

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Txs</i>	<i>Outcome measure</i>	<i>Results</i>
El Koumi 2013 <sup>41</sup>	Egypt	Range: 9–17 yrs n=50	Outcomes-based	TCM	Standardized	20: 10 days of consecutive Txs/mo ×2	Pt diary	Acu=+

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews).

+ denotes positive results.

Acu, acupuncture; Tx, treatment; yrs, years; TCM, Traditional Chinese Medicine; mo, month; Pt, patient.

The results suggested that acupuncture may be beneficial, but the authors cautioned that effects “might be overstated due to low methodological qualities.”

An outcomes-based trial (excluded from the new systematic review) provided a course of acupuncture treatment for children who were unresponsive to medications and behavioral therapy.<sup>41</sup> Results suggested that acupuncture was beneficial for children with nocturnal enuresis and that the effects were maintained at a 1-year follow-up.

*Synopsis:* The most-recent systematic review was cautiously optimistic regarding the effects of acupuncture for nocturnal enuresis.<sup>42</sup> In support of this, a new outcomes study suggests positive effects in children nonresponsive to usual care.<sup>41</sup> The current authors agree with the earlier overviews by Libonate et al.<sup>7</sup> and by Yang et al.,<sup>8</sup> which concluded that results are promising and warrant additional research.

### Miscellaneous Conditions

A single publication was identified for each of four other conditions: intellectual disability<sup>43</sup>; brachial plexus neuropathy<sup>44</sup>; obesity<sup>45</sup>; and mumps<sup>46</sup> (Table 14). For the

article on mumps, a systematic review by the Cochrane Collaboration, the researchers were unable to locate trials that met the predefined inclusion criteria.<sup>46</sup> The clinical trials are presented in Table 14, but no summary is provided here.

## DISCUSSION

For the current review, 71 English-language publications (59 clinical trials and 12 reviews) were identified on the use of acupuncture within the pediatric population. Compared to the 333 randomized controlled trials on acupuncture published in the 10-year period 1997–2007, the 20 pediatric clinical trials (from same timeframe) represent a small subset (6%) of the acupuncture research.<sup>47</sup>

This review highlighted diverse acupuncture treatment styles (e.g., TCM, Japanese meridian therapy, and research-based single acupoint needling). Each of these treatment styles applied varying stimulation techniques, ranging from a single 2-second stimulation to 20-minute needle retention with EA. The sample sizes of the clinical trials ranged from 2 to 761 participants; yet, the majority of the trials were

TABLE 14. NEW CLINICAL TRIALS FOR MISCELLANEOUS CONDITIONS

<i>Ist author, year &amp; reference</i>	<i>Country</i>	<i>Ages &amp; # of participants</i>	<i>Design</i>	<i>Acu style</i>	<i>Acupoint protocol</i>	<i># Txs</i>	<i>Condition</i>	<i>Outcome measure</i>	<i>Results</i>
Tian 2010 <sup>43</sup>	China	Range: 1–16 yrs n=100	Acu vs. herbs	TCM	Semi-individualized	60: 5×/wk	Intellectual disability	Total effective rate	Acu=+
Ding 2008 <sup>44</sup>	China	Range: 20 days–15 mo n=68	Acu vs. UC	TCM	Semi-individualized	30: 10 qd; 2-day rest	Brachial plexus neuropathy	Total effective rate	Acu=+
Zhang 2011 <sup>45</sup>	China	Range: 9–14 yrs n=10	Outcomes-based	TCM	Individualized	8: 2×/wk for 4 wks	Obesity	<i>Pilot:</i> Multiple outcomes (BMI, adiposity, etc.)	Feasible; might be useful

<sup>a</sup>Condition summary provides commentary on new publications (i.e., those not included within the prior overviews). One trial on mumps was a systematic review and is not included in this table.

+ denotes positive results.

Acu, acupuncture; Tx, treatment; yrs, years; mo, months; UC, usual care; TCM, Traditional Chinese Medicine; BMI, body mass index.

small-scale, with 81% having sample sizes of  $n \leq 100$  (48%  $n \leq 50$ ). In addition, the number and frequency of treatments varied widely, from 1 to 72 treatments administered over a maximum of 9-months.

The earlier overviews of research within the pediatric population suggested promising effects for cerebral palsy, nocturnal enuresis, nausea and vomiting, and pain.<sup>5,7,8</sup> The current review findings indicate that research has slowed in two of these areas: in nausea and vomiting and in nocturnal enuresis.

Although speculative, the downturn in the area of nausea and vomiting may, in part, be a result of the negative findings of the most recent and largest trial ( $n = 282$ ).<sup>29</sup> This trial controlled for parental expectations, and found no effect for adjunctive acupuncture. However, it would be misleading to suggest that acupuncture is ineffective for addressing PONV, as this trial assessed acupuncture needling at a single acupoint (PC 6). Indeed, the authors in that trial called for future research to “investigate acupuncture treatment which balances adequate dose and technique and a feasible, child-friendly acupuncture treatment.”<sup>29</sup> Although this approach (only needling PC 6) may be rare in clinical practice, it was the protocol in seven of eight clinical trials; the eighth trial utilized PC 6 and CV 13.<sup>48</sup>

In contrast, this review identified an increase in the number of trials on ASD, cerebral palsy, colic, and pain. Similar to the trials of PONV, all of the trials on colic ( $n = 4$ ) investigated acupuncture needling at a single acupoint: either ST 36 or LI 4.<sup>24,25</sup> Although neither line of research was able to draw definitive conclusions, it bears repeating that it would be inappropriate to cease conducting trials. Indeed, the Swedish team of researchers published a commentary suggesting that “Inconclusive results...can be due to different acupuncture points, different insertion times, different needling methods...,” and that future trials with additional acupoints are warranted.<sup>49</sup>

Pain is an area that warrants comment, as it is a common complaint within the pediatric population; prevalence rates for chronic pain are estimated at 11%–38%.<sup>50</sup> This review’s findings indicate that a sparse 10% (6/59) of the current research literature investigated pain and only two studies investigated chronic pain. It is promising to note that the majority (4/6) of these trials were conducted recently. This is likely a result of the earlier overviews that strongly urged additional research in this area.<sup>7,8,51</sup>

### Limitations

These findings should be considered in light of the exclusion of non-English publications. Given that a significant number of trials were conducted in other countries (e.g., China, Norway, and Germany), the current review findings may not represent the totality of the literature. For example, a systematic review of epilepsy identified articles on 11

clinical trials, but articles on 10 of the trials were published in Chinese and not included in this review.<sup>42</sup>

### Implications

A recommendation on the benefit of acupuncture for each of the 20 conditions is beyond the scope of this review. This would require, among other items, methodological assessment of trials and pooling of data. When drawing conclusions on the effects of acupuncture, caution is warranted, as acupuncture needling in clinical research may not be equivalent to acupuncture treatment in clinical practice. These differences bring to the foreground ecologic validity (i.e., the extent to which a study reflects real-world clinical practice)—a concept suggested as an imperative in acupuncture research.<sup>52</sup> As a generalization, in clinical practice, combinations of acupoints are chosen on the basis of classical Traditional East Asian Medicine signs and symptoms. For example, among the research on pain, one trial assessed individualized Japanese-style acupuncture treatments while another trial investigated a single acupoint (*Yintang*). Inferring generalization from these trials about the benefits of *acupuncture* for pain would be misleading.

An earlier overview concluded: “With such sparse research being conducted in pediatric acupuncture, all studies should be encouraged, but larger studies will ultimately be most valuable.”<sup>7</sup> Given the dearth of articles, future trials are warranted for all conditions. Yet, starting with smaller, not larger trials may be key. In particular, a focused line of research is recommended that employs the early phase research model (including ecologic validity).<sup>53</sup> For example, a small ( $n = 6$ ) outcomes-based study assessed the effects of Japanese-style acupuncture treatments to reduce pain caused by acute appendicitis.<sup>33</sup> The positive trends and feasibility led the authors to call for a future trial with a larger sample and include a comparator group (usual care). This exemplar trial assessed a therapeutic treatment as it was clinically applied in a real-world setting with minimal costs and multiple outcomes, providing ample ground for a future trial to investigate the different components of this treatment approach separately.

### CONCLUSIONS

Based on this assessment of the literature, acupuncture is well-received among the pediatric population for a variety of conditions ( $N = 20$ ). The current authors agree with earlier overviews that promising evidence for the benefits of acupuncture is mounting for the following common pediatric conditions: amblyopia; cerebral palsy; nocturnal enuresis; and pain.<sup>5,7,8</sup> The current authors also posit that the early phase research model, with particular focus on ecologic validity, should be employed to all areas of study. The conditions with promising evidence may represent key areas of focus for future research.

## ACKNOWLEDGMENTS

The authors express appreciation to Candise Branam, MLS, for guidance and assistance with database search strategies, and to Richard Hammerschlag, PhD, for guidance, editing, and critical comments that improved the article greatly. In addition, the authors thank their colleagues on the board of the Society for Acupuncture Research, for guidance and support on the development of this article.

## AUTHOR DISCLOSURE STATEMENT

No competing financial interests exist for any authors, and there was no specific outside funding.

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