

Physical and Psychologic Effects of Aromatherapy Inhalation on Pregnant Women: A Randomized Controlled Trial

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Abstract

Objectives: Stress reduction care is important for pregnant women to decrease obstetric complications and children's health problems after birth. The aim of this study is to clarify the physical and psychologic effects of inhalation aromatherapy on pregnant women. Essential oils with high linalool and linalyl acetate content that may be used during pregnancy were selected and among these, and the one preferred by the participant was used.

Design: This was a prospective, randomized, controlled trial.

Settings/location: This trial was performed at a gynecology outpatient department in a hospital in Kyoto, Japan.

Participants: The study included pregnant women in week 28 of a single pregnancy with a normal course.

Interventions: Participants were randomly assigned into an aromatherapy group and a control group. They were seated in the resting, seated position for 10 minutes. During the latter 5 minutes of each 10-minute session, aromatherapy inhalation was performed for the aromatherapy group.

Outcome measures: Before and after the intervention, the Profile of Mood States (POMS) was measured. During the trial, the heart-rate fluctuations were measured for the autonomic nervous system regulation.

Results: A total of 13 pregnant women participated in the trial. Seven (7) participants were assigned to the aromatherapy group and 6 participants to the control group. The results of the POMS were such that based on an intragroup comparison, significant differences were observed in the Tension-Anxiety score ($p < 0.05$) and the Anger-Hostility score ($p < 0.05$), and the respective improvements observed were due to aromatherapy. The results of the autonomic nervous system regulation were such that based on an intragroup comparison within the aromatherapy group, the parasympathetic nerve activity increased significantly ($p < 0.05$).

Conclusions: Aromatherapy inhalation using essential oils containing linalyl acetate and linalool was found to be effective for the POMS and parasympathetic nerve activity, based on an intragroup comparison. However, based on a comparison between the groups, no substantial difference was observed; hence, further study is necessary in the future.

Introduction

IT IS WELL known that stress during pregnancy can lead to depression and an increased risk of preterm delivery and low-birth-weight infants.^{1,2} Stress hormones, transmitted through the placenta, can cause neurological effects on both fetuses and neonates.^{3–7} Therefore, it is important to reduce stress where possible in pregnancy women.

In recent years, complementary and alternative medicine (CAM) has been widely used for the purpose of relaxation in our stressful modern society. Along with this situation, a significant number of pregnant women use CAM, including aromatherapy.⁸

Some studies have clarified the relaxing effects of essential oils containing linalyl acetate or linalool. Animal studies have shown such effects to extend even to the muscles and the nervous system. These studies observed a decline in either the disturbed behavior or aggressiveness resulting from the absorption of linalool performed in mice,⁹ the relaxation of the vascular smooth muscles in the rabbit resulting from linalyl acetate,¹⁰ decreased hyperactivity due to the use of lavender, after the administration of caffeine in rats in order to cause hyperactivity,¹¹ and a local anesthetic action in rats or rabbits resulting from the use of lavender.¹²

In addition, even in studies performed in humans, the presence of relaxing effects has been suggested, as the

absorption of lavender on healthy adults leads to a reduction in serum cortisol.^{13,14} Moreover, in a single test of linalool, relaxing effects were observed in several physiologic indices, such as the pulse rate.¹⁵ According to a systematic review of aroma massage, even when treatment is not required for anxiety, anxiety relief effects have been observed.¹⁶ However, few such studies have so far been performed in pregnant women. It is necessary to clarify the physical and psychologic effects of aromatherapy due to changes in the olfaction and smell preferences during pregnancy.

The overall aim of this study is to examine the physical and psychologic effects of inhalation aromatherapy in pregnant women. The essential oils containing linalyl acetate and linalool were used.

Materials and Methods

Participants

The participants comprised 28-week-pregnant women who had undergone a checkup for pregnant women on an outpatient basis at a department of obstetrics and gynecology located in a hospital in Kyoto prefecture in Japan. All participants were experiencing smooth courses of singleton pregnancy.

Study design

A randomized controlled trial was used. Registration was carried out during pregnancy checkups performed in week 26. Explanations were provided regarding the objectives and the methods, and consent was obtained from participants. At the pregnancy checkups in week 28, the participants were assigned to the aromatherapy group and the control group according to an opaque envelope they chose. Each envelope contained a piece of paper on which was written "aroma" or "control." Subsequently, the test was performed. Due to the nature of the intervention, blinding was not possible. The participants were aware of which group they were put into.

Essential oils used

Each participant chose one of the essential oils listed below. They are high in linalool and linalyl acetate. These essential oils are safe to use in pregnancy.

1. Lavender (*Lavandula angustifolia*) (Rohto Pharmaceutical Co., Ltd., Lot No.: 8F1); linalyl acetate content: 30.68%; linalool content: 31.77%
2. Petitgrain (*Citrus aurantium(Fe)*) (Pranarom Co., Lot No.: CAL4); linalyl acetate content: 50.45%; linalool content: 25.31%
3. Bergamot (*Citrus aurantium L. ssp. Bergamia*) (Sanoflore Co., Lot No.: 710229); linalyl acetate content: 24.76%; linalool content: 9.16%

Outcome measures

The Profile of Mood States (POMS): POMS is a questionnaire containing 30 items that measure mood states by six scales. The Tension-Anxiety (T-A) scale indicates that the higher the score, the more tense the subject is. The Depression-Dejection (D) scale indicates that the higher the score, the more self-confidence the participants have. The Anger-Hostility (A-H) scale indicates that the higher the score, the more anger the subject feels. The Vigor (V) scale is a reverse item

and suggests that the lower the score, the more energy is lost. The Fatigue (F) scale indicates that the higher the score, the more fatigue the participants feel. The Confusion (C) indicates that the higher the score, the more confused the participants are and the more difficult it is for participants to put their thoughts in order.

Autonomic nervous system: The amount of activity of the sympathetic nerves and parasympathetic nerves was measured. They were assessed through heart rate measurements as physiologic indicators.¹⁷ For the heart rate measurements, the portable heart rate meter Active Tracer 301[®] (AC-301), manufactured by GMS Co., Ltd. (Tokyo), was used. Electrocardiogram electrode stickers were used to attach the meter to the chest with double induction, and while the meter was attached, the R-R interval was measured continuously. Because the skin becomes thin and susceptible to itching during pregnancy, for the electrode stickers, Erurode produced by Mets Co., Ltd. (Tokyo) were used; they are composed of solid gel and do not cause itching.

Data analyses were conducted using MemCalc/Win produced by GMS Co., Ltd. to calculate the integral values of the Low Frequency domain (LF: 0.04-0.15 Hz) and the High Frequency domain (HF: 0.15-0.40 Hz) from the R-R interval power spectra, and LF and HF/LF were used as indicators of parasympathetic nerve activity and sympathetic nerve activity, respectively.

Intervention method

Before the test, the participants in both groups filled out the POMS and wore an AC-301. For 5 minutes after starting the test, participants rested in a seated position. In order to constrain the parasympathetic stimulus resulting from closing the eyes, and for neutral stimulus purposes, a landscape photograph was placed in front of the eyes, and the participants were asked not to close their eyes. Five (5) minutes later, the aromatherapy group took an aromatherapy inhalation with a diffuser.

The diffuser was placed 30 cm away from the participants, and the direction of the wind was shifted so that the wind did not blow on them directly. Five (5) drops of the essential oil were dropped on the filter paper. The control group was verbally informed when 5 minutes had elapsed. Subsequently, for another 5 minutes, the participants in the control group rested, and after the test was over, they filled out the POMS again.

To collect data on the autonomic nervous system (ANS):
Pre-intervention: the first 2 minutes were omitted. Data were collected following the next 3 minutes.

Post-intervention: the first 30 seconds were omitted. Data were collected following the next 4 minutes (Fig. 1). A room

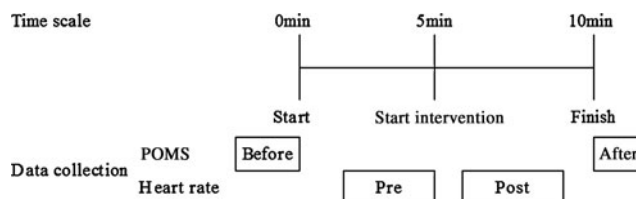


FIG. 1. Experimental procedures and data collection. The participants in both groups filled out the Profile of Mood States (POMS) before and after experiment. They wear the portable heart rate meter Active Tracer 301[®] throughout the experiment.

adjacent to the gynecology outpatient department was used as the test room. There was a small waiting room upon entering from the hallway and the room was located in the back; therefore, no external noise could be heard. The room was equipped with an air conditioner, and during the test, the room temperature was maintained at 26°C–28°C and the humidity at 50%–60%.

Statistical analysis

For intragroup comparisons of the POMS, LF and HF/LF were analyzed using the Wilcoxon signed-rank test. For intergroup comparisons, the Mann-Whitney *U* test was performed to compare both groups at each measurement point.

Statistical processing was performed using JMP® 7.0.1 produced by SAS Institute Inc.

Ethical issues

The participants were provided verbal and written explanations regarding a description of the study. Pregnant women from whom consent was obtained were asked to provide a written signature on a consent form, and they became the participants of the study. This study was approved by the ethics committee of Meiji University of Integrative Medicine.

Results

Participants

Of 20 pregnant women who met the entry conditions, 13 provided consent for participation in the study. Reasons for nonparticipation included a full schedule (6 women) and a dislike of the fragrances (1 woman). The 13 participants were randomly divided into 7 for the aromatherapy group and 6 for the control group. None of the participants withdrew their participation from the study after randomization (Fig. 2).

The age of the participants was 29.3 (4.3 standard deviation [SD]) for the aromatherapy group and 27.3 (6.1 SD) for the control group. There were no major differences observed between the two groups (Table 1).

POMS

Based on the intragroup comparison within the aromatherapy group, the mean value of the T-A, which shows the

TABLE 1. BACKGROUND OF PARTICIPANTS

		Aroma (n=7)		Control (n=6)	
		n	%	n	%
Obstetric history	Primigravid	5	71.4	4	66.7
	Parous	2	28.6	2	33.3
Occupation	Homemaker	3	42.9	3	50.0
	Employed	4	57.1	3	50.0
Originally interested in aromatherapy	Yes	5	71.4	6	100
	No	2	28.6	0	0
Experience using aromatherapy	Yes	2	28.6	2	33.3
	No	5	71.4	4	66.7

level of tension, decreased from 3 to 1 ($T = -10.5, p < 0.05$) and the A-H, which shows feelings of anger, significantly decreased from 2 to 0 ($T = -10.5, p < 0.05$). Moreover, based on a comparison between the groups, with regard to F, which shows feelings of Fatigue, the control group showed 0.5, and the aromatherapy group showed 0 after performing aromatherapy, and although there was a tendency for fatigue to be lower in the aromatherapy group, no significant difference was observed ($U = 1.93, p = 0.053$) (Fig. 3).

Autonomic nervous system activity

In terms of changes in the autonomic nervous system, sympathetic nerve (LF/HF) and parasympathetic nerve (HF) components were measured, based on changes in the pulse rate. In the aromatherapy group, based on the intragroup comparison after starting aromatherapy, HF value increased ($T = 12.0, p < 0.05$). No significant difference was observed based on the comparison between the groups.

On the other hand, for LF/HF, no significant difference was observed based on the intragroup comparison and the comparison between the groups (Fig. 4).

Discussion

In the present study, the focus was on the physical and psychologic effects of aromatherapy on pregnant women in week 28. Thirteen (13) pregnant women were randomly assigned to the aromatherapy group and control group. Regarding the essential oils, the pregnant women selected their preferred fragrance from among several essential oils (lavender, petitgrain, and bergamot), which all contained a large amount of linalyl acetate and linalool, which have been suggested to possibly have a relaxing effect. The essential oils were administered by inhalation in the aromatherapy group for 5 minutes.

The results of the intervention were such that based on the intragroup comparison within the aromatherapy group, a significant difference was observed in the Tension-Anxiety (T-A) and the Anger-Hostility (A-H) of the POMS, and improvement was observed resulting from performing aromatherapy. Based on the comparison between the groups, there was a tendency for the Fatigue (F) to improve after performing aromatherapy in the aromatherapy group, though there was no significant difference.

These results are supported from prior studies of non-pregnant adults. In a study in which aromatherapy was

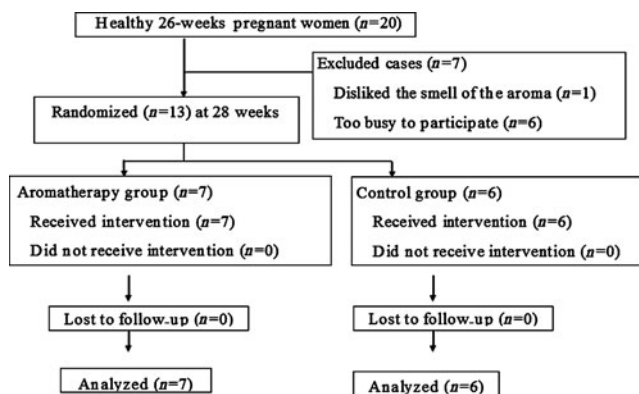


FIG. 2. Flowchart of participants from recruitment through completion.

FIG. 3. Changes of POMS (mean values). Intergroup comparisons were conducted using the Mann-Whitney *U* test. Intragroup comparisons were conducted using the Wilcoxon signed-rank test. The Tension-Anxiety scale score (T-A) decreased from 3 to 1 ($T = -10.5, p < 0.05$) and the Anger-Hostility scale score (A-H) decreased from 2 to 0 ($T = -10.5, p < 0.05$) after performing aromatherapy based on the intragroup comparison. D, Depression-Dejection scale score; V, Vigor scale score; F, Fatigue scale score; C, Confusion scale score.

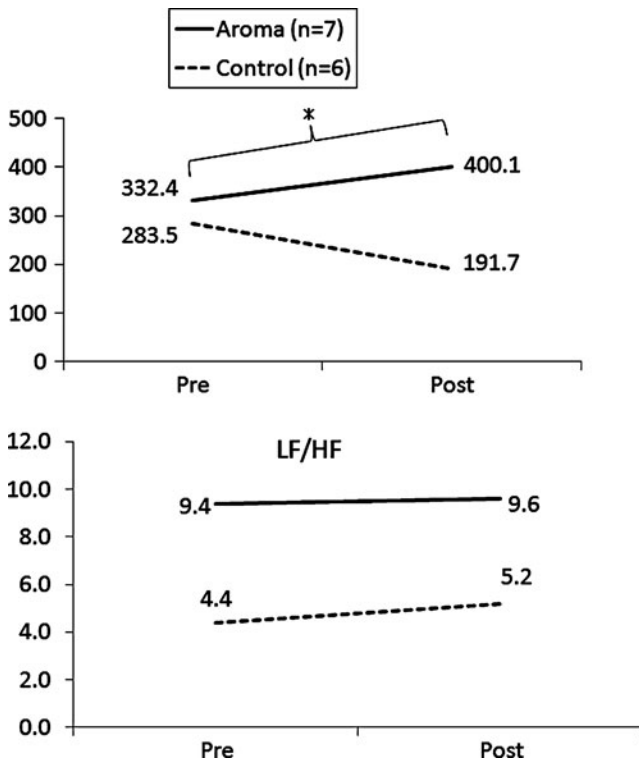
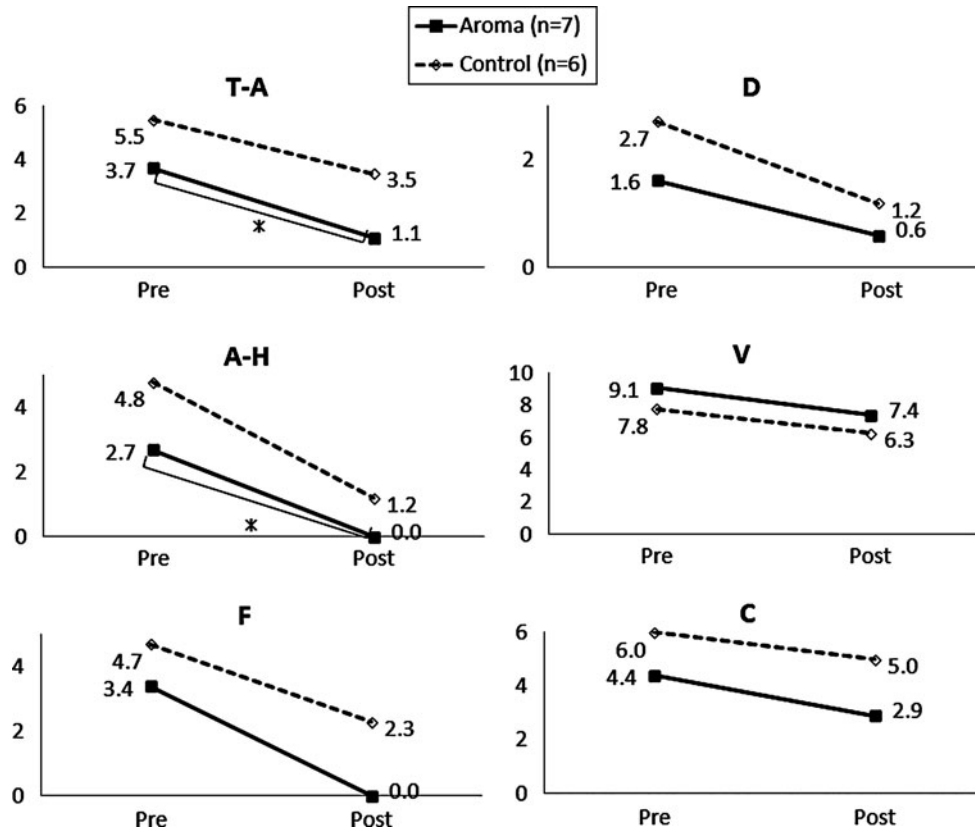


FIG. 4. Changes of sympathetic nerve (low frequency [LF]/high frequency [HF]) and parasympathetic nerve (HF) components (mean values). Intergroup comparisons were conducted using the Mann-Whitney *U* test. Intragroup comparisons were conducted using the Wilcoxon signed-rank test. HF value increased ($T = 12.0, p < 0.05$) after starting aromatherapy based on the intragroup comparison.

performed on patients using lavender before the patients underwent endoscopy, although there were no effects of anxiety relief, there were many positive findings based on postaromatherapy interviews, thus suggesting that aromatherapy could be used in the waiting room.¹⁸ In another study performed on nonpregnant adults, aromatherapy using lavender and rosemary essential oils improved a depressed mood according to the POMS.¹⁹

Moreover, although significant differences were not observed, there was a tendency for the score for Fatigue to decrease in the aromatherapy group. During the gestational period, pregnant women are inclined to feel tired easily; therefore, the fact that fatigue can be reduced by performing aromatherapy using essential oils containing linalyl acetate or linalool is believed to be utilized for relieving fatigue for pregnant women even in everyday life.

According to indices for the ANS, in the aromatherapy group, based on intragroup comparisons, the parasympathetic components increased, and even with physiologic measurements, relaxing effects were observed. Even in prior studies in which changes in brain waves and autonomic nervous activity were observed as a result of using lavender, an increase in the parasympathetic nervous activity was observed after aromatherapy^{20,21}; moreover, in an experimental study in rats, the intestinal nerve, a parasympathetic nerve, was stimulated by lavender and linalool, which is a component of lavender.²² It was revealed that not only did aromatherapy provide psychologic effects for pregnant women if performed for 5 minutes, but it also provided some physiologic effects. In the future, it is believed that it can be utilized further in broader areas for relaxation purposes.

Based on the intragroup comparison within the aromatherapy group, a significant improvement was observed in the Tension-Anxiety (T-A), the Anger-Hostility (A-H), and the parasympathetic nervous activity, while for the control group there was a tendency for the pregnant women to feel psychologically calm by only being in a resting, seated position. Aromatherapy inhalation using essential oils containing linalyl acetate and linalool has a potentially useful effect on pregnant women with an irritable mood while in a waiting room at a hospital. Pregnancy checkups must be conducted many times during pregnancy, and pregnant women have to tolerate a long waiting time. Aromatherapy is believed to be effective in order to relieve tension or feelings of anger during the waiting time. Furthermore, not only can this be used in the waiting room, but it can also be utilized at various locations for psychologic relaxation purposes.

In the present study, there was no uniformity in the essential oils. This is attributable to the fact that in prior studies, no difference was observed in the ANS for participants who had negative or neutral impressions toward fragrances,²¹ changes in the olfactory sense during pregnancy,²³ and changes in fragrance preferences due to pregnancy.²⁴ In this study, the fact that pregnant women could select a preferred fragrance among fragrances containing a large amount of linalyl acetate and linalool is also believed to be one of the reasons that effects were indicated. Allowing a participant to choose an essential oil from a safe selection is not a method that has appeared in the literature before. This ability to choose is an important step forward in both aromatherapy research and clinical practice.

In this study, a stable period during the gestation period was selected to perform the tests; however, it has also been reported that functions of the olfactory sense decrease from approximately week 36, in comparison to week 21 of pregnancy²⁵; therefore, it is also necessary to study these effects during other periods. Furthermore, in this study, only the effect 5 minutes following the use of aromatherapy was investigated, and it was unknown how long the effect lasted subsequently. In this study, the patient was required to sit quietly in order to measure the autonomic nerve; however, doing so for an extended period of time cannot be forced upon pregnant women. Therefore, the time of 5 minutes prior to and 5 minutes following commencement of aromatherapy was set as the time for the experiment. It is essential to confirm the duration of the effect, and this remains a research topic for the future. Moreover, regarding the experimentation method, blinding was difficult in this study due to the nature of the intervention, and it was difficult to adopt a crossover protocol because the body changes depending on the period during pregnancy. In future research on aromatherapy, the development of a research method that can overcome these difficulties is hoped for.

In recent years, many pregnant women use CAM including aromatherapy,⁸ and the use of CAM is widespread in midwifery practice²⁶ because the use of CAM has become increasingly prevalent in industrialized countries. This study clarified that 5 minutes of aromatherapy inhalation promote a patient's physical and psychologic well-being; therefore, aromatherapy is believed to potentially become a useful treatment modality in the future.

Conclusions

The results of the present trial had the objective of providing psychologic effects for pregnant women from aromatherapy inhalation using essential oils containing linalyl acetate and linalool, based on an intragroup comparison, and which suit the preferences of pregnant women; the aromatherapy was effective, even when the fragrance was provided for a short time, for improving the temporary mood on the Tension-Anxiety and Anger-Hostility scales. Moreover, the amount of parasympathetic activity increased, and from a physiologic perspective, relaxing effects were observed. In this study, it was believed that an effect was easily obtained by having the participant choose a scent of their own preference and then using the selected scent. However, based on a comparison between the groups, no difference was observed; hence, further study is necessary in the future.

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Disclosure Statement

No competing financial interests exist.

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