



Contents lists available at ScienceDirect

Journal of Traditional and Complementary Medicine

journal homepage: <http://www.elsevier.com/locate/jtcm>

Acupuncture for pediatric pain: The trend of evidence-based research

Yuan-Chi Lin*, Sierra Perez, Cynthia Tung

Medical Acupuncture Service, Department of Anesthesiology, Critical Care and Pain Medicine, Boston Children's Hospital, Harvard Medical School, USA

ARTICLE INFO

Article history:

Received 10 April 2019

Received in revised form

14 August 2019

Accepted 16 August 2019

Available online 17 August 2019

Keywords:

Pediatrics

Children

Child

Adolescent

Pain management

Moxibustion

Cupping

ABSTRACT

Background and aim: Acupuncture is part of thousand years Traditional Chinese Medicine. There was promising evidence to support the efficacy of acupuncture in reducing postoperative surgery and dental pain, as well as chemotherapy-related nausea and vomiting. The US National Health Statistics Report indicated that there was significant increase in the use of acupuncture. Research on acupuncture has allowed for its integration into common adult pain practice. Acupuncture can also be utilized in pediatric patients.

Experimental procedure: We evaluate the evidence-based acupuncture for pediatric pain research from 2008 to 2017.

Results: and Conclusions: Acupuncture treatment is well supported to be effective treatment for pediatric procedural pain, infantile colic, adolescent pelvic pain, and headaches under specific intervention methods. There is increasing interest in using acupuncture and related techniques for pediatric pain management. However, the evidence-based randomized controlled trials using acupuncture for pediatric pain management is very limited. Further randomized controlled trial research in pediatric pain is urgently needed.

© 2019 Center for Food and Biomolecules, National Taiwan University. Production and hosting by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Acupuncture is part of Traditional Chinese Medicine (TCM) that has been practiced for over 2000 years. Clinicians specialized in TCM have been referenced to appear between 481 BCE and 403 BCE during the Warring States. The United States National Institutes of Health issued a Consensus Statement of Acupuncture, declaring there was promising evidence to support the efficacy of acupuncture in reducing postoperative surgery and dental pain, as well as chemotherapy-related nausea and vomiting.¹ The panel also cited other pain conditions for which acupuncture may be effective, which included headache, menstrual cramps, tennis elbow, fibromyalgia, myofascial pain, osteoarthritis, lower back pain, and carpal tunnel syndrome. The National Health Statistics Report indicated that there was used by 1.5% of adults in 2012; and a small but significant linear increase in the use of acupuncture.² Research on acupuncture has allowed for its integration into common adult pain practice. Acupuncture can also be useful in the care of pediatric

patients less than 18-year-old. We evaluate evidence-based randomized controlled trials (RCT) acupuncture for pediatric pain research during a ten-year period from 2008 to 2017.

2. Methods

The following data base was searched: the electronic database of PubMed including Medline, The Cochrane Library, EMBASE, PsycINFO (EBSCOhost), and Science Citation Index Expanded (Web of Science). We adopted a sensitive search strategy using the following combination of keywords: "Pediatrics", "Children", "Child", "Adolescent", "Pain", "Pain Management", "Acupuncture", "Moxibustion", and "Cupping."

In addition, to avoid missing relevant articles, the references of all selected articles were screened for additional potentially eligible publications. All searches were performed up to from 2008 to 2017. The final selection of studies was based on specific inclusion and exclusion criteria. Studies were included for review if they were (1) prospective, (2) used a randomized study design, (3) there was access to the full report, (4) the study was related to pain, (5) valid and reliable measures were used, (7) subjects were followed over time, and (8) the article was published between 2008 and 2017.

Studies were excluded if: (1) the data were collected retrospectively, (2) the goal of the study was other than to determine the

* Corresponding author.

E-mail address: yuan-chi.lin@childrens.harvard.edu (Y.-C. Lin).

Peer review under responsibility of The Center for Food and Biomolecules, National Taiwan University.

effect of the treatment (3) only specific patient groups were targeted (e.g., neonate, adolescents, patients less than 18 years old), (4) the studies were not in English, or (5) the reference was related to a letter or meeting abstract. Thus, we excluded nonrandomized comparative studies, uncontrolled before-after studies, and descriptive time-series studies. Those references that were repeated or judged to be based on the same study were also excluded.

3. Results

A total of ($n = 598$) unfiltered records were initially found through database searching (Fig. 1). ($n = 413$) records were remaining after duplicate records were excluded. ($n = 285$) records were excluded through preliminary screening, resulting in ($n = 128$) records for review. The full-text articles were accessed and additionally screened for required criteria until ($n = 22$) articles remained (Table 1).

Most of the selected research addressed procedure related pediatric pain (55%), infant colic pain (23%), adolescent pelvic pain (18%), and headache (5%). The majority of the research techniques utilized filiform needle for acupuncture treatment (50%), while the other techniques also included acupressure (23%), auricular acupuncture (23%), laser acupuncture (14%), magnetic acupressure, and electro stimulation of the acupuncture points. Eighteen out of twenty-two trials (82%) in pediatric pain management had positive results. Four out of twenty-two trials (18%) did not conclude acupuncture as a statically significant or effective comparative treatment. The four studies that found acupuncture ineffective included two studies on heel lancing in newborns^{3,4} and two studies on colic in infants^{5,6}.

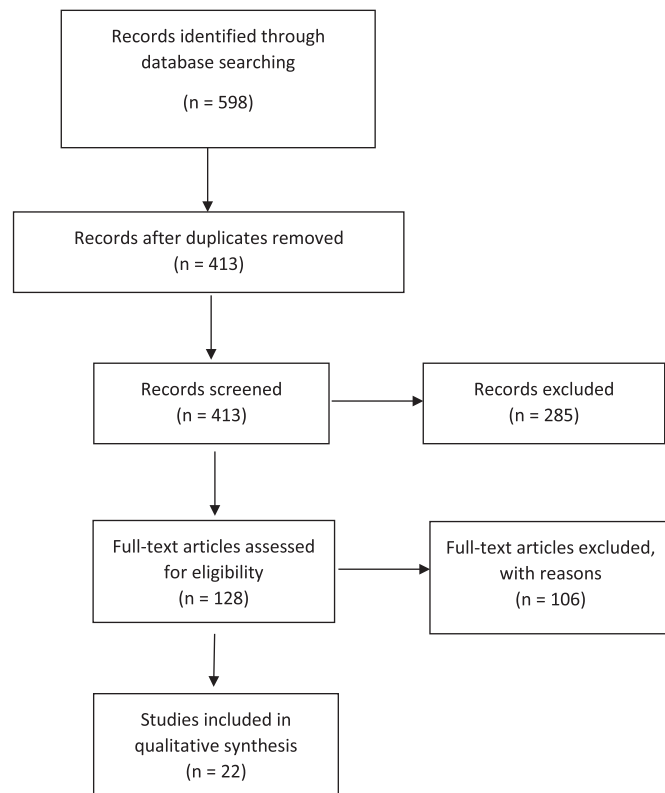


Fig. 1. Database record selection process to determine studies included in qualitative synthesis. There were a total of 22 Randomized Controlled Trial (RCT) publications in acupuncture and related techniques for pediatric pain management selected.

4. Discussions

Most of the pediatric acupuncture related studies addressed procedure related pediatric pain, infant colic pain, adolescent pelvic pain, and headache. This report evaluates research in pediatric acupuncture and pain management, in which approximately 55% of the selected articles were related to procedural pediatric pain management. The pediatric procedures included infant heel lancing,^{3,4,7-9} tonsillectomy^{10,11} and dental-related,¹² myringotomy tube surgery,¹³ kidney biopsy,¹⁴ ventipuncture,¹⁵ and endoscopic pre-procedural anxiety.¹⁶ Collectively, these studies researched how acupuncture could lead to the reduction of post-operative pain, emergence irritation, procedural time, and infantile crying.

The studies that considered the effectiveness of acupuncture treatment prior to heel lancing procedures of infants used either the Premature Infant Pain Profile (PIPP) or the Neonatal Infant Pain Score (NIPS) to measure the physiological, behavioral, or contextual effects on infants. The selected studies for acupuncture related to heel lancing in infants have found acupuncture of the EX-HN3 (Yinyang) points to decrease the pain scores and the time of crying,⁹ acupressure of the BL60 (Kunlun) and KI3 (Taixi) points to decrease the time of the procedure and crying,⁷ and acupuncture of the Cingulate Gyrus, Thalamus, Omega 2, Point Zero, and HT7 (Shenmen) auricular points to reduce pain scores.⁸ The selected studies that did not find acupuncture treatment effective for procedural pain related to heel lancing of infants have found acupuncture of EX-HN3 to be less effective than oral sucrose,³ and acupuncture of ST36, SP6, BL60, and KI3 to be less-effective than sucrose yet safe.⁴ A study of acupuncture treatment prior to tonsillectomies and adenoidectomies concluded that the bilateral HT7 acupoints can prevent emergence agitation (retching, laryngospasms, and vomiting), lower pain scales, and shortened recovery time.¹⁰ A similar study of intraoperative tonsillectomies found acupuncture of LI4 (Hegu), ST36 (Zusanli), P6 (Neiguan), SJ5 (Waiguan), KI6 (Zhaohai), HT7 (Shenmen), and acupuncture of Cingulate, Master Cerebral, and Tonsil acupuncture points to reduce post-operative pain and lead to earlier oral intake.¹¹

The selected articles that researched pediatric tonsillectomies and dental procedures reached a consensus that acupuncture can be an effective treatment in children between the ages of 2–12 years old. A study focused on pre-operative needle acupuncture before local anesthesia dental procedures of the bilateral LI4 acupuncture points resulted in lower pain scores, lower heart rates, and increased satisfaction of patients and family members.¹²

Heel lancing and tonsillectomies with dental procedures are the most common topics in pain management procedures in the selected random controlled trials in pediatric acupuncture, however there are several other independent topics that have found acupuncture to be effective for procedural pediatric pain. Pre-procedural anxiety related to endoscopic procedures has been shown to be reduced in ages 8–17 years old by EX-HN3 (Yintang), or “Extra-1”.¹⁶ Post-operative pain and emergence agitation have been shown to be reduced without adverse side effects in ages 1–6 years old with acupuncture performed bilaterally to LI4 (Hegu) and HT7 (Shenmen) prior to bilateral myringotomy tympanostomy tube insertion.¹³ Post-procedural pain in ages 7–26 years old has shown to be reduced in percutaneous kidney biopsies with acupuncture of GB25, BL52, BL21, BL22, and BL 23 bilaterally performed pre-operatively.¹⁴ Acupressure of EX-HN3 and P8 (Laogong) in ages 6–12 years old has been shown to effectively lower pain comparable to topical anesthesia cream.¹⁵

4.1. Infantile colic

Our report evaluates RCT studies in pediatric acupuncture and

Table 1
Acupuncture for pediatric pain management in selected Randomized Controlled Trials.

Authors	Age Range	No.	Diagnosis	Study Type	Conclusions
Reinthal et al., 2008	Mean age = 6 weeks	40	Colic Pain	Two-arm RCT	Four treatments with light needling on LI4 acupuncture points may alleviate crying and pain related behavior without any noted side effects. ¹⁹
Wayne et al., 2008	Adolescents	18	Endometriosis	Two-arm RCT	Acupuncture may be an effective, safe, and well-tolerated adjunct therapy for endometriosis-related pelvic pain in adolescents. ²⁰
Wang et al., 2008	8–17 year old	42	Procedure anxiety	Two-arm RCT	Acupressure bead treatment at Extra-1 acupoint reduces pre-procedural anxiety in children. ¹⁶
Gottschling et al., 2008	Mean age = 12.3 years	43	Headache	Two-arm RCT	Active laser acupuncture is better than placebo and can provide a significant benefit for children with headache. ²⁴
Lin et al., 2009	1–6 year old	60	Myringotomy tube surgery	Two-arm RCT	Acupuncture treatment may be effective in diminishing both pain and emergence agitation in children after bilateral myringotomy tube insertion without adverse effects. ¹³
Chen et al., 2010	Adolescents	134	Menstrual distress	Four-arm RCT	Acupressure is an effective and safe non-pharmacologic strategy for the treatment of primary dysmenorrhea. ⁸
Landgren et al., 2010	2–8 weeks	81	Colic pain	Two-arm RCT	Minimal acupuncture at LI4 acupuncture points shortened the duration and reduced the intensity of crying in infants with colic. ¹⁸
Ecevit et al., 2011	Preterm babies	10	Heel pricks	Randomized crossover	Acupuncture is an effective method for the treatment of pain in neonates. ⁹
Landgren et al., 2011	2–8 weeks	90	Colic pain	Two-arm RCT	Minimal acupuncture had no major effect on feeding, stooling and sleep, although a minor effect on stooling and sleep cannot be ruled out. ⁵
Acar et al., 2012	2–8 year old	50	Emergence agitation after tonsillectomy and/or adenoidectomy	Two-arm RCT	Application of capsiem plasters on HT7 acupoints offers a valuable choice in the prevention of EA in children. ¹⁰
Skjeie et al., 2013	Infants	90	Colic pain	Two-arm RCT	Acupuncture treatment at ST36 acupuncture points for infantile colic showed no statistically significant or clinically relevant effect. ⁶
Yeh et al., 2013	Adolescents	113	Dysmenorrhea	Two-arm RCT	Auricular acupressure relieves menstrual pain and distress in adolescents. ²¹
Abbasoglu et al., 2015	Term newborns	42	Heel lancing	Two-arm RCT	Laser acupuncture at the Yintang acupuncture point before heel lancing is less effective than oral sucrose for reducing the discomfort of this procedure. ³
Abbasoglu et al., 2015	Preterm infants	32	Heel lancing	Two-arm RCT	Applying acupressure at the BL60 and KI3 acupuncture points before heel lancing was associated with shorter procedural time and shorter duration of crying in preterm infants. ⁷
Tsao et al., 2015	3–12 year old	59	Post-Tonsillectomy pain	Two-arm RCT	Acupuncture group has significant improvements in pain control postoperatively and earlier oral intake. ¹¹
Cha et al., 2016	Adolescents	91	Dysmenorrhea	Two-arm RCT	Auricular acupressure therapy was an effective treatment for alleviating abdominal pain, back pain, and primary dysmenorrhea of female adolescents. ²²
Mitchell et al., 2016	Term neonates	162	Heel lancing	Four-arm RCT	Noninvasive electrical stimulation at acupuncture points at 3.5 mA, 10 Hz is not effective in relieving pain during heel sticks in neonates. ⁴
Usichenko et al., 2016	Mean age = 10 year old	49	Dental procedure	Two-arm RCT	Acupuncture at LI4 acupuncture points reduces pain and autonomic distress in children during local anesthetic injection in dental procedures. ¹²
Chen et al., 2017	Preterm infants	40	Heel pricks	Two-arm RCT	Auricular noninvasive magnetic acupuncture is feasible in neonates and may reduce Premature Infant Pain Profile scores during heel pricks. ⁸
Landgren et al., 2017	Infants	147	Colic pain	Three-arm RCT	Acupuncture at LI4 acupuncture point appears to reduce crying in infants with colic safely. ¹⁷
Oates et al., 2017	7–26 year old	69	Procedure pain in kidney biopsy	Two-arm RCT	Adjunctive laser acupuncture significantly improved pain after pediatric percutaneous kidney biopsies. ¹⁴
Pour et al., 2017	6–12 year old	120	Venipuncture pain	Three-arm RCT	Acupressure at the Extra –1 (Yintang) and the PC8 (Laogong) was as effective as topical anesthesia cream in alleviating children's venipuncture pain. ¹⁵

pain management, in which approximately 23% of the selected articles are related to infantile colic. In this ten-year period of research, there is a mixed consensus of the effectiveness of acupuncture treatment for infantile colic. The studies that have found acupuncture significant in treating colic have used acupuncture of the LI4 acupuncture point.^{17–19} These study interventions involved inserting the needles for 2–30 s intervals with 4–6 treatment over 2–3 weeks. Through diaries and questionnaires completed by the infants' parents, these treatments were found to be effective in decreasing the intensity and amount of time infants spent crying with no major side effects. In the opposition, acupuncture of LI4 for 6 treatments over 3 weeks for 2 s intervals was found to have no major impact on stool, sleep, or eating

patterns in infants with colic. This study was unable to rule out minor effects from acupuncture.⁵ The other study that did not find acupuncture statistically significant in the treatment of colic had used needle acupuncture bilaterally on acupuncture point ST36 for 30 s without manipulation for 3 days of treatment.⁶

4.2. Adolescent pelvic pain

There is evidence-based research through RCTs that supports acupuncture can be effective in the treatment of adolescent pelvic pain related to endometriosis and dysmenorrhea. Acupuncture with sixteen treatments over eight weeks with 8–12 acupoints focused on Extraordinary and Divergent acupuncture channels

with electrical stimulation of auricular points has shown may be effective in treating endometriosis-related pelvic pain in adolescents.²⁰ There is also evidence that different techniques of acupressure can relieve dysmenorrhea and menstrual distress. Auricular acupressure of the Shenmen, Kidney, Liver, Internal Genitals, Central Rim, and Endocrine acupoints has been shown to be significantly more effective in relieving menstrual pain and distress than by sham acupressure.²¹ Additionally, acupressure on the acupoints Jagung, Sinmun, Gyogam, and Naebunbi has lowered adolescent abdominal pain, back pain, and primary dysmenorrhea.²² Lastly, a comparative acupressure study of LI4 (Hegu) and SP6 (Sanyinjiao) matched points versus LI4 (Hegu) and ST36 (Zusanli) single points provides meaningful insight in choosing the most effective acupuncture points for treating menstrual distress. Chen et al. found acupressure resulted in LI4 and SP6 matched points effectively relieved pain, distress, and anxiety of menstruating adolescents. Alternatively, this study also found that single acupressure on the LI4 point resulted only in the relief of pain, and single acupressure on the ST36 acupoints resulted in no significant relief of menstrual symptoms.²³

4.3. Headache

There is a significant need for more random controlled studies in acupuncture for the treatment for headaches. One of the 22 qualifying research papers in this study focused on the treatment of pediatric headaches. Focused on children with an average age of 12.3 ± 2.6 years old, laser acupuncture was found to provide significant benefit for migraine and tension-type headaches.²⁴ This research pursued different acupuncture points depending on the presenting headache symptoms. Frontal headaches lead to points LI4 (Hegu) and ST36 (Zusanli), lateral headaches lead to SJ6 (Zhigou) and GB34 (Yung Ling Quan), occipital headaches lead to SI3 (Hou Xi), BL60 (Kunlun), and holocephalic pain lead to GV20 (Bai Hui). Body and auricular points were additionally pursued individually. This research found acupuncture to be safe, noninvasive, and lowered the severity and frequency of headaches.

5. Conclusions

Acupuncture treatment is well supported to be effective treatment for pediatric procedural pain, infantile colic, adolescent pelvic pain, and headaches under specific intervention methods. Because the studies reviewed were clinically heterogeneous in terms of treatment types, and outcome measures, pooling of the results was not possible. As a result, our analysis was generally qualitative rather than quantitative. It is the difference in application of acupuncture that will result in the variability of treatment effectiveness; not the intervention of acupuncture itself. However, studies that use similar intervention methods for the same conditions display consistency in results. Non-consensus in the effectiveness of acupuncture treatment can be traced to a difference in method.

Acupuncture has become an increasingly evident part of health delivering system in the Western medical society. There is increasing interest in using acupuncture and related techniques for pediatric pain management. However, this report indicates that the evidence-based RCT using acupuncture for pediatric pain management is very limited. Further extensive research to evaluate the value of integrating acupuncture in pediatric pain management is urgently needed and strongly encouraged.

Disclosures

Name: **Yuan-Chi Lin, MD, MPH.**

Contribution: This author helped with writing and editing the manuscript.

Conflicts of Interests: None.

Name: **Sierra L. Perez, BS.**

Conflicts of Interests: None.

Name: **Cynthia Tung, MD, MPH.**

Acknowledgements

We are grateful for the assistance of Meaghan Muir, MLIS, Manager, Library Services at Boston Children's Hospital, who provided help with the literature search.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jtcme.2019.08.004>.

References

1. NIH consensus conference. Acupuncture. *J Am Med Assoc.* 1998;280:1518–1524.
2. Clarke TC, Black LI, Stussman BJ, Barnes PM, Nahin RL. *Trends in the Use of Complementary Health Approaches Among Adults: United States, 2002–2012.* Natl Health Stat Report; 2015:1–16.
3. Abbasoglu A, Cabioglu MT, Tugcu AU, Yapakci E, Tekindal MA, Tarcan A. Laser acupuncture before heel lancing for pain management in healthy term newborns: a randomised controlled trial. *Acupunct Med.* 2015;33:445–450.
4. Mitchell AJ, Hall RW, Golianu B, et al. Does noninvasive electrical stimulation of acupuncture points reduce heelstick pain in neonates? *Acta Paediatr.* 2016;105:1434–1439.
5. Landgren K, Kvorning N, Hallstrom I. Feeding, stooling and sleeping patterns in infants with colic—a randomized controlled trial of minimal acupuncture. *BMC Complement Altern Med.* 2011;11:93.
6. Skjeie H, Skonnord T, Fetveit A, Brekke M. Acupuncture for infantile colic: a blinding-validated, randomized controlled multicentre trial in general practice. *Scand J Prim Health Care.* 2013;31:190–196.
7. Abbasoglu A, Cabioglu MT, Tugcu AU, et al. Acupressure at BL60 and K3 points before heel lancing in preterm infants. *Explore.* 2015;11:363–366.
8. Chen KL, Lindrea KB, Quah-Smith I, et al. Magnetic noninvasive acupuncture for infant comfort (MAGNIFIC) – a single-blinded randomised controlled pilot trial. *Acta Paediatr.* 2017;106:1780–1786.
9. Ecevit A, Ince DA, Tarcan A, Cabioglu MT, Kurt A. Acupuncture in preterm babies during minor painful procedures. *J Tradit Chin Med.* 2011;31:308–310.
10. Acar HV, Yilmaz A, Demir G, Erucar SG, Dikmen B. Capsicum plasters on acupoints decrease the incidence of emergence agitation in pediatric patients. *Paediatr Anaesth.* 2012;22:1105–1109.
11. Tsao GJ, Messner AH, Seybold J, Sayyid ZN, Cheng AG, Golianu B. Intraoperative acupuncture for posttonsillectomy pain: a randomized, double-blind, placebo-controlled trial. *The Laryngoscope.* 2015;125:1972–1978.
12. Usichenko TI, Wolters P, Anders EF, Splieth C. Acupuncture reduces pain and autonomic distress during injection of local anesthetic in children: a pragmatic crossover investigation. *Clin J Pain.* 2016;32:82–86.
13. Lin YC, Tassone RF, Jahng S, et al. Acupuncture management of pain and emergence agitation in children after bilateral myringotomy and tympanostomy tube insertion. *Paediatr Anaesth.* 2009;19:1096–1101.
14. Oates A, Benedict KA, Sun K, Brakeman PR, Lim J, Kim C. Laser acupuncture reduces pain in pediatric kidney biopsies: a randomized controlled trial. *Pain.* 2017;158:103–109.
15. Pour PS, Ameri GF, Kazemi M, Jahani Y. Comparison of effects of local anesthesia and two-point Acupressure on the severity of venipuncture pain among hospitalized 6–12-year-old children. *J Acupunct Meridian Stud.* 2017;10:187–192.
16. Wang SM, Escalera S, Lin EC, Maranets I, Kain ZN. Extra-1 acupressure for children undergoing anesthesia. *Anesth Analg.* 2008;107:811–816.
17. Landgren K, Hallstrom I. Effect of minimal acupuncture for infantile colic: a multicentre, three-armed, single-blind, randomised controlled trial (ACU-COL). *Acupunct Med.* 2017;35:171–179.
18. Landgren K, Kvorning N, Hallstrom I. Acupuncture reduces crying in infants with infantile colic: a randomised, controlled, blind clinical study. *Acupunct Med.* 2010;28:174–179.
19. Reintal M, Andersson S, Gustafsson M, et al. Effects of minimal acupuncture in children with infantile colic – a prospective, quasi-randomised single blind controlled trial. *Acupunct Med.* 2008;26:171–182.
20. Wayne PM, Kerr CE, Schnyer RN, et al. Japanese-style acupuncture for endometriosis-related pelvic pain in adolescents and young women: results of a randomized sham-controlled trial. *J Pediatr Adolesc Gynecol.* 2008;21:247–257.
21. Yeh ML, Hung YL, Chen HH, Wang YJ. Auricular acupressure for pain relief in

- adolescents with dysmenorrhea: a placebo-controlled study. *J Altern Complement Med.* 2013;19:313–318.
22. Cha NH, Sok SR. Effects of auricular acupressure therapy on primary dysmenorrhea for female high school students in South Korea. *J Nurs Scholarsh.* 2016;48:508–516.
23. Chen HM, Chen CH. Effects of acupressure on menstrual distress in adolescent girls: a comparison between Hegu-Sanyinjiao matched points and Hegu, Zusanli single point. *J Clin Nurs.* 2010;19:998–1007.
24. Gottschling S, Meyer S, Gribova I, et al. Laser acupuncture in children with headache: a double-blind, randomized, bicenter, placebo-controlled trial. *Pain.* 2008;137:405–412.