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Systematic Review

Aromatherapy for the Management of Menopause Symptoms: An Updated Systematic Review and Meta-analysis

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Abstract

Introduction: Numerous studies have found aromatherapy beneficial during menopause; however, some of its effects are still unclear in past meta-analyses, and no comprehensive study has consolidated and analyzed grading evidence of its impact on menopausal symptoms. Therefore, the present meta-analysis aimed to determine and update the impact of aromatherapy on the management of menopausal symptoms.

Methods: We conducted a comprehensive literature search using PubMed, Web of Science, Scopus, and the Cochrane Library until January 20, 2024, without any limitations on language, time, or region to find randomized clinical trials. To evaluate the included trials' methodology, we used version 2 of the Cochrane Handbook's risk-of-bias assessment, as well as GRADEpro GDT (Guideline Development Tool) for quality evidence and Review Manager software (RevMan version 5.1) for analysis.

Results: We conducted a meta-analysis of 13 randomized controlled trials (RCTs) with mixed quality from 15 trials with 1217 participants. Compared to the control group, aromatherapy reduced physical (SMD -0.93, 95% CI -1.19 to -0.67, $P<0.00001$), psychological (SMD -0.83, 95% CI -1.13 to -0.54, $P<0.00001$), and overall symptoms (SMD -1.51, 95% CI -2.11 to -0.90, $P<0.00001$), enhanced sexual function (MD 5.58, 95% CI 0.98 to 10.17, $P=0.02$), and the quality of sleep (MD -4.51, 95% CI -7.45 to -1.57, $P=0.003$). The evidence grading for physical symptoms was moderate, and other variables were low to very low.

Conclusion: Aromatherapy is efficacious for managing the symptoms of menopause. However, there is insufficient high-quality evidence for some outcomes, indicating the necessity for additional research.

Introduction

Menopause is a significant milestone in a woman's life that signifies the conclusion of her ability to reproduce.[1] The average worldwide life expectancy recorded a major increase from 66.8 years in 2000 to 73.3 years in 2019.[2] The World Health Organization predicts that the population of menopausal women will reach 1.2 billion by the year 2030.[1] By 2030, it is expected that 76% of the projected population will reside in developing countries.[3] The health of women during menopause has become a global concern, as they typically spend approximately one-third of their lifespan at this stage.[4] The symptoms experienced during menopause are diverse and result from a complex combination of biological, social, and psychological variables.[5] The typical manifestations of menopause can be classified into three main groups: short-term impacts such as hot flashes, sweating, psychological issues, sleep disturbances, and joint pain; intermediate difficulties including vaginal and urinary symptoms, as well as sexual difficulties; and long-term symptoms such as osteoporosis and cardiovascular disease.[6,7] Globally, moderate-to-severe vasomotor symptoms were more common in Europe (40%) than the USA (34%), and both were greater than Japan (16%),[8] 31% in France, and 52%

in Italy.[9] Between 13% and 87% of women experiencing menopause have at least one symptom associated with genitourinary syndrome of menopause.[10]

Menopause, a natural stage of the female life course that occurs as a result of aging in women, could increase the risk of health problems.[11] The treatment options for menopause symptoms are broadly classified into two categories: pharmacological and nonpharmacological. Long-term use of hormone replacement therapy is a pharmacological treatment that has a risk of major side effects. Consequently, during the past ten years, a large number of women have been investigating safer and more profitable alternative medicines.[12] Among the non-pharmacological, complementary, and alternative therapies available, aromatherapy is highlighted as one of the various approaches. [13]

The results of an investigation of a study carried out in Indonesia indicate that fennel aromatherapy has a significant impact on reducing the severity of menopausal symptoms ($P<0.0001$).[14] The findings of Kian et al, which demonstrate that fennel can enhance menopausal women's quality of life and reduce menopausal symptoms without having any negative side effects, further confirm this.[15] Another study's findings indicate that using Lavandula angustifolia Mill. essential oil reduces menopause symptoms.[16] Additionally, according to Lucena et al the aromatherapy intervention using lavender essential oil was effective in improving the overall quality of life in postmenopausal women.[17] Aromatherapy has also been shown to reduce anxiety and enhance relaxation, potentially providing relief for distressing menopausal symptoms.[18]

Even though several studies have found aromatherapy to be beneficial during menopause, there is presently no updated comprehensive study that consolidates and analyzes all of the effects of this alternative method on menopausal symptoms. Therefore, the present meta-analysis aimed to determine and update the impacts of aromatherapy on the management of menopausal symptoms. While previous studies have explored the benefits of specific aromatherapies such as lavender,[19,20] this updated meta-analysis is unique in its attempt to consolidate and analyze the effects of various massage and inhalation aromatherapies on menopausal symptoms. This study addresses a significant gap in the literature by providing an updated synthesis of evidence on the use of safe and effective non-pharmacological therapies for managing menopausal symptoms. Another key novelty of this study is its recency, as it provides an updated synthesis of evidence that surpasses previous reviews from at least the past four years.[21,22] This ensures the inclusion of the latest research findings, making it a timely and valuable contribution to the field of menopause management and alternative medicine. The ultimate goal of this study is to empower menopausal women to manage their symptoms autonomously and securely, enhancing their quality of life.

Material and Methods

This research project has received approval from the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran (Ref. No: IR.AJUMS.REC.1402.642), ensuring that the study adheres to the highest ethical standards.

Study Design

The design of this study is a systematic review and meta-analysis, which adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This approach guarantees a transparent and rigorous reporting of the study.[23]

Search Strategy

We formulated an extensive search strategy to identify pertinent studies. We searched the databases of PubMed, Web of Science, Scopus, and Cochrane Library from their inception until January 20, 2024. The search terms comprised variations of "aromatherapy," "menopause," "symptoms," and "randomized controlled trials." We also manually searched the reference lists of the included studies and relevant reviews (Supplementary file 1).

Study Selection

Two independent reviewers conducted a screening of the titles and abstracts of the articles retrieved to identify studies that could potentially be relevant. We then evaluated the full texts of the chosen articles for eligibility based on pre-established inclusion and exclusion criteria.

Inclusion and Exclusion Criteria

The studies that were considered for inclusion were randomized controlled trials (RCTs) that compared the impact of aromatherapy with a control group in managing symptoms of menopause. Secondary outcomes included menopausal women's sleep quality and sexual function. We excluded studies that were not RCTs, did not involve menopausal patients, or did not report relevant outcomes.

Data Extraction

Two independent reviewers performed data extraction using a standardized form. The extracted information from each study included study characteristics (author, year of publication), randomization, blindness, participant characteristics, intervention details, control or comparison, outcomes assessed, tools, and findings.

Assessment of Risk of Bias

The Cochrane Risk of Bias 2 (RoB2) tool[21] was used to assess the methodological quality of the included studies. This standardized tool is used for assessing the risk of bias in RCTs included in systematic reviews and meta-analyses. The RoB2 tool evaluates bias in five key domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to

missing outcome data, bias in the measurement of the outcome, and bias in the selection of the reported result. For each domain, the RoB2 tool provides specific signaling questions that guide reviewers in assessing the risk of bias. These questions help reviewers evaluate the adequacy of randomization, blinding, handling of missing data, and other factors that could affect the validity of study results. Based on individual domains, we assessed the overall risk of bias for each included study. The assessment rated the studies as either high, with some concerns, or low quality.[24]

Data Synthesis

In our quantitative analysis, the mean difference (MD) was calculated as the primary effect size for continuous outcomes measured on the same scale across all trials, with results reported as MD and 95% CI. For outcomes assessed using different scales in the included studies, the standardized mean difference (SMD) was used instead.[25] Forest plots were utilized to make a graph of the estimated data for the effect size and a *P* value of 0.05 was determined to be statistically significant. The I^2 value, which calculates the amount of overall variance that may be attributed to heterogeneity, was used to assess heterogeneity. The fixed effects model was selected for pooling the results of the studies if the values were less than 50%. We used a random effects model if it was greater than 50%. Publication bias was assessed using funnel plots. The RevMan 5.1 software (Cochrane Collaboration, Oxford) was used for all analyses. Findings that could not be meta-analyzed were reported qualitatively.

Evidence Certainty Assessment

To determine the quality of evidence for outcomes, we used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) tool. This tool categorizes systematic reviews or meta-analyses into four groups: 'high', 'moderate,' 'low,' and 'very low'. We started with a 'high' grade and downgraded it if we found bias, inconsistency (I-squared statistics > 50%), indirectness (intervention differences), imprecision (95% CI includes 1.0), or publication bias. Conversely, we raised the rating to 25 if there was a significant intervention effect or if all reasonable biases would reduce the amount of the intervention's effect in the event of a dose-response association.[26] Two researchers independently performed the GRADE assessment and resolved any discrepancies through discussion.

Ethical Considerations

We conducted this meta-analysis strictly adhering to ethical standards in research. Existing studies were the primary data sources, and as a result, no direct human or animal subjects were included in our analysis. However, we ensured that all included studies had obtained appropriate ethical approval from their respective institutional review boards or ethics committees.

Results

Study Selection

The selection process is depicted in Figure 1. Initially, a total of 250 records were found from the database search.

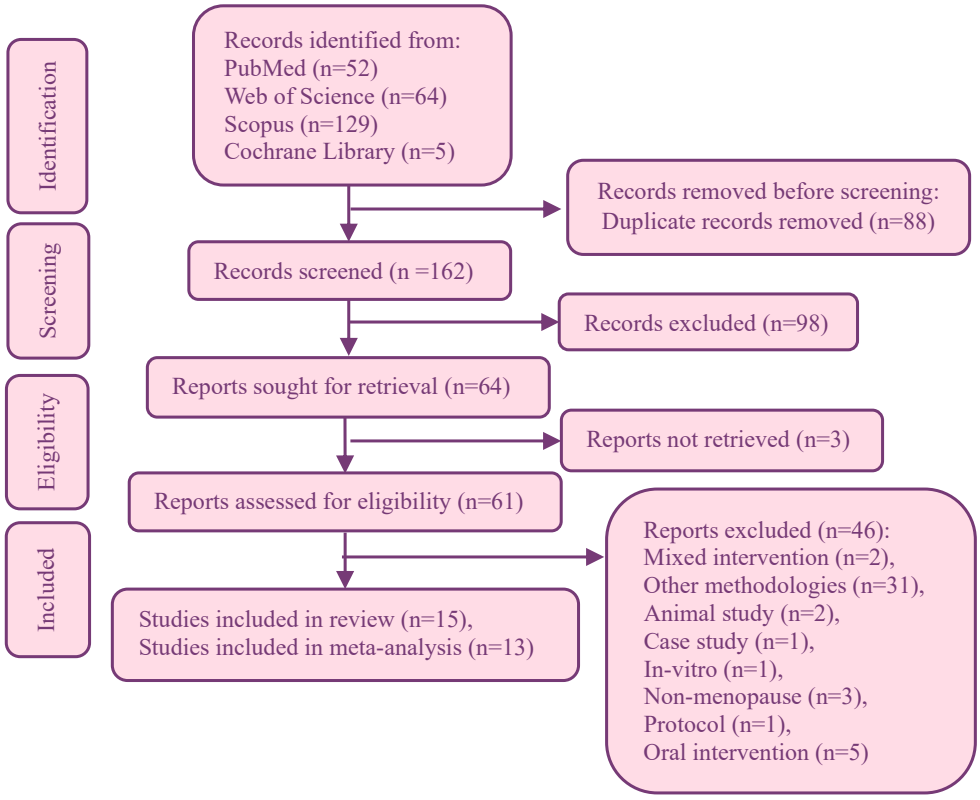

Figure 1. PRISMA 2020 Flow Diagram For Systematic Reviews

After the removal of duplicates, we were left with 162 studies. Upon reviewing the titles and abstracts, 98 studies were excluded. During the full-text review, an additional 46 studies were excluded. Consequently, 15 studies with a total of 1217 participants were included in the systematic review, and out of these, 13 RCTs were considered for the meta-analysis.

Included Studies Characteristics

The characteristics of the included studies are shown in Table 1. The included studies were conducted in Iran (n = 13), South Korea (n = 1), Turkey (n = 1), and Brazil (n = 1). The included RCTs were published between 2012[27] and 2023.[28,29] Two studies were published in Farsi[30,31] and others in English. Four studies were designed as a three-arm RCT[27,28,32,33] and one was four-arm trial.[34] The remaining ten had two arms. In seven trials, lavender oil was used for aromatherapy,[30,35-40] two studies used *Citrus aurantium*[41,42] and one study used officinalis.[29] In Döner et al's study, lemon and peppermint oils were compared with placebo.[28] Four RCTs used combined aroma oils.[27,31,32,34] Massage aromatherapy was used in three studies[27,28,32] and inhalation aromatherapy was used in other studies.

Methodological Quality

The risk of bias judgment for included studies is depicted in Table 2 and Figure 2 shows the review authors' judgments about each risk of bias domain presented as percentages across all included RCTs. Seven trials were judged to be at low risk of bias for all domains. However, four studies were rated as having some concerns.[30,34,37,38] These concerns could be related to randomization, deviations from the intended interventions, and missing outcome data. Additionally, four studies[27,31,32,40] were judged to be at high risk of bias. The high risk of bias in these studies could be due to several factors such as randomization, blinding, selective outcome reporting, or incomplete outcome data. While the presence of a high risk of bias or some concerns does not necessarily invalidate the results of these studies, it does suggest that we should interpret the findings with caution. The potential impact of these biases on the overall results of our meta-analysis was carefully considered in our interpretation and conclusions. Throughout the process, the authors observed no disagreement, indicating a consensus in evaluating the risk of bias in the included studies. This consensus strengthens the reliability of our bias assessment and, consequently, the validity of our meta-analysis findings.

The findings of the Meta-analysis

Effect of Aromatherapy on Menopause Symptoms

Figure 3 illustrates the impact of aromatherapy on the various symptoms associated with menopause. A meta-analysis of four RCTs with a total of 259 women who have undergone menopause, indicates a notable decrease in physical menopausal symptoms for those who received aromatherapy compared to the control group (SMD -0.93, 95% CI -1.19 to -0.67, $P < 0.0001$) (Figure 3A). The low heterogeneity among the studies warranted the use of a fixed effect model ($\chi^2 = 4.70$, $I^2 = 36\%$, $P = 0.19$), and the limited number of studies meant that publication bias was not assessed for this outcome.

Furthermore, the study found a considerable alleviation of psychological symptoms in postmenopausal women who underwent aromatherapy when compared to the control group (SMD -0.83, 95% CI -1.13 to -0.54, $P < 0.00001$) (Figure 3B). The presence of heterogeneity led to the adoption of a random effect model ($\chi^2 = 18.39$, $I^2 = 56\%$, $P = 0.02$). Subgroup analysis further demonstrated that both inhalation (SMD -0.64, 95% CI -0.89 to -0.39, $P < 0.00001$) and massage (SMD -1.09, 95% CI -1.71 to -0.47, $P = 0.0006$) methods of aromatherapy significantly lessened psychological symptoms of menopause. The presence of heterogeneity led to the adoption of a random effect model for massage aromatherapy ($\chi^2 = 12.35$, $I^2 = 76\%$, $P = 0.006$). No heterogeneity was found in the inhalation subgroup ($\chi^2 = 1.06$, $I^2 = 0\%$, $P = 0.90$). Figure 4 presents the funnel plot illustrating the effect of aromatherapy on the psychological symptoms of menopause. A visual inspection of the plot reveals noticeable asymmetry, which may indicate the presence of publication bias. However, the reliability of this observation is limited due to the small number of included studies. Additionally, the observed asymmetry could be influenced by other factors,

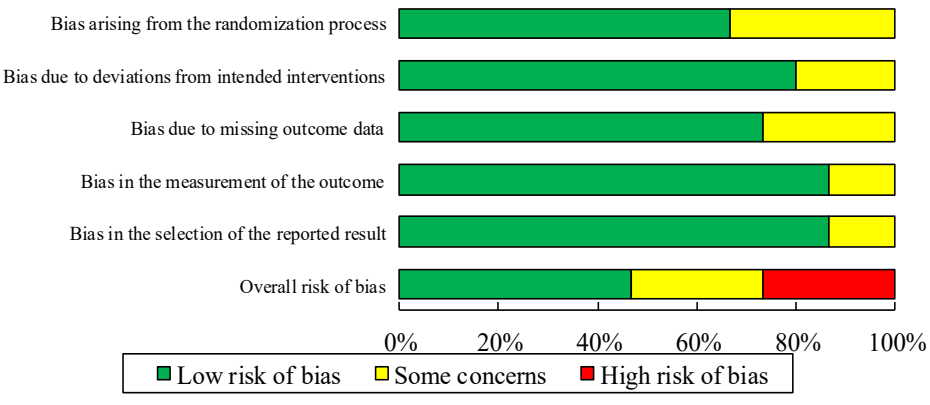

Figure 2. Risk of bias graph: review authors' judgments about each risk of bias domain presented as percentages across all included RCTs

Table 1. Characteristics of the included studies

First author/ country/ year	Randomization/ concealment/ blindness	Participants age range	Inclusion criteria	Intervention	Control	Outcome(s)	Tool(s)	Finding(s)
Abbaspoor et al[41] Iran 2022	Table of random numbers/ identical containers coded by a pharmacist/ double-blinded	45-60	Menstrual cessation for at least 12 months, ability to read and write, a score ≥ 5 from the Pittsburgh sleep quality questionnaire, no mental and physical diseases, no smoking, no drinking alcohol, no history of allergic rhinitis or a known respiratory problem such as asthma, no experience of stressful events during the 6 months before the study, and available health records in the health care center.	N = 40 Inhalation aromatherapy with 2 drops of *Citrus aurantium*, twice a day, for 4 days in a week, for 4 weeks	N = 40 Placebo (almond oil)	Quality of sleep	PSQI	After 4-weeks of intervention, the mean score of sleep quality and all dimensions of PSQI were improved significantly in the intervention group compared to the control
Bakhtiari et al[36] Iran 2019	systematic random sampling/ coded envelops /single-blinded	> 45	Lack of a menstrual period during at least the last 12 months, passage of a maximum of 5 years and at least 1 year of menopause age, confirmation of general health by a physician, lack of chronic diseases, lack of sensitivity to herbal medicines, lack of use of treatments like HRT in the last 6 months, lack of emotional problems with spouse, lack of severe stress, anxiety, insomnia, or depression in the past 6 months	N = 35 Inhalation aromatherapy with 2% lavender essential oil every night before bedtime for 20 minutes during one month.	N = 35 Placebo (distilled water)	Quality of Life	MENQOL	The mean score of life quality and all its dimensions were improved significantly in the intervention group compared to the control
Choi et al[42] South Korea 2014	random number table / coded bottles by compounder/ double-blinded	≤ 65	Natural menopause, no experience of HRT or aromatherapy in the previous 6 weeks, no history of psychiatric illness, no current medication for anxiety or depression, no disturbance of olfactory acuity, no allergies related to aromatherapy	N = 27 Inhalation aromatherapy with 0.1% neroli oil (*Citrus aurantium* L. var. amara) for 5 min twice daily for 5 days N = 27 Inhalation aromatherapy with 0.5% neroli oil for 5 min twice daily for 5 days	N = 27 Placebo (almond oil)	Menopause-related symptoms, sexual desire, stress, serum cortisol and estrogen, blood pressure, pulse rate	MENQOL VAS	Two groups treated with neroli oil demonstrated notable enhancements in the physical domain score of the MENQOL and in sexual desire. The group that inhaled 0.5% neroli oil exhibited a significantly reduced systolic blood pressure compared to the control group. When compared to the control group, both neroli oil groups displayed a significant decrease in diastolic blood pressure and showed tendencies towards improved pulse rates and serum cortisol and estrogen levels
Darsareh et al[27] Iran 2012	Block randomization/ NI/ NI	45-60	Amenorrhea for at least 12 months, no serious chronic medical conditions, normal pap smear test in the past 12 months, no abnormal clinical findings, lack of allergies related to aromatherapy	N = 28 Massage aromatherapy in 30-minute sessions twice a week for 4 weeks with aroma oil (lavender, rose geranium, rose, and rosemary in a 4:2:1:1 ratio, diluted almond (90%) and evening primrose oil (10%) at a final concentration of 3%.)	N = 29 placebo (odorless liquid petrolatum N = 30 Control (no treatment)	Menopausal symptoms	MRS	The menopausal score was lower in both the group receiving aromatherapy massage and the group receiving placebo massage, compared to the control group.
Döner et al[28] Turkey 2023	Internet-based randomization/ NI/ double-blinded	45-65	Having a score above 1 point in the MRS, no respiratory disease such as asthma or bronchitis absence of HRT, no allergy to the aromatherapy, being diagnosed with a menopausal or postmenopausal period by a doctor.	N = 21 Massage aromatherapy with lemon oil twice a week for 4 weeks in 30 min-sessions N = 21 Massage aromatherapy with peppermint oil in the same way	N = 20 Placebo (almond oil)	Menopausal symptoms	MRS	Menopausal symptoms were effectively alleviated by both peppermint and lemon oil. However, peppermint essential oil demonstrated a higher efficacy in reducing these symptoms compared to lemon oil

Table 1. Continued.

First author/ country/ year	Randomization/ concealment/ blindness	Participants age range	Inclusion criteria	Intervention	Control	Outcome(s)	Tool(s)	Finding(s)
Dos Reis Lucena et al[35] Brazil 2021	Excel random number generator / numbered bottles/ double-blinded	48-65	Postmenopausal women with at least one year of amenorrhea and clinically diagnosed with insomnia	N=17 Inhalation aromatherapy with Lavandula and sleep hygiene instructions (2 min just smelling the oil lightly and repeated after 10 min. After the second inhalation, they should be ready for bed. They were instructed to empty the contents of the bottle onto a cotton ball positioned beside the pillow)	N=18 Placebo (sunflower oil) and sleep hygiene instructions	Sleep quality Polysomnography data, Severity of insomnia, Anxiety and depression symptoms, Postmenopausal symptoms	PSQI ISI HADS MRS	No significant differences were observed between groups
Gholamalian et al[30] Iran 2015	NI/ NI/ double-blinded	45-65	At least one year has passed since the last menstrual period, no history of allergic rhinitis and known respiratory problems such as asthma, no physical and mental illnesses, no drug, tobacco and alcohol use.	N=38 Inhalation aromatherapy with 2 drops of lavender essential oil (10%) for 3 nights in a week, for a month	N=38	Sleep quality	PSQI	Significant improvement of sleep quality in the intervention group compared to the control group
Heydarpour et al[29] Iran 2023	Table of random numbers/ identical coded containers/ triple blinded	45-60	Menopause for at least 12 months, ability to read and write, FSFI score≤28, being married and living with a husband, not having mental or physical illness, not smoking, no alcohol consumption, no history of allergic rhinitis or known respiratory problems, no experience of stressful events during the 6 months before the study, and having a health record at the health care center	N=32 Inhalation aromatherapy with 2 drops of 10% Salvia officinalis essence, respectively on the skin of their forearm twice a day for 5 consecutive days per week, continued for 6 weeks	N=32 Placebo (almond oil)	Sexual function, sexual satisfaction	FSFI Lindaberg's Sexual Satisfaction Questionnaire	Significant improvement of sexual function and satisfaction in the intervention group compared to the control group
Jokar et al[37] Iran 2018	Lottery/ identical coded containers / dingle-blinded	≥45	No menstrual cycle in the past twelve months, being menopause for 1–5 years, high general health status as approved by a general physician, no history of sensitivity to herbal products, no use of HRT in the past six months, no marital conflict, no serious stress in the past six months, no olfactory disorder and chronic disease	N=35 Inhalation aromatherapy with two drops of 2% lavender essential oil for twenty minutes per night before sleep for four weeks	N=35 Placebo (distilled water)	Menopausal symptoms	KMI	Menopausal symptoms in both intervention and placebo groups significantly decreased during the study, but the decrease in the intervention group was significantly greater than the placebo group
Jokar et al[38] 2020	Lottery/ sealed numbered envelops/ double blinded	>45	Absence of menstrual periods for at least 12 months and postmenopausal for a maximum of 5 years, a depression score>10 on the BDI	N=25 Inhalation aromatherapy with two drops of 2% lavender essential oil for 20 minutes per night before sleep for four weeks	N=25 Placebo (distilled water)	Depression Anxiety	BDI STAI	state anxiety and depression were less in the intervention group compared with the control group. no significant difference was observed between the 2 groups in the mean score of trait anxiety
Kazemzadeh et al[39] Iran 2016	computerized random number table/ numbered bottles in the same shape and size/ double-blinded	45-55	Lack of menstruation in the past 12 months, having normal blood pressure, not taking HRT in the past 6 months, lack of asthma and other allergies, married, and literate	N=50 Inhalation aromatherapy with lavender twice a week for 20 minutes for 12 weeks	N=50 Placebo (diluted milk)	hot flushing numbers	Daily recording by the women	The flushing number significantly decreased in the intervention group than in the control group

Table 1. Continued.

First author/ country/ year	Randomization/ concealment/ blindness	Participants age range	Inclusion criteria	Intervention	Control	Outcome(s)	Tool(s)	Finding(s)
Malakouti et al[31] Iran 2016	random number table/ sealed numbered envelops/ double-blinded	45-55	Women with natural menopause, no use of any drugs affecting the sexual response of the individual, no known mental problems or systemic disease affecting sexual performance, no disturbance in the sense of smell according to the person's statement, and absence of digestive disorders	N = 60 Inhalation aromatherapy with 2-3 drops of aroma solution (combination of lavender, fennel, geranium and rose in equal proportions) 3 times a day for 6 weeks	N = 60 Placebo (propylene glycol)	Sexual function	FSFI	Significant improvement of sexual function in the intervention group compared to the control group
Mojtehedi et al[34] Iran 2022	Random allocation software/ numbered opaque envelopes/ no blindness	50-60	Married literate postmenopausal women, FSFI score < 28, having mild to moderate anxiety based on the Beck Anxiety Scale, having sexual intercourses, monogamous family, normal menopause, no physical and mental illnesses, no use of drugs that affect sexual intercourse, no consumption of herbal substances to increase sexual desire in man or woman, no allergy to any of the herbal medicines, no addiction or 2018 habitual consumption of alcohol and tobacco by the woman, an unfortunate event at the last 3 months, no impaired smelling sense and other nasal disorders, and not using of HRT for the past 6 months.	N = 33 Inhalation aromatherapy & routine care. A combined aroma with a concentration of 0.04% of bergamot essential oil and 5% lavender was used 3 times a day for 8 weeks N = 33 Aromatherapy & mindfulness N = 33 Mindfulness & placebo	N = 33 Placebo (propylene glycol) & routine care	Sexual function Anxiety Depression	FSFI BAI BDI-II	It appears that both mindfulness and aromatherapy have positive effects on sexual function and anxiety during menopause. Specifically, mindfulness enhances sexual function, whereas aromatherapy helps alleviate anxiety and depression
Nikjou et al[40] Iran 2018	Random number table/ NI/ double-blinded	45-55	Lack of menstruation in recent 12 months, having normal blood pressure, married, literate	N = 50 Inhalation aromatherapy with lavender two times daily for 20 min during 12 weeks	N = 50 Placebo (diluted milk)	Menopausal symptoms	Greene Climacteric Scale	the rate of the menopause symptoms has been decreased significantly in the intervention group compared to the control
Taavoni et al[32] Iran 2013	NI/ NI/ no blindness	45-60	Amenorrhea for at least 12 months, married, no serious chronic medical conditions, normal pap smear in the past 12 months, no clinically abnormal findings in physical examinations, no allergies to aromatherapy	N = 30 Massage aromatherapy with a combination of lavender, geranium, rose and rosemary in a 4:2:1:1 ratio, diluted almond (90%) and evening primrose oil (10%) in 30 min sessions, twice a week, for four weeks N = 30 Message with odorless oil (soft paraffin)	N = 30 no treatment	Psychological symptoms of menopause	Psychological subscale of MRS	Aromatherapy massage decreased the psychological score more than massage therapy

PSQI: Pittsburgh Sleep Quality Index; MENQOL: Menopause-Specific Quality of Life Questionnaire; HRT: hormone replacement therapy; VAS: Visual analog scale; MRS: Menopause rating scale; NI: No information; HADS: Hospital Anxiety and Depression Scale; ISI: Insomnia Severity Index; FSFI: Female sexual function index; KMI: Kupperman Menopausal Index; STAI: Spielberger State-Trait Anxiety Inventory; BAI: Beck Anxiety Inventory; BDII: Beck Depression Inventory.

Table 2. Risk of bias judgment for included studies

First author's name, year	D1	D2	D3	D4	D5	Overall
Abbaspoor et al[41] 2022	Low	Low	Low	Low	Low	Low
Bakhtiari et al[36] 2019	Low	Low	Low	Low	Low	Low
Choi et al[42] 2014	Low	Low	Low	Low	Low	Low
Darsareh et al[27] 2012	Some concerns	Some concerns	Low	Low	Low	High
Döner et al[28] 2023	Low	Low	Low	Low	Low	Low
Dos Reis Lucena et al[35] 2021	Low	Low	Low	Low	Low	Low
Gholamalian et al[30] 2015	Some concerns	Low	Low	Low	Low	Some concerns
Heydarpour et al[29] 2023	Low	Low	Low	Low	Low	Low
Jokar et al[37] 2018	Low	Low	Some concerns	Low	Low	Some concerns
Jokar et al[38] 2020	Low	Low	Some concerns	Low	Low	Some concerns
Kazemzadeh et al[39] 2016	Low	Low	Low	Low	Low	Low
Malakouti et al[31] 2016	Some concerns	Low	Some concerns	Low	Low	High
Mojtehedi et al[34] 2022	Low	Some concerns	Low	Low	Low	Some concerns
Nikjou et al[40] 2018	Some concerns	Low	Some concerns	Some concerns	Some concerns	High
Taavoni et al[32] 2013	Some concerns	Some concerns	Low	Some concerns	Some concerns	High

D1: Bias arising from the randomization process; D2: Bias due to deviations from intended interventions; D3: Bias due to missing outcome data; D4: Bias in the measurement of the outcome; D5: Bias in the selection of the reported result.

such as heterogeneity in intervention effects.

In terms of overall menopausal symptoms, the intervention group experienced a substantial reduction (SMD -1.51, 95% CI -2.11 to -0.90, $P<0.0001$) (Figure 3C). However, subgroup analysis revealed that while inhalation aromatherapy did contribute to a decrease in overall symptoms, the change was not statistically significant ($P=0.05$). Conversely, massage aromatherapy did result in a significant diminution of these symptoms ($P<0.0001$). Owing to notable heterogeneity ($\chi^2=25.35$, $I^2=80\%$, $P=0.0001$), a random effect model was applied, and similar to the physical symptoms, the small number of studies precluded the evaluation of publication bias for overall symptoms.

Effect of Aromatherapy on the Sexual Function of Menopausal Women

Figure 5 shows a forest plot of the effect of aromatherapy on menopausal women's sexual function. The overall effect size and the test for overall effect suggest that aromatherapy is beneficial for improving sexual function in menopausal women when compared to a control group (MD 5.58, 95% CI 0.98 to 10.17, $P=0.02$). The high I^2 value indicates substantial heterogeneity among the studies ($\chi^2=68.32$, $I^2=97\%$, $P<0.00001$). We did not assess the publication bias for this outcome due to the limited number of studies.

Effect of Aromatherapy on Sleep Quality of Menopausal Women

Based on Figure 6, which is about the impact of aromatherapy and sleep quality of menopausal women, the meta-analysis of 3 studies on 181 women showed that aromatherapy caused a significant improvement in the sleep quality of menopausal women compared to the control group (MD -4.51, 95% CI -7.45 to -1.57, $P=0.003$). The random effect model was used because significant heterogeneity was found ($\chi^2=46.49$, $I^2=96\%$, $P<0.00001$). The publication bias was not calculated.

Certainty of the Evidence

Table 3 shows the GRADE evidence profiles for outcomes among the trials included in the systematic review. The evidence grading for physical symptoms of menopause was considered moderate, having received one downgrade due to serious imprecision. The evidence grading for the sleep quality was low. Serious inconsistency, imprecision, and a serious risk of bias led to their downgrading. Ultimately, the grading of the evidence for overall

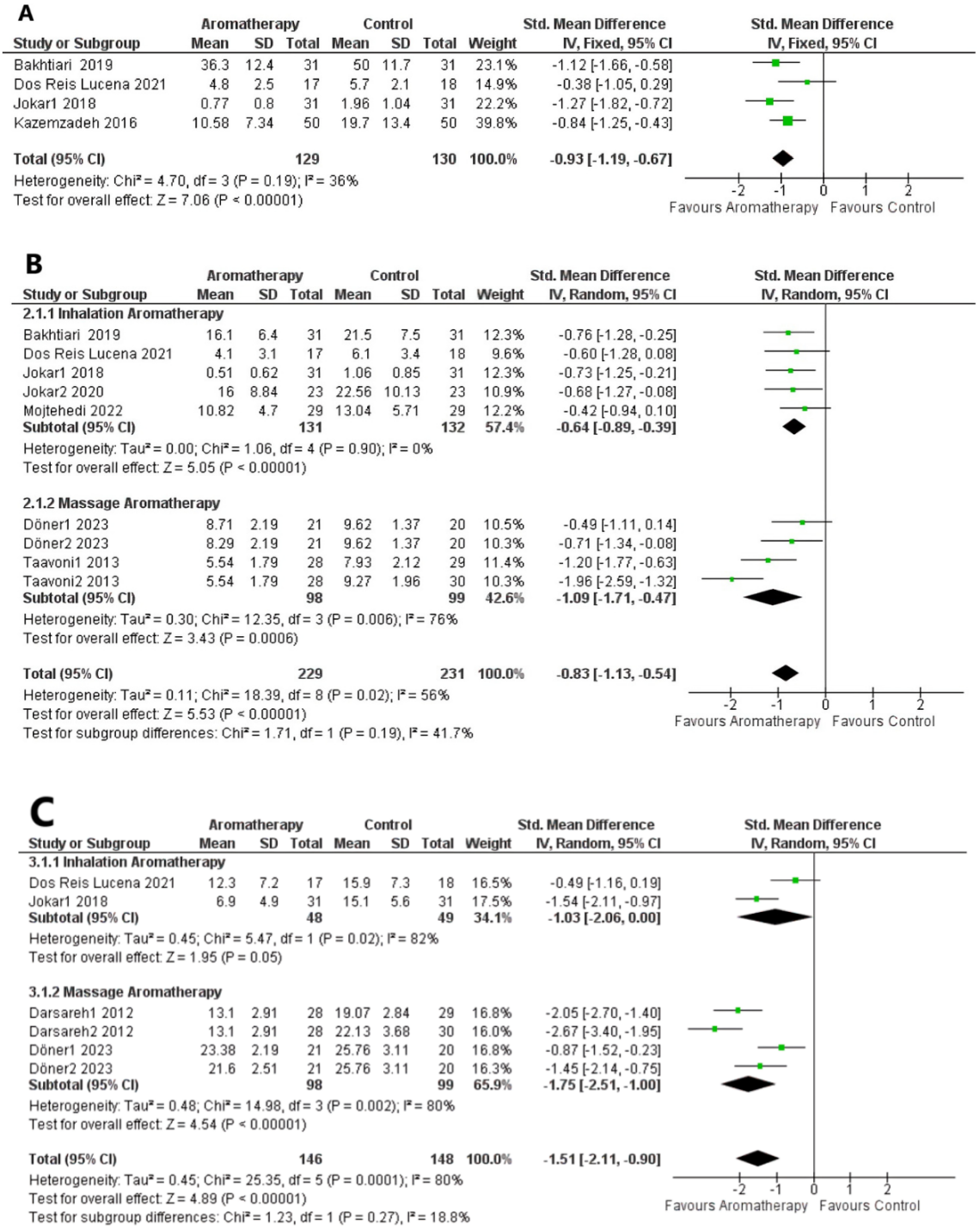

Figure 3. Forest plot of the effect of aromatherapy on physical (A), psychological (B), and overall symptoms (C) of menopause

symptoms of menopause, psychological symptoms of menopausal women, and sexual function was very low due to downgrades caused by a serious risk of bias, serious inconsistency, publication bias, or very serious imprecision.

Discussion

This meta-analysis indicates that aromatherapy significantly reduces physical and overall symptoms of menopause. This aligns with earlier systematic reviews which also found aromatherapy to be beneficial in easing physical symptoms associated with menopause.[19,20,21]

The potential influence of aromatherapy on physical symptoms could stem from the engagement of the autonomic nervous system when essential oils are inhaled. For instance, the compound linalool found in lavender might regulate the parasympathetic nervous system via the hypothalamus, which is linked to the senses of touch and smell.[43] Theoretically, inhaling or massaging with essential oils could trigger the release

of neurotransmitters like serotonin, dopamine, and endorphins. Nevertheless, further foundational research is necessary to fully comprehend how aromatherapy acts to alleviate menopausal symptoms.

Both massage and inhalation as methods of aromatherapy have been found to significantly reduce the psychological symptoms associated with menopause. Echoing recent findings, other meta-analyses have also indicated that groups receiving aromatherapy massage and inhalation experienced significantly fewer psychological issues like depression compared to control those.[44] The beneficial effects of aromatherapy massage on depression may be attributed to enhanced blood circulation in the brain's frontal cortex, stimulation of the body's soft tissues leading to metabolic equilibrium, and the creation of a nurturing environment that conveys care and affection to the patient.[45] This study rated the quality of evidence for aromatherapy's impact on physical menopausal symptoms as moderate while rating it low for psychological symptoms and very low for overall symptoms.

It is important to note, however, that the studies reviewed primarily document the short-term benefits of aromatherapy on psychological symptoms, leaving the long-term effects uncertain. Additionally, the researchers' emotional support during aromatherapy, which did not extend to the control group, could have influenced the outcomes.

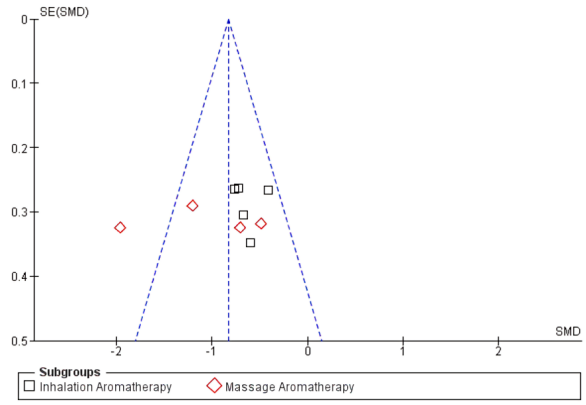

Figure 4. Funnel plot of the effect of aromatherapy on the psychological symptoms of menopause

The present research findings demonstrate the beneficial effects of aromatherapy on improving sexual function in menopausal women. The meta-analysis conducted by Khadivzadeh et al revealed that aromatherapy, whether with neroli oil or lavender (used individually) or a combination of lavender, fennel, geranium, and rose oils, had a significant positive impact on human sexual function. However, they did not observe significant alterations in the serum estrogen level.[22] Another meta-analysis demonstrated the efficacy of lavender, administered either as a capsule or through aromatherapy, in enhancing the sexual desire of menopausal women. However, the authors cautioned that we should interpret these findings cautiously, given the study's limitations.[20] Aromatherapy employs herbal essential oils in various ways, such as inhaling the odor molecules, stimulating the sense of smell, and sending impulses to the olfactory part of the brain. This part of the brain interacts with various control systems, including emotions, memory, hormones, sexual sensations, and heart rate. This interaction results in the release of hormones capable of stimulating, incubating, calming, or euphoria absorption, as well as the skin absorption of volatile oils and their subsequent penetration into the bloodstream. The grading of the evidence for sexual function was very low, primarily due to the significant risk of bias, serious inconsistency, and severe imprecision. Given the limitations of this review, including a lack of standardized instruments, a small number of studies, and short-term follow-up, it is important to present these findings with caution.

Aromatherapy caused a significant improvement in the sleep quality of postmenopausal women compared

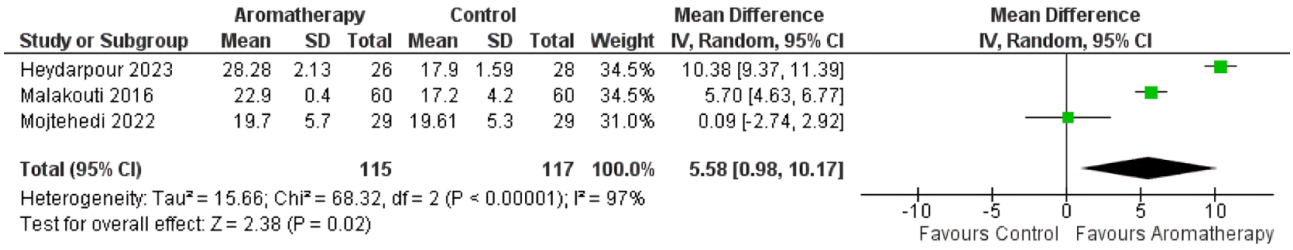

Figure 5. Forest plot of the effect of aromatherapy on the sexual function of menopausal women

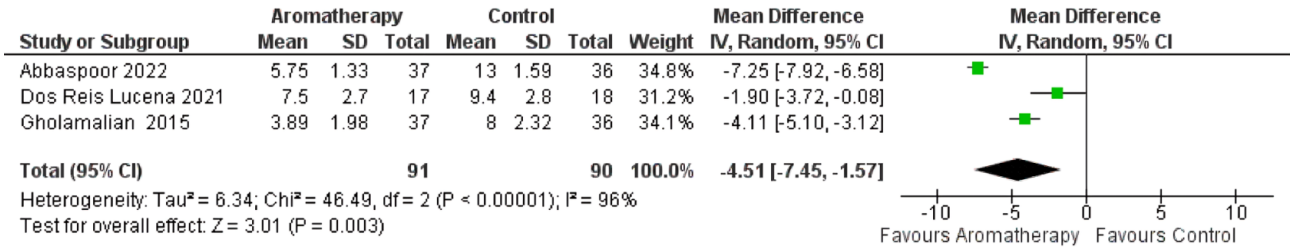

Figure 6. Forest plot of the effect of aromatherapy on sleep quality of menopausal women

Table 3. GRADE evidence profiles for outcomes among the trials included in the systematic review

Certainty assessment							No. of patients		Effect		Certainty	Importance
No. of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**[aromatherapy]**	**[comparison]**	**Relative (95% CI)**	**Absolute (95% CI)**		
Physical symptoms												
4	randomised trials	not serious	not serious	not serious	serious[a]	none	129	130	-	SMD 0.93 SD lower (1.19 lower to 0.67 lower)	⊕⊕⊕◯ Moderate	CRITICAL
Psychological symptoms												
9	randomised trials	serious[b]	serious[c]	not serious	publication bias strongly suspected[d]	none	229	231	-	SMD 0.83 SD lower (1.13 lower to 0.54 lower)	⊕◯◯◯ Very Low	CRITICAL
Overall symptoms												
6	randomised trials	serious[b]	serious[c]	not serious	serious[a]	none	146	148	-	SMD 1.51 SD lower (2.11 lower to 0.9 lower)	⊕◯◯◯ Very low	CRITICAL
Sexual function												
3	randomised trials	serious[b]	serious	not serious	very serious[e]	none	115	117	-	MD 5.58 higher (0.98 higher to 10.17 higher)	⊕◯◯◯ Very low	IMPORTANT
Sleep quality												
3	randomised trials	not serious	serious[c]	not serious	serious[a]	none	91	90	-	MD **4.51 lower** (7.45 lower to 1.57 lower)	⊕⊕◯◯ Low	IMPORTANT

CI: confidence interval; MD: mean difference; SMD: standardized mean difference

Explanations

a. The optimal information size (OIS) criterion is not met.

b. 50% of the data is derived from high risk or some concerns studies.

c. Significant heterogeneity has been found between studies.

d. The funnel plot is asymmetrical.

e. The OIS criterion is not met and there is a relatively large confidence interval.

to the control group, which is consistent with the results of Lin et al, who supported aromatherapy in effectively improving sleep quality in other populations.[46] Previous meta-analyses of menopausal women also align with this result.[19] This result suggests that the reduction of physical symptoms and improvement of psychological problems will enhance the quality of sleep for these women.[20,30,47] The evidence grading for menopausal women's sleep quality was low, indicating that the current research may not provide a robust or reliable basis for concluding the impact of the intervention on sleep quality in this population. This underscores the need for further high-quality studies to better understand and address the effect of aromatherapy on sleep disturbances in menopausal women. In future research, it is also important to consider individual differences and other potential confounding factors.

Strengths and Limitations

The following are the study's key strengths: We implemented a thorough search strategy that encompassed a broad spectrum of databases and search terms, thereby enhancing the probability of identifying all included studies. One of our study's strengths is that it included articles in both Persian and English, enhancing the diversity and comprehensiveness of the research incorporated in our analysis. This bilingual approach broadens the scope of the study and allows for a more inclusive examination of the subject matter. The exclusive inclusion of RCTs, considered the gold standard in clinical research due to their ability to minimize bias and confounding factors, further strengthened the meta-analysis. The GRADE framework's application to assess the quality of evidence bolstered the study's rigor. GRADE is a systematic and transparent approach used to describe the quality of evidence and the strength of recommendations in healthcare.[48]

However, the study also had several limitations. We observed notable heterogeneity among the included studies, potentially due to variations in study design, population characteristics, intervention protocols, and the type and dosage of essential oils used for aromatherapy. This could limit the applicability of the findings. Additionally, some of the included trials assessed a high risk of bias, potentially impacting the results of the meta-analysis. Moreover, the quality of evidence for some comparisons was very low, which undermines confidence in the effect estimates. These strengths and limitations should be considered when interpreting the findings of this study. Further, high-quality studies are required to validate these results and provide more robust evidence.

Conclusion

Few studies have thoroughly assessed how aromatherapy impacts symptoms experienced during menopause. These inquiries predominantly utilized lavender for aromatherapy. Findings suggest that using lavender or other herbs for aromatherapy, as mentioned in these RCTs, could potentially alleviate a range of menopausal symptoms, including physical, psychological, and sexual function, when compared to a control group. However, we recommend conducting additional research on different types of essential oils. The conclusions drawn from these studies are tentative due to the small number of studies, the small sample size, and the indeterminate risk of bias. Therefore, we should exercise caution when generalizing these results due to potential heterogeneity in the essential oil composition and the countries where the experiments took place.

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Mona Larki[2,3],

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Data curation: Leila Karimi, Solmaz Mohammadi, Masoumeh Safyari.
Formal analysis: Somayeh Makvandi, Mona Larki.
Investigation: Leila Karimi, Solmaz Mohammadi.

Research Highlights

What is the current knowledge?

- Menopause symptoms, such as hot flashes, sleep disturbances, and mood swings, significantly impact women's quality of life.
- Hormone replacement therapy (HRT) is a commonly used pharmacological treatment, but it is associated with risks like cardiovascular issues and cancer.
- Non-pharmacological treatments, including complementary and alternative therapies, have gained popularity as safer options.
- Aromatherapy, which utilizes essential oils, has been explored for its potential to alleviate menopause symptoms through relaxation and hormonal balance.
- Previous systematic reviews on aromatherapy for menopause symptoms are limited and often lack comprehensive meta-analyses and evidence grading.

What is new here?

- Aromatherapy demonstrated significant efficacy in reducing physical, psychological, and overall menopause symptoms, while also enhancing sexual function and sleep quality, with statistically robust results.
- The evidence grading indicates moderate quality for physical symptoms and low to very low quality for other outcomes, highlighting gaps in research and the need for higher-quality studies.

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Project administration: Somayeh Makvandi.
Resources: Somayeh Makvandi.
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Writing–review & editing: Mona larki, Somayeh Makvandi, Masoumeh Safyari.

Competing Interests
There is nothing to declare.

Data Availability Statement
The datasets are available from the corresponding author upon reasonable request.

Ethical Approval
The Ahvaz Jundishapur University of Medical Sciences ethics committee provided the research's ethics code (Ref. No: IR.AJUMS.REC.1402.642). Consent to participate is not applicable.

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Supplementary Files
Supplementary file 1. Search strategy.

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