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Pain relief assessment by aromatic essential oil massage on outpatients with primary dysmenorrhea: A randomized, double-blind clinical trial

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Abstract

Aim: This study assessed the effectiveness of blended essential oils on menstrual cramps for outpatients with primary dysmenorrhea and explored the analgesic ingredients in the essential oils.

Material and Methods: A randomized, double-blind clinical trial was conducted. Forty-eight outpatients were diagnosed with primary dysmenorrhea by a gynecologist and had 10-point numeric rating scales that were more than 5. The patients were randomly assigned to an essential oil group ($n = 24$) and a synthetic fragrance group ($n = 24$). Essential oils blended with lavender (*Lavandula officinalis*), clary sage (*Salvia sclarea*) and marjoram (*Origanum majorana*) in a 2:1:1 ratio was diluted in unscented cream at 3% concentration for the essential oil group. All outpatients used the cream daily to massage their lower abdomen from the end of the last menstruation continuing to the beginning of the next menstruation.

Results: Both the numeric rating scale and the verbal rating scale significantly decreased ($P < 0.001$) after one menstrual cycle intervention in the two groups. The duration of pain was significantly reduced from 2.4 to 1.8 days after aromatherapy intervention in the essential oil group.

Conclusion: Aromatic oil massage provided relief for outpatients with primary dysmenorrhea and reduced the duration of menstrual pain in the essential oil group. The blended essential oils contain four key analgesic components that amount to as much as 79.29%; these analgesic constitutes are linalyl acetate, linalool, eucalyptol, and β-caryophyllene. This study suggests that this blended formula can serve as a reference for alternative and complementary medicine on primary dysmenorrhea.

Key words: aromatherapy, dysmenorrhea, essential oils, massage, pain.

Introduction

Dysmenorrhea is one of the most reported symptoms by adolescent girls and adult women in obstetrics and gynecology departments. The term dysmenorrhea is derived from the Greek words *dys* (difficult, painful, or abnormal), *meno* (month) and *rrhea* (flow).[1] In Asia, the prevalence of dysmenorrhea was 83% among college students in Korea,[2] 55.5% among university students in Turkey,[3] 65.6% among high school students in Anatolia,[4] and over 60% among college students in Taiwan.[5] Most young unmarried women have suffered from primary dysmenorrhea (PD). PD is defined as spastic abdominal pain at the onset of menstruation and persisting for approximately 2–3 days without gynecological pathologies. The uncomfortable symptoms of

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menstrual cramps cause adolescent girls and adult women to be absent from school and work. About half of the participants in a study by Eryilmaz[4] preferred to take medicine to alleviate menstrual cramps. Nonsteroidal anti-inflammatory drugs (NSAIDs) are the first-line treatment by clinical specialists for PD patients. Nevertheless, NSAIDs supervene many adverse effects, including indigestion, headaches, and drowsiness, leading to a failure rate of up to 20% in alleviating PD. Recently, some non-pharmaceutical treatments in complementary and alternative medicine (CAM) have contended with menstrual pain of primary dysmenorrhea; for example, acupressure,[6] rose tea,[7] transcutaneous electrical nerve stimulation (TENS),[8] nutrition support, and behavioral interventions.[1] Therefore, an increasing number of females choose CAM to relieve menstrual pain. Aromatherapy is a highly popular CAM in Europe, the USA, and Japan; and is a convenient and safe method that can be performed by the average person and by doctors.[9]

Aromatherapy usually uses aromatic essential oils, which are highly volatile organic compounds extracted by distillation from plants to achieve physiological and psychological health. Researchers have shown that aromatherapy could significantly improve terminal illness in hospices,[10] relieve menopausal symdrome,[11] dementia,[12] and depression.[13] Previous studies have reported the advantages of lavender oil in alleviating anxiety,[14] mild depression,[10] and pain[15] in human trials, and anti-inflammatory, analgesic properties in mice models.[16] Clary sage oil is beneficial in regulating menstrual cycles[2] and ameliorating symptoms of hot flashes and night sweats in menopausal women[11] due to hormone-like components and ester ingredients.[17] Marjoram oil provides analgesic and vasodilatory properties, which alleviate menstrual cramps.[17] Therefore, we propose that blended essential oils of lavender, marjoram, and clary sage could be beneficial in relieving PD pain.

Material and Methods

Participants

Participants were diagnosed with PD by a gynecologist and confirmed to have no pregnancy, abortion, or other gynecological organic diseases before enrollment in this study. Inclusion criteria were as follows: over 18 years of age, menstrual experience at least once a year, and meeting the criteria of more than 5 scores evaluated by 10-point numeric rating scales (NRS). Forty-eight outpatients at a district hospital in central Taiwan were included in the study. The experimental protocol (08-B-018) was approved by the Institutional Review Board (IRB) at Hungkuang University in Taiwan. We performed the experiment from 15 September 2009 until 31March 2010.

Materials

This study was a double-blind clinical trial. All participants were randomly assigned to either an essential oil (EOG) or a synthetic fragrance group (SFG) using a randomized number chart. For EOG, lavender, clary sage, and marjoram oils, in a 2:1:1 ratio, were diluted into 3% massage cream in an unscented jojoba cream. Lavender oil (*Lavandula angustifolia*), clary sage oil (*Salvia sclarea*) and marjoram oil (*Origanum majorana*) were purchased from Natural Planter Aromatherapy (Taichung, Taiwan). To prevent any doubt in the outpatients, a synthetic fragrance was added to the jojoba cream for the SFG. The synthetic fragrance was purchased from Heng Yi (Taichung, Taiwan). We inspected the ingredients of the essential oils and synthetic fragrances, which diluted in methanol, were analyzed using gas chromatography-mass spectrometry (GC-MS).

Interventions

After pelvic and ultrasound examinations, outpatients completed questionnaires regarding demographic information. The patients were then directed to take the cream home to massage themselves. The dosage was two 1-g spoonfuls each day by massage. The pre-intervention data of NRS and verbal rating scale (VRS) were collected from the first day to the third day of menstruation in the recent first menstrual cycle. When the first menstrual cycle ended, the participants began to apply the massage cream to their lower abdomens every day until the next menstrual cycle. After one menstrual cycle of intervention, the post-intervention data were also collected from the first day to the third day of menstruation in the second menstrual cycle.

Evaluated tools

Table 1 shows the questionnaires of demographic information. Menstrual pain was assessed by NRS and VRS. The NRS was rated on a line of 10 points, from no pain (0) to worst pain (10). A higher score represents more severe intensity, and a lower score represents less severe intensity. The VRS is designed for six grades of severity, including none, very mild, mild, moderate, severe, and very severe. These two scales could accurately assess the intensity and severity of pain, with a mutual correlation coefficient as high as 0.89.[18]

Table 1 Demographic characteristics of patients in the study of pain relief by aromatic essential oil massage in primary dysmenorrhea

Characteristic	EOG ($n = 24$)	SFG ($n = 24$)	Total ($n = 48$)	P-value†
Age (years)	24.9 ± 7.2	24.0 ± 6.0	24.5 ± 6.6	0.33
Age at menarche (years)	12.8 ± 1.1	13.1 ± 1.3	13.0 ± 1.2	0.41
Dysmenorrhea over 3 years	22 (91.7%)	15 (62.5%)	37 (77.0%)	0.43
Use of analgesics	15 (62.5%)	9 (37.5%)	24 (50.0%)	0.43
Duration of menstruation (days)				
Pre-intervention	6.0 ± 1.7	6.5 ± 1.4	6.2 ± 1.6	0.39
Post-intervention	5.9 ± 1.0	6.1 ± 1.2	6.0 ± 1.1	0.41
Difference	0.08 ± 1.28	0.42 ± 1.47	0.25 ± 1.4	
t-value (within)	0.32	1.39	1.26	
Duration of pain (days)				
Pre-intervention	2.4 ± 0.8	2.4 ± 0.7	2.4 ± 0.8	0.41
Post-intervention	1.8 ± 0.7	2.1 ± 0.8	2.0 ± 0.8	0.41
Difference	0.63 ± 0.82	0.33 ± 0.87	0.48 ± 0.85	
t-value (within)	3.72***	1.88	3.90***	

Data are mean ± standard deviation. Analyzed using independent sample t-test. ***Days of pain duration between pre-intervention and post-intervention yielded significant differences ($P < 0.001$) using paired t-test for each group comparison. †Independent sample t-test between the essential oil and synthetic fragrance groups. EOG, essential oil group; SFG, synthetic fragrance group.

Data analysis

The data were analyzed using Statistical Program for Social Sciences (SPSS12.0.1C for Windows, SPSS, Chicago, IL). We examined the difference of pre- and post-interventions using a paired t-test within groups. After statistical significance testing, P-values of less than 0.05 were considered statistically significant.

Results

Demography

The demographic characteristics are listed in Table 1. The mean age was 24.5 ± 6.6 years with a range of 19–45 years, and the average age at menarche was 13.0 ± 1.2 years. A total of 77.0% participants had dysmenorrhea over 3 years, and 50% had never used analgesics. Duration of menstruation before intervention was 6.2 ± 1.6 days, and after intervention was 6.0 ± 1.1 days. As a whole, duration of pain was 2.4 ± 0.8 days for pre-intervention and 2.0 ± 0.8 days for post-intervention. Only in the EOG, the duration of pain significantly decreased from 2.4 ± 0.8 to 1.8 ± 0.7 days, but not significantly in the SFG. The demographic characteristics showed no significant differences between the two groups ($P > 0.05$).

Outcomes

Table 2 shows the results of the NRS and VRS from the first day to the third day of the menstrual period of the two groups. The differences in the NRS were 2.92, 2.21, and 1.38, respectively for the first, second, and third days. These changes among three days are statistically significant with $P < 0.001$ for the first two days and $P < 0.05$ for the third day. In the SFG, only first two days changed significantly. The differences in the same three days of the NRS were 1.96, 1.62, and 0.96, respectively.

The VRS gradually decreased during the first 3 days of the menstrual period of the two groups. In the EOG, the differences in VRS between pre- and post-interventions were 1.08, 0.96 and 0.63. All of these three changes were statistically significant with $P < 0.001$ for the first two days and $P < 0.05$ for the third day. In the SFG, the differences were also significant. Nevertheless, the differences between pre- and post-interventions were 1.00, 0.50 and 0.58; those values were less than the values in the EOG. When we compared these two groups using an independent t-test, a significant difference was noted between the groups on the second and third days ($P < 0.05$).

Chemical components

Components of blended essential oil analysis by gas chromatography-mass spectrometry are listed in Table 3. The top five contents were 36.84% linalyl acetate, 22.53% linalool, 17.21% eucalyptol, 3.29% α-terpineol, and 2.69% β-caryophyllene. The maximum content was ester at 39.16%, including linalyl acetate, nerol acetate, and 2-methyl-1-butyl acetate. The second

Table 2 Results of the NRS and VRS from the first day to the third day in the two groups

Group	EOG ($n = 24$)			SFG ($n = 24$)			Independent t-test		
Day	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
NRS									
Pre	6.83 ± 2.20	4.92 ± 2.15	2.71 ± 2.39	6.33 ± 1.73	5.08 ± 2.00	3.04 ± 2.26	0.88	–0.28	–0.50
Post	3.92 ± 2.39	2.71 ± 1.88	1.33 ± 1.66	4.33 ± 2.55	3.46 ± 2.04	2.08 ± 1.56	–0.58	–1.33	–1.61
Difference	2.92 ± 2.60	2.21 ± 2.55	1.38 ± 3.06	1.96 ± 2.31	1.62 ± 2.14	0.96 ± 2.39			
t-value	5.49***	4.24***	2.20*	4.15***	3.72***	1.97			
VRS									
Pre	3.00 ± 0.98	2.13 ± 1.08	1.04 ± 1.04	3.08 ± 0.93	2.33 ± 0.87	1.46 ± 1.22	–0.30	–0.74	–1.28
Post	1.92 ± 1.25	1.17 ± 0.82	0.42 ± 0.58	2.08 ± 1.32	1.83 ± 0.92	0.88 ± 0.74	–0.45	–2.66†	–2.38†
Difference	1.08 ± 1.44	0.96 ± 1.20	0.63 ± 1.24	1.00 ± 1.22	0.50 ± 1.02	0.58 ± 1.35			
t-value	3.68***	3.92***	2.46*	4.03***	2.40*	2.12*			

Data are mean ± standard deviation. Comparison between pre- and post-intervention was noted *($P < 0.05$) and ***($P < 0.001$) using paired t-test for each group. †A significant difference was noted between the groups on the second and third days ($P < 0.05$). EOG, essential oil group; NRS, numeric rating scales; SFG, synthetic fragrance group; VRS, verbal rating scales.

Table 3 Ingredients of blended essential oils analyzed by gas chromatography-mass spectrometry

No.	Ingredient	Percentage
1	Linalyl acetate	36.84
2	Linalool	22.53
3	Eucalyptol	17.21
4	α-Terpineol	3.29
5	Caryophyllene	2.69
6	γ-Cadinene	1.71
7	β-Pinene	1.69
8	Nerol acetate	1.49
9	β-trans-Ocimen	1.33
10	(+)-Sabinene	1.18
11	Geraniol acetate	1.17
12	4-Terpineol	1.05
13	α-Pinene	1.05
14	cis-β-Ocimene	0.98
15	2-Methyl-1-butyl acetate	0.83
16	β-Farnesene	0.78
17	Ethyl amyl ketone	0.75
18	Borneol	0.59
19	β-Myrcene	0.53
20	Germacrene D	0.44
21	D-Limonen	0.35
22	α-Santalene	0.31
23	γ-Elemene	0.29
24	Geranyl isobutyrate	0.28
25	Elemol	0.23
26	B-Terpineol	0.19
27	(Z,Z)-α-Farnesene	0.16
28	Allyl propionate	0.08
Total		100.00

maximum content was alcohol at 24.89%, including linalool, α-terpineol, and 4-terpineol. The same analysis applies to synthetic fragrance because the main ingredient is usually common in cosmetics fragrances. The four components are ethylene brassylate (41.83%), dipropylene glycol (22.35%), polycyclic musk (13.76%), and isopropyl myristate (6.79%). These components are ineffective for pain relief; they are simply general ingredients found in cosmetics.

Discussion

In our study, the mean age at menarche was 13.0 ± 1.2 years with a range of 11–15 years, similar to 12.0–13.5 years in Eryilmaz[4] and Han[2] studies. Many studies have reported that the menstrual pain started from the first day or onset of menstrual flow and continued for 24–72 h; therefore, we measured the first three sequential days in our trial. Seventy-seven percent of outpatients in this study had dysmenorrhea over 3 years, compared to 53.6% in the study by Eryilmaz.[4] Fifty percent of outpatients used oral analgesics to relieve menstrual discomfort in this study; the percentages were higher than those in the studies by Han[2] and Eryilmaz.[4] The reason is that all subjects were outpatients of the Obstetrics and Gynecology Department, a contrast to previous research involving high school or college students. Duration of menstruation was 6.2 ± 1.6 days, which was similar to other reports and did not change appreciably between pre- and post-intervention in both groups. The days of menstrual pain showed a significant difference ($P < 0.001$) in the EGO with values from 2.4 on pre-intervention decreasing to 1.8 on post-intervention. This indicates that aromatherapy massage could shorten the duration of pain and reduce the inconvenience caused by dysmenorrhea.

Massaging with essential oils is a useful method to promote health and prevent disease. Whether the

effectiveness of such promotion and prevention can be attributed to either the massage or the essential oils is difficult to clarify. To avoid the influences of massage, our study design did not massage at menstruation. The purpose of massage during non-menstrual periods was only to enhance aroma cream penetrating into the body. Massage can reduce stress hormone levels by excreting endorphins in the plasma,[19] promoting parasympathetic activation, and increase secretion of the neurotransmitter serotonin to block the conduction of pain.[20] Indeed, massage may possess positive influences on relieving menstrual pain. However, it has no persistent analgesic efficacy,[2,10] only temporary efficacy when after massage therapy.[20] The efficacy of pain relief was due to certain components in the massage cream, and not to the practice of massage itself in our study. In Table 2, the decrease in NRS and VRS scales on the first day to the third day of menstruation in the EOG was greater than in the SFG, and aromatherapy decreased the duration of pain. We claim that this aromatherapy intervention is more effective using essential oil (EOG) than synthetic fragrance (SFG) for relieving PD. In addition, most outpatients affirmed that the aromatic essential oil massage had analgesic effects and that they paid more attention to their menstrual health. No participants needed analgesics after intervention. The aromatherapy had a positive influence on the autonomic nervous system, released anxiety,[21] and controlled pain.[22] Puttler[23] emphasized that the chemical ingredients of essential oils had more significant contributions to therapy than the scent itself.

In view of this, we analyzed the ingredients of blended essential oils by GC-MS. Table 3 shows the components of the blended oil. The key components were linalyl acetate (36.84%) and linalool (22.53%). These two components originate mainly from lavender and clary sage oils, and have demonstrated analgesic and anti-inflammatory effects in human trials[22,24] and animals models.[25,26] Linalool is effective in inhibiting the secretion of prostaglandins (PGs) that cause uterine muscle contraction in PD. Clinical medical researchers have proposed that the amount of PGs increases in menstrual fluid. If the secretion of PGs is excessive, there is stronger myometrial contraction, uterine ischemia, and cramping followed by pelvic pain. Eucalyptol (1.8-cineole), which is a terpene oxide, comes from marjoram oil, and can inhibit the metabolism of arachidonic acid, which is a precursor of PGs with inflammatory effects tested on human blood monocytes.[27,28] Moreover, some terpenes also have analgesic effects;[24] although there was only 2.69% β-caryophyllene in our formula, and this species has local anesthetic activity.[29] Conclusively, these four components, totaling 79.27%, play important roles in alleviating menstrual pain.

This study demonstrated that aromatic essential oil massage can relieve primary dysmenorrhea in outpatients for three reasons. First, EGO significantly shortened the duration of pain from 2.4 to 1.8. Second, the decrease in NRS and VRS scales on the first day to the third day of menstruation in the EOG was more than that in the SFG. Finally, the blended essential oils with four components totaling to 79.27% demonstrated analgesic effects. The blended formula contained lavender, clary sage, and marjoram oils in a 2:1:1 ratio and diluted to a 3% concentration massage cream. These three oils contain four key analgesic components that amount to as much as 79.29%; these analgesic constitutes are linalyl acetate, linalool, eucalyptol, and β-caryophyllene. We claim that this blended formula can serve as a reference to alternative and complementary medicine for primary dysmenorrhea. From the preventive medicine viewpoint, aromatherapy can effectively reduce the severity of pain and promote awareness in women concerned about their health, and can be an alternative and complementary method for alleviating menstrual pain from PD.

Our study has several limitations due to the outcomes created by subjectively measured questionnaires. If further research is conducted, more complementary tools are required to assess pain. We suggest monitoring the concentration of PGs in plasma before and after intervention, because decreasing the amount of PGs may relieve menstrual cramps.[30] In addition, inspecting blood flow of uterine by color doppler ultrasound may be another clinical research choice. These two methods can provide more direct evidence to assess dysmenorrhea. For future research design, extending the time of intervention and tracing two menstrual cycles are also recommended. The question remains how long the effects of essential oils persist in relieving PD; therefore, and more practice and evidence is required for conclusive proof.

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Disclosure

None declared.

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