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Aromatherapy in Obstetrics: A Critical Review of the Literature

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Abstract: Aromatherapy is the use of highly concentrated aromatic plant oils administered in various ways for a wide range of therapeutic indications. The purpose of this review is to present an overview of the evidence on aromatherapy during the perinatal period. There is research on the prenatal use of aromatherapy to treat nausea and vomiting, reduce stress, and support immune function; the intrapartum use of aromatherapy for labor pain/anxiety and labor progress; and the postpartum use of aromatherapy for postcesarean symptoms, perineal trauma, sleep, and symptoms of depression and anxiety. Overall, the evidence suggests that aromatherapy can be administered safely and effectively in obstetrics.
Key words: aromatherapy, essential oils, complementary medicine, parturition, prenatal, labor pain

The term "aromatherapie" first came into use in the early 20th century, although aromatic essential oils from plants have been used as perfumes and medicines for over 3500 years. René-Maurice Gattefossé, a French chemist and perfumer, coined the term, perhaps to distinguish between essential oils used in perfumery versus those used medicinally to enhance physical and mental wellbeing.[1] Unlike herbal medicine, which uses whole plants to achieve a therapeutic effect, essential oils used in aromatherapy are highly concentrated extracts derived from plant roots, leaves, bark, seeds, and flowers.[2] It can take many pounds/kilograms of plant material to produce one bottle of essential oil. The concentrated chemicals in the oils give them different properties (ie, relaxing, stimulating, pain-relieving) that can be harnessed for a beneficial effect.

Aromatherapy may help with pain management by activating thought and mental processes that interrupt the transmission of pain signals, taking attention away from a painful sensation, stimulating the release of endorphins, and helping to reframe thoughts about uncomfortable

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sensations. The theory behind this overarching pain management modality is known as "Control of the higher centers of the central nervous system," or CNSc.[3] Other pain relief strategies within the CNSc theoretical model include meditation, yoga, hypnotherapy, continuous support, breathing/relaxation techniques, and music. In addition to the CNSc mechanism, aromatherapy may also work by reducing cortisol and increasing serotonin levels.[4]

Researchers have theorized that aromatherapy exposes people to scent molecules that attach to olfactory receptors in the nasal cavity. Electrical signals are then transmitted to the brain by olfactory sensory neurons. These electrical signals stimulate the limbic system (the part of the brain that deals with emotions and memories), and by doing so aromatherapy can decrease anxiety and reduce pain perception.[4] In this regard, choosing a fragrance that is personally appealing may offer individualized benefits. In addition, models have demonstrated that the components of essential oils (when inhaled or absorbed through the skin) can enter the systemic circulation and cross the blood-brain barrier.[5]

Examining complementary and alternative medicine (CAM) therapies, such as aromatherapy, is important because their application can result in significant maternal benefits throughout the peripartum period. Beneficial effects may be due in part to the receipt of individualized, woman-centered care, as this is a philosophy of care inherent to all CAM modalities. CAM therapies embrace the concept of "holism," in which the individual is viewed as a whole person with interlinking physical, mental, and spiritual conditions. Aromatherapy is viewed as a holistic therapy, especially when administered with a manual modality such as massage. The manual effects of the massage, when combined with the psychoemotional effects of the essential oils, can create a sense of wellbeing, thus affecting body, mind, and spirit.[1]

CAM therapies, such as aromatherapy, deserve attention in obstetrics because they have become increasingly popular over recent decades. Studies report prevalence rates of CAM use in pregnancy ranging between 1% and 87%, with most estimates ranging between 20% and 60%.[6] Some of this use is self-prescribed, and some is due to health care providers prescribing or offering advice on CAM therapies. A survey of 135 health care providers (midwives, obstetricians, anesthetists) in Northeast Scotland found that a third of respondents had recommended the use of CAM therapy to pregnant clients, and of these, 24% had recommended aromatherapy.[7] In Australia, a large cross-sectional questionnaire conducted in 2009 surveyed a nationally representative sample of 8200 women about self-prescribed use of aromatherapy oils. About 10% (804) of the survey respondents were pregnant at the time of the survey, and 15.2% of these reported that they self-prescribed aromatherapy oils during pregnancy.[8] However, despite its common use in the perinatal population, some obstetric care providers remain unaware of the research evidence on aromatherapy. Therefore, this narrative review provides a critical synthesis of the best available evidence in the current literature (from within the last 10 y) on perinatal effects of aromatherapy.

Methods

We performed a search on PubMed using the key words aromatherapy AND (obstetrics or pregnancy or prenatal or labor or delivery or postpartum). Results were retrieved from within the last 10 years up to October 2020. This review was limited to studies published in the English language, and we excluded research studies on aromatherapy and breastfeeding. The search revealed 135 results. Criteria for the inclusion of studies were full-length, peer-reviewed meta-analyses, systematic reviews,

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randomized controlled trials (RCTs), and quasi-experimental trials that evaluated the effects of aromatherapy during the prenatal, intrapartum, or postpartum periods. We identified 36 studies that met our criteria for inclusion (10 meta-analyses/systematic reviews and 26 RCTs/quasi-experimental trials). A review of this literature will be discussed in the following sections.

Results

DESCRIPTION OF STUDIES

We formulated search terms and screened abstracts for all studies meeting the inclusion criteria. Altogether, this review discusses 1 systematic review[9] on nausea and vomiting during pregnancy; 2 RCTs[10,11] on stress reduction and immune function during pregnancy; 4 meta-analyses,[2,12–14] 2 systematic reviews[15,16] and 1 quasi-experimental trial[17] on labor pain/anxiety and labor progress/outcomes; 1 meta-analysis[18] and 2 RCTs[19,20] on postcesarean symptoms; and 2 systematic reviews[21,22] and 1 RCT[23] on perineal trauma, postpartum sleep, and symptoms of depression and anxiety. Supplementary Table 1 (Supplemental Digital Content, http://links.lww.com/GRF/A26) details notable essential oils that demonstrated a significant effect for each indication compared to control in randomized trials.

PRENATAL USE OF AROMATHERAPY

There is research from RCTs on the prenatal use of aromatherapy for nausea and vomiting during pregnancy, as well as for stress reduction and immune function.

Nausea and Vomiting

We found a 2018 systematic review of RCTs that investigated different complementary medicine methods used to treat nausea and vomiting during pregnancy.[9] Participants had experienced nausea with or without vomiting, were overall healthy, with a single fetus, and without any history of gastrointestinal disease. Studies were restricted to only those with the strongest methodology per Jadad criteria (a score of 3 or higher of 5). The Jadad score is a tool used to assess the methodological quality of controlled trials between 0 (very poor) and 5 (rigorous).

Of the 21 papers included in this review of complementary medicine methods, 2 assessed peppermint aromatherapy (Jadad scores of 4 and 5), and one assessed lemon aromatherapy (Jadad score of 5).

The first of the 2 studies on peppermint aromatherapy was a double-blinded study by Pasha et al[24] that randomly assigned 60 pregnant participants with nausea and vomiting to peppermint essential oil or normal saline placebo. Women in the peppermint group slept for 4 consecutive nights with a bowl of water containing 4 drops of pure peppermint essential oil placed on the floor near their beds, while those in the control group used 4 drops of saline. The researchers mentioned that they attempted to blind mothers in the control group by pouring some peppermint oil into the inner parts of the saline container's lid. The Visual Analog Scale (VAS) was used to assess the severity of nausea, and the frequency of vomiting was recorded before, during, and after the intervention. There was a decreasing trend in the peppermint group that did not reach statistical significance, possibly due to the small sample size. During the 4 days of intervention, the mean of nausea intensity was 3.50 ± 1.95 and 4.38 ± 2.18 in the peppermint and saline groups, respectively ($P = 0.140$). The mean of vomiting intensity during the 4-day intervention was 2.23 ± 1.88 in the peppermint group and 2.55 ± 2.55 in the saline group ($P = 0.577$).

Joulaeerad et al[25] carried out a single-blinded study comparing peppermint oil to almond oil (placebo) and similarly found no significant effect on the severity of nausea and vomiting during pregnancy. A total of 56 participants, all between 6 and 20 weeks of gestation with mild to moderate nausea and vomiting, were randomly assigned to

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peppermint oil or placebo. For 4 days, they were asked to drop 5 drops onto a cotton ball, hold it 1 cm below the nose, and take 3 deep breaths through the nose. They were asked to repeat this 4 times per day when they felt nauseous. Nausea and vomiting scores were assessed as a single measure with the Pregnancy Unique Quantification of Emesis/Nausea questionnaire. The results showed no difference in the severity of nausea and vomiting between placebo and intervention groups during the 4-day intervention period. At the end of the 4 days, mean scores were 5.18 ± 1.90 and 5.82 ± 2.14 in the peppermint oil and placebo groups, respectively ($P = 0.227$).

Yavari Kia et al[26] found a significant reduction in nausea and vomiting during pregnancy with lemon aromatherapy compared with placebo. In this double-blinded trial, 100 participants with nausea and vomiting during pregnancy were randomly assigned to a lemon essential oil (*Citrus lemon*) or placebo (almond oil combined with carrots to match the color of lemon oil). The participants had singleton pregnancies between 6 and 16 weeks gestation, with no major medical problems. They were taught to put 2 drops onto a cotton ball, hold it 3 cm below the nose, and take 3 deep breaths through the nose whenever they felt nauseated. The procedure could be repeated 5 minutes later. Nausea and vomiting scores were assessed with the Pregnancy Unique Quantification of Emesis/Nausea questionnaire. The mean scores of nausea and vomiting were significantly lower with lemon aromatherapy on the second [mean deviation (MD): −1.06 (−1.94 to −0.19), $P = 0.017$] and fourth [MD: −1.00 (−1.95 to −0.05), $P = 0.039$] days of treatment. The researchers reported no adverse effects from the treatment and concluded that the results were promising.

Stress Reduction and Immune Function

In the first study of its kind, researchers longitudinally followed 52 healthy women from 16 to 36 weeks gestation to determine the effects of aromatherapy massage on participants' stress levels and immune function.[10] Women with high-risk pregnancies were excluded (ie, multiple gestations, fetal growth restriction, or other abnormalities) as well as those with a history of severe illness (including depression) or reported use of medications with the potential for abuse. The intervention group received routine prenatal care plus 70 minutes of aromatherapy massage every other week for a total of 10 sessions, while the control group received only routine prenatal care (which did not include aromatherapy or massage). A certified aromatherapist delivered the massage treatment using a combination of effleurage, friction, petrissage, and vibration applied with moderate pressure to the head, neck, shoulders, arms, waist, back, legs, and feet. The massage oil consisted of 2% lavender (*Lavandula angustifolia*) essential oil; ~30 mL was used for each massage.

The study authors used salivary cortisol (μg/dL) as an indicator of stress, and salivary immunoglobulin (Ig) A (μg/mL) as an indicator of immune function. Saliva samples were collected from participants in both groups before and after the intervention group received aromatherapy massage treatment. Analysis of the saliva samples revealed that participants in the aromatherapy massage group had lower salivary cortisol ($P < 0.001$) and higher IgA ($P < 0.001$) levels immediately after each treatment compared with those in the control group. In the control group, the pretest and posttest salivary cortisol and IgA levels were similar at each time point. Aromatherapy massage also showed significant long-term effects in salivary IgA levels; the pretest levels at 32 ($P = 0.002$) and 36 ($P < 0.001$) weeks gestation were higher than the pretest IgA levels at 16 weeks (baseline).

In this study, they found no evidence of long-term effects of aromatherapy massage on salivary cortisol levels. This could be due to a physiological increase in stress

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as the pregnancy progresses, particularly after ~32 weeks gestation. In the control group, there was a significant increase in pretest salivary cortisol levels between 16 and 36 weeks. The frequency of aromatherapy massage may need to be increased after 32 weeks gestation to once or twice a week to overcome rising stress levels during pregnancy.[10] The findings suggest that prenatal aromatherapy massage could immediately relieve stress and enhance long-term immune function. However, this study was limited by the inability to separate the effects of aromatherapy from those of massage, and blinding was not possible given the nature of the intervention.

An earlier, much smaller RCT also assessed the effects of aromatherapy on stress during pregnancy.[11] This study used the Profile of Mood States (POMS) questionnaire that measures mood states by 6 scales and heart rate measurements to examine the physical and psychological effects of aromatherapy inhalation. A total of 13 pregnant women in week 28 of a low-risk pregnancy were assigned to intervention (n = 7) or control (n = 6). Participants were asked to choose one essential oil out of lavender (*L. angustifolia*), petitgrain [*Citrus aurantium* (*Fe*)], and bergamot (*C. aurantium*). All of these essential oils are high in linalool and linalyl acetate, which are thought to have relaxing effects.

Pregnant women in both groups filled out the POMS and then rested in a seated position for 10 minutes while wearing a portable heart rate monitor. During the second half of the 10-minute session, aromatherapy inhalation was given to those in the intervention group. All study subjects were aware of their group assignment. In the intervention group, the researchers observed improvements in the Tension-Anxiety Score ($P < 0.05$) and the Anger-Hostility Score ($P < 0.05$) of the POMS after aromatherapy inhalation treatment. There was also an intragroup increase in parasympathetic nerve activity ($P < 0.05$) after the intervention. The intragroup comparison suggests that aromatherapy inhalation with essential oils high in linalool and linalyl acetate could significantly decrease heart rates and improve anxiety and anger for pregnant women. There were, however, no differences observed between intervention and control groups, so further research is required. There is also a need to study these effects over longer periods of time. In this study, participants were only assessed 5 minutes postintervention.

INTRAPARTUM USE OF AROMATHERAPY

We found 2 areas of research in which there is evidence from RCTs: labor pain and anxiety, and labor progress and outcomes.

Labor Pain and Anxiety

Smith et al[2] conducted the first systematic review and meta-analysis specifically on aromatherapy for pain management in labor and concluded there is a lack of research evaluating the role of aromatherapy for labor pain management. This Cochrane review included 2 RCTs with 535 participants. In one trial, women in the experimental group could choose from 5 essential oils: Roman chamomile (*Chamaemelum nobile*), clary sage (*Salvia sclarea*), frankincense (*Boswellia carteri*), lavender (*Lavandula augustifolium*), and mandarin (*Citrus reticulata*), while the control group received standard care only. In the other trial, the experimental group was assigned to the essential oil of ginger and the control group received another essential oil (lemongrass). The trials found no difference between groups in pain intensity or epidural use.

A more recent meta-analysis and systematic review by Lakhan et al[12] referenced the above-mentioned Cochrane findings and included 2 new clinical trials. The first of these (n = 160) found lower mean pain intensity with lavender compared with control at 30 and 60 minutes

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after the intervention ($P < 0.001$).[27] The second new trial (n = 126) also found reduced pain severity following aromatherapy with a bitter orange (*C. aurantium*) at 3 to 4 cm ($P < 0.05$), 5 to 7 cm ($P < 0.05$), and 8 to 10 cm ($P < 0.05$) dilatations compared with control.[28] Both of these studies (Kaviani and colleagues; Namazi and colleagues) were included in the following 2 meta-analyses.

A 2020 systematic review and meta-analysis of 8 RCTs and 1 quasi-experimental study evaluated the effects of aromatherapy on anxiety and pain during the first stage of labor in nulliparous participants.[13] Full-text trials published in English before January 2019 were eligible for inclusion. Study subjects were low-risk primigravida with a singleton, cephalic pregnancy at term (gestational age over 37 wk) in spontaneous first-stage labor (defined as > 3 contractions in 10 min with cervical change). The authors used VAS to measure pain from 0 (no pain) to 10 (worst possible pain). To measure anxiety, they used the first 20 questions of the Spielberger's State-Trait Anxiety Inventory questionnaire, with possible scores between 20 (no anxiety) and 80 (highest possible anxiety). Trials were excluded that used different case selection criteria and measurement methods.

The 9 included trials were published between 2010 and 2018; 7 were published in Iran, 1 in Taiwan, and 1 in Thailand. The studies used different methods of administering the aromatherapy intervention. In 5 RCTs it was given via inhalation, while the control group received distilled water placebo (4 studies) or usual care (1 study). In 3 RCTs the experimental group received drops of essential oils applied to gauzes attached to their neck collars, while participants in the control groups received gauzes with drops of normal saline. Finally, the quasi-experimental study compared with massage with essential oil to massage with carrier oils alone. The essential oils administered in the studies were rose (*Rosa damascena*), bitter orange (*C. aurantium*), lavender (*L. angustifolia*), geranium (*Pelargonium graveolens*), and sweet orange (*Citrus sinesis*). One study had participants in the experimental group select from lavender, geranium rose, citrus, and jasmine, based on their personal preference. Another study with 2 experimental groups assigned participants to jasmine (*Jasminum officinale*) or salvia (*Salvia officinalis*).

Aromatherapy was shown to reduce pain in latent (cervical dilatation of 3 to 4 cm), early active (cervical dilation 5 to 7 cm), and late active (cervical dilation 8 to 10 cm) phases of first-stage labor compared with control. The corresponding VAS score reductions were MD: −1.88 (−2.98 to −0.78), $P = 0.0008$ in latent labor (5 RCTs); MD: −1.78 (−2.83 to −0.72), $P = 0.001$ in early active labor (4 RCTs); and MD: −1.72 (−2.69 to −0.76), $P = 0.0004$ in late active labor (4 RCTs). It is worth noting that although aromatherapy resulted in significantly lower pain scores compared with control, mean pain scores were still at moderate to severe levels in both groups (~6.9 vs. 8.6 in the late active phase). Epidural analgesia was not typically available or used by participants in these studies; therefore, more research is required to assess aromatherapy as an addition to pharmacological analgesia.[13,29] High heterogeneity was observed among the studies in each comparison, which could indicate effect variation from different essential oils and methods of administering aromatherapy. Subgroup analysis of lavender inhalation (2 RCTs) found a significant reduction in pain in the latent phase with moderate heterogeneity; however, the effect on early active and late active labor was not statistically significant. An analysis of 4 trials did not find a significant difference between baseline pain scores (on admission) in the experimental group and pain scores after the aromatherapy intervention [MD: −0.67 (−2.49 to 1.16), $P = 0.47$]. It may be that the pain-relieving

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effect before versus after aromatherapy was masked by an inherent increase in pain intensity with the progression of active labor, especially since epidurals were not typically utilized.

Aromatherapy also reduced participants' anxiety during latent labor compared with control [MD: −9.29 (−15.88 to −2.69), $P = 0.006$]. As with pain scores, the intragroup results comparing anxiety before and after aromatherapy did not find a significant effect [MD: −5.64 (−16.00 to 4.71), $P = 0.29$].

Another meta-analysis by Chen et al[14] also found a significant reduction in pain scores with aromatherapy during labor. Lavender was the most common oil used in these trials. The authors conducted separate analyses of RCTs with cervical dilation info and those without. The 6 trials with dilation info reported a wide range of dilations but all included the 8 to 10 cm transition phase. The aromatherapy group reported reduced pain scores in the transition phase compared with the control group [MD: −0.82 (−1.55 to −0.09), $P = 0.03$]. Meta-analysis of the 4 trials without dilation info also showed a reduction in pain scores postintervention [MD: −2.01 (−3.63 to −0.39), $P = 0.02$].

Our literature search also identified a quasi-experimental trial by Sriasih et al[17] that was too recent to be included in any of the meta-analyses. Participants were randomly assigned to massage with frangipani (Plumeria) aromatherapy oil (n = 35) or massage with virgin coconut oil as control (n = 35). The massage was applied to the back region at thoracic vertebrae 10, 11, 12, and lumbar 1 levels. Midwives began the massage treatment at 4 cm and continued the massage for 5 to 6 hours until maximal dilation at the end of first-stage labor. Before the massage treatment, both groups reported pain scores on a scale of 7 to 9 (considered severe pain). After the treatment, pain scores were significantly reduced to a median of 7 in the control group and 6 in the aromatherapy group ($P < 0.001$).

Two systematic reviews in the last few years have assessed the effectiveness of aromatherapy at managing labor pain and anxiety. Tabatabaeichehr and Mortazavi[15] evaluated 33 randomized trials conducted in English and Persian. Twenty-seven of the 33 studies were carried out in Iran. Aromatherapy was administered with inhalation, massage, footbath, birthing pool, acupressure, and compress. The essential oil most commonly used in the studies was lavender, either alone or in combination with other essential oils. Other essential oils used in the included studies were geranium, frankincense, rose, chamomile, bitter orange, jasmine, sweet orange, mandarin, peppermint, and clove. The majority of the studies (29/33) reported that aromatherapy had a significant positive effect on reducing labor pain and/or anxiety. No serious side effects to aromatherapy were reported in any of the studies. The systematic review concluded that aromatherapy could help in relieving maternal anxiety and pain during labor.

Ghiasi et al[16] reviewed 16 randomized trials, specifically focusing on aromatherapy to relieve anxiety during the first stage of labor. Aromatherapy was administered with inhalation in 12 studies and by massage in 4 studies. Lavender was the most frequently studied oil; other oils included rose, clary sage, geranium, frankincense, chamomile, bitter orange, sweet orange, peppermint, mandarin orange, jasmine, and clove. Of the 16 studies, all but 1 study found that aromatherapy significantly lowered anxiety during the first stage of labor. The systematic review recommended that aromatherapy could be applied as a complementary therapy for reducing anxiety during the first stage of labor; however, they cited the need for more methodologically rigorous studies.

Overall, the available evidence suggests that aromatherapy reduces pain and anxiety during the first stage of labor.

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Labor Progress and Outcomes

Six trials in the Chen et al[14] meta-analysis reported a comparison of the duration of the active phase of the first stage of labor. The results showed that aromatherapy consistently reduced the duration of the active phase (h) compared with control across trials [MD: −0.69 (−1.02 to −0.36), $P < 0.0001$]. There was also a reduction in the duration of the third stage (min) with aromatherapy [MD: −3.32 (−6.26 to −0.38), $P = 0.03$]; however, high heterogeneity across trials suggests other factors such as third-stage management could have influenced this outcome. The analysis showed a nonsignificant trend towards the shorter duration of second-stage labor and shorter total duration of first-stage labor (early phase, active phase, and transition phase) with aromatherapy.

Aromatherapy during labor does not appear to have an effect on the risk of intrapartum cesarean or newborn Apgar scores, suggesting that aromatherapy can be safely administered intrapartum. Six trials in the Chen et al[14] meta-analysis compared the incidence of intrapartum cesarean between groups and no differences were observed [relative risk (RR): 0.78 (0.48 to 1.26), $P = 0.31$]. Similarly, the 2 trials in Smith et al[2] found no difference in the duration of labor, rate of cesarean, or rate of assisted vaginal birth. Three trials in the Liao et al[13] meta-analysis investigated aromatherapy's potential influence on Apgar scores at 1 and 5 minutes after birth. The results did not find a significant effect on Apgar scores. The studies consistently showed no effect from aromatherapy on the cesarean rate or Apgar score.

POSTPARTUM USE OF AROMATHERAPY

We found systematic reviews and randomized controlled evidence on aromatherapy for use with postcesarean symptoms, perineal trauma, sleep, and symptoms of depression and anxiety.

Postcesarean Symptoms

A Cochrane review on CAM for postcesarean pain found 4 trials that examined the effects of aromatherapy on postcesarean pain.[18] All 4 studies provided pharmacological analgesia in both the aromatherapy groups and the control groups. Two trials tested the effects of lavender versus sham lavender or placebo, 1 via mask inhalation and the other using drops applied to cotton; 1 study compared chamomile to placebo using drops applied to cotton; and 1 study compared *C. aurantium* to saline, also using drops applied to cotton. Due to differences in data collection, data from all 4 studies could not be pooled for most of the outcomes. The Cochrane reviewers found low-certainty evidence that aromatherapy plus analgesia may slightly decrease postcesarean pain as measured by the VAS at 12 hours [MD: −2.63 (−3.48 to −1.77), $P < 0.00001$, 3 studies] and 24 hours [MD: −3.38 (−3.85 to −2.91), $P < 0.00001$, 1 study] compared with placebo plus analgesia. One study found lower diastolic blood pressure in the aromatherapy group [MD: −3.62 mm Hg (−6.97 to −0.27), $P = 0.03$], and 2 studies found a 42% reduction in RR of using additional pain medication [RR: 0.58 (0.45 to 0.75)]. The Cochrane reviewers found uncertain effects of aromatherapy on postcesarean anxiety (1 study) and vital signs other than diastolic blood pressure. There were no data on potential adverse events. Only 1 study measured patient satisfaction; the researchers found that 90% of the aromatherapy group was satisfied, compared with 50% in the placebo group ($P = 0.002$).

An additional double-blind RCT on postcesarean pain published in 2019 by Abbasijaharomi et al[19] was too new to be included in the Cochrane review. Ninety mothers who gave birth by cesarean were randomly assigned to aromatherapy with lavender, aromatherapy with damask rose, or control with distilled water. The

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aromatherapy and control treatments were administered by asking the mothers to inhale cotton balls imbibed with 3 drops of oil or water for 30 minutes. Before the intervention or control, there was no difference in VAS pain levels between groups ($P = 0.072$). Five minutes after the intervention was completed, average pain levels were significantly lower in both aromatherapy groups compared with the control (damask rose: 4.97 ± 1.92; lavender: 5.80 ± 2.01; control: 6.03 ± 1.43; $P = 0.042$). Five-minute postintervention pain levels were lower in the damask rose group than the lavender group; however, the lavender group had a trend towards the highest pain levels at baseline, which may explain why lavender did not have postintervention results as low as damask rose.

Our literature search identified 1 small RCT on aromatherapy to treat postcesarean nausea.[20] Participants were invited to take part in this study if they were scheduled for a nonemergency cesarean, English speaking, at least 18 years of age, nonsmoker, and became nauseated after their cesarean. Anyone with an allergy to peppermint or food colorings was excluded, as well as those diagnosed with persistent vomiting or receiving magnesium sulfate therapy. Potential participants were told they would be randomly assigned to 1 of 3 groups: peppermint spirits aromatherapy (*Mentha piperita*), sterile water placebo (mixed with green food coloring), or standard antiemetic therapy. The "peppermint spirits" consisted of ethyl alcohol 82%, peppermint oil, purified water, and peppermint leaf extract.

Thirty-five participants experienced postcesarean nausea and were randomly assigned to peppermint aromatherapy ($n = 22$), placebo ($n = 8$), or standard antiemetic therapy ($n = 5$). Baseline nausea was assessed with a 6-point nausea scale immediately before administering the interventions and reassessed 2 and 5 minutes after the initial intervention. Participants in all 3 groups had similar levels of nausea at baseline. The aromatherapy and placebo groups inhaled from a mini ziplock bag containing a cotton ball with 1 mL of peppermint spirits or sterile water, respectively. They held the bag 2 inches under the nose and took 3 slow, deep breaths. This intervention was conducted at baseline and again 2 and 5 minutes postbaseline. The nausea levels of participants in the peppermint spirits group were significantly lower than those of participants in the other 2 groups at 2 and 5 minutes after the initial intervention [peppermint vs. placebo at 2 min ($P < 0.001$) and 5 min ($P < 0.001$); peppermint vs. antimetic therapy at 2 min ($P = 0.001$) and 5 min ($P = 0.003$)]. Within the peppermint aromatherapy group, 17 of the 22 participants reported no nausea or slight nausea at 5 minutes, while everyone in the placebo and standard care groups still reported moderate to extreme nausea or "about to vomit." The authors concluded that peppermint spirits could be a useful adjunct in the treatment of postoperative nausea.

Perineal Trauma

Tsai et al[21] published a systematic review of 15 studies evaluating the effects of aromatherapy on a variety of postpartum outcomes. Their paper included 5 RCTs on postepisiotomy pain and healing. The results suggested that regular use of lavender inhalation and lavender added to bathwater may have beneficial effects on wound healing and pain after an episiotomy. The largest study of postepisiotomy healing included in this review was published by Vakillian et al.[30] This study took place in Iran, where nearly all primiparous women who give birth vaginally have an episiotomy. Vakillian et al[30] randomly assigned 120 postpartum women to receive lavender oil (distilled in a sitz bath twice daily for 10 d) versus povidone-iodine wound care, which is routinely recommended for postepisiotomy care in Iran. Ten days after

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entering the study, there was a trend towards more people with zero pain in the lavender oil group (41.7% vs. 28.3%), and fewer people with severe pain in the lavender oil group (13.3% vs. 30%), but the result was not statistically significant ($P = 0.063$). Examination results from a blinded midwife showed more people had zero redness in the lavender oil group (51.7% vs. 21.7%, $P = 0.001$), but there were no differences between groups in rates of edema, dehiscence, or infections.

We found one study that was not published in the Tsai et al's review; this trial took place in Egypt, which also has extremely high rates of episiotomy. In this RCT, Marzouk et al[23] analyzed data from 60 women who were randomly assigned to aromatherapy with lavender or placebo with saline. The aromatherapy group was instructed to use a sitz bath twice daily for 7 days; women were given a solution of 2% lavender-thymol (1:1) dissolved in jojoba oil, and they were instructed to mix it with 4 L of warm water. The control group followed similar instructions but added a prepared solution containing 10 mL of saline to the 4 L of warm tap water. All women received a postpartum home visit on day 7 and week 7 to evaluate incision healing and pain. The mean VAS pain scores were significantly lower in the aromatherapy group at 7 days (2.1 ± 2.2 vs. 3.5 ± 1.9, $P = 0.011$), and dyspareunia was more severe in the placebo group (5.3 ± 2.7 vs. 2.7 ± 1.5, $P < 0.001$).

An examination of analgesic use from the first 3 days postpartum revealed more analgesic use in the placebo group than the aromatherapy group. Wound healing was also better in the aromatherapy group—on day 7 the aromatherapy group had a significantly better (lower) overall Redness, Edema, Ecchymosis, Discharge, and Approximation (REEDA) score (a measurement of perineal healing) compared with the placebo-treated group (2.03 vs. 3.93, $P = 0.013$), as well as better scores on the individual subscales of redness, edema, and discharge.

Sleep

We found 2 systematic reviews on aromatherapy for postpartum sleep. The Rezai-Keikhai et al's[22] review included 3 randomized trials, while Tsai et al[21] examined only 2 of those studies and excluded the third because it did not test true aromatherapy. In the first study included in the Tsai and colleagues' review, Keshavarz Afshar et al[31] enrolled 158 healthy, nondepressed mothers who were exclusively breastfeeding their infants and had poor quality sleep as measured by the Pittsburgh Sleep Quality Index score (a scale from 0 to 21 with higher scores indicating worse sleep quality). During the first week, postpartum, participants randomly assigned to the aromatherapy group were instructed to put 4 drops of lavender oil on a cotton ball and place it in a container about 20 cm away. They took 10 deep breaths, then placed the container by their pillow until morning. The placebo group followed the same instructions but used a placebo oil instead. Eight weeks after beginning the study protocol, sleep quality was significantly improved in the aromatherapy group (from 8.29 ± 2.12 down to 6.80 ± 2.37, $P < 0.05$), but not in the control group (8.46 ± 2.3 to 7.57 ± 1.15, $P > 0.05$). Eight-week postintervention sleep quality was also significantly improved in the aromatherapy group compared with the control group (6.80 ± 2.37 vs. 7.60 ± 1.15, $P = 0.033$).

In the second randomized trial on aromatherapy for postpartum sleep, Mirghafourvand et al[32] randomly assigned 96 women in the first week postpartum to ingest placebo or essential oils. Women were excluded if they had a diagnosis of depression during pregnancy. The aromatherapy intervention consisted of drinking a glass of water with 10 drops essential orange peel oil (*C. sinensis* L.), 3

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times daily for 8 weeks. The placebo was similar in appearance and odor to the orange peel oil and ingested using the same protocol; the study was triple-blinded. Sleep quality was measured with the Pittsburgh Sleep Quality Index. At 8 weeks, after controlling for the baseline sleep score, sleep quality was significantly improved in the aromatherapy group (MD = 5.0, 95% confidence interval: 3.9-6.1, $P = 0.001$). In terms of side effects, study participants reported similar levels of dizziness in both groups. The control group had reports of heart palpitations (9.3%) and nausea (4.2%), while the aromatherapy group reported increased urination (10.4%).

Symptoms of Depression and Anxiety

We found 2 systematic reviews evaluating the effects of aromatherapy on postpartum mental health (Rezaie-Keikhaie and colleagues; Tsai and colleagues), with the Tsai and colleagues' review being more comprehensive and of higher quality.[21,22] Tsai and colleagues assessed the quality of studies using the modified Jadad scale, in which studies are scored between 0 (the lowest quality) and 8 (the highest quality); the review authors considered all studies scored ≥ 4 to be "high" quality. Tsai and colleagues found mixed results on the effects of aromatherapy on psychological health postpartum. Three studies of inhalation aromatherapy of either lavender or *C. aurantium* found improved symptoms of depression or anxiety levels. The largest of these trials (n = 140) was published by Kianpour et al[33] (modified Jadad score of 4). Immediately after giving birth, participants in Iran were randomly assigned to aromatherapy or routine care after discharge (no placebo was used). The researchers excluded anyone with pregnancy complications. The aromatherapy group was instructed to put 3 drops of lavender oil on their palms, rub them together, and inhale. This process was carried out 3 times daily for 4 weeks. The researchers measured stress, anxiety, and depressive symptoms (21-item Depression, Anxiety, and Stress Scale and the Edinburgh Postnatal Depression Scale) at 2 weeks, 1 month, and 3 months postpartum. The authors did not report baseline levels of depression and anxiety. Average scores of stress, depression, and anxiety were significantly lower in the aromatherapy group at all 3 follow-up time points. For example, at 3 months, the aromatherapy group had significantly lower stress levels (3.81 ± 3.48 vs. 7.27 ± 5.11, $P = 0.001$), anxiety levels (1.23 ± 1.94 vs. 4.13 ± 3.43, $P = 0.001$), and depressive symptoms (2.13 ± 2.44 vs. 5.07 ± 3.97, $P = 0.001$). Furthermore, the distribution of depression was significantly lower in the aromatherapy group at 2 weeks (18.6% vs. 35.7%, $P = 0.023$), 1 month (2.9% vs. 30%, $P = 0.001$), and 3 months (4.3% vs. 24.3%, $P = 0.001$). Although the results are significant, this study is limited by its lack of a placebo treatment.

Although 3 of the trials in the Tsai and colleagues' review show promising results for aromatherapy's effects on postpartum psychological symptoms, 2 trials—testing a lavender-infused bath and citrus-imbibed drink—did not find any significant effects from aromatherapy on depression and anxiety. In a high-quality study (modified Jadad score of 6), Mirghafourvand and colleagues carried out a double-blinded, RCT testing the effects of ingesting orange peel essential oil (*C. sinensis* L.) in 96 postpartum women without a history of depression. The trial protocol was previously described in the sleep section of this paper; the sleep results were published separately from the depression results. In contrast to the findings from Kianpour and colleagues, Mirghafourvand and colleagues did not find any differences between aromatherapy and placebo groups in depression (as measured by the Edinburgh Postanal Depression Scale) or state/trait anxiety (as measured by the State-Trait Anxiety Inventory questionnaire) at 8 weeks

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postpartum. Depressive symptoms improved in both groups over time (aromatherapy: 8 ± 3.6 to 6.7 ± 4.8; placebo: 8.1 ± 3.3 to 6.7 ± 4.9; $P = 0.005$) but there was no difference between groups ($P = 0.925$). State and trait anxiety scores were similar at baseline and 8 weeks postpartum in both groups.

Discussion

The physiological effects of aromatherapy are best understood from a holistic point of view, in that the whole "package" should be considered instead of just its parts. To start with, each essential oil contains many chemical constituents in various proportions to form its chemical profile. The oil's chemical profile is affected by climate, altitude, seasons, and the plant's growing conditions; deterioration occurs over time with exposure to air (oxidation), heat, and ultraviolet light.[1] Next, the method, dose, and frequency of administration influence the effects of aromatherapy. For example, hot water and steam from a bath or footbath encourages greater absorption of essential oils via the skin and via the respiratory tract; likewise, massage enhances absorption due to increased blood flow from manipulating the skin and via the inhalation of vaporized molecules.[1] Methods of administration that combine CAM therapies may have a beneficial synergistic effect, such as aromatherapy with hydrotherapy, or aromatherapy with massage therapy. Importantly, the mother's involvement in decision-making (autonomy), any additional support from care providers, and the quality of the care provider-patient relationship may also influence the therapeutic effects of aromatherapy. Finally, individual recipients may respond differently to aromatherapy because of personal characteristics affecting bioavailability (ie, age, metabolism, skin integrity) and because of their unique psychology.

Overall, we found evidence that aromatherapy can positively impact outcomes in the prenatal, intrapartum, and postpartum periods. Although 2 trials have found that peppermint oil did not reduce prenatal nausea and vomiting, 1 randomized trial found promising results for lemon oil inhalation.[23] Another randomized trial found that prenatal massage with lavender essential oil had immediate effects on stress relief, as well as a beneficial effect on long-term immune function.[10]

Aromatherapy (administered either via body massage or inhalation) appears beneficial at reducing pain throughout the entire first stage of labor and reducing anxiety during the latent phase of first-stage labor.[13] The intervention has unknown effects on anxiety in second-stage and third-stage labor. In addition, aromatherapy may be beneficial in reducing the duration of the active phase of first-stage labor and the duration of the third stage compared with control.[14] Aromatherapy during labor has not demonstrated an effect on the risk of intrapartum cesarean or newborn Apgar scores.[13,14]

Aromatherapy (administered via drops on cotton or with a mask) plus analgesia may slightly decrease pain at 12 and 24 hours after a cesarean compared with placebo plus analgesia.[18] Lavender oil added to sitz baths may benefit wound healing and pain after an episiotomy.[21,23] Aromatherapy has unknown effects on perineal tears; therefore, more research is needed to see if aromatherapy would be beneficial when caring for tears unrelated to episiotomy use. However, given the benefits seen in postepisiotomy trials, it's possible that it may be beneficial with other types of perineal trauma. In terms of postpartum sleep, lavender inhalation seemed to confer benefits on sleep quality.[31] These results are consistent with research showing a positive effect of lavender aromatherapy on sleep quality in other populations.[34,35]

A growing number of researchers have also evaluated the effects of aromatherapy on symptoms of depression and anxiety

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after giving birth. So far, inhalation of lavender and *C. aurantium* have been found to be helpful in randomized trials, while lavender-infused baths and ingestion of citrus oils have not been shown to be effective.[21] More high-quality research on aromatherapy and postpartum mental health is needed, particularly with placebo-control, blinding, and transparent reporting of randomization techniques.

Missing from the research are the voices of birthing people, as we were not able to find any qualitative studies on the use of aromatherapy in the peripartum period. However, there are several older studies that include some questions related to satisfaction and reasons for using aromatherapy. In 2000, a British prospective study by Burns et al[36] found that > 50% of mothers (n = 8058) rated aromatherapy as helpful for coping with labor. In this study, 10 different essential oils were used, based on consultation with an aromatherapist: rose (*Rosa centifolia*), jasmine (*Jasminum grandiflorum*), chamomile (*C. nobile*), eucalyptus (*Eucalyptus globulus*), lemon (*Citrus limonum*), mandarin (*C. reticulata*), clary sage (*S. sclarea*), frankincense (*B. carteri*), lavender (*L. angustifolia*) and peppermint (*Mentha piperita*). Of these, rose oil was rated most highly by mothers for coping with labor (71%), followed by lavender (50%), and frankincense (44%). Peppermint oil was rated as highly effective for nausea and/or vomiting during labor. In another study, researchers from the UK found in a retrospective analysis that women who used an aromatherapy and massage intrapartum service (AMIS) had significantly lower rates of epidural anesthesia, spinal anesthesia, and general anesthesia compared with those who did not use AMIS after adjustment for parity.[37] The most commonly reported reasons for using AMIS were for relaxation/calming (29.9%, n = 645) and pain relief (29.6%, n = 638). The researchers proposed that if aromatherapy during labor decreases the use of pain medication, this could lead to a lower cost of care. The authors reported that a year's supply of aromatherapy and massage oils cost about $500 at a center with 3000 births per year. For a comprehensive discussion of aromatherapy in maternity care and how to implement aromatherapy in practice, see the study by Tiran.[1]

POTENTIAL RISKS AND SAFETY PRECAUTIONS

Essential oils are highly concentrated chemicals that work in the same way as pharmacologic drugs once absorbed in the body. In a professional handbook authored by Tiran, the author writes that there is a misconception that aromatherapy simply involves the use of fragrant oils.[1] Instead, essential oils are very powerful and can be potentially hazardous if used inappropriately. While most oils are suitable for use in clinical aromatherapy, including during pregnancy, some are contraindicated.[1,38,39] For example, oils from sweet birch (*Betula lenta*) and wintergreen (*Gaultheria procumbens*) can cause salicylate toxicity similar to overdose from aspirin. Oils that contain high levels of phenols, such as cinnamon bark (*Cinnamomum camphora*) and clove bud, leaf, or stem (*Syzygium aromaticum*), are also generally contraindicated because of high potential for skin irritation.

All essential oils are toxic at high doses. The clinical guidelines by Tiran recommend dosages of 1% to 1.5% in pregnancy (1 drop of essential oil to 5 mL carrier oil, with grape seed being one of the most popular and inexpensive carrier oils), and 2% during labor and the postpartum period (2 drops of essential oil to 5 mL carrier oil).[1] No > 3 essential oils should be used in a blend so that problematic oils can be quickly identified. For hydrotherapy, 4 to 6 drops of essential oil in 2 mL of carrier oil can be added while running a bath (not in the presence of ruptured

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membranes), while 3 to 4 drops can be mixed into a footbath. It is thought that vaporizers should be used for no >10 to 15 minutes at a time (as overuse may desensitize the recipient to the effects of the essential oils and potentially lead to nausea, headaches, and drowsiness); vaporizers should only be used after careful consideration of all individuals who might be exposed to the vapors. Administering essential oils via the mucus membranes (oral, vaginal, or rectal) during pregnancy is not recommended. It is important to purchase oils from a reputable supplier to avoid adulteration with lower quality substances.

There is a lack of evidence on the safety of specific essential oils in the peripartum period. However, no adverse events were reported in any of the included studies[2,9,12,15] and there was no evidence of an effect on Apgar scores[13] or the rate of cesareans.[2,14] In 2000, Burns et al[36] published a large prospective study that followed 8058 mothers who gave informed consent to receive aromatherapy during labor at a British teaching hospital between 1990 and 1998. Overall, only 1% of mothers reported undesired effects from aromatherapy. The reports were typical of symptoms commonly reported during labor, so it is impossible to know whether the symptoms were caused by the aromatherapy. Also, the symptoms in this study might have been related to pharmacologic analgesia—when the study began in 1990, 13% of mothers who used aromatherapy also used pethidine; however, by 1997 this figure was <0.2%. Complaints included nausea (n = 60), itchy rash (n = 15), headache (n = 13), and quick labor (n = 9). None of the reports were linked to any adverse health outcomes.

Skin irritation and allergic contact dermatitis are potential adverse skin reactions to essential oils. A systematic review of adverse effects of aromatherapy identified lavender and peppermint among the oils most likely to cause dermatitis.[39] To minimize adverse skin reactions, clinicians are advised to take a medical history about the client's skin condition and any sensitivities or allergies.[1] Taking care to dilute the oil appropriately is for the client's benefit as well as the care provider, who may also be at risk of dermatitis from frequent exposure. Photosensitivity is a potential side effect of essential oils, especially with citrus oils (including *C. lemon* and *C. aurantium*). Although citrus oils are among the safest oils for use in pregnancy, it is best to avoid strong sun exposure for a few hours after dermal application.[1]

It is outside the scope of this review to provide complete profiles on essential oils; more detailed information can be found in professional handbooks.[1] Aromatherapy may not be appropriate for people with certain medical or pregnancy-related complications, or with particular medications. For example, aromatherapy is considered contraindicated with epilepsy, major respiratory disorders, major cardiac disease, liver/gallbladder/kidney disorders, and insulin-dependent diabetes. Note that caution is needed when using lavender with hypotension or with epidural anesthesia as it may lower blood pressure. Rose oil should be avoided until the late third trimester because of a possible mild emmenagoguic effect (herbal emmenagogues were traditionally used as abortifacients). Clary sage, also, should be avoided until term due to a possible effect on uterine action.[1]

LIMITATIONS

There has been an increase in RCTs on this topic in recent years, and the majority of trials have found benefits from aromatherapy; however, there are considerable limitations to the available research that complicate its practical application to maternity care. First, many of the trials have small sample sizes and combine other complementary therapies with aromatherapy. It is difficult or impossible to separate the effects of aromatherapy from

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those of combination interventions such as massage therapy and hydrotherapy. Second, the majority of trials on aromatherapy during the peripartum period were conducted in the Middle East (most notably Iran), which may limit generalizability to other populations with different perinatal practices. Third, another limitation is that very few studies have been conducted for several of the clinical indications. For example, the supportive evidence on aromatherapy to treat nausea and vomiting during pregnancy comes from a single trial on lemon oil. Similarly, we identified only one trial on lavender aromatherapy to reduce stress and enhance immune function during pregnancy. Stronger evidence from future RCTs and meta-analyses will be necessary to build on current findings.

Furthermore, although researchers have attempted double-blinded trials of aromatherapy (ie, with normal saline placebo, almond oil placebo), blinding may have been inadequate given the nature of the intervention. However, determining the impact of the placebo effect on the effectiveness of aromatherapy may be less important with this treatment, as aromatherapy intervention is low cost and appears to have few adverse effects,[40] although few studies have examined specific safety outcomes with aromatherapy during the peripartum period.

The authors of the Liao and colleagues' meta-analysis described the general quality of studies on aromatherapy for labor pain and anxiety as "moderate" because of weaknesses in methodology and the impractical of blinding. None of the 9 included trials in the Liao et al[13] meta-analysis were double-blinded. There was also high heterogeneity across the trials, and this limitation requires further exploration in subgroup analyses. Therefore, more clinical trials with high methodological quality are needed before strong recommendations regarding efficacy can be made to expectant parents and clinicians. As far as using aromatherapy to decrease postcesarean pain, the Cochrane authors called the evidence "low-certainty" due to the risk of bias. The evidence on using aromatherapy to treat postcesarean nausea is limited to 1 small RCT. Finally, there is limited data on which specific essential oils are best for different clinical indications; lavender oil was featured in many studies, however, this may be more a sign of its popularity rather than superior clinical effectiveness.[1] Future trials should be conducted in diverse settings with a large enough sample size to detect effects on clinical outcomes. Studies with random assignment to several different essential oils and methods of administration may be especially useful.

However, despite these research limitations, the essential oils covered in the reviewed studies were not shown to cause harm during the perinatal period. The use of aromatherapy appears to be accepted by clients as helpful for coping with nausea/vomiting and stress during pregnancy, labor pain, and anxiety, and postcesarean symptoms, perineal trauma, sleep quality, and depression/anxiety.

Conclusions

In the past 10 years, a growing body of research has demonstrated the potential benefits of aromatherapy during the perinatal period. Obstetric providers should be aware that pregnant clients in their care might be using this modality during pregnancy, labor, and postpartum. Similarly, there is a need for more open communication between pregnant people and care providers about aromatherapy use, as well as a need for provider training on aromatherapy (and other CAM modalities). To attain a more holistic set of skills and knowledge, obstetric care providers should understand the reasons why clients may seek aromatherapy during the peripartum period, contraindications and precautions regarding aromatherapy, and the evidence on aromatherapy for a variety of indications.

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