Original Articles

EFFECTS OF AROMATHERAPY FOR SELF-CARE DURING PREGNANCY

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Abstract: Stress reduction care is important for pregnant women to decrease obstetric complications and children's health problems after birth. We investigated the long-term effects during pregnancy of daily self-care with aromatherapy using essential oils containing linalyl acetate and linalool. We randomly assigned 16 healthy pregnant women into an aromatherapy group and a control group. Nine participants were assigned to the aromatherapy group and seven participants to the control group. Intervention was started at 28 weeks of pregnancy and the results were assessed at 32 and 36 weeks of pregnancy as well as during childbirth. We conducted a comprehensive assessment using State-Trait Anxiety Inventory (STAI) and Visual Analogue Scale (VAS) as subjective questionnaire surveys and autonomic nervous activity from heart-rate variability as objective physiological indicators as well as the results of childbirth. The STAI traits showed significant aromatherapy effects ($p<0.05$) for reducing anxiety. Moreover, a dose-response relationship was observed which demonstrated a significant difference ($p<0.016$) within the aromatherapy group for the relaxing effects by VAS. This study revealed that it is effective to recommend self-care using aromatherapy with essential oils containing linalyl acetate and linalool for the purpose of reducing anxiety and providing relaxation over the long term during pregnancy. However, it is necessary to conduct further studies with an increased number of participants to investigate the effects on the autonomic nervous system and the effects on childbirth.

Key words : aromatherapy, linalyl acetate, linalool, pregnancy

INTRODUCTION

It is well-known that stress during pregnancy is associated with an increased risk of preterm delivery and low-birth-weight infants[1,2], neurological effects on fetuses and neonates through stress hormones transmitted through the placenta[3-5] affecting the future health problems of children[6], and increasing in neonatal crying and difficulty due to maternal depression during pregnancy[7]. Thus, it is important to provide pregnant women with care for stress reduction.

At the same time, in recent years, aromatherapy has been widely used for the purpose of

relaxation in our stressful modern society and has become known in the medical setting in Japan in conjunction with the spread of complementary and alternative medicine (CAM)[8].

In previous studies, lavender essential oil has often been used in experimental studies and relaxing effects have been observed9-11). In animal experiments, it was also reported that linalyl acetate and linalool, which are the components of lavender, provoke the reflex[12,13]. At the same time, some clinical studies also reported such positive effects to improve relaxation and reduce the anxiety. However, most previous clinical studies employed not only aromatherapy but also massage therapy at the same time[14-16]. There are few reports using solely aromatherapy in a clinical setting. From a practical point of view, it is believed that it is not easy to continue providing massages as part of nursing service because such nurses are usually overwhelmed with their workload[17]. It is beneficial to use aromatherapy not only in a clinical setting with health care professionals but also at home by the pregnant women themselves. Therefore, the aim of this study was to evaluate the long-term effects of aromatherapy which were conducted by the pregnant women themselves using essential oils containing linalyl acetate and linalool. Physical and mental relaxing effects during pregnancy were then measured using subjective questionnaire surveys and objective physiological indicators as well as birth outcomes.

METHODS

Participants

The participants comprised 26-week pregnant women with no underlying conditions who had undergone checkups 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

The study was designed as a randomized controlled trial. The subjects joined the study in the 26th week of pregnancy and were randomly assigned to an aromatherapy group and a control group through the envelope method. Intervention with aromatherapy was started in week 28, and the effects were judged at weeks 32 and 36 and during childbirth. As this study involves intervention with aromatherapy, it was not a double-blind study.

Method of intervention

Aromatherapy group: For the aromatherapy group, in addition to regular care, we used aroma pendants (Hyper Plants Co., Ltd.) and had them use the fragrance at any time. The aroma pendants provided a space for storing a corked glass container in an aluminum pendant top and the fragrance of essential oils could be used through the cork at any time. The pendant top had a diameter of 9 mm and a height of 45 mm while the chain had a length of 71 cm, and the total weight was 18 g. In each of the glass containers, 1 cc of an essential oil was inserted as a liquid concentrate. The essential oils were replaced every 2 weeks.

To measure the frequency of use of aromatherapy, each pregnant woman recorded the times they wore the pendant and the number of times they brought the pendant to their noses to proactively use the fragrance.

Control group: The control group did not undergo aromatherapy and were provided only regular medical treatment and care. While we did not limit the use of aromatherapy outside the scope of the intervention of this study by the participants themselves, we asked that they report to the researchers if they performed aromatherapy.

Essential oils used

We had each participant select a preferred essential oil from the following 3 types.

(a) Lavender (*Lavandula angustifolia*) (Rohto Pharmaceutical Co., Ltd., Lot No.: 8F1); linalyl acetate content: 30.68%; linalool content: 31.77%

(b) Petitgrain (*Citrus aurantium(Fe)*) (Pranarom Co., Lot No.: CAL4); linalyl acetate content: 50.45%; linalool content: 25.31%

(c) Bergamot (*Citrus aurantium L. ssp. Bergamia*) (Sanoflore Co., Lot No.: 710229); linalyl acetate content: 24.76%; linalool content: 9.16%

Assessment method

Questionnaire surveys during pregnancy: At weeks 28, 32, and 36 of pregnancy, measurements were carried out using the State-Trait Anxiety Inventory-form JYZ (STAI), which is the Japanese version of the State-Trait Anxiety Inventory-form Y, and the Visual Analogue Scale (VAS).

The STAI was used to calculate state anxiety and trait anxiety. State anxiety is a transient situational response to an event that arouses anxiety, and the score increases in situations in which a threat is perceived to assess "How I feel at this moment". Trait anxiety is a relatively stable reactive tendency toward experiences of anxiety and the score is used to assess "How I generally tend to feel". Higher scores indicate higher levels of anxiety.

In the VAS, the participants were provided 100-mm horizontal lines on which the right end indicated the best state and the left end indicated the worst state for questions regarding their ability to relax and their level of stress. Higher scores indicate better assessments.

These questionnaire surveys were used to assess the current state at week 28 of pregnancy, the period between weeks 28 and 32 of pregnancy at week 32 of pregnancy, and the 4 weeks between weeks 32 and 36 at week 36 of pregnancy.

Physiological indicators during pregnancy: The sympathetic nerves and parasympathetic nerves were assessed through heart rate measurements as physiological indicators during pregnancy[18]. For the heart rate measurements, we used the portable heart rate meter Active Tracer 301® (AC-301) manufactured by GMS Co., Ltd. (Tokyo). 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.

The Active Tracer 301® was fixed with a special rubber belt at a position that would not interfere with the abdomen and measurements were taken over 24 hours except during baths. However, we explained that use of the meters could be discontinued at any time if there was any discomfort or inconvenience. As the skin becomes thin and susceptible to itching during pregnancy, for the electrode stickers, we used Erurode produced by Mets Co., Ltd. (Tokyo),

which are composed of solid gel and do not cause itching.

Data were collected at weeks 32 and 36 of pregnancy and analyses were conducted using MemCalc/Win produced by GMS Co., Ltd. to calculate the integral values of the Low Frequency domain (LF: 0.04-0.15Hz) and the High Frequency domain (HF: 0.15-0.40Hz) 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.

Birth outcomes

We compared the weight gain during pregnancy, the gestational days at childbirth, the length of labor, the amount of bleeding, the occurrence of abnormalities during childbirth, the neonatal birth weight, and the Apgar score.

Statistical analysis

We conducted T-tests and -2 tests for the attributes and results at childbirth. For intragroup comparisons of the STAI and VAS, the changes between week 28 and weeks 32 and 36 were analyzed using the Wilcoxon signed-rank test. For the P value, a Bonferroni correction was made and 0.016 (0.05/3) was used. For intergroup comparisons, the Mann-Whitney U test was performed to compare both groups at each measurement point.

For the LF and HF/LF used as indicators of sympathetic nerve and parasympathetic nerve activity, intergroup comparisons at weeks 32 and 36 were conducted using a T test, and intragroup comparisons were conducted using a corresponding T test. Statistical processing was performed using JMP® 7.0.1 produced by SAS Institute Inc.

Ethical issues

This study was approved by the ethics committee of Meiji University of Integrative Medicine. An outpatient midwife of the hospital was consulted for the selection of participants and we asked for participation from healthy pregnant women. The participants were provided verbal and written explanations regarding a description of the study, respect for individual free will with respect to participation in and withdrawal from the study, and the protection of privacy. We asked pregnant women from whom consent was obtained to provide a written signature on a consent form and they became the participants of the study.

We noted that the participants were participating in a study on aromatherapy in their medical records and put in place emergency measures so that the participants could contact the hospital during emergencies such as medical problems caused by the fragrances.

RESULTS

Participants

Out of 20 pregnant women who met the entry conditions, 16 provided consent for participation in the study. Reasons for non-participation included a full schedule (3 women) and a dislike of the fragrances (1 woman). Upon randomizing the participants using the envelope method, the 9 participants were assigned to the aromatherapy group and 7 participants to the control group. None of the participants withdrew their participation from the study after randomization (Fig. 1). There were no differences between both groups in

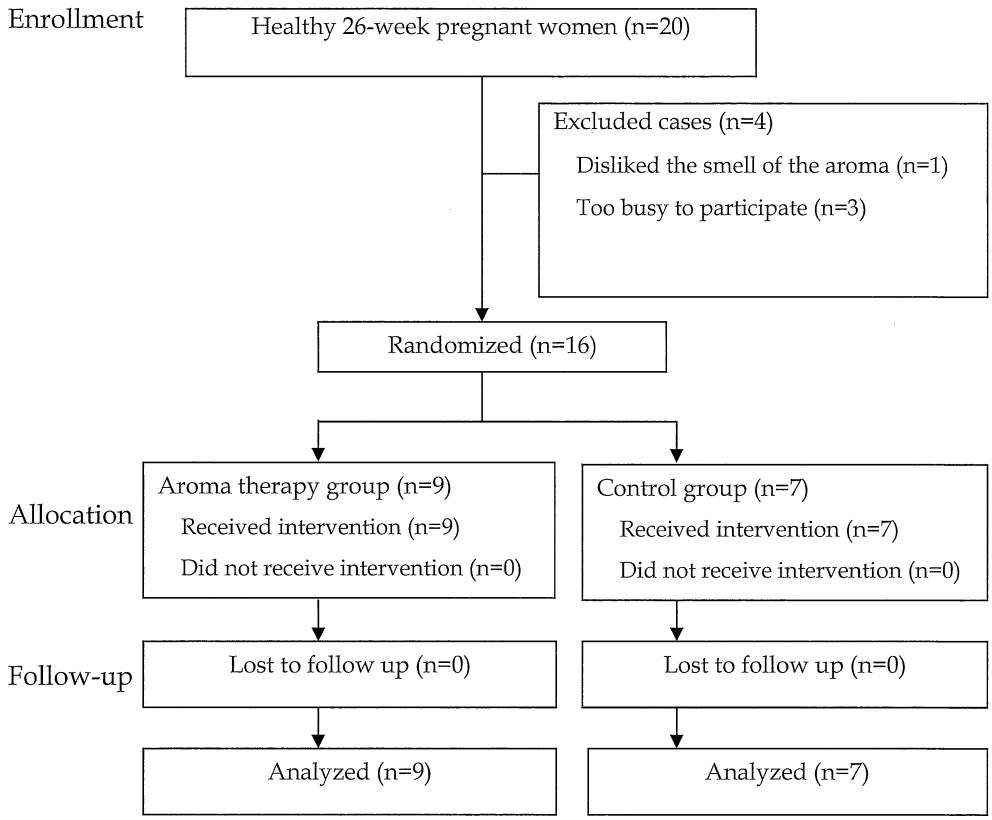

Fig. 1. Participation flow in the study.

terms of age, previous childbirth experience, BMI before pregnancy, or other characteristics (Table 1).

State-Trait Anxiety Inventory (STAI)

In comparisons between the aromatherapy and control group at weeks 32 and 36, significant differences were observed in trait anxiety. Trait anxiety means the general responses to anxiety, and this was observed to decrease in the aromatherapy group. The anxiety scores for state anxiety, which indicates transient anxiety, were lower in the aromatherapy group. However, there were no statistically significant differences. Moreover, no significant differences were observed in the intragroup comparisons (Table 2).

Visual Analogue Scale (VAS)

Regarding the item "Able to relax", there was a significant difference between the groups at week 32, wherein good results were observed in the aromatherapy group. Moreover, in the intragroup comparison of the aromatherapy group, the relaxation scores increased significantly as the number of weeks of pregnancy increased and there was a dose-response relationship.

Table 1. Participants

	Aroma (n=9)		Control (n=7)			
	Mean	S.D.	Mean	S.D.	t-value	P value
Age	29.3	4.3	27.3	6.1	0.73	NS
Height	159.2	4.7	160.9	3.1	0.80	NS
Body weight before pregnancy	53.2	6.2	51.5	5.4		NS
BMI before pregnancy	21	2.7	19.9	2		NS

		n	(%)	n	(%)	$\chi 2$ value	P value
Obstetric history	Primigravid	7	77.8	5	71.4	0.08	NS
	Parous	2	22.2	2	28.6		
Occupation	homemaker	4	44.4	4	57.1	0.26	NS
	Employed	5	55.6	3	42.9		
Stress	Yes	4	44.4	2	28.6	0.43	NS
	No	5	55.6	5	71.4		
Interest in aromatherapy	Yes	7	77.8	6	85.7	0.17	NS
	No	2	22.2	1	14.3		
Experience using aromatherapy	Yes	3	33.3	3	42.9	0.91	NS
	No	6	66.7	4	57.1		

Regarding the item "No stress", the median score in the control group decreased from 50 to 48 to 37 in weeks 28, 32, and 36, respectively, whereas the score increased from 59 to 60 to 69, respectively, in the aromatherapy group. It indicates that stress-reducing effects were observed in the aromatherapy group although there were no statistically significant differences (Table 2).

Indicators of autonomic nervous system activity

For the 24-hour heart rate measurements conducted at weeks 32 and 36 of pregnancy, data were obtained from seven participants in the aromatherapy group and five participants in

Table 2. STAI and VAS median values (minimum value-maximum value)

			28w	32w	36w
STAI	State anxiety	Aroma	36.5 (22-43)	38 (21-49)	36 (22-43)
		Control	38 (29-51)	49 (33-51)	50 (29-53)
	Trait anxiety	Aroma	36 (25-46)	40 (22-49) *	33 (27-43) *
		Control	47 (29-54)	46 (45-57) *	45 (36-54) *
VAS	Able to relax	Aroma	70 (38-93) *	74 (49-100) * *	82 (48-94)
		Control	67 (38-79)	51 (42-72) *	51 (30-85)
	No stress	Aroma	59 (37-100)	60 (38-100)	69 (43-98)
		Control	50 (9-94)	48 (29-86)	37 (27-91)

Intergroup comparisons were conducted using the Mann-Whitney U test with a significant difference defined as $p < .05$.

Intragroup comparisons were conducted using the Wilcoxon signed-rank test with a significant difference defined as $P < .016$ (0.05/3).

the control group. Reasons for failure by four participants to conduct the examination included: unable to wear the meter for 24 hours due to busy schedule taking care of children (tow participants); did not want to wear the electrodes due to sensitive skin (one participants); and did not want to wear the meter due to concern about electromagnetic waves (one subject).

In the indicators of autonomic nervous system activity obtained from the instantaneous heart rate, high levels of LF/HF, which is an indicator of sympathetic nerve activity, were observed in the aromatherapy group while HF, which is an indicator of parasympathetic nerve activity, tended to be higher in the control group, but no significant differences were observed (Table 3).

Effects on birth outcomes

As assessments conducted during childbirth, we compared weight gain during pregnancy, gestational days at childbirth, length of labor, amount of bleeding, and use of a C-section or

Table 3. Mean values (and standard deviations) for sympathetic nerve (LF/HF) and parasympathetic nerve (HF) components

		n	32w	36w
LF/HF	Aroma	7	4.1 (1.6)	3.9 (1.3)
	Control	5	2.8 (1.0)	2.4 (1.6)
HF	Aroma	7	205.1 (130.7)	191.7 (94.3)
	Control	5	441.9 (230.5)	464.9 (296.6)

The corresponding T-test was used for intragroup comparisons and the T-test was used for intergroup comparisons. There were no significant differences.

induced or accelerated labor, but there were no significant differences. The reasons for performing a C-section for three of the participants included: decreased fetal heart tone when childbirth was induced after exceeding the due date (tow participants); and early membrane rupture before the breech presentation was corrected in the last trimester (one participant). Neither of the groups included cases involving abnormalities during the course of pregnancy (Table 4).

DISCUSSION

In this study, we investigated whether daily self-care using aromatherapy for pregnant women had any long-term effects throughout the duration of pregnancy. Using essential oils containing linalyl acetate and linalool in order to obtain relaxing effects[19], we conducted comprehensive assessments based on measurements of the effects using subjective questionnaire surveys (STAI and VAS) and objective physiological indicators (autonomic nervous system activity) as well as the results of childbirth.

The subjective effects of aromatherapy for the pregnant women included reduced anxiety and relaxing effects but these did not affect the automatic nervous system, which is an objective indicator. Moreover, no differences were observed in the results of childbirth, including the time required for childbirth and the amount of bleeding, and the psychological effects of aromatherapy throughout the duration of pregnancy exerted neither any favorable effects for childbirth nor any side effects caused by the aromas.

In the STAI scores obtained as a subjective examination, there were no changes in the state anxiety, thus indicating transient responses to bouts of anxiety, in either group or throughout the examination period. As this indicates transient feelings of anxiety during the examination, the absence of differences is believed to indicate that there were no problems with the examination. At the same time, regarding trait anxiety, which indicates relatively

Table 4. Results of childbirth

	Aroma (n=9)		Control (n=7)			
	Mean	S.D.	Mean	S.D.	t-value	P value
Weight gain (Kg)	12.1	4.1	10.4	2.2	2.2	NS
Gestational days	275.3	11.0	281.3	10.9	2.2	NS
Length of labor (minutes)	476.7	219.8	542.3	219.0	2.3	NS
Bleeding (g)	746.3	419.5	715.3	513.5	2.2	NS
Birth weight (g)	3107.2	332.9	3212.1	347.0	2.2	NS
Apgar score	9.3	0.7	9.6	0.5	2.2	NS

		n	(%)	n	(%)	$\chi 2$ value	
Emergency C-section	Yes	1	6.3	2	12.5	0.608	NS
	No	8	50.0	5	31.3		
Induced or accelerated labor	Yes	2	12.5	3	18.8	0.779	NS
	No	7	43.7	4	25.0		

stable responses to anxiety (i.e., anxiety that is felt on a regular basis), significant differences were observed between the groups at weeks 32 and 36, which were respectively four weeks and eight weeks after starting aromatherapy, and anxiety was relieved in the aromatherapy group. It was revealed that daily aromatherapy has effects for reducing anxiety over the long term throughout the duration of pregnancy.

In the VAS, which is another subjective examination, there was a dose-response relationship related to relaxation in the aromatherapy group and the degree of relaxation increased as the course of pregnancy progressed. In previous studies, reductions in anxiety and relaxing effects have been observed in experimental studies using lavender10,19,20). Moreover, although there were no statistically significant differences in the degree of stress

felt, there was a tendency toward stress reduction in the aromatherapy group, and it is therefore necessary to conduct further studies with larger numbers of participants. This study revealed that essential oils containing high levels of linalyl acetate and linalool components reduce anxiety and have relaxing effects for pregnant women and are effective over the long term for daily self-care.

When we examined the autonomic nerve activity as an objective indicator, in contrast with the subjective results, no effects of aromatherapy were observed. Past experimental studies using autonomic nerve activity as an indicator suggest that the effects of lavender include increased parasympathetic nerve activity and relaxing effects[21]. In this examination, we asked pregnant women to wear portable electrocardiograms for 24 hours, and due to the burden thereof, the number of participants able to participate in the examination decreased. It is possible that the number of participants was too low for statistical processing using physiological indicators, and it is believed that there were no significant differences. Moreover, although there were no significant differences, sympathetic nerve activity increased in the aromatherapy group. In studies using lavender, there are reports in which, in addition to relaxing effects, there were effects for maintaining concentration and remaining alert over long periods[20, 21]. The effects of aromatherapy are said to include not only the scientific effects of the essential oils but also the effects of nerve activity caused by past memories and the like, and it is believed that there are great differences between individuals. It is necessary to measure the results with an increased number of participants using methods with a reduced burden placed on the participants by, for example, shortening the time required for measurements.

Regarding the results obtained during childbirth, the reductions in anxiety and relaxing effects caused by aromatherapy during pregnancy did not have any obstetric effects on the amount of time required for childbirth or the amount of bleeding. Moreover, although it has been suggested that lavender has effects for storing fat[22, 23], in the examinations of this study, there were no effects on weight gain during pregnancy or the body weights of the delivered infants and there were no other side effects caused by the aromas. Past studies have stated that aromatherapy performed during childbirth effectively reduced some of the pain experienced during delivery, while also reducing the number of cases transferred to the NICU[24, 25], and it is necessary to investigate whether the aromas that had a relaxing effect during pregnancy may also exert additional effects when used during childbirth.

The results of this study revealed that it is effective to recommend self-care using aromatherapy. It has been indicated that pregnancy causes changes in the olfactory functions of women[26, 27], and it is believed that the ability of the pregnant women to select fragrances and perform aromatherapy at any time by using aroma pendants enhanced the relaxing effects. As the purpose of this study was to obtain relaxing effects, essential oils were selected with a focus on linalyl acetate and linalool, but it is necessary to also investigate other essential oils as they also have various effects.

Moreover, while we were able to obtain results regarding the psychological relaxing effects, we were unable to determine any physical effects of effects on childbirth. The participants of this study comprised pregnant women with no complications in the 28th week of pregnancy or later, but based on reports indicating that stress among pregnant women

may cause preterm delivery or the birth of low-birthweight infants[1,2] as well as neurological effects on fetuses and neonates[3-5], it is therefore necessary to conduct further investigations with a wider range of participants.

CONCLUSION

This study revealed that it is effective to recommend self-care using aromatherapy with essential oils containing linalyl acetate and linalool for the purpose of reducing anxiety and providing relaxation over the long term during pregnancy. However, it is necessary to conduct further studies with an increased number of participants to investigate the effects on the autonomic nervous system and the effects on childbirth and the fetus.

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