Critical Reviews™ in Eukaryotic Gene Expression, 32(2):61–89 (2022)

Labor Analgesia: A Systematic Review and Meta-Analysis of Non-Pharmacological Complementary and Alternative Approaches to Pain during First Stage of Labor

Antonio Melillo,[a,b] Patrizia Maiorano,[c] Sarah Rachedi,[a] Giuseppe Caggianese,[d] Elisabetta Gragnano,[a] Luigi Gallo,[d] Giuseppe De Pietro,[d] Maurizio Guida,[a] Antonio Giordano,[b,c] & Andrea Chirico[e,*]

[a]Department of Neuroscience, Reproductive Sciences and Dentistry, University of Naples Federico II, Naples, Italy; [b]Sbarro Institute for Cancer Research and Molecular Medicine, Center for Biotechnology, College of Science and Technology, Temple University, Philadelphia, Pennsylvania; [c]Department of Medical Biotechnology, University of Siena, Siena, Italy; [d]Institute for High Performance Computing and Networking, National Research Council of Italy (ICAR-CNR), Naples, Italy; [e]Department of Social and Developmental Psychology, "Sapienza" University of Rome, Rome, Italy

*Address all correspondence to: Prof. Andrea Chirico, PhD, Department of Social and Developmental Psychology, Sapienza University of Rome, Via dei Marsi, 78-00185 Rome, Italy; Tel.: +0644917654; Fax: +0649917652, E-mail: andrea.chirico@uniroma1.it

ABSTRACT: the aim of the study was to conduct a meta-analysis to evaluate the efficacy of non-invasive and non-pharmacological techniques on labor first-stage pain intensity. Literature databases were searched from inception to May 2021, and research was expanded through the screening of previous systematic reviews. Inclusion criteria were: (1) population: women in first stage of labor; (2) intervention: non-pharmacological, non-invasive, or minimally invasive intrapartum analgesic techniques alternative and/or complementary to pharmacological analgesia; (3) comparison: routine intrapartum care or placebos; (4) outcomes: subjective pain intensity; and (5) study design: randomized controlled trial. Risk of bias of included studies was investigated, data analysis was performed using R version 3.5.1. Effect size was calculated as difference between the control and experimental groups at posttreatment in terms of mean pain score. A total of 63 studies were included, for a total of 6146 patients (3468 in the experimental groups and 2678 in the control groups). Techniques included were massage (n = 11), birth balls (n = 5) mind-body interventions (n = 8), heat application (n = 12), music therapy (n = 9), dance therapy (n = 2), acupressure (n = 16), and transcutaneous electrical nerve stimulation (TENS) (n = 8). The present review found significant evidence in support of the use of complementary and alternative medicine for labor analgesia, and different methods showed different impact. However, more high-quality trials are needed.

KEY WORDS: labor, pain, analgesia, complementary, childbirth

I. INTRODUCTION

A. Description of the Condition

Labor is described as one of the most painful events women can experience through their lives[1,2] while being, besides, the only physiological mechanism inherently and, without medical intervention, inevitably painful. From an evolutionary point of view, why this process should cause pain is still a matter of scientific debate. Nevertheless, the physiological nature of labor pain is not the only basis of its exceptionality, being also characterized by some very peculiar features, such as its rhythmic fluctuation and progressive increase, which are interpretable in the light of its biological grounds. Labor pain is caused by a heterogeneous number of mechanisms, which differ significantly depending on the labor stage. As is known, labor is commonly divided into three different stages. The first stage, or dilatative stage, is the phase when the dilatation of the uterine cervix occurs. This stage can be further divided into three phases, namely the latent or passive phase (mean duration 11.8 h), during which more irregular and far apart uterine contractions cause the uterine cervix to slowly dilate until the reference point of 4 cm of cervical dilatation is reached, active (from 4 cm to 8 cm with a median duration from 3.7 to 5.9 hours) and transitional phase (from 8 cm to 10 cm). The second stage, or expulsive stage, generally lasting less than 4 hours in nulliparous women, consists of the expulsion of the baby. The third stage, usually lasting only minutes, consists of the expulsion of the placenta. During the dilatative stage, labor pain is essentially visceral. The uterine contractions cause the inferior uterine segment and the cervix to expand and their tissues to stretch. In addition to this, uterine contractions compress the myometrial blood vessels, hence inducing hypoxia. These mechanical and chemical stimuli activate C-fibers which conduct the nociceptive stimuli to the ipsilateral dorsal roots (T10 to L1).[3,4] Therefore, especially during this stage, pain strictly follows the rhythm and progression of uterine activity, increasing together with the cervical dilatation. On the contrary, during the expulsive stage, pain becomes mainly somatic and is caused by the pelvic, perineal, and vaginal tissues' progressive stretching. This mechanical stimulus is transmitted to the spinal roots from S2 to S4.[5]

However, the study of the physiological basis of labor pain should not distract the clinicians from the multidimensional nature of the experience of labor. Although undoubtedly central, pain is not the only factor that will define the mother's satisfaction,[6–9] as this is shown also to be determined by other factors such as labor duration, psychological factors such as the levels of fear and anxiety,[10–13] the feeling of control, the presence of midwife care,[14–16] collateral effects of the drugs administered.[17,18] Consistently, the pharmacological elimination of pain is not a guarantee of a more positive childbirth experience. In a five-year follow-up study, Maimburg et al. reported a less positive recollection of the childbirth experience in a sample of women who had received epidural.[19]

B. Description of the Intervention

Women's preference and priorities in choosing labor analgesia were shown to differ greatly, depending on many factors, such as personal experience and background (parity above all), information sources, and, importantly, psychological attitude towards pain and childbirth in general (anxiety, fear of childbirth, self-efficacy)[20,21] Consequently, research in the field has aimed to offer a wider range of analgesic techniques to allow women to receive personalized and patient-tailored assistance.

The current gold standard for labor analgesia is represented by pharmacological pain management techniques (PPMT) and specifically by neuraxial blockade. Since their introduction, the use of PPMT has become more and more frequent[22]; however, their application is still today flawed by a variable degree of invasiveness, by the risk of collateral effects, and by the high financial costs.[23] Particularly noteworthy are the psychological effects of such techniques, as some studies have reported adverse emotional effects during labor, such as an increase of fear of childbirth and lower satisfaction.[6,8,9,24,25]

Considering these adverse effects and the limitations cited above, a mainstream of literature evaluated the role of complementary and alternative medicine (CAM) in reducing labor pain. CAM is defined by the U.S. National Center for Complementary and Integrative Health as a practice that can be used together with traditional and standard care (complementary) or instead of it (alternative).[26,27] The interest towards and use of CAM has shown an increasing trend, and it is currently particularly common among women of reproductive age, with almost half reporting use. Their application during labor is as well particularly common, as a recent survey conducted on a large cohort representative of the Australian population reported as much as 74% of women using CAM during labor.[28] The different analgesic CAM techniques can be categorized as massage techniques, birth ball, heat applications, acupressure, transcutaneous electrical nerve stimulation (TENS), and different "mind-body" interventions such as music, dancing, distraction techniques, praying, virtual reality, for purely summarizing purposes, the next paragraphs will briefly describe these techniques.

Massage, the active manipulation of soft tissues, is a well-known and ancient method. It can consist of various techniques, some of which (Swedish massage and effleurage, Hoku points massage, kneading technique) are examined in randomized controlled trials (RCTs) reviewed in the present article. Several beneficial effects have been attributed to these techniques while the mechanisms underlying these results are still not perfectly clear. The analgesic effect of massage can be, in part, surely explained through the Gate Control Theory, first proposed by Melzack and Walls.[29] According to this theory, the manipulation of soft tissue, stimulating large diameter β nerve fibers, inhibits nociceptive transmission by inhibiting the spinal cord T-cell activity. Ranjbaran et al.,[30] in a systematic review of RCTs conducted in Iran before January 2016, confirmed the efficacy of massage techniques for pain relief hence also corroborating the results of other previous reviews. However, a Cochrane systematic review by CA Smith et al. of RCTs until 2017,[31] updating a previous review published in 2012, rated the evidence of massage providing a greater pain reduction than standard care as "low-quality" regarding the risk of bias defined by GRADE working group grades of evidenze.[32] Single trials also reported greater satisfaction, self-efficacy, and lower anxiety, in the intervention groups than the control ones, but, also in this case, the evidence in favor of these results was found as "low-quality."

Birth balls or Swiss balls were first introduced for the treatment of lumbar musculoskeletal pain and it was then proposed as a childbirth tool. The analgesic effect of their use may rely in theory partly on the decreased pressure on the nerves that lie over the iliosacral articulation, while also providing a distraction from the perception of pain. The use of birth balls has been associated also to a facilitated foetal descent, partly due to gravity and to the rocking movement which according to the advocates of this tool may help the foetus find a better fit in the birth canal. A 2015 meta-analysis of four RCTs by Makvandi et al., the only one focused on the subject, concluded that the birth ball may be an effective tool, but that more rigorous data were needed.[33]

Heat therapy is the application of heat to the body, which can consist of superficial application techniques (warm water, warm rocks, heat wraps, hot towels, hot baths) or deep application techniques (diathermy, ultrasound). The mechanism behind the analgesic effects of such techniques seem to depend on the activation of the Transient Receptor Potential Cation channels vanilloid 1 (TRPv1), which seems to induce the activation of descending antinociceptive transmission pathways.[34]

Acupressure is a manual technique borrowed from traditional Chinese medicine which shares many common theoretical grounds as acupuncture. Both these techniques are indeed based on the stimulation of acupoints across the meridians, channels within our body through which life energy (qi) flows. The exact scientific grounds of acupressure are still not clear but may involve neurological as well as neuroendocrine mechanisms. A recent (2016) meta-analysis by Makvandi et al. suggested acupressure could positively affect the progression and duration of labor,[35] and a 2017 systematic review by Najafi et al. added it could also reduce pain severity.[36] Finally, a 2020 review by Chen et al. confirmed acupressure may have promising effects on both labor duration and labor pain, but as well reaffirmed the necessity of higher-quality RCTs.[37] Despite this evidence, current guidelines such as the National Institute for Health and Care Excellence (NICE)[38] intrapartum care for healthy women and babies recommend not to offer acupressure or acupuncture, but not to prevent women from resorting to them, if that is their will.

TENS is an analgesic therapy technique based on the application of a transcutaneous electrical stimulation. TENS techniques can differ on electricity frequency, intensity and duration. TENS-induced analgesia is thought to depend on both central and peripheral mechanisms, but a certain quota of its effects seems to be possibly explained by the electrical activation of large diameter β nerve afferent fibers which will then exert a "gate control" inhibitory effect on spinal pain transmission. A Cochrane review by Dowswell et al. updated in 2011 concluded there is some evidence women who receive TENS are less likely to rate labor pain as severe, but that more evidence was needed.[39] A 2020 meta-analysis by Thuvarakan et al. confirmed the statistical significance of the evidence about TENS efficacy in treating pain.[40]

Mind-body interventions, such as music therapy, dance, distraction techniques, or virtual reality exert their beneficial effects centrally, by affecting the perception of pain through their effects on attention, emotive state, or both.[41]

Music therapy is a complementary analgesic therapy that has been applied more and more widely because of its safety and the ease of its administration compared with other CAM techniques. It is also currently supported by the NICE intrapartum care guidelines.[38] A 2020 review by Santiñavez-Acosta et al. confirmed its beneficial effects on both labor pain and labor anxiety but classified the evidence in support as "low-quality."[42]

Dance therapy aims to combine the beneficial effects of music therapy to the effects on labor of the upright position and movements such as pelvic tilting and rocking, which seem to have an effect on labor progression.[43]

Hypnosis is an alternative technique which was first experimented during childbirth in August of 1957. The scientific debate regarding this therapy is still ongoing, and there is no consensus yet on how the psychological state it can induce should be interpreted.[44,45] The hypnotic state has been described as characterized by narrowed attention, deep relaxation and decreased awareness of external stimuli, pain stimulation included. During childbirth hypnosis may be induced by a practitioner or by the parturient herself after antepartum training sessions. A 2016 review by Madden et al. analyzed the evidence supporting this therapy concluding no clear differences between women receiving hypnosis and women receiving standard care can be found regarding satisfaction with pain relief nor epidural use.[46]

Virtual reality is a technology that allows the isolation of the user from the real world through the immersion in a virtual multidimensional scenario which can require or not his interaction through the use of tools such as keyboards or game controllers. Originally developed for military use and later applied mainly to the entertainment industry, in the last years this technology has been experimented in many medical fields, including neurological rehabilitation, treatment of phobias and other psychiatric disorders and finally for both acute and chronic pain management.[47–51] Regarding labor pain management the potential of this technology has been recently tested by two RCTs that brought promising results.[52,53]

C. Goal of the Present Review

The present study aims to meta-analytically review the efficacy of different complementary and alternative therapies for analgesia during the first stage of labor. In particular, in the present meta-analysis, we examined the literature on the effects of alternative, non-invasive and non-pharmacological techniques in the light of a single specific outcome: pain intensity as measured through subjective tools such as the visual analogue scale (VAS) or the numerical pain rating (NPR) scales. By doing so, we aim to provide a summary of the statistical evidence on the analgesic efficacy of these alternative approaches as evaluated by the users themselves.

II. MATERIALS AND METHODS

This study was conducted according to the preferred reporting items for systematic reviews and meta-analyses.[54]

A. Database Search

Main online databases (PubMed, Scopus) were searched from inception to May 2021. Search terms included: labor OR labour AND pain AND relief OR analgesia* AND alternative OR massage OR vr OR acupressure OR tens OR music OR dance OR ball OR warm OR breathing OR hypnosis OR hydrotherapy OR distraction. In addition, we expanded our search through screening the reference list of previous meta-analyses and systematic reviews. The first author performed the literature search. The first and the second authors independently screened titles and abstracts as well as full texts' reference list against eligibility criteria. Final selection of articles was discussed by the first and the second authors.

B. Eligibility Criteria

Study eligibility was assessed using the PICOS tool[55] to be included, studies had to fulfil the following inclusion criteria: (1) population: women in first stage of labor; (2) intervention: non-pharmacological, non-invasive, or minimally invasive intrapartum analgesic techniques alternative and/or complementary to pharmacological analgesia; (3) comparison: routine intrapartum care or placebos; (4) outcomes: subjective pain intensity; (5) study design: RCT. Studies published in English, Spanish, and Italian were all considered. We did not exclude intrapartum interventions that required some kind of antepartum preparation of the performer (partner, midwife, researcher) or of the woman herself, as far as the latter could be considered just preliminary to the intervention itself, and not part of it.

C. Data Extraction

Information of the included studies were recorded by the first author within a standardized extraction form. The form was built to extract the following study characteristics: (1) number of participants for intervention and control group, (2) description of the experimental treatment, (3) description of the control treatment, (4) number of participants per group, (5) labor stage of intervention, (6) timing and number of interventions, (7) duration of interventions, (8) Unit of measure of the pain scores, (9) pain measurement results, (10) timing of each measurement, and (11) other outcomes examined. Findings regarding the effect of non-pharmacological analgesic approaches on labor pain severity measured at post-treatment were extracted and coded for data analyses. Although some studies reported within groups differences before and after treatment, we only considered differences between treatment and control conditions at post-treatment (between-group comparison) as robust evidence to assess the effect of non-pharmacological techniques on pain severity. For meta-analytic calculations, post-treatment means and standard deviations (SDs) on pain measurement data were extracted by the first author and cross-checked by the second author. When more than one pain measurement was conducted by the researchers, we prioritized the selection of the measurement immediately after the intervention, where it was available. If the measurement of pain immediately after the intervention was not available, we selected the first measurement available after the intervention. If the intervention lasted throughout the whole dilatative stage to allow the comparison we selected the measurement timing similar to the other studies. When values were not reported, corresponding authors of original papers were asked to provide them. If needed data was not available, studies were subsequently excluded. Details about the timing measurements are reported in Table 1.

D. Risk of Bias

Risk of bias of included studies was investigated based on the revised RoB version 2.0 Cochrane tool.[56] Our risk of bias assessment was therefore structured into six domains through which bias might be introduced into the result: (1) bias arising from the randomization process, (2) bias arising from allocation concealment, (3) bias arising from the blinding of participants and/or personnel, (4) bias in measurement of the outcome, (5) bias due to incomplete outcome data (attrition bias), or (6) bias due to selection of the reported result. Risk of bias of each included study was rated as "low risk of bias" (i.e., low risk of bias for all the five domains), "some concerns" (i.e., some concerns in at least one domain, but not to be at high risk of bias for any domain), or "high risk of bias" (i.e., high risk of bias in at least one domain or some concerns for multiple domains in a way that substantially lowers confidence in the result). Risk of bias assessment was completed in parallel by the first and the second authors and disagreement between assessors was resolved by discussion.

E. Data Analysis

Analysis was performed with R version 3.5.1[57] using the tidyverse[58] and metafor[59] packages. For each comparison of analgesic treatment with a control, we calculated the effect size indicating the difference between the two groups at posttreatment in terms of mean pain score. To allow the comparison, we divided the experimental treatments into eight subgroups: massage, acupressure, TENS/electrical acupressure, application of warm tools/warm shower/ warm bath, music therapy, dance therapy, distraction/mind-body techniques, birth ball. The peculiarities differentiating the techniques applied in each randomized controlled trial are summarized in Table 1. We used Hedge's g as an effect size measure to

TABLE 1: Description of the study

Study	Description of intervention	Labor phase of intervention	Timing and duration of intervention	Measure of pain	Timing of measurements	Other outcomes	*N*	Results and summary
Akbarzadeh et al., 2014a[131]	Three groups: Acupressure (BL32 point), control and supportive care	Active phase	Intervention lasted 20 minutes during which acupressure was performed only during contractions	VAS	Immediately after intervention	Mode of delivery	50 in each group	Acupressure was not significantly effective compared to constant doula care
Akbarzadeh et al., 2014b[135]	Acupressure SP6. Three groups, acupressure mono-stage, acupressure bi-stage and control group	Active phase	30 seconds intervention and 30 seconds of rest for a total of 20 minutes	VAS	Immediately, 30 and 60 minutes after intervention	labor duration, caesarean sections	50 for each group	Acupressure was effective in reducing labor pain, duration and caesarean section incidence
Akin, 2021[103]	VR, images of the foetus ultrasound	Active stage	14 ± 14 minutes-long intervention	VAS	before intervention (4 cm of dilatation) and at 9 cm of dilatation	Perinatal anxiety (PASS), Satisfaction with supportive care received (POBS)	50 in each group	VR significantly reduced labor pain measured at 9 cm of dilatation
Akin and Saydam, 2020[153]	Dance. Two sub-groups: One practiced dance with the spouse/partner, the second practiced dance with the midwife	Active phase; dance training was administered during pre-natal phase	Throughout the whole phase	VAS	4 cm and 9 cm of dilatation	Childbirth Satisfaction (MCSRS), Apgar score, oxygen saturation levels of the newborn	80 in the control group, 40 in each experimental group	Mean VAS scores in both dance groups were significantly lower at both timings
Alimoradi et al., 2020[122]	Acupressure. Two sub-groups: Ear acupressure and body acupressure	Dilatation phase	Body acupressure: 3 sessions at 4, 6, 8 cm of dilatation. Ear acupressure: every 30 minutes	VAS	4 cm and 10 cm of dilatation	Duration of dilatation phase from 4 to 10 cm	30 in each group	Ear acupressure reduced both pain and duration of dilatation phase; Body acupressure only reduced pain scores
Amiri, 2019[101]	Distraction facilities (movies, puzzles, counting and memorizing exercises)	Active phase; home practicing and counseling sessions were administered from 3 to 36th week	Throughout the whole phase	VAS	Every hour during active phase	Perceived stress (PSS), fear of childbirth (WDEQ-A), duration of labour, Apgar score, oxytocin consumption	33 in experimental group, 30 in control group	Distraction reduced both perceived stress and pain; no statistical difference in duration of labour

TABLE 1: (*continued*)

Báez-Suárez et al., 2016[137]	TENS, two sub-groups	Active phase	30 minutes	VAS	At 4 cm; after 10, 30 minutes of intervention	Childbirth satisfaction (COMFORTS), apgar score	21 in each group	High-frequency TENS was effective on both pain and satisfaction
Behmanesh et al., 2009[104]	Heat therapy: warm bag applied to lumbar region during first and to perineal region during second stage	First stage from 3–4 cm and Second stage	Minimum time during first stage: 80 min; minimum time during second stage	VAS	At 3–4, 6–7, 9–10 cm during first stage; after delivery for second stage	Duration of first and second stage, apgar score	32 in each group	Heat therapy reduced pain intensity and duration of first stage
Benfield et al., 2001[108]	Warm bath	Active phase	Intervention started at 4 cm dilatation and lasted 60 minutes	VAS	15 and 60 minutes after beginning of intervention	Anxiety (VAS), urine catecholamines	9 in each group	Warm baths reduced both anxiety and pain
Buglione et al., 2020[120]	Music therapy: music of their choice	Active phase	Throughout the whole stage	VAS	Every hour	Anxiety (VAS), apgar score, incidence of episiotomy, use of analgesics	15 in each group	Music reduced both pain and anxiety levels
Çevik and Karaduman, 2019[83]	Sacral massage: effleurage and vibration technique	First stage	3 30 minutes-long massage sessions at 3–4, 5–7, 8–10 cm	VAS	Immediately after intervention	Anxiety (STAI), Satisfaction	30 in each group	Massage reduced pain and anxiety and led to greater postpartum satisfaction
Chung et al., 2003[67]	Three groups: comparison between acupressure (LI4 and BL67 points) abdominal effleurage and standard care	First stage	20 minutes intervention at the beginning of latent, active and transitional phases	VAS	Immediately after intervention	Duration of labor, uterine contractions intensity (Montevideo Units)	43 in the acupressure group, 42 each in the control and effleurage group	Acupressure lessened pain during active phase without effects on uterine activity
Dabiri and Shahi, 2014[126]	Acupressure LI4 point. Comparison with gentle touching and standard care	Active phase	30 minutes-long intervention at the beginning of active phase	VAS	30 minutes, 1 hour and every hour after intervention until delivery	None	50 in both acupressure and touching groups, 49 in control group	Acupressure was effective in reducing pain
Da Silva et al., 2009[107]	Warm bath	Active phase	Intervention started at 6 cm dilatation and lasted 60 minutes	NPR	Immediately after intervention	Duration of labor, neonatal outcomes	54 in each group	Mean labor pain scores in the control group were significantly higher than those in the experimental group

TABLE 1: (*continued*)

Study	Description of intervention	Labor phase of intervention	Timing and duration of intervention	Measure of pain	Timing of measurements	Other outcomes	*N*	Results and summary
Dehcheshmeh and Rafiei, 2015[84]	Comparative study: Music therapy and Hoku points ice massage	First stage	3 interventions at 4, 6 and 8 cm. Music sessions lasting 30 minutes, Hoku ice massage sessions lasting 20 minutes	VAS	Immediately after intervention	None	30 in each group	Hoku ice massage and music have similar effects in relieving labor pain
Desmawati et al., 2020[100]	Islamic praying	Active phase	3 interventions at the 1st, 2nd and 3rd hour after reaching a 3–4 cm of cervical dilatation. Praying sessions lasting at least 30 minutes	VAS	Immediately after intervention, always after the end of a contraction	Pain behavior (PBOS)	41 in the control group, 42 in the experimental group	Praying significantly reduced pain intensity and pain behavior
Dolatian et al., 2011[91]	Massage, foot reflexology. Comparison with both standard care and psychological support	Active phase	20 minutes on each foot	VAS	Immediately after intervention and at 6 and 10 cm of dilatation	labor duration	40 in each group	Reflexology reduced both labor pain and duration
Dong et al., 2014[139]	TENS. Two experimental groups, application of electricity on two different acupoints: SP6 and EX-B2	Active phase	Intervention lasted 20 minutes	VAS	30, 60 and 120 minutes after intervention	Duration of labor, Neonatal outcomes, use of oxytocin	60 in each group	TENS was effective in reducing pain when applied to both acupoints
Erdogan et al., 2017[92]	Low back massage	Dilatation stage	three thirty minutes interventions at 3–4, 5–7, and 8–10 cm of dilatation	VAS	After the most intense contraction	Satisfaction, labor duration, behavior of women (delivery room observation form), neonatal outcomes	31 in each group	Intervention decreased pain and increased satisfaction
Erenoğlu and Baser, 2019[90]	Massage, expressive touching	first stage	15–20 minutes	VAS	Immediately after intervention	Pain threshold and sensitivity	40 in each group	Pain sensitivity and pain scores were significantly lower after intervention
Farahmand et al., 2020[110]	Warm compression, two interventions at 7 and 10 cm of dilatation	Transitional stage	2 15–20 minute long interventions at 7 and 10 cm of dilatation	VAS	Immediately after intervention	None	75 in each group	The intervention significantly reduced pain

TABLE 1: (*continued*)

Frey et al., 2019[52]	Virtual reality	First stage	10-minute session, starting after VAS pain levels equaled > 4/10	VAS	Immediately after intervention	Anxiety (VAS)	Crossover design, 27 patients	VR significantly reduced anxiety pain it all its affective, cognitive and sensorial components
Ganji et al., 2013[105]	Application of warm water packs, ice packs, then warm water packs again	Active phase and second stage	Heat application session lasted 30 minutes, Ice application session lasted 10 minutes during active phase. Duration was halved for second stage	VAS	Three measurements at the beginning of acceleration, maximum slop and deceleration phase for the active phase. Pain intensity during second stage was measured postpartum	Labor duration, oxytocin application duration, fetal heart rate, labor satisfaction (Likert)	32 in each group	Intervention significantly reduced both pain intensity and duration
Garcia et al., 2012[95]	Birth ball	Active phase	Intervention lasted at least 20 minutes	VAS	At 4 cm and immediately after intervention	Labor duration, oxytocin application, request of analgesia	34 in each group	Intervention was effective in reducing perceived pain
Gau et al., 2011[94]	Birth ball	Active phase	Exercise with ball was encouraged every hour between 4 and 8 cm of cervical dilatation. Training with ball was requested ante-natally	VAS	Two measurements, at 4 cm and 8 cm, respectively	Pain (McGill), childbirth self-efficacy (CBSEI)	48 in the experimental group, 39 in the control group	Birth ball reduces pain and improves self-efficacy
Gokyildiz et al., 2018[118]	Music (Acemasiran mode)	First stage	Intervention started at 4 cm dilatation and lasted 3 hours with 10 minutes-long pauses every 20 minutes	VAS	After the first 30 minutes, then every hour	Anxiety (STAI; face anxiety scale)	25 in each group	Music was not effective in reducing pain after the first 30 minutes while was found effective at later measurements
Gönenç and Dikmen, 2020[116]	Two intervention groups: music (music of their choice) and dance	Active phase	Dance and music therapy were administered at 4–5 cm of dilatation for 30 minutes	VAS	Three measurement, immediately after intervention, 30 minutes and 60 minutes after intervention	Fear of childbirth (WDEQ-A)	31 in the dance group, 30 in the music group, 32 in the control group	Both dance and music significantly reduce pain and fear
Gönenç and Terzioğlu, 2020[89]	Acupressure, SP6 point	First stage	3 30 minutes-long interventions during latent, active and transitional phase respectively	VAS	After 30, 60 minutes	None		

TABLE 1: (*continued*)

Study	Description of intervention	Labor phase of intervention	Timing and duration of intervention	Measure of pain	Timing of measurements	Other outcomes	*N*	Results and summary
Gür and Apay, 2020[102]	Virtual reality, four intervention groups: videos of newborn photographs with classical music, the video of the newborn photograph album, an introductory film of Turkey, only classical music	Active phase	10 minutes-long intervention	VAS	Immediately after intervention	None	55 in groups B, C, and D; 54 in groups A and control	All techniques reduced pain but especially newborn related contents
Hamidzadeh et al., 2012[127]	Acupressure LI4 point	Active phase	20 minutes-long intervention at the beginning of active phase	VAS	Immediately after intervention, then 20, 60, 120, 180, 240 minutes after intervention	Duration of labor, neonatal outcomes, Satisfaction with labor (6 points scale)	50 in each group	Acupressure was effective in reducing pain and labor duration
Hamlaci and Yazici, 2017[125]	Acupressure LI4 point	Active and transitional phases	Acupressure was applied 16 times during each uterine contraction, 8 times at 4 to 5 cm of cervical dilatation and 8 times at 7 to 8 cm cervical dilatation	VAS	After 8 acupressure stimulations	Duration of labor	44 in each group	Acupressure reduced both pain and labor duration
Hosseini et al., 2013[117]	Music therapy. Music not chosen by parturient	Active phase	3 Music sessions: two 30 minutes music session and a 2 hours-long session	VAS	Three measurements, immediately after each session	Labor duration	15 in each group	Music decreases the sensation of pain
Kaçar et al., 2021[125]	Three groups: lumbosacral massage and warm pack application	Active phase	Two 15 minutes long interventions at 4–5 cm and 7–8 cm of dilatation	VAS	Immediately after, half an hour and one hour after the intervention	Labor duration, received care satisfaction (CEQ)	70 in each group	Mechanical massage reduced pain and increased childbirth satisfaction more than warmth application
Karami et al., 2006[87]	Massage therapy: effleurage technique	Active phase	Not specified	VAS	Three measurements at 4, 8 and 10 cm	Labor duration	30 in each group	Massage therapy reduces pain and cesarean section

TABLE 1: (*continued*)

Kashanian and Shahali, 2010[128]	Acupressure SP6 point	Active phase	30 minutes intervention at the beginning of active phase	VAS	Immediately after intervention	Duration of labor, percentage of cesarean sections, neonatal outcomes, necessity and amount of oxytocin needed	60 in each group	Acupressure reduced pain, labor duration, cesarean section rates
Kaur et al., 2020[109]	Heat therapy: warm pack on the lumbosacral region	Active phase	Three 20 minutes warm compression sessions	NPS	Three measurements, 30 minutes after each warm compression session	Satisfaction (5 points scale), fetal heart rate, labor duration	44 in each group	Warm compression reduces pain and increases satisfaction
Kimber et al., 2008[88]	Comparative study: music therapy and massage performed by partner combined with breathing techniques	First stage Prenatal training	Throughout the whole stage	VAS	One measurement post-natally for mean first and second stage pain intensity	Anxiety (Cambridge birth worry scale), epidural use, labor duration, labor experience (LAS)	30 in each experimental group, 28 in the control group	Pain reduction was not significant. No differences in epidural use
Labrecque and Rancourt, 1999[138]	TENS	Active phase	Intervention started at beginning of active phase. Duration not specified	VAS	15, 60, 90, 120, and 180 minutes after beginning of intervention	Percentage of epidural use, cesarean delivery, time between randomization and epidural request	12 in the experimental group, 3 in the control group	TENS was not effective in reducing pain compared to standard care
Lee et al., 2004[129]	Acupressure. SP6 point	First stage	Intervention lasted 30 minutes, during which acupressure was applied for the duration of each incoming contraction. Intervention started at 3 cm of dilatation	VAS	Immediately after intervention, then after 30 and 60 minutes	Duration of labor, anxiety (VAS), use of analgesics	36 in the acupressure group, 39 in the control group	Acupressure reduced both pain and duration
Lee et al., 2013[112]	Warm shower application	Active stage	Two 20-minute-long interventions at 4 and 7 cm of dilatation	VAS	10 and 20 minutes after intervention	Labor experience (LAS)	39 in the experimental group, 41 in the control group	Warm showers improved labor experience and reduced labor pain
Liu et al., 2010[114]	Music therapy: music chosen by parturient among relaxing genres	Latent and active phase	At least 30 minutes	VAS	Immediately before and after intervention	Anxiety (five-point scale)	30 in each group	Pain reduction was significant during latent phase and not significant during active phase

TABLE 1: (*continued*)

Study	Description of intervention	Labor phase of intervention	Timing and duration of intervention	Measure of pain	Timing of measurements	Other outcomes	*N*	Results and summary
Liu et al., 2015[140]	TENS stimulation on BL32 and T10-L3 acupressure points. Comparison with both control and pharmacological methods	Active phase	40 minutes long intervention	VAS	30 and 60 minutes after intervention and at 7 and 10 cm of cervical dilatation	Maternal and neonatal outcomes	30 in each group	There was a significative difference in pain intensity between TENS group and control
Ma et al., 2011[142]	TENS on SP and acupressure point	Active stage	30-minute-long intervention	VAS	20 minutes, 50 minutes, 1, 2, 3 and 4 hours after intervention	Labor duration, obstetrical and neonatal outcomes, uterine contractions (pressure, duration)	116 in the experimental group, 117 in the control group	TENS was effective in reducing both pain and labor duration
Maddady et al., 2018[113]	Three groups study: comparison of warm shower application with standard care and hyoscine injection	Active stage	Two 20-minute-long interventions at 4 and 7 cm of dilatation	VAS	During intervention	Labor duration, adverse effects,	49 in the control group, 50 in the experimental group	Warm showers reduced pain and active stage duration
Mafetoni and Shimo, 2016[123]	Acupressure Sanyinjiao point (SP6)	Active phase	Intervention lasted less than 20 minutes and started at beginning of active phase	VAS	20 and 60 minutes after treatment	None	52 for each group	The use of acupressure on the Sanyinjiao point is a useful way to alleviate pain
Mansouri et al., 2018[134]	Acupressure, bladder GV20 and gall-bladder G20 group versus control group	Dilatation stage	Four 5 minutes-long interventions with intervals of 30 minutes	VAS	Immediately and 30 minutes after intervention	labor duration, uterine contraction duration	55 in each group	Both intervention reduced pain but pain intensity for gall-bladder GV20 group was significantly lower than others
Mirzaee et al., 2020[133]	Three groups: acupressure on LI4 point with or without ice versus control	Active phase	Throughout the whole phase during each contraction	VAS	Before intervention and at 10 cm of dilatation	Anxiety	30 in each group	The intervention was significantly effective on pain but not on anxiety levels
Njogu et al., 2021[141]	TENS stimulation on LI4, PC6 acupoints and paravertebral region (T10-L1, S1-S4)	Active stage	Single intervention, duration not specified	VAS	Immediately after, 30, 60 and 120 minutes after intervention and postpartum	Labor duration and progression, neonatal outcomes, oxytocin use	161 in the experimental group, 165 in the control group	TENS reduced both pain intensity and labor duration

TABLE 1: (*continued*)

Ozgoli et al., 2016[124]	Acupressure. Two experimental groups: LI4 and BL32 points	Active and transitional phases	Three interventions at 4–5, 6–7 and 8–10 cm dilatation	NRS	Immediately after intervention	Neonatal outcomes, willingness to use technique in the future mode of delivery	35 in each group	Both interventions were effective compared with standard care with BL32 stimulation slightly superior
Phumdoung and Good, 2003[119]	Music of their choice among five relaxing types (no words, slow beats)	Active phase	Intervention started at 3 or 4 cm dilatation and lasted for 3 hours	VAS	Every hour	None	55 in each group	Music was effective in reducing pain and anxiety
Santana et al., 2016[136]	TENS	Active phase	30 minutes at the beginning of active phase	VAS	Immediately after intervention	Labor duration, Localization of pain, birth modality, timing of pharmacological analgesia	23 in each group	TENS reduces pain and postpones pharmacological analgesia
Sehhatie-Shafaie et al., 2013[130]	Acupressure SP6 and LI4 points	Active phase and transitional phases	Intervention started at 4 cm of dilatation and then was repeated at 6 and 8 and 10 cm. Acupressure was applied for 20 minutes during contractions	VAS	At 4, 6 8 and 10 cm of dilatation after each intervention	None	42 in each group	Acupressure on Sanyinjiao and Hugo points decreases the labor pain
Shirazi et al., 2019[97]	Birth ball, four different exercises	Dilatation phase	Throughout the whole phase, starting point not specified	VAS	two measurements, at 4 and 8 cm of dilatation	Self-efficacy (CBSEI), labor duration	43 in the experimental group, 39 in the control group	Birth ball could decrease pain but the analgesic effect may be mostly due to an increase in self-efficacy
Silva Gallo et al., 2013[86]	Massage, kneading technique applied to posterior/lateral lumbar region and sacral region	Active phase	30 minutes, starting at 4–5 cm dilatation	VAS	Immediately after intervention	Pain (McGill), location of pain, Apgar scores	23 in each group	Massage reduced pain intensity despite not changing its characteristics nor location
Silva Gallo et al., 2018[85]	Sequential administration of swiss ball (at 4–5 cm), lumbosacral massage (at 5–6 cm) and warm shower (at > 7 cm)	Active phase	40 minutes for each intervention	VAS	Immediately after intervention	Labor duration, timing of pharmacological analgesia, requests of supplementary analgesia	23 in each group	The sequence of interventions significantly reduced pain between 4 and 7 cm of dilatation

TABLE 1: (*continued*)

Study	Description of intervention	Labor phase of intervention	Timing and duration of intervention	Measure of pain	Timing of measurements	Other outcomes	*N*	Results and summary
Simavli et al., 2014[115]	Music therapy. Music chosen by parturient	First stage	Every hour, with 20 minutes breaks	VAS	At 2, 5–7 and 10 cm of dilatation	Anxiety (VAS), maternal hemodynamic parameters, FHR	67 in the music group, 65 in the control group	Music reduces pain and anxiety at every stage of labor
Taavoni et al., 2011[96]	Birth ball	Active phase	Intervention started between 4 and 8 cm of dilatation. Minimum duration: 30 minutes	VAS	Before and after intervention (30, 60 and 90 minutes)	Duration and interval between contractions, duration of active phase	29 in the experimental group, 31 in the control group	Birth ball reduces pain
Taavoni et al., 2013[106]	Heat therapy: sacrum-perineum	Active phase	Intervention started between 4 and 8 cm of dilatation. Minimum duration: 30 minutes	VAS	Every 30 minutes until 8 cm dilatation was reached	Satisfaction (VAS)	31 in the experimental group, 32 in the control group	Heat therapy reduces pain and increases satisfaction
Torkiyan et al., 2021[143]	Acupressure, GB21 point, comparison with both standard care and sham intervention	Dilatation phase	Three interventions, at 3–5, 6–7 and 8–10 cm of dilation during a contraction	NRS	Immediately after each intervention	Maternal and neonatal outcomes	58 in each group	Pain reduction was significantly higher in experimental group
Vixner et al., 2015[132]	Two experimental groups: Electrical and manual acupuncture	First stage	4 sessions with 10 minutes intervals	VAS	2 months after childbirth	Postnatal depression (EPDS), labor duration, use of epidural	83 in MA group, 87 in EA group, 83 in control group	EA reduces use of pain relief compared with SC and MA but does not reduce recollected pain intensity
Waisblat et al., 2016[99]	Hypnosis: rocking, gentle touching and hypnotic communication	First stage, just before epidural catheter placement	One 7-minute session. Intervention was started after pain reached > 4/10 on NPS	NPS	Immediately after rocking and immediately after hypnotic communication	Fear (NPS)	79 in experimental group, 76 in control group	Hypnosis reduces both pain and fear
Wong et al., 2020[53]	Virtual reality	First stage	Interventions started when pain > 4/10 and < 7/10 cm	VAS	Immediately after, 2h after and 4h after intervention	Maternal hemodynamic values, mode of delivery	21 in the experimental group, 19 in the control group	VR was effective in reducing pain

TABLE 1: (*continued*)

Yazhdkhasti et al., 2018[111]	Three groups, heat therapy and ice application versus control group	Active phase	Three interventions at 5–6, 7–8 and 9–10 interventions	VAS	Immediately after intervention	Maternal and neonatal outcomes, satisfaction, breastfeeding	34 in the control group, 35 in the heat therapy and 36 in the ice therapy group	Both interventions were effective in reducing pain without adverse effects on maternal and fetal outcomes.
Yildrim and Sahin, 2004[98]	Breathing techniques and skin stimulation	First and second stage	Throughout the whole delivery	VAS	At 2, 4, 6, 8, 10 cm of dilatation and then 2 h after delivery	Emotional behavior	20 in each group	The intervention was effective in reducing pain

CBSEI, childbirth self-efficacy inventory; CEQ, childbirth experience questionnaire; COMFORTS, the care in obstetrics, a measure for testing satisfaction scale; CSRS, Mackey childbirth satisfaction rating scale; EA, electrical acupuncture; EPDS, edinburgh postnatal depression scale; FHR, foetal heart rate; LAS, labour agentry scale; MA, manual acupuncture; NPS, neuropathy pain scale; PASS, perinatal anxiety screening scale; PBOS, pain behavioral observational scale; POBS, prosocial organizational behavior scale; PSS, perceived stress scale; STAI, state-trait anxiety inventory; TENS, "transcutaneous electrical nerve stimulation"; VAS, visual analogue scale; VFAS, visual facial anxiety scale; VR, virtual reality; WDEQ-A, wijma delivery expectancy/experience questionnaire.

address small sample sizes, according to the procedures described in Hedges and Olkin.[60] Hedge's g was the quotient of the difference between the mean of the experimental group against the mean of the control group, divided by the pooled weight SD incorporating Bessel's correction:

$$g = \frac{\mu_{exp} - \mu_{ctrl}}{S} \quad (1)$$

where μ_{exp} and μ_{ctrl} indicate the means of the experimental and control group, respectively, whilst s the pooled weighted SD, which was calculated as follows:

$$s = \frac{\sqrt{(n_{exp} - 1)SD^2 \exp + (n_{cntrl} - 1)\mathrm{SD}^2 \mathrm{cntrl}}}{n_{exp} + n_{cntrl} - 2} \quad (2)$$

where n_{exp} and n_{ctrl} indicate the number of participants and SD^2exp and SD^2cntrl the SD points for the experimental and control group, respectively. Moreover, because some studies reported standard errors instead of SD as measures of dispersion, the latter was calculated as follows:

$$\mathrm{SD} = \mathrm{SD}^* \sqrt{n} \quad (3)$$

where n denotes the sample size of the group. Effect sizes of 0–0.32 are interpreted as small, effect sizes of 0.33–0.55 are moderate, and effect sizes of 0.56–1.2 are large,[61] with negative g values interpreted as higher impact of experimental treatment compared to standard care. The random-effects model, i.e., maximum likelihood estimator modelling, was implemented for the main analysis to take into account between-study variation in effects.[62–64] The number of studies included in each analysis is reported with the letter k. We checked for outliers by visually inspecting forest plots. Outliers were defined as studies in which the 95% confidence interval (95% CI) around the effect size did not show overlap with the 95% CI of the pooled effect size. For each outcome, heterogeneity analyses were conducted to test for the implementation of a fixed-effects model.[64] To test heterogeneity, Cochran's Q and Higgins's I2 were calculated. Cochran's Q is computed as a weighted sum of squared differences between single study effects and the pooled effect across studies. Significant values indicate a high level of heterogeneity between effects that need to be further investigated. Higgins's I2 assesses the variability in effect estimates that is due to between-study heterogeneity rather than due to chance, with higher levels of I2 indicating higher heterogeneity. Therefore, following the procedure reported in Mitchell et al.[64] sensitivity analysis was performed to assess the effect of model choice (i.e., fixed vs. random) on the effect size estimations. Specifically, this was done by performing fixed effects models to outcomes measures with no evidence of significant heterogeneity and comparing the results with those provided from random-effects models.

Publication bias was assessed via visual inspection of the funnel plots and Egger's weighted regression test for funnel plot asymmetry. In the Egger test, precision (the inverse of the standard error) is used to predict the standardized effect (effect size divided by the standard error). In this equation, the size of the treatment effect is captured by the slope of the regression line and bias is captured by the intercept.[65]

III. RESULTS

A. Study Selection

Main databases (PubMed, Scopus) searching yielded a total of 578,422 results. After eligibility criteria screening, a total of 84 studies were selected. Of these, 16 studies[43,66–80] were excluded because of missing data. To conduct a general statistical analysis of all the outcomes without mathematical distortions, we chose to exclude studies that adopted pain scales different from the VAS and NPS scales. This led to the exclusion of five studies, which used different scales such as 1- to 5-point Likert-like scales (n = 1),[74] 0- to 7-point Likert scales (n = 1),[72] the McGill pain questionnaire (n = 1),[73] the PBI scale (n = 1)[81] or a 1- to 6-point Likert-like scale (n = 1).[82] A total of 63 studies were therefore analyzed. A flowchart of the searching process can be found in Fig. 1.

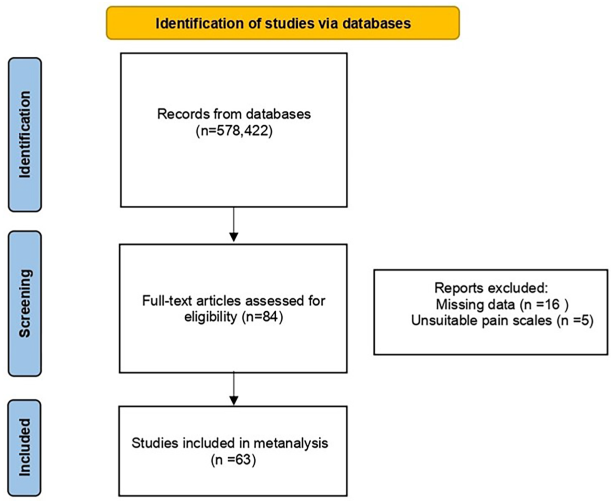

FIG. 1: Flowchart of the selection process

A. Study Characteristics

Detailed description of included studies is reported in Table 1. A total of 6146 patients were included (3468 in the experimental groups and 2678 in the control groups). Two studies used the NPS scale as a unit of measurement, and the remaining 59 studies used the VAS scale. Among the analyzed studies the interventions experimented were the following: 11 studies tested some form of massage,[83–93] five studies tested the efficacy of birth balls,[85,94–97] eight studies tested distraction or mind-body interventions,[52,53,98–103] 12 studies tested the efficacy of heat application,[85,93,104–113] nine studies tested the efficacy of music therapy,[84,88,114–120] two studies tested the efficacy of dance therapy,[116,121] 16 studies tested the efficacy of acupressure,[89,110,122–135] and eight studies applied TENS during labor.[132,136–142] An interesting focus of our study was also represented by the extensive heterogeneity in terms of intervention protocols within the bounds of the application of the same therapy, especially regarding massage, acupressure, heath therapy and dance therapy. As to the massage trials, in 1 protocol the massage was performed by the partner[88] while regarding the technique, this consisted of either effleurage technique (*n* = 1),[87] effleurage combined with vibration technique (*n* = 1),[83] Hoku points ice massage (*n* = 1)[84] or kneading technique (*n* = 1),[86] foot reflexology (*n* = 1)[91] or expressive touching (*n* = 1).[90] In the Silva Gallo et al. 2018 trial, lumbosacral massage was tested as part of an intervention sequence and it was hence preceded by the use of a Swiss ball and followed by the application of a warm shower.[85] Finally in four cases the exact technique was not specified.[83,89,92,93] Regarding acupressure, trials differed as to the specific acupressure point tested: LI4 Hegu point (*n* = 5),[124–127,133] LI4 and SP6 combined (*n* = 1),[126] BL32 point (*n* = 2),[124,131] bladder GV20 and gallbladder GV20[134] combined (*n* = 1), GB21 point (*n* = 1),[143] SP6 point alone (*n* = 4),[89,123,128,129] SP6 combined it with a simultaneous massage (*n* = 1),[87] and SP6 combined it with the stimulation of the LI4 point (*n* = 1).[130] Alimoradi et al. compared the sequential stimulation of several body acupressure points (GB30, GB32, BL32, LI4, and SP6) with the stimulation of different left ear acupressure points.[122] In the Vixner et al. trial, the manual stimulation of different acupoints was exerted through the use of needles.[132] Regarding heat therapy, this could consist of the application of warm packs or bags on the perineal (*n* = 1)[110] or lumbosacral region (*n* = 7),[93,104–106,109,111] two of which alternated this with the application of ice packs as well.[105,111] Two studies tested the use of warm baths,[107,108] three studies tested the use of warm shower,[85,112,113] while Gallo Silva et al. tested the efficacy of warm shower as part of an intervention sequence.[85] Regarding dance therapy, the main difference among protocols was represented by the identity of the dance practice partner. Akin and Saydam compared the efficacy of practicing with the spouse/partner versus practicing with the midwife,[121] and in the Gonenc and Dikmen trial, parturient were asked to dance with the researcher but executing specific dance moves.[116] The trials investigating music therapy also differed among each other as to the type of music chosen, but most studies allowed some degree of freedom of choice between preselected pieces which were judged as “relaxing” by the researcher. The heterogeneity of protocols shown in the distraction/mind-body interventions is of course a result of the generic nature of the category itself: Although it indeed comprises therapies that do share, at least in part, common physiological mechanisms, all acting above all on the central perception of pain, it does include techniques very much different from each other. In our analysis, four studies involved the use of distraction through virtual reality,[52,53,102,103] one through distraction facilities such as puzzles and movies,[101] through Islamic praying,[100] one through the combination of skin caressing and breathing techniques,[98] and one through the combination of skin caressing, rocking, and hypnotic communication exerted by the researcher.[99] Regarding TENS, five studies applied electricity at acupoints[132,139–142] and four applied it at the lower back area,[136–138,141] with Báez-Suárez also comparing the application of constant high frequencies versus the use of fluctuating frequencies.[137]

Regarding the timing of the pain scores measurement, the trials included showed a vast heterogeneity: 70.31% of the studies (n = 45) set the timing of the measurement in relation to the timing of the intervention (e.g., immediately after intervention, 20 minutes after intervention), 17.46% (n = 11) in relation to the cervical dilatation progression, 7.93% (n = 5) decided to set a fixated measurement frequency (e.g., every hour) and 3.17% of the trials (n = 2) recorded the mean pain intensity based on the postnatal recollection of the patient. This was of course often a reflection of the timing number and duration of interventions: 11.11% of the studies (n = 7) applied the intervention throughout the whole labor phase examined, with or without the use of facultative or mandatory pauses; 47.61% of the studies (n = 30) applied a single, time-limited intervention; in 39.68% of the studies (n = 25) more than one intervention was performed; finally, in one of the trials data regarding the timing of the intervention was insufficient. Studies differed also regarding the starting point of the intervention, with most studies indicating a specific cervical dilatation but a few studies preferring a before treatment pain intensity score (e.g., 4 out of 10 on a VAS scale).

B. Risk of Bias

The risk of bias assessment results is reported in Fig. 2. As also shown by the systematic reviews that preceded our contribution, the evidence supporting the use of CAM techniques is currently often classifiable as at high risk of bias: 85.93% of the studies included (n = 55) were considered at high risk of distortions in at least one of the six domains examined, with 10.93% (n = 7) showing high risk in three or more domains and 51.56% (n = 33) in at least two domains.

The randomization process yielded reviewers' concerns in 29.68% of the cases and was deemed at high risk of distortions in 4.48%. Regarding the domain of the allocation sequence concealment, 7.81% of the studies were at high risk of bias and 54.68% showed reasons of concern. The selective reporting of outcomes was assessed as at high risk of distortions in 10.93% of the cases, while some concerns could be raised for 31.25% of the studies. Moreover, the current assessment highlighted a recurring limitation to the current evidence, specifically the difficulties in the blinding of the participants, a domain in which 81.25% of the studies were judged at high risk of distortions. This limitation inevitably affected the domain of the blinding of the outcome assessment as well (40.62% at high risk of bias), given how this was always conducted by the participants. However, it must be considered how these difficulties may be an inherent vice of the nature of most of the techniques involved in the intervention, which in many cases could not be easily simulated for the control group through a sham intervention to eliminate the possible placebo effect. Finally, 9.37% of the studies showed high risk of attrition bias.

C. Data Analysis

Results of the main analysis are graphically described in Figs. 3 to 10, where results are reported for the single subsets. In relation to the massage subset, effect size was large and significant: $k = 11$, $g = –1.23$, $p < 0.001$, 95% CI: –1.65 to –0.81. Regarding the birth ball subset, effect size was found to be large and significant $k = 5$, $g = –1.30$, $p < 0.001$, 95% CI: –1.58 to –1.03. For the distraction subset, effect size was found to be large and significant $k = 11$, $g = –0.94$, $p < 0.001$, 95% CI: –1.38 to –0.50. For the warmth subset, effect size was found to be moderate and significant: $k = 13$, $g = –0.83$, $p < 0.001$, 95% CI: –1.14 to –0.52. As to the music subset, effect size was large and significant $k = 8$, $g = –0.99$, $p < 0.001$ 95% CI: –1.40 to –0.57. Regarding the dance subset, effect size was found to be small and

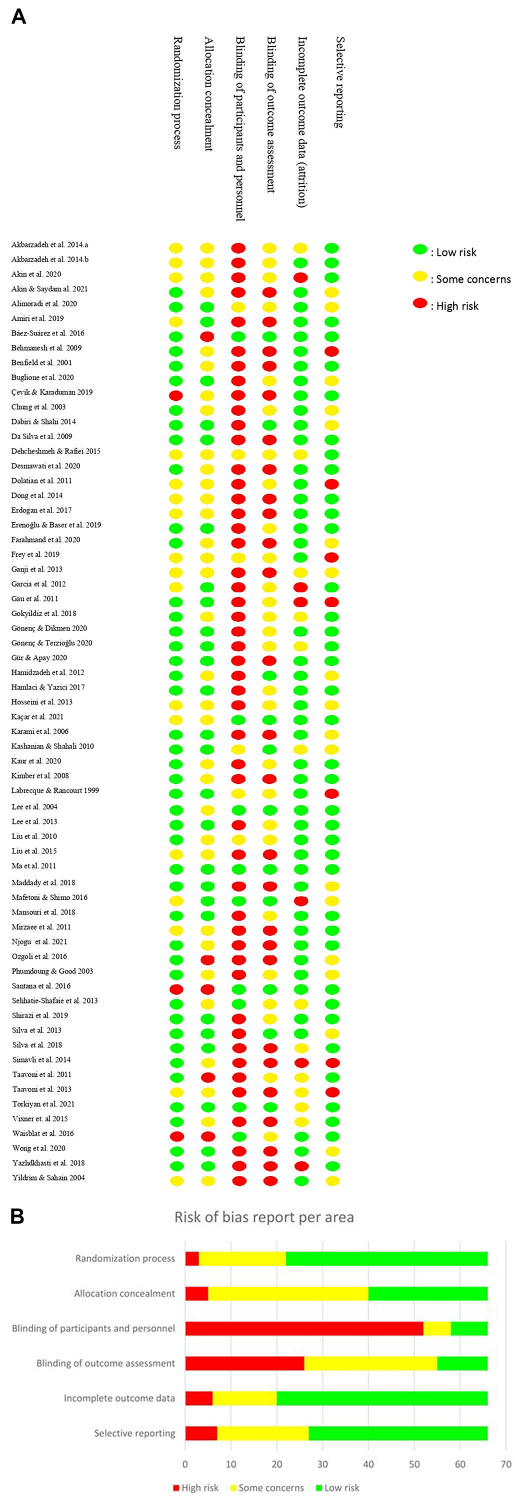

FIG. 2: (A) Risk of bias assessment for the included studies. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year. (B) Statistics of the risk of bias assessment.

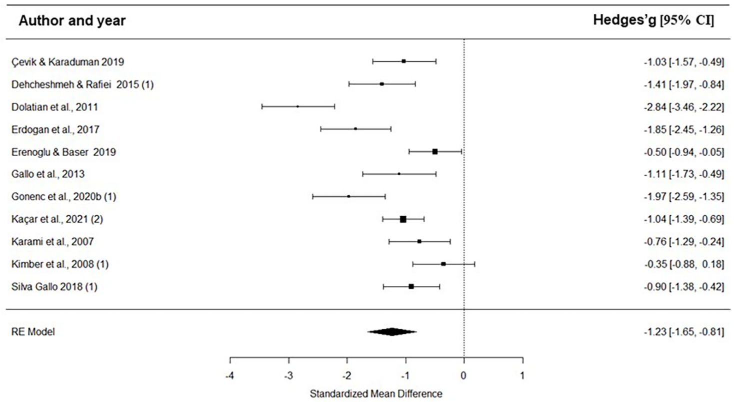

FIG. 3: Forest plot for massage. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

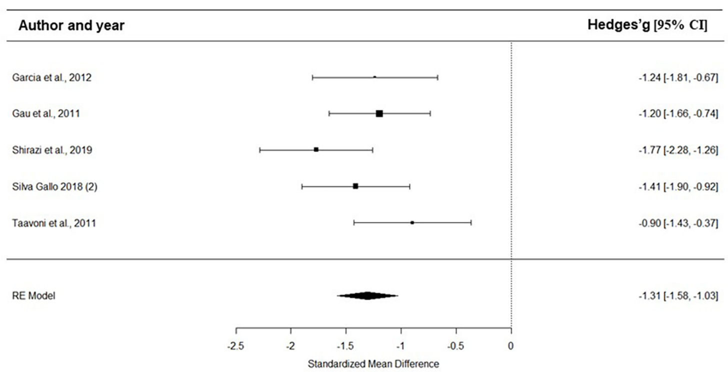

FIG. 4: Forest plot for birth balls. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

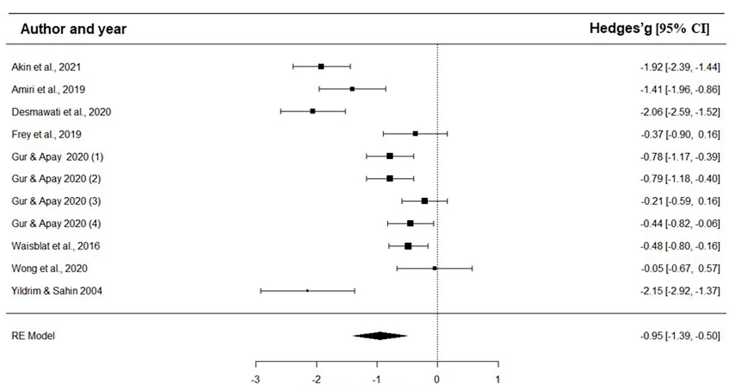

FIG. 5: Forest plot for distraction or mind-body interventions. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

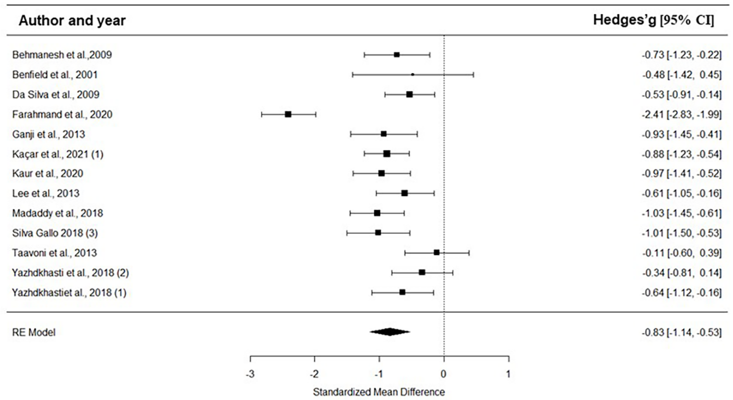

FIG. 6: Forest plot for heat application. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

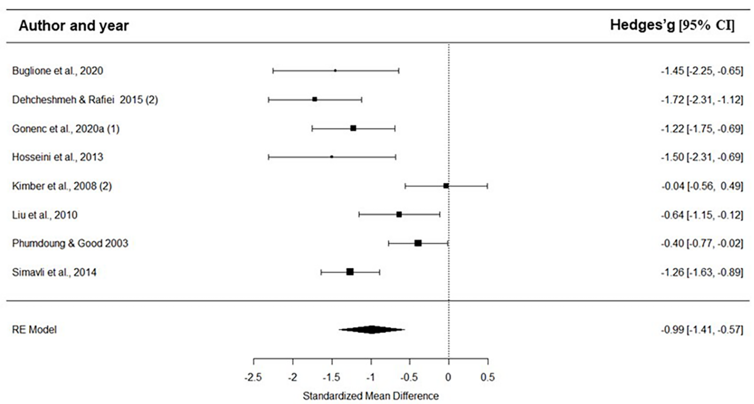

FIG. 7: Forest plot for music. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

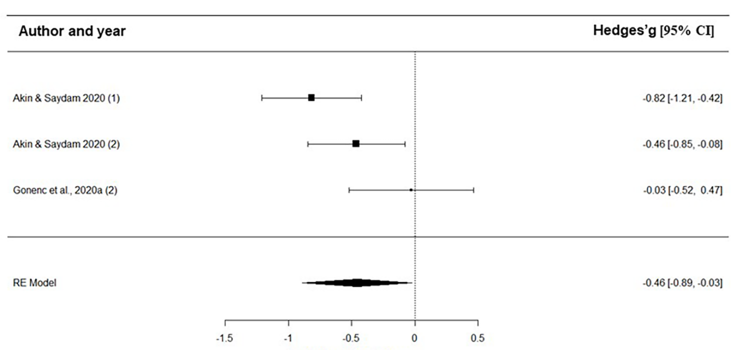

FIG. 8: Forest plot for dance. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

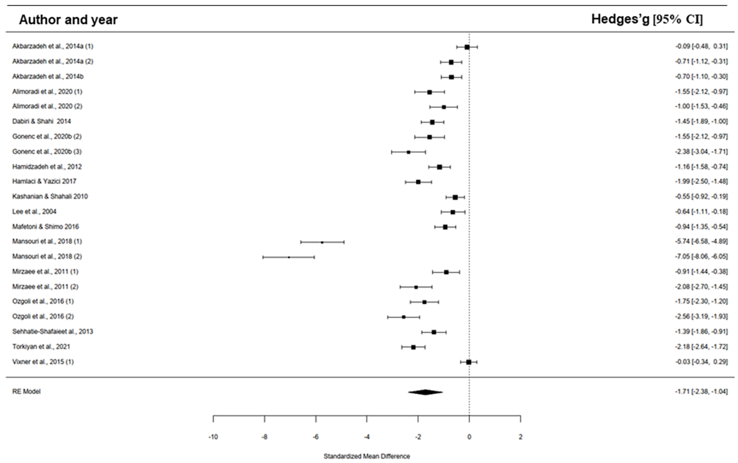

FIG. 9: Forest plot for acupressure. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

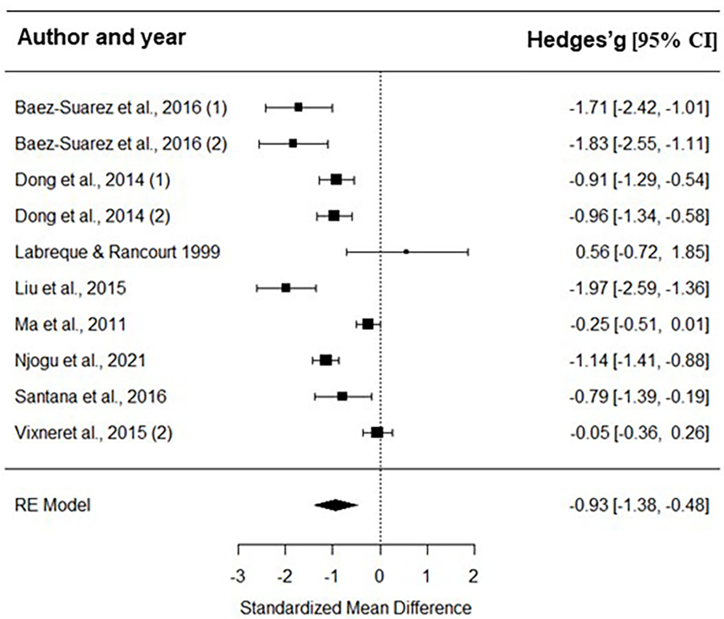

FIG. 10: Forest plot for TENS. Numbers in parentheses represent different samples from the same study; letters after the year differentiate different studies in the same year.

significant: $k = 3$, $g = -0.45$, $p = 0.038$, 95% CI: –0.88 to –0.02. With reference to the acupressure subset, effect size was found to be large and significant: $k = 22$, $g = -1.71$, $p < 0.001$, 95% CI = –1.61 to –1.04. As to the TENS subgroup, effect size was found to be large and significant: $k = 10$, $g = -0.93$, $p < 0.001$, 95% CI: –1.37 to –0.48. For descriptive purposes, a general analysis of the whole sample of the studies showed a large effect size: $k = 63$, $g = -1.14$, $p < 0.001$, 95% CI = –1.35 to –0.93.

IV. DISCUSSION

The goal of the present review was to examine the evidence regarding the efficacy of complementary and alternative analgesic therapies during labor.

On this matter our statistical analysis showed a significant effect size of all these techniques when compared with standard care. Nonetheless, our evaluation of the risk of bias did show, as also reported by past reviews on the same subject, how the evidence in favor of these techniques may be at the present time still rated as low-quality, with 85.93% of the studies included (*n* = 55) were considered at high risk of distortions in at least one of the six domains examined.

An important focus of our review was the great methodological heterogeneity among study protocols testing the same technique. In relation to this issue more comparative trials may be needed to establish how the sometimes-macroscopic differences among protocols and especially in the specific technique applied may affect the efficacy of the therapy at issue. This comparative analysis is a necessary preliminary step to the definitive establishment of common shared practices as a solid and wide-spread alternative to pharmacological methods. Some of the included trials already investigated this issue through comparative studies.[84,88,89,93,102,111,113,116,121,122,124,131–134,137,144] Some trials of the acupressure subgroup tried to address the scientific debate regarding which acupoint may be more effective in influencing labor pain and labor progression.[113,124,134] Another area of diversity is represented by the duration of the intervention. We reported how 47.61% of the included studies (*n* = 30) applied a single, time-limited intervention. Although this modality may be generally safer for the intervention group volunteers in addition to being more practical, it does not answer the question of whether the technique may or may not be extensively applied to the dilatative stage of labor in all its length without for example a decrease of its efficacy and/or an increase of its collateral effects. However, possibly the most relevant area of methodological heterogeneity, partially undermining the possibility a comparison between the outcomes reported and hence also of a meta-analysis of the current evidence, is represented by the differences in the timing of the intervention and especially the timing and number of the measurements of the pain intensity. Given the fluctuating and progressive nature of labor pain any difference in the starting point of the intervention and in the timing of the measurements is bound to influence the outcome. On this topic, it is also worth noticing how just a minority of studies reported the temporal relationship between the measurement timing and the contractions, which of course can violently affect the pain score recorded. Therefore, a limitation of the present review was a result of the difficulty of comparing outcomes recorded according to very different timing protocols. When more than one post-treatment measurement was carried out, we selected the score to be analyzed trying to apply a uniform criterium to the same subgroup, to minimize distortions in the comparison between trials. This however was not always possible. An example is represented by the massage subgroup, in which three of the 11 trials reported as outcome the mean pain score of the whole labor phase examined, one of which[88] was recorded *ex post,* the second of which[87] was a mean of three measurements performed at 3, 4, and 10 cm of cervical dilatation. A third article[92] recorded the pain after the most severe contraction after the intervention, and the remaining eight[83–86,89–91,93] carried out the pain score measurement immediately after the intervention. On these grounds, we share the concerns expressed by Dualé et al.[145] on the formal validity of the current evidence and therefore confirm the need for a shared methodological approach. As already mentioned, we decided to undertake this meta-analysis on the efficacy of CAM for labor analgesia under the light of a single parameter, subjective pain as resulting from pain scale scores. Other than by reason of a methodological rationale, this was also due to the well-known relevance of pain in the determination of other outcomes as well, such as the incidence of postnatal depression,[146–148] breastfeeding success,[149] and its crucial importance for patients' satisfaction,[24,131] which should in our opinion be regarded as one of the ultimate outcomes on which to evaluate the offered analgesic assistance. Nonetheless, this does represent a limitation of the present review: Although pain scores are of course the first outcome to be considered when examining the efficacy of analgesic therapies for labor they are not however the only one. Indeed, the scientific literature as well as some of the included trials have been trying to scrutinize the effect of these techniques on other clinical outcomes as well, such as labor duration, incidence of labor complications, and operative deliveries, need for oxytocin, neonatal outcomes and maternal outcomes.[17,31,150] Particularly in relation to labor duration, it is worth noting the results of the multicenter cohort study conducted by Favilli et al.,[151] which through both pre-labor and post-labor questionnaires, recorded how women' preferences about labor mainly focus on pain intensity and labor duration. Accordingly, Kempe and Vikström-Bolin[152] reported an independent significant effect of prolonged labor on maternal satisfaction and indicated it as one of the main determinants, together with the mode of delivery, of the women's experience of childbirth. Under this light the application of acupressure has brought promising results, showing a significant effect on both labor pain and labor duration, although as shown by Chen et al., the quality of the evidence in support of this technique is still low.[37]

V. CONCLUSIONS

The present review found significant evidence in support of the use of CAM for labor analgesia. However, more high-quality trials are needed. In addition, a standardization of the methods and protocols in this research field is needed.

ACKNOWLEDGMENT

This project has been supported by the Sbarro Health Research Organization (www.shro.org).

REFERENCES

1. Melzack R, Kinch R, Dobkin P, Lebrun M, Taenzer P. Severity of labour pain: Influence of physical as well as psychologic variables. Can Med Assoc J. 1984;130(5):579–84.
2. Melzack R. The myth of painless childbirth (The John J. Bonica Lecture): Pain. 1984;19(4):321–37.
3. Farnham T. Reviewing pain management options for patients in active labor. Nursing. 2020;50(6):24–30.
4. Wong C. Advances in labor analgesia. Int J Womens Health. 2010;1:139–54.
5. Shnol H, Paul N, Belfer I. Labor main mechanisms. Int Anesthesiol Clin. 2014;52(3):1–17.
6. Kannan S. Maternal satisfaction and pain control in women electing natural childbirth. Reg Anesth Pain Med. 2001;26(5):468–72.
7. Chalmers BE, Dzakpasu S. Interventions in labour and birth and satisfaction with care: The canadian maternity experiences survey findings. J Reprod Infant Psychol. 2015;33(4):374–87.
8. Hodnett E. Pain and women's satisfaction with the experience of childbirth: A systematic review. Am J Obstet Gynecol. 2002;186(5):S160–72.
9. Morgan BM, Bulpitt CJ, Clifton P. Analgesia and satisfaction in childbirth (the queen charlotte's 1000 mother survey). Lancet. 1982;2(8302):808–10.
10. Williams CE, Povey RC, White DG. Predicting women's intentions to use pain relief medication during childbirth using the theory of planned behaviour and self-efficacy theory. J Reprod Infant Psychol. 2008;26(3):168–79.
11. Wijma K. Why focus on "fear of childbirth"? J Psychosom Obstet Gynaecol. 2003;24(3):141–3.
12. Alehagen S, Wijma B, Lundberg U, Wijma K. Fear, pain and stress hormones during childbirth. J Psychosom Obstet Gynaecol. 2005;26(3):153–65.
13. Alehagen S, Wijma K, Wijma B. Fear during labor. Acta Obstet Gynecol Scand. 2001;80(4):315–20.
14. Hatem M, Sandall J, Devane D, Soltani H, Gates S. Midwife-led versus other models of care for childbearing women. Cochrane Database Syst Rev. 2008;4:CD004667.
15. Hildingsson I, Rubertsson C, Karlström A, Haines H. A known midwife can make a difference for women with fear of childbirth-birth outcome and women's experiences of intrapartum care. Sex Reprod Healthc. 2019;21:33–8.
16. Sandall J, Soltani H, Gates S, Shennan A, Devane D. Midwife-led continuity models versus other models of care for childbearing women. Cochrane Database Syst Rev. 2016;4:CD004667.
17. Anim-Somuah M, Smyth RM, Cyna AM, Cuthbert A. Epidural versus non-epidural or no analgesia for pain management in labour. Cochrane Database Syst Rev. 2018;5:CD000331.
18. Grant E, Tao W, Craig M, McIntire D, Leveno K. Neuraxial analgesia effects on labour progression: Facts, fallacies, uncertainties and the future. BJOG. 2015;122(3):288–93.
19. Maimburg RD, Væth M, Dahlen H. Women's experience of childbirth – A five year follow-up of the randomised controlled trial "Ready for Child Trial." Women Birth. 2016;29(5):450–4.
20. Sitras V, Šaltytė Benth J, Eberhard-Gran M. Obstetric and psychological characteristics of women choosing epidural analgesia during labour: A cohort study. PLoS One. 2017;12(10):e0186564.
21. Lindholm A, Hildingsson I. Women's preferences and received pain relief in childbirth – A prospective longitudinal study in a northern region of Sweden. Sex Reprod Healthc. 2015;6(2):74–81.
22. NHS Maternity statistics 2018–2019 [page on the

Internet]. NHS Digital [updated 2019 October 31; cited 2021 May 7]. Available from: https://digital.nhs.uk/data-and-information/publications/statistical/nhs-maternity-statistics/2018-19.
23. Bonouvrié K, van den Bosch A, Roumen FJME, van Kuijk SM, Nijhuis JG, Evers SMAA, Wassen MMLH. Epidural analgesia during labour, routinely or on request: A cost-effectiveness analysis. Eur J Obstet Gynecol Reprod Biol. 2016;207:23–31.
24. Jonsdottir SS, Steingrimsdottir T, Thome M, Oskarsson GK, Lydsdottir LB, Olafsdottir H, Swahnberg K. Pain management and medical interventions during childbirth among perinatal distressed women and women dissatisfied in their partner relationship: A prospective cohort study. Midwifery. 2019;69:1–9.
25. Logtenberg SLM, Verhoeven CJ, Oude Rengerink K, Sluijs A-M, Freeman LM, Schellevis FG, Mol BW. Pharmacological pain relief and fear of childbirth in low risk women; secondary analysis of the RAVEL study. BMC Pregnancy Childbirth. 2018;18(1):347.
26. Tournaire M, Theau-Yonneau A. Complementary and alternative approaches to pain relief during labor. Evid Based Complement Alternat Med. 2007;4(4):409–17.
27. Allaire AD, Moos MK, Wells SR. Complementary and alternative medicine in pregnancy: A survey of North Carolina certified nurse-midwives. Obstet Gynecol. 2000;95(1):19–23.
28. Frawley J, Adams J, Sibbritt D, Steel A, Broom A, Gallois C. Prevalence and determinants of complementary and alternative medicine use during pregnancy: Results from a nationally representative sample of Australian pregnant women. Aust N Z J Obstet Gynaecol. 2013;53(4):347–52.
29. Moayedi M, Davis KD. Theories of pain: From specificity to gate control. J Neurophysiol. 2013;109(1):5–12.
30. Ranjbaran M, Khorsandi M, Matourypour P, Shamsi M. Effect of massage therapy on labor pain reduction in primiparous women: A systematic review and meta-analysis of randomized controlled clinical trials in Iran. Iran J Nursing Midwifery Res. 2017;22(4):257.
31. Smith CA, Levett KM, Collins CT, Dahlen HG, Ee CC, Suganuma M. Massage, reflexology and other manual methods for pain management in labour. Cochrane Database Syst Rev. 2018;3:CD009290.
32. Schünemann HJ, Best D, Vist G, Oxman AD, GRADE Working Group. Letters, numbers, symbols and words: How to communicate grades of evidence and recommendations. CMAJ. 2003;169(7):677–80.
33. Makvandi S, Latifnejad Roudsari R, Sadeghi R, Karimi L. Effect of birth ball on labor pain relief: A systematic review and meta-analysis: Effect of birth ball on labor pain. J Obstet Gynaecol Res. 2015;41(11):1679–86.
34. Malanga GA, Yan N, Stark J. Mechanisms and efficacy of heat and cold therapies for musculoskeletal injury. Postgrad Med. 2015;127(1):57–65.
35. Makvandi S, Mirzaiinajmabadi K, Sadeghi R, Mahdavian M, Karimi L. Meta-analysis of the effect of acupressure on duration of labor and mode of delivery. Int J Gynaecol Obstet. 2016;135(1):5–10.
36. Najafi F, Jaafarpour M, Sayehmiri K, Khajavikhan J. An evaluation of acupressure on the Sanyinjiao (SP6) and Hugo (LI4) points on the pain severity and length of labor: A systematic review and meta-analysis study. Iran J Nurs Midwifery Res. 2018;23(1):1–7.
37. Chen Y, Xiang XY, Chin KHR, Gao J, Wu J, Lao L, Chen H. Acupressure for labor pain management: A systematic review and meta-analysis of randomized controlled trials. Acupunct Med. 2020;39(4)243–52.
38. Delgado Nunes V, Gholitabar M, Sims JM, Bewley S. Intrapartum care of healthy women and their babies: Summary of updated NICE guidance. BMJ. 2014;349: g6886.
39. Dowswell T, Bedwell C, Lavender T, Neilson JP. Transcutaneous electrical nerve stimulation (TENS) for pain management in labour. Cochrane Database Syst Rev. 2009;2:CD007214.
40. Thuvarakan K, Zimmermann H, Mikkelsen MK, Gazerani P. Transcutaneous electrical nerve stimulation as a pain-relieving approach in labor pain: A systematic review and meta-analysis of randomized controlled trials. Neuromodulation. 2020;23(6):732–46.
41. Duncan LG, Cohn MA, Chao MT, Cook JG, Riccobono J, Bardacke N. Benefits of preparing for childbirth with mindfulness training: A randomized controlled trial with active comparison. BMC Pregnancy Childbirth. 2017;17(1):140.
42. Santiváñez-Acosta R, Tapia-López E de las N, Santero M. Music therapy in pain and anxiety management during labor: A systematic review and meta-analysis. Medicina. 2020;56(10):526.
43. Abdolahian S, Ghavi F, Abdollahifard S, Sheikhan F. Effect of dance labor on the management of active phase labor pain and clients' satisfaction: A randomized controlled trial study. Glob J Health Sci. 2014;6(3):219–26.
44. Moss D, Willmarth E. Hypnosis, anesthesia, pain management, and preparation for medical procedures. Ann Palliat Med. 2019;8(4):498–503.
45. Kendrick C, Sliwinski J, Yu Y, Johnson A, Fisher W, Kekecs Z, Elkins G. Hypnosis for acute procedural pain: A critical review. Int J Clin Exp Hypn. 2016;64(1): 75–115.
46. Madden K, Middleton P, Cyna AM, Matthewson M, Jones L. Hypnosis for pain management during labour and childbirth. Cochrane Database Syst Rev. 2016;5:CD009356.
47. Chirico A, Lucidi F, De Laurentiis M, Milanese C, Napoli A, Giordano A. Virtual reality in health system: Beyond entertainment. A mini-review on the efficacy of VR during cancer treatment. J Cell Physiol. 2016;231(2):275–87.
48. Chuan A, Zhou JJ, Hou RM, Stevens CJ, Bogdanovych A. Virtual reality for acute and chronic pain management

in adult patients: A narrative review. Anaesthesia. 2020;76(5):695–704.
49. Atzori B, Hoffman HG, Vagnoli L, Patterson DR, Alhalabi W, Messeri A, Grotto LS. Virtual reality analgesia during venipuncture in pediatric patients with onco-hematological diseases. Front Psychol. 2018;9:2508.
50. Atzori B, Lauro Grotto R, Giugni A, Calabrò M, Alhalabi W, Hoffman HG. Virtual reality analgesia for pediatric dental patients. Front Psychol. 2018;9:2265.
51. Chi B, Chau B, Yeo E, Ta P. Virtual reality for spinal cord injury-associated neuropathic pain: Systematic review. Ann Phys Rehabil Med. 2019;62(1):49–57.
52. Frey DP, Bauer ME, Bell CL, Low LK, Hassett AL, Cassidy RB, Sharar SR. Virtual reality analgesia in labor: The VRAIL pilot study—a preliminary randomized controlled trial suggesting benefit of immersive virtual reality analgesia in unmedicated laboring women. Anesth Analg. 2019;128(6):e93–6.
53. Wong MS, Spiegel BMR, Gregory KD. Virtual reality reduces pain in laboring women: A randomized controlled trial. Am J Perinatol. 2021;38(S 01):e167–72.
54. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P, Moher D. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
55. Methley AM, Campbell S, Chew-Graham C, McNally R, Cheraghi-Sohi S. PICO, PICOS and SPIDER: A comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. BMC Health Serv Res. 2014;14(1):579.
56. RoB 2: A revised Cochrane risk-of-bias tool for randomized trials [Internet]. [cited 2021 Jun 29]. Available from: https://methods.cochrane.org/bias/resources/rob-2-revised-cochrane-risk-bias-tool-randomized-trials.
57. R Core Team. A language and environment for statistical computing. R Foundation for Statistical Computing. A Language and Environment for Statistical Computing [Internet]. 2018; Available from: https://www.R-project.org.
58. Viechtbauer W. Conducting meta-analyses in *R* with the metafor Package. J Stat Softw. 2010;36(3):1–48.
59. Tidyverse.tidyverse.org [Homepage on the Internet]. [updated 2021 April 15, cited 2021 May 12]. Available from: https://tidyverse.tidyverse.org/.
60. Hedges LV, Olkin I. Statistical methods for meta-analysis. San Diego, CA: Academic Press; 2014.
61. Lipsey MW, Wilson DB. The efficacy of psychological, educational, and behavioral treatment: Confirmation from meta-analysis. Am Psychol. 1993;48(12):1181–209.
62. Sidik K, Jonkman JN. A comparison of heterogeneity variance estimators in combining results of studies: Comparison of heterogeneity variance estimators. Stat Med. 2007;26(9):1964–81.
63. Konstantopoulos S. Fixed effects and variance components estimation in three-level meta-analysis: Three-level meta-analysis. Res Syn Meth. 2011;2(1):61–76.
64. Mitchell LJ, Bisdounis L, Ballesio A, Omlin X, Kyle SD. The impact of cognitive behavioural therapy for insomnia on objective sleep parameters: A meta-analysis and systematic review. Sleep Med Rev. 2019;47:90–102.
65. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629–34.
66. Pawale M, Salunkhe J. Effectiveness of back massage on pain relief during first stage of labor in primi mothers admitted at a tertiary care center. J Family Med Prim Care. 2020;9(12):5933.
67. Chung UL, Hung LC, Kuo SC, Huang CL. Effects of LI4 and BL 67 acupressure on labor pain and uterine contractions in the first stage of labor. J Nurs Res. 2003;11(4):251–60.
68. Shahoei R, Shahghebi S, Rezaei M, Naqshbandi S. The effect of transcutaneous electrical nerve stimulation on the severity of labor pain among nulliparous women: A clinical trial. Complement Ther Clin Pract. 2017;28:176–80.
69. Chao AS, Chao A, Wang TH, Chang YC, Peng HH, Chang SD, Chao A, Chang C, Lai C, Wong AMK. Pain relief by applying transcutaneous electrical nerve stimulation (TENS) on acupuncture points during the first stage of labor: A randomized double-blind placebo-controlled trial. Pain. 2007;127(3):214–20.
70. Freeman RM, Macaulay AJ, Eve L, Chamberlain GV, Bhat AV. Randomised trial of self hypnosis for analgesia in labour. BMJ. 1986;292(6521):657–8.
71. Yesilcicek Calik K, Komurcu N. Effects of SP6 acupuncture point stimulation on labor pain and duration of labor. Iran Red Crescent Med J. 2014;16(10):8.
72. Field T, Hemandez-Reif M, Taylor S, Quintino O, Burman I. Labor pain is reduced by massage therapy. J Psychosom Obstet Gynaecol. 1997;18(4):286–91.
73. Janssen P, Shroff F, Jaspar P. Massage therapy and labor outcomes: A randomized controlled trial. Int J Ther Massage Bodywork. 2012;5(4):15–20.
74. Mortazavi SH, Khaki S, Moradi R, Heidari K, Vasegh Rahimparvar SF. Effects of massage therapy and presence of attendant on pain, anxiety and satisfaction during labor. Arch Gynecol Obstet. 2012;286(1):19–23.
75. Stark MA. Testing the effectiveness of therapeutic showering in labor. J Perinat Neonatal Nurs. 2017;31(2):109–17.
76. Yildirim E, Alan S, Gokyildiz S. The effect of ice pressure applied on large intestinal 4 on the labor pain and labor process. Complement Ther Clin Pract. 2018;32:25–31.
77. Türkmen H, Çeber Turfan E. The effect of acupressure on labor pain and the duration of labor when applied to the SP6 point: Randomized clinical trial. Jpn J Nurs Sci. 2020;17(1):e12256.

78. Bergström M, Kieler H, Waldenström U. Psychoprophylaxis during labor: Associations with labor-related outcomes and experience of childbirth. Acta Obstet Gynecol Scand. 2010;89(6):794–800.
79. Hjelmstedt A, Shenoy ST, Stener-Victorin E, Lekander M, Bhat M, Balakumaran L, Waldenström U. Acupressure to reduce labor pain: A randomized controlled trial. Acta Obstet Gynecol Scand. 2010;89(11):1453–9.
80. Marlin R. Reduction of labour pain with back massage. Enfermería Clínica. 2020;30:209–12.
81. Chang M-Y, Wang S-Y, Chen C-H. Effects of massage on pain and anxiety during labour: A randomized controlled trial in Taiwan. J Adv Nurs. 2002;38(1):68–73.
82. Taghinejad H, Delpisheh A, Suhrabi Z. Comparison between massage and music therapies to relieve the severity of labor pain. Womens Health. 2010;6(3):377–81.
83. Akköz Çevik S, Karaduman S. The effect of sacral massage on labor pain and anxiety: A randomized controlled trial. Jpn J Nurs Sci. 2020;17(1):e12272.
84. Dehcheshmeh FS, Rafiei H. Complementary and alternative therapies to relieve labor pain: A comparative study between music therapy and Hoku point ice massage. Complement Ther Clin Pract. 2015;21(4):229–32.
85. Gallo RBS, Santana LS, Marcolin AC, Duarte G, Quintana SM. Sequential application of non-pharmacological interventions reduces the severity of labour pain, delays use of pharmacological analgesia, and improves some obstetric outcomes: A randomised trial. J Physiother. 2018;64(1):33–40.
86. Silva Gallo RB, Santana LS, Jorge Ferreira CH, Marcolin AC, PoliNeto OB, Duarte G, Quintana SM. Massage reduced severity of pain during labour: A randomised trial. J Physiother. 2013;59(2):109–16.
87. Karami NK, Safarzadeh A, Fathizadeh N. Effect of massage therapy on severity of pain and outcome of labor in primipara. Iran J Nurs Midwifery Res. 2007;12(1):6–9.
88. Kimber L, McNabb M, Court C, Haines A, Brocklehurst P. Massage or music for pain relief in labour: A pilot randomised placebo controlled trial. Eur J Pain. 2008;12(8):961–9.
89. Gönenç IM, Terzioğlu F. Effects of massage and acupressure on relieving labor pain, reducing labor time, and increasing delivery satisfaction. J Nurs Res. 2020;28(1):e68.
90. Erenoğlu R, Başer M. Effect of expressıve touchıng on labour paın and maternal satısfactıon: A randomized controlled trial. Complement Ther Clin Pract. 2019;34:268–74.
91. Dolatian M, Hasanpour A, Montazeri S, Heshmat R, Alavi Majd H. The effect of reflexology on pain intensity and duration of labor on primiparas. Iran Red Crescent Med J. 2011;13(7):475–9.
92. Unalmis Erdogan S, Yanikkerem E, Goker A. Effects of low back massage on perceived birth pain and satisfaction. Complement Ther Clin Pract. 2017;28:169–75.
93. Kaçar N, Özcan Keser N. Comparison of the effect of mechanical massage and warm mechanical massage application on perceived labor pain and childbirth experience: A randomized clinical trial. Eur J Midwifery. 2021;5:5.
94. Gau M-L, Chang C-Y, Tian S-H, Lin K-C. Effects of birth ball exercise on pain and self-efficacy during childbirth: A randomised controlled trial in Taiwan. Midwifery. 2011;27(6):e293–300.
95. Delgado-García BE, Orts-Cortés MI, Poveda-Bernabeu A, Caballero-Pérez P. Ensayo clínico controlado y aleatorizado para determinar los efectos del uso de pelotas de parto durante el trabajo de parto. Enfermería Clínica. 2012;22(1):35–40.
96. Taavoni S, Abdolahian S, Haghani H, Neysani L. Effect of birth ball usage on pain in the active phase of labor: A randomized controlled trial. J Midwifery Womens Health. 2011;56(2):137–40.
97. Ghasab Shirazi M, Kohan S, Firoozehchian F, Ebrahimi E. Experience of childbirth with birth ball: A randomized controlled trial. Int J Womens Health Reprod Sci. 2018;7(3):301–5.
98. Yildirim G, Sahin NH. The effect of breathing and skin stimulation techniques on labour pain perception of Turkish women. Pain Res Manag. 2004;9(4):183–7.
99. Waisblat V, Langholz B, Bernard FJ, Arnould M, Benassi A, Ginsbourger F, Guillou N, Hamelin K, Houssel P, Hugot P, Martel-Jacob S, Moufouki M, Musellec H, Mansour SN, Ogagna D, Paqueron X, Zerguine S, Cavagna P, Bloc S, Jensen MP, Dhonneur G. Impact of a hypnotically-based intervention on pain and fear in women undergoing labor. Int J Clin Exp Hypn. 2017;65(1):64–85.
100. Desmawati, Kongsuwan W, Chatchawet W. Effect of nursing intervention integrating an Islamic praying program on labor pain and pain behaviors in primiparous Muslim women. Iran J Nursing Midwifery Res. 2019;24(3):220.
101. Amiri P, Mirghafourvand M, Esmaeilpour K, Kamalifard M, Ivanbagha R. The effect of distraction techniques on pain and stress during labor: A randomized controlled clinical trial. BMC Pregnancy Childbirth. 2019;19(1):534.
102. Gür EY, Apay SE. The effect of cognitive behavioral techniques using virtual reality on birth pain: A randomized controlled trial. Midwifery. 2020;91:102856.
103. Akin B, Yilmaz Kocak M, Küçükaydın Z, Güzel K. The effect of showing images of the foetus with the virtual reality glass during labour process on labour pain, birth perception and anxiety. J Clin Nurs. 2021;30(15-6):2301–8.
104. Behmanesh F. The effect of heat therapy on labor pain severity and delivery outcome in parturient women. Iran Red Crescent Med J. 2009;11(2):188–92.
105. Ganji J, Shirvani MA, Rezaei-Abhari F, Danesh M. The effect of intermittent local heat and cold on labor pain and child birth outcome. Iran J Nurs Midwifery Res. 2013;18(4):7.
106. Taavoni S, Abdolahian S, Haghani H. Effect of sacrum-perineum heat therapy on active phase labor pain and

client satisfaction: A randomized, controlled trial study. Pain Med. 2013;14(9):1301–6.
107. da Silva FMB, de Oliveira SMJV, Nobre MRC. A randomised controlled trial evaluating the effect of immersion bath on labour pain. Midwifery. 2009;25(3):286–94.
108. Benfield RD, Hortobágyi T, Tanner CJ, Swanson M, Heitkemper MM, Newton ER. The effects of hydrotherapy on anxiety, pain, neuroendocrine responses, and contraction dynamics during labor. Biol Res Nurs. 2010;12(1):28–36.
109. Kaur J, Sheoran P, Kaur S, Sarin J. Effectiveness of warm compression on lumbo-sacral region in terms of labour pain intensity and labour outcomes among nulliparous: An interventional study. J Caring Sci. 2020;9(1):9–12.
110. Farahmand M, Khooshab E, Hasanzadeh F, Amooee S, Akbarzadeh M. The effect of warm compress bi-stage on pain strength in labor stages and after delivery. Int J Womens Health Reprod Sci. 2019;8(1):46–52.
111. Yazdkhasti M, Moghimi Hanjani S, Mehdizadeh Tourzani Z. The effect of localized heat and cold therapy on pain intensity, duration of phases of labor, and birth outcomes among primiparous females: A randomized, controlled trial. Shiraz E-Med J. 2018;19(8):e65501.
112. Lee SL, Liu CY, Lu YY, Gau ML. Efficacy of warm showers on labor pain and birth experiences during the first labor stage. J Obstet Gynecol Neonatal Nurs. 2013;42(1):19–28.
113. Maddady SM, Charandabi SM-A, Shafaei FS, Mirghafourvand M. Comparing the effects of hot shower and intravenous injection of hyoscine on the pain intensity and duration of active phase of labour in nulliparous women. J Clin Diagn Res. 2018;12(8):QC07–11.
114. Liu YH, Chang MY, Chen CH. Effects of music therapy on labour pain and anxiety in Taiwanese first-time mothers. J Clin Nurs. 2010;19(7-8):1065–72.
115. Simavli S, Gumus I, Kaygusuz I, Yildirim M, Usluogullari B, Kafali H. Effect of music on labor pain relief, anxiety level and postpartum analgesic requirement: A randomized controlled clinical trial. Gynecol Obstet Invest. 2014;78(4):244–50.
116. Gönenç İM, Dikmen HA. Effects of dance and music on pain and fear during childbirth. J Obstet Gynecol Neonatal Nurs. 2020;49(2):144–53.
117. Hosseini SE, Bagheri M, Honarparvaran N. Investigating the effect of music on labor pain and progress in the active stage of first labor. Eur Rev Med Pharmacol Sci. 2013;17(11):1479–87.
118. Gokyildiz Surucu S, Ozturk M, Avcibay Vurgec B, Alan S, Akbas M. The effect of music on pain and anxiety of women during labour on first time pregnancy: A study from Turkey. Complement Ther Clin Pract. 2018;30:96–102.
119. Phumdoung S, Good M. Music reduces sensation and distress of labor pain. Pain Manag Nurs. 2003;4(2):54–61.
120. Buglione A, Saccone G, Mas M, Raffone A, Di Meglio L, di Meglio L, Toscano P, Travaglino A, Zapparella R, Duval M, Zullo F, Locci M. Effect of music on labor and delivery in nulliparous singleton pregnancies: A randomized clinical trial. Arch Gynecol Obstet. 2020;301(3):693–8.
121. Akin B, Saydam BK. The effect of labor dance on perceived labor pain, birth satisfaction, and neonatal outcomes. Explore. 2020;16(5):310–7.
122. Alimoradi Z, Kazemi F, Gorji M, Valiani M. Effects of ear and body acupressure on labor pain and duration of labor active phase: A randomized controlled trial. Complement Ther Med. 2020;51:102413.
123. Mafetoni RR, Shimo AKK. The effects of acupressure on labor pains during child birth: Randomized clinical trial. Rev Lat Am Enfermagem. 2016;24:e2738.
124. Ozgoli G, Sedigh Mobarakabadi S, Heshmat R, Alavi Majd H, Sheikhan Z. Effect of LI4 and BL32 acupressure on labor pain and delivery outcome in the first stage of labor in primiparous women: A randomized controlled trial. Complement Ther Med. 2016;29:175–80.
125. Hamlacı Y, Yazici S. The effect of acupressure applied to point LI4 on perceived labor pains. Holist Nurs Pract. 2017;31(3):167–76.
126. Dabiri F, Shahi A. The effect of LI4 acupressure on labor pain intensity and duration of labor: A randomized controlled trial. Oman Med J. 2014;29(6):425–9.
127. Hamidzadeh A, Shahpourian F, Orak RJ, Montazeri AS, Khosravi A. Effects of LI4 acupressure on labor pain in the first stage of labor. J Midwifery Womens Health. 2012;57(2):133–8.
128. Kashanian M, Shahali S. Effects of acupressure at the Sanyinjiao point (SP6) on the process of active phase of labor in nulliparas women. J Matern Fetal Neonatal Med. 2010;23(7):638–41.
129. Lee MK, Chang SB, Kang D-H. Effects of SP6 acupressure on labor pain and length of delivery time in women during labor. J Altern Complement Med. 2004;10(6):959–65.
130. Sehhatie-Shafaie F, Kazemzadeh R, Amani F, Heshmat R. The effect of acupressure on Sanyinjiao and Hugo points on labor pain in nulliparous women: A randomized clinical trial. J Caring Sci. 2013;2(2):123–9.
131. Akbarzadeh M, Masoudi Z, Hadianfard MJ, Kasraeian M, Zare N. Comparison of the effects of maternal supportive care and acupressure (BL32 acupoint) on pregnant women's pain intensity and delivery outcome. J Pregnancy. 2014;2014:129208.
132. Vixner L, Mårtensson LB, Schytt E. Acupuncture with manual and electrical stimulation for labour pain: A two month follow up of recollection of pain and birth experience. BMC Complement Altern Med. 2015;15(1):180.
133. Mirzaee F, Hasaroeih FE, Mirzaee M, Ghazanfarpour M. Comparing the effect of acupressure with or without ice in LI-4 point on labour pain and anxiety levels during labour: A randomised controlled trial. J Obstet Gynaecol. 2021;41(3):395–400.
134. Mansouri E, Kordi M, Aval SB, Shakeri MT, Mirteimouri M. Comparison of the effect of pressure on bladder-GV20 and gallbladder-GV20 points on the ability to cope with

labor pain among the primiparous women: A randomized clinical trial. Iran J Obstet Gyne. 2019;11(30):38–47.
135. Akbarzadeh M, Moradi Z, Jowkar A, Zare N, Hadianfard MJ. Comparing the effects of acupressure at the jian jing-gall bladder meridian (GB-21) point on the severity of labor pain, duration and cesarean rate in mono-and bi-stage interventions. Women's Health Bull. 2014;2(1):8.
136. Santana LS, Gallo RBS, Ferreira CHJ, Duarte G, Quintana SM, Marcolin AC. Transcutaneous electrical nerve stimulation (TENS) reduces pain and postpones the need for pharmacological analgesia during labour: A randomised trial. J Physiother. 2016;62(1):29–34.
137. Báez-Suárez A, Martín-Castillo E, García-Andújar J, García-Hernández JÁ, Quintana-Montesdeoca MP, Loro-Ferrer JF. Evaluation of different doses of transcutaneous nerve stimulation for pain relief during labour: A randomized controlled trial. Trials. 2018;19(1):652.
138. Labrecque M, Nouwen A, Bergeron M, Rancourt JF. A randomized controlled trial of nonpharmacologic approaches for relief of low back pain during labor. J Fam Pract. 1999;48(4):259–63.
139. Dong C, Hu L, Liang F, Zhang S. Effects of electro-acupuncture on labor pain management. Arch Gynecol Obstet. 2015;291(3):531–6.
140. Ye L, Mingjun X, Xiangming C, Junqin H, Dandan G, Guosheng Z, Guogang Z, Zhang S, Kai K, Chunlei Z, Yinan W, Shan L, Qinglin Z, Li X, Ming Z, Bin H, Yumiao J, Ning Z. Effect of direct current pulse stimulating acupoints of JiaJi (T10-L3) and Ciliao (BL 32) with Han's acupoint nerve stimulator on labour pain in women: A randomized controlled clinical study. J Tradit Chin Med. 2015;35(6):620–5.
141. Njogu A, Qin S, Chen Y, Hu L, Luo Y. The effects of transcutaneous electrical nerve stimulation during the first stage of labor: A randomized controlled trial. BMC Pregnancy Childbirth. 2021;21(1):164.
142. Ma W, Bai W, Lin C, Zhou P, Xia L, Zhao C, Hao Y, Ma H, Liu X, Wang J, Yuan H, Xie Y, Lu A. Effects of Sanyinjiao (SP6) with electroacupuncture on labour pain in women during labour. Complement Ther Med. 2011;19:S13–8.
143. Torkiyan H, Sedigh Mobarakabadi S, Heshmat R, Khajavi A, Ozgoli G. The effect of GB21 acupressure on pain intensity in the first stage of labor in primiparous women: A randomized controlled trial. Complement Ther Med. 2021;58:102683.
144. PourAhmad S. The effects of training based on BASNEF model and acupressure at GB21 point on the infants' physical growth indicators. Iran J Neonatol. 2014;5(3):18–24.
145. Dualé C, Breysse G, Pereira B. A systematic review of labor pain used as an outcome criterion in clinical research. Clin J Pain. 2018;34(8):769–77.
146. Lim G, Farrell LM, Facco FL, Gold MS, Wasan AD. Labor analgesia as a predictor for reduced postpartum depression scores: A retrospective observational study. Anesth Analg. 2018;126(5):1598–605.
147. Ioscovich AM, Riazanova OV, Alexandrovich YS. The relationship between labor pain management, cortisol level and risk of postpartum depression development: A prospective nonrandomized observational monocentric trial. Rom J Anaesth Intensive Care. 2018;25(2):123–30.
148. Lim G, LaSorda KR, Farrell LM, McCarthy AM, Facco F, Wasan AD. Obstetric pain correlates with postpartum depression symptoms: A pilot prospective observational study. BMC Pregnancy Childbirth. 2020;20(1):240.
149. Karakoyunlu Ö, Ejder Apay S, Gürol A. The effect of pain, stress, and cortisol during labor on breastfeeding success. Dev Psychobiol. 2019;61(7):979–87.
150. Smith CA, Levett KM, Collins CT, Armour M, Dahlen HG, Suganuma M. Relaxation techniques for pain management in labour. Cochrane Database Syst Rev. 2018;3(3):CD009514.
151. Favilli A, Laganà AS, Indraccolo U, Righi A, Triolo O, D'Apolito M,Gerli S. What women want? Results from a prospective multicenter study on women's preference about pain management during labour. Eur J Obstet Gynecol Reprod Biol. 2018;228:197–202.
152. Kempe P, Vikström-Bolin M. Women's satisfaction with the birthing experience in relation to duration of labour, obstetric interventions and mode of birth. Eur J Obstet Gynecol Reprod Biol. 2020;246:156–9.
153. Akin B, Saydam BK. The effect of labor dance on perceived labor pain, birth satisfaction, and neonatal outcomes. Explore. 2020;16(5):310–7.