ScienceDirect

Effect of lavender inhalation on the symptoms of primary dysmenorrhea and the amount of menstrual bleeding: A randomized clinical trial[☆]

CrossMark

Ziba Raisi Dehkordi [a,*], Fatemeh Sadat Hosseini Baharanchi [b,c], Reza Bekhradi [d]

[a] Department of Midwifery, School of Nursing and Midwifery, Shahrekord University of Medical Sciences, Shahrekord, Iran
[b] Department of Biostatistics, Faculty of Medical Sciences, Tarbiat Modares University, Tehran, Iran
[c] Department of Mathematics & Statistics, Eyvanakey Institute of Higher Education, Semnan, Iran
[d] Research Development Unit, Barij Essence Pharmaceutical Company, Kashan, Iran

Available online 6 January 2014

Summary

Objective: The purpose of this study was to explore the effect of *Lavandula angustifolia* (lavender) inhalation on the symptoms of dysmenorrhea and the amount of menstrual bleeding in female students with primary dysmenorrhea.

Design: This study is an experimental clinical trial. The subjects were 96 female students residing in dormitory at Tehran University of Medical Sciences in 2011 and suffering from level two or three dysmenorrhea according to the verbal multi-dimensional scoring system. The inclusion criteria were as: being single, suffering from primary dysmenorrhea, having no genital organs disorder, having no systemic disease, having regular menstrual cycles, using no contraceptives, etc. The follow-up time was 4 menstrual cycles.

Interventions: The subjects were randomized into two groups: experimental ($n = 48$) who inhaled lavender based on sesame oil, and placebo ($n = 48$) who inhaled sesame oil only.

Main outcome measures: The severity of dysmenorrhea symptoms was measured through a questionnaire, and the amount of menstrual bleeding was measured by sanitary towel usage.

Methods: Ordinal logistic regression and generalized estimating equation (GEE) were used to analyze the data.

Results: The symptoms of dysmenorrhea were significantly lowered in the lavender group compared to the placebo group ($p < 0.001$). The amount of menstrual bleeding in the lavender group was reduced in comparison to the placebo group but the difference was not statistically significant ($p = 0.25$). No significant difference was observed for blood clot among the students ($p = 0.666$).
Conclusions: This study showed that lavender inhalation was effective in alleviating dysmenorrhea symptoms, suggesting that it could be applied by midwives in a safe manner because of no side effects, simplicity and cost-effectiveness for all patients.

Introduction

Dysmenorrhea is one of the most commonly reported symptoms by adolescent girls and adult women in obstetrics and gynecology departments that can have adverse effects on their quality of life.[1,2] Primary dysmenorrhea (functional) is a common painful condition, which may be accompanied by other symptoms. It recurs every month across the reproductive years, and is associated with normal ovulatory cycles and with no pelvic pathology.[3,4] Dysmenorrhea is the primary cause of short-term absences from school[5] and activity limitations.[6] It usually begins a few hours before or just after the start of menstrual bleeding and lasts for 2—3 days.[7,8] The prevalence of primary dysmenorrhea, in the absence of organic pelvic lesions, ranges from 43% to 90% among various populations.[9] Poureslami reported a dysmenorrhea incidence of 70.5% among adolescent girls in Iran.[10] Several studies in Iran have shown that around 71%—89.8% of all menstruating women experience some discomfort.[11,12]

Many adolescents suffer from a number of physical and emotional symptoms associated with dysmenorrhea[13—14] such as headache, vomiting, nausea, abdominal pain, dizziness, weakness, diarrhea, mood change (depression, irritability and nervousness), faint and hot flushing. Symptoms of dysmenorrhea accompany the onset of menstrual flow or occur within a few hours before or after the onset of menstruation. Severity of dysmenorrhea symptoms positively correlates with early menarche as well as the duration and the amount of menstrual flow.[15,16] The etiology of primary dysmenorrhea has not been precisely understood yet, but most symptoms can be explained by the action of uterine prostaglandins. Severity of dysmenorrhea symptoms is highest during the first two days of menses.[17]

Different methods have been used to treat dysmenorrhea: pharmacological, non-pharmacological and surgical.[18] Also complementary and alternative medicines (CAM) such as herbal preparations, transcutaneous nerve stimulation, acupuncture, exercise,[4] acupressure,[19] massage and aromatherapy (inhalation)[20] have been reported to relieve dysmenorrhea. Menorrhagia is defined as a menstrual loss of 80 ml or more blood per period.[21] It is a common clinical problem among the women of reproductive age.[21] Menstruation can be a cause of shame and discomfort to many women, and has a major influence on women's lifestyle.[22] Recently, inhalation has been widely used as a nursing intervention worldwide.[23] Inhalation is defined as a treatment using scents that are extracted from herbs, flowers and other plant parts to treat various diseases.[24,25] Inhalation is thought to be therapeutically effective due to both the psychological effect of the odor and the physiological effect of the inhaled volatile compounds.[26,27] Many benefits are claimed for lavender use including positive emotional states including relief of stress and depression symptoms, improving mood, and relaxation.[28,29]

There are many types of essential oils, which are used for inhalation, such as melissa, eucalyptus, rosemary, lavender and clary sage that help in treating dysmenorrhea.[30] It is important that essential oils are always diluted with carrier oil prior to use.[31] A carrier can be any high-quality vegetable oil like almond, grape seed or sesame.[31] It is recommended that essential oils must be applied some days before dysmenorrhea.[31] Recently, lavender oil has been used predominantly in inhalation or massage therapy.[32] Many varieties of lavender are cultivated around the world. One the most common species that has medicinal effect is *Lavandula angustifolia* or *L. officianalis*.[33] Linalyl acetate and linalool can be detected in blood after inhalation of *L. angustifolia*.[34,35] Linalool and linalyl acetate are able to cause central nervous system depression. Linalyl acetate has narcotic actions, and linalool acts as a sedative.[36] The authors suggest that the mechanism of action is related to antimuscarinic activity and/or ion (Na^+ or Ca^{2+}) channel blockade.[37] It has been also reported that lavender increases blood flow.[38] Aromatherapy with lavender is a good alternative the treatment of anxiety, stress and depression.[39] It is can also be used as a strong sedative.[39] Although inhalation of lavender oil may alter psychological parameters, its exact effects are still controversial.[40—42]

The purpose of this study was to investigate the therapeutic effect of lavender oil inhalation on dysmenorrhea symptoms, amount of bleeding, and blood clot to palliate the dysmenorrhea complaints and discomforts, and thus to improve women's quality of life.

Methods

This randomized clinical trial study was contained with the participation of 96 female students who resided in the nearest dormitory of the Tehran University of Medical Sciences in 2011. There were 300 students were aged between 18 and 28 years old. The inclusion criteria were being single, suffering from level two or three primary dysmenorrhea according to the Andersch and Milsom's verbal multi-dimensional scoring system with attention to the timing and onset of the symptoms (typically a few hours before the onset of bleeding and lasting for 1—3 days),[43] absence of any genital organs diseases (such as myoma or fibrocystadenoma, endometriosis, chronic pelvic inflammatory disease, chronic pelvic pain, metrorrhagia, ovarian cysts, obstructive vaginal or uterine congenital anomalies, adenomyosis and other pelvic pathologies), having no systemic diseases (such as

inflammatory bowel disease, irritable bowel syndrome and other systemic diseases), having regular menstrual cycles, using no contraceptives, having a normal sense of smell, being able to smell the fragrances, having no allergy to fragrances or scents, and using no analgesics to overcome dysmenorrhea. The exclusion criterion was having allergy to lavender regarding the Andersch and Milsom's verbal multidimensional scoring system.[15] Dysmenorrhea symptoms were scored from 1 to 4 (1: none, 2: mild, 3: moderate and 4: severe) regarding the intensity experienced by the subjects. Mild dysmenorrhea defines menstruation that is painful but seldom inhibits the woman's normal activity, and analgesics are sometimes needed. Moderate dysmenorrhea affects daily activities and requires analgesics, but missing work or school is unusual. Finally, severe dysmenorrhea clearly inhibits one's daily activity and is poorly managed by analgesics. In this study, we included only students with level two or three primary dysmenorrhea.

The Ethics Committee of Tehran University of Medical Sciences approved the study (code No. IRCT201105086412N1). A written consent was obtained from all of the students.

Interventions

The intervention group used lavender aroma diluted in sesame oil in a 2:1 ratio, and the placebo group used sesame oil only. The treatments were provided by Barij Essence Pharmaceutical Company in Iran. The students were asked to strew 3 drops of the treatment on their palms, rub them together, keep their hands at the distance of 7—10 cm from their nose and inhale for 5 min. The treatments were administered to the students for 1 h after experiencing dysmenorrhea. They were asked to use the treatments every 6 h for the first three days of menstruation. During the two consecutive menstrual cycles, one of the two treatments (placebo or lavender) was administered to the students.

Randomization and blinding

Using NCSS PASS11 software, Procedure menu and DOE submenu, the numbers 1—96 were randomly assigned into two groups (A and B). This random sequence was sent to the Barij Essence Pharmaceutical Company. They provided 96 quite similar bottles with labels A and B (48 bottles for each), one contained lavender and the other contained placebo. Hence, the students, the investigators and the data analysts were all blind to the treatments.

Outcomes and their measurements

The students' age, BMI and menstrual characteristics were registered. Abdominal pain and backache, tiredness, vomiting, nausea, weakness, diarrhea, headache, mood change, faint, hot flushing and nasal congestion called were considered as dysmenorrhea symptoms. The severity of dysmenorrhea symptoms, primary outcomes, was measured using a researcher-made questionnaire to assess the efficacy of the treatments. The questionnaire was developed through the review of the related literature. The students were requested to select one of the scores from 0 to 3 before

and after the treatment. According to this questionnaire, score 0 represents no symptoms, score 1 represents light symptoms, which do not inhibit one's daily activity, score 2 represents light symptoms that inhibit one's daily activity but are not debilitating, and finally, score 3 represents symptoms, which are severe and debilitating completely. The amount of menstrual bleeding, the other primary outcome, was determined for each group on the 1st, 2nd and 3rd days of menstruation period by the original pictorial blood assessment chart (defined by Higham et al. in 1990)[44] before and after the treatment. This original scoring system is based on the visual appearance of stained towels and tampons, and the presence of blood clots. Passage of clots (size equated with the size of different coins) and episodes of flooding are recorded. In this study, the amount of menstrual bleeding was determined by sanitary towel because single girls only use sanitary towel instead of tampon in Iran. Finally, the students were asked if they had blood clots or not in their menstrual blood, the secondary outcome, before and after the treatment. They were instructed how to fill the forms properly as follows.

Pictorial blood assessment chart

Towels: 1 point for each lightly stained towel, 5 points for each moderately soiled towel, 20 points if the towel is completely saturated with blood. *Tampons*: 1 point for each lightly stained tampon, 5 points for each moderately soiled tampon, 20 points if the tampon is completely saturated with blood. *Clots*: 1 point for small clot and 5 points for large clot.

Statistical analysis

Frequency table was used for summarizing the qualitative variables. In addition, the quantitative variables were summarized using mean and standard deviation (SD). Binary logistic regression and ordinal logistic regression were utilized for estimating the odds ratio (OR) and its confidence interval (95% CI). Odds ratio is a measure of association obtained in logistic models. It allows the investigator to evaluate the effect of predictor variables on odds of outcome. Moreover, generalized estimating equation (GEE) methodology with AR(1) correlation structure was used to assess the effect of lavender on the repeated measurements of dysmenorrhea symptoms and menstrual bleeding adjusting for time and baseline. The data were analyzed using SPSS 16.0 software, and the significance level was set at 0.05.

Results

Among the total of 300 dormitory residing students, 250 volunteered to enter the study. These students were followed for 4 menstrual periods. During the first and the second periods, the students themselves documented the severity of their dysmenorrhea and menstrual characteristics without any intervention. Finally, 113 students met all the inclusion criteria whom 96, needed sample size, were recruited to the study randomly. All other details have been become in Fig. 1.
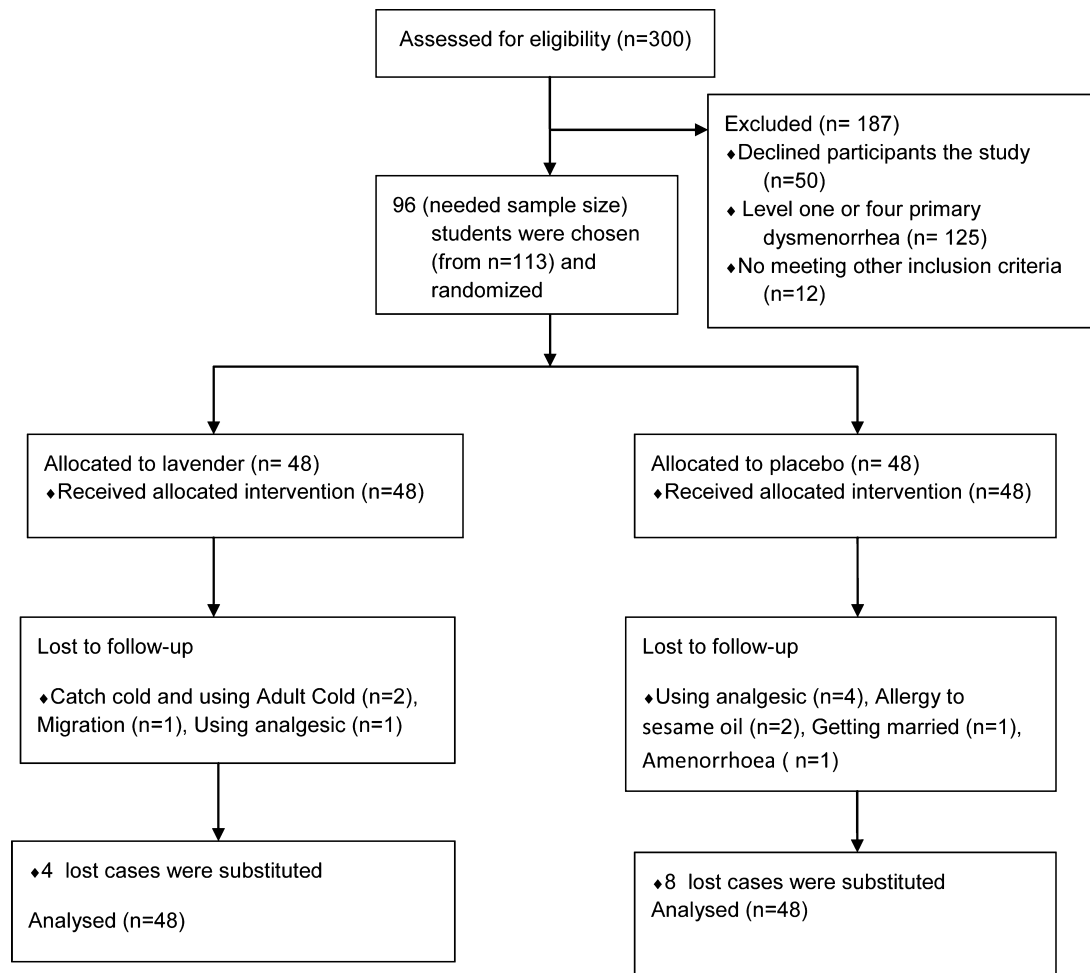
```
┌─────────────────────────────────┐
│  Assessed for eligibility (n=300)│
└─────────────────────────────────┘
                │                          ┌────────────────────────────────────┐
                │ ───────────────────────► │ Excluded (n= 187)                  │
                │                          │ ♦Declined participants the study   │
                ▼                          │    (n=50)                          │
┌─────────────────────────────────┐       │ ♦ Level one or four primary        │
│  96 (needed sample size)         │       │    dysmenorrhea (n= 125)           │
│  students were chosen            │       │ ♦No meeting other inclusion criteria│
│  (from n=113) and                │       │    (n=12)                          │
│  randomized                      │       └────────────────────────────────────┘
└─────────────────────────────────┘
```

┌──────────────────────────────────────┐   ┌──────────────────────────────────────┐
│ Allocated to lavender (n= 48)   │   │ Allocated to placebo (n= 48)   │
│ ♦Received allocated intervention (n=48)│   │ ♦Received allocated intervention (n=48)│
└──────────────────────────────────────┘   └──────────────────────────────────────┘

┌──────────────────────────────────────┐   ┌──────────────────────────────────────┐
│ Lost to follow-up   │   │ Lost to follow-up   │
│   │   │   │
│ ♦Catch cold and using Adult Cold (n=2),│   │ ♦Using analgesic (n=4), Allergy to   │
│ Migration (n=1), Using analgesic (n=1)│   │ sesame oil (n=2), Getting married (n=1),│
│   │   │ Amenorrhoea (n=1)   │
└──────────────────────────────────────┘   └──────────────────────────────────────┘

┌──────────────────────────────────────┐   ┌──────────────────────────────────────┐
│ ♦4 lost cases were substituted   │   │ ♦8 lost cases were substituted   │
│   │   │ Analysed (n=48)   │
│ Analysed (n=48)   │   │   │
└──────────────────────────────────────┘   └──────────────────────────────────────┘

Figure 1   The study flowchart.

Table 1   Baseline characteristics in the lavender and the control groups.

Characteristic	Category	Control group	Lavender group
Onset of dysmenorrhea	One day before or simultaneously	38 (79.2%)	37 (77.1%)
	Some days before	10 (20.8%)	11 (22.9%)
Family history of dysmenorrhea	Yes	44 (91.7%)	42 (87.5%)
	No	4 (8.3%)	6 (12.5%)
Frequency of painful menstruation	Always	15 (31.2%)	14 (29.2%)
	Most times	29 (60.4%)	25 (52.1%)
	Sometimes	4 (8.3%)	9 (18.8%)
Age ($\pm$SD), year	—	20.29 ($\pm$1.35)	20.35 ($\pm$1.43)
Age at menarche ($\pm$SD), year	—	14 ($\pm$1.28)	13.68 ($\pm$1.25)
Age at onset of dysmenorrhea ($\pm$SD), year	—	14.85 ($\pm$1.62)	14.47 ($\pm$1.48)
Duration between two menstruations ($\pm$SD), day	—	28.25 (1.19)	28.31 (1.50)
Bleeding duration ($\pm$SD), day	—	6.10 (0.95)	5.93 (1.21)
Pain duration ($\pm$SD), day	—	2.25 (0.75)	2.43 (0.64)
BMI ($\pm$SD), kg/m^2	—	21.89 (3.93)	20.97 (2.03)

Table 2 Percentage of students in each level of symptoms for the lavender and the control groups along with OR (95% CI) estimate using ordinal logistic regression for each symptom.

Symptoms	Control group (%)			Lavender group (%)			OR[a] (95% CI)[b]
	None	Mild	Moderate	None	Mild	Moderate	
Abdominal pain and backache	26	4.2	69.8	31.2	42.7	26	6.8 (2.9, 15.9)
Tiredness	21.9	14.6	63.4	33.3	47.9	18.8	12 (4.6, 31.5)
Vomiting	46.9	46.9	6.2	37.5	41.7	20.8	8.7 (3.2, 23.3)
Nausea	58.3	29.2	12.5	40.6	40.5	18.9	11.5 (4.6, 29)
Weakness	25	37.5	37.5	28.1	52.1	19.8	6.48 (2.6, 15.6)
Diarrhea	49	41.7	9.4	37.5	41.7	20.8	6.6 (2.8, 15.4)
Headache	28.1	65.6	6.2	39.6	43.8	16.7	12.6 (4.9, 32.4)
Mood change	24	65.6	10.4	34.4	42.7	22.9	5.6 (2.3, 13.6)
Faint	24	65	11	33.3	50	16.7	16.2 (4.9, 53.8)
Hot flushing	24	67.7	8.3	32.3	51	16.7	9.1 (3.2, 25.5)
Nasal congestion	31.2	63.5	5.2	38.5	43.8	17.7	8.5 (3.2, 22.1)

[a] For example, the odds of abdominal pain and backache in the control group was 6.8 times that of in the lavender group
[b] If the 95% CI excludes the value of 1 is statistically significant.

Baseline characteristics of the students were comparable between the lavender and the control groups (Table 1).

Dysmenorrhea symptoms

At first step, we assessed the effect of lavender on the students' dysmenorrhea symptoms. Since there was not enough sample size in the severe category to fit the ordinal logistic regression, the severe and moderate categories were combined into a single group, namely moderate category. The ordinal logistic regression was fitted to estimate the lavender effect controlling for baseline in each of the 11 dysmenorrhea symptoms. OR (95% CI) in Table 2 shows that lavender was highly effective in reducing the score of symptoms ($p < 0.001$).

Baseline was only significant in four symptoms: mood change, faint, hot flushing and nasal congestion ($p < 0.001$). The ordinal logistic regression parameters demonstrated that in the control group, the estimated odds of abdominal pain and backache, below any fixed level, were 6.8 times the estimated odds in the lavender group. Also the estimated odds of tiredness, nausea and headache in the control group, below any fixed level, were 12 times the estimated odds in the lavender group. The estimated odds of faint below any fixed level in the control group were 16 times the estimated odds in the lavender group, which was statistically significant. Most of the ordinal regressions satisfied the proportional odds' property ($p > 0.05$) while some of them, though negligible, did not satisfy the assumption.

Amount of menstrual bleeding

At the second step of data analysis, due to small sample size in the amount of bleeding levels, moderate and heavy bleedings were combined into a single group. Frequencies and ORs (95% CI) in Table 3 show that the students' amount of menstrual bleeding has decreased over the time.

Binary logistic regression parameters revealed that the estimated odds of moderate and heavy bleedings in the lavender group were 1.4 times the estimated odds of moderate and heavy bleedings at the control group in the 1st day of menstruation. In addition, in the lavender group, the

Table 3 The frequency (%) of students in each level of amount of menstrual bleeding at first 3 days in both groups before and after the treatment along with OR (95% CI) using binary logistic regression.

Day	Amount of bleeding	Control group n (%)		Lavender group n (%)		OR[a] (95% CI)[b]
		Before	After	Before	After	
1st	Light	6 (12.5)	6 (12.5)	4 (8.3)	8 (16.6)	1.4 (0.4, 4.3)
	Moderate and heavy	42 (87.5)	42 (87.5)	44 (91.7)	40 (83.4)	
2nd	Light	2 (4)	8 (16.6)	3 (6.2)	6 (12.5)	0.7 (0.2, 2.2)
	Moderate and heavy	46 (96)	40 (83.3)	45 (93.8)	42 (87.5)	
3rd	Light	5 (10.5)	18 (37.5)	4 (8.3)	9 (18.7)	0.3 (0.1, 0.9)
	Moderate and heavy	43 (89.5)	30 (62.5)	44 (91.7)	39 (81.3)	

[a] For example: at first day, the odds of moderate and heavy bleeding in the control group are 1.4 times that of in the lavender group.
[b] If the 95% CI excludes the value of 1 is statistically significant.

estimated odds of moderate and heavy bleedings were 0.7 and 0.3 times the estimated odds of moderate and heavy bleeding in the control group in the 2nd and 3rd days of menstruation, respectively. The baseline measurements of the amount of menstrual bleeding were not significant ($p > 0.05$) in the three models. The effect of lavender on the amount of bleeding was not significant in the 1st and 2nd days. It was seen that lavender's effectiveness in the 1st day was in the opposite direction of its effectiveness in the 2nd and 3rd days. At the next step of data analysis, because of the repeated and correlated nature of responses (amount of menstrual bleeding in consecutive days), binary logistic regression was fitted with AR(1) correlation structure using GEE approach. The result did not show a significant effect of lavender on menstrual bleeding ($p = 0.25$). The frequency of days with moderate and heavy menstrual bleedings in the first 3 days before the treatment was considered as baseline in this model.

Blood clot

Binary logistic regression was fitted to estimate the effect of lavender on blood clot controlling for baseline. The parameter estimate showed that the effect of lavender (−0.23) did not reduce the students' blood clot statistically ($p = 0.666$).

Discussion

Aromatherapy is a therapy to maintain and promote one's physical, mental and psychological health. It can be provided through massage or inhalation which are widely used as nursing interventions.[45] This study aimed to explore the effect of lavender inhalation on dysmenorrhea symptoms and amount of menstrual bleeding in university students suffer from primary dysmenorrhea. In this study, participants were university girls in their early 18s because dysmenorrhea is most severe in the second and third decades among the women of conceivable age. Aroma inhalation is effective for mental and physical stability, refreshing and concentration. In this method, the essential oil is absorbed into the lung and blood through the nose.[29,46] Lavender is used as a sedative, anti-depressant,[47] anti-spasmodic,[48] anti-flatulent,[49] and also to treat infertility,[47,50] infection, anxiety, fever, stress,[47,50] symptoms from restlessness to colic in infants,[51] varicose ulcers[52] and carpal tunnel syndrome.[53] The results of this study showed that lavender inhalation had an alleviating effect on the severity of dysmenorrhea. This result has been supported by previous findings such as massage with lavender oil compared to placebo (odorless liquid petrolatum) which decreased dysmenorrhea symptoms at a statistically significant rate.[30] Besides, it was showed that massage using essential oils of lavender, clary sage, and rose were effective in treating menstrual discomforts. However, there was some skin irritation reports.[20] Since aromatherapy through massage can occur skin irritation,[20] likely due to inhalation of lavender we did not receive any report based on skin irritation in the present study. Marzouk et al. revealed abdominal massage using essential oils (cinnamon, clove, rose, and lavender in a base of almond oil) was effective in reducing dysmenorrhea. They stated that the positive effect were mainly due to aromatherapy and not due to the massage.[54] When essential oils extracted from plants are inhaled, olfactory receptor cells are stimulated and the impulses are transmitted to the emotional center of the brain, or ''limbic system''.[55,56] Aromatherapy with lavender could be used as an alternative therapy for patients with depression symptoms.[57−59] It can also be used to decrease agitation[60], neuroleptics[61], and to relieve pain.[1,62] Lavender oil has also found several applications in midwifery to relieve pain and discomfort following labor.[42,63] Although inhalation of lavender oil has influence on altering the patient's mood and improving sleep patterns, there is still considerable debate about its benefits in this regard.[40,41] Regular menstruation usually lasts 4−6 days.[64] The average volume of menstrual fluid during a monthly menstrual period is 35 ml and ranges within 10−80 ml.[65] Greater menstrual flow is associated with more severe pain.[66] Natural treatments such as herbal remedies offer a gentler alternative to promoting normal levels of monthly bleeding. These remedies are safe to use and support women's overall health. Herbs such as honey, vitx and fennel essential oil promote menstrual and hormonal health.[67−69]

The results of this study showed that there is no significant association between lavender inhalation and the amount of menstrual bleeding during the first 3 days. In addition, no statistically significant effect of lavender inhalation was observed on blood clot. Marzouk et al. reported that using aromatherapy turned more students from excessive to average menstrual bleeding in the first and second days but not in the third day compared with students in the placebo group.[54] Moreover, the findings showed that students in the lavender group experienced lower dysmenorrhea according to VAS (Visual Analogues Scale) noticeably (this result has been submitted elsewhere).

It is suggested to conduct future trials with crossover design to recognize the effect of lavender inhalation on dysmenorrhea more clearly. Moreover, future studies need to discover inhalation effect mechanism of essential oils extracted from lavender and other species of family Lamiaceae having pharmaceutical effects.

Conclusions

Inhalation of lavender relieves the severity of primary dysmenorrhea symptoms. Because of simplicity, cost-effectiveness and no side effects, this method can be applied by midwives for all female patients suffering from primary dysmenorrhea.

Conflict of interest statement

Authors have not any conflict of interest.

Acknowledgements

References

1. Ou MC, Hsu TF, Lai AC, Lin YT, Lin CC. Pain relief assessment by aromatic essential oil massage on outpatients with primary dysmenorrhea: a randomized, double-blind clinical trial. *Journal of Obstetrics and Gynaecology Research* 2012;**38**(5):817—22.

2. Tseng YF, Chen CH, Yang YH. Rose tea for relief of primary dysmenorrhea in adolescents: a randomized controlled trial in Taiwan. *Journal of Midwifery & Women's Health* 2005;**50**(5):e51—7.

3. Dawood MY. Primary dysmenorrhea: advances in pathogenesis and management. *Obstetrics & Gynecology* 2006;**108**(2):428—41.

4. Harel Z. Dysmenorrhea in adolescents and young adults: etiology and management. *Journal of Pediatric and Adolescent Gynecology* 2006;**19**(6):363—71.

5. Banikarim C, Chacko MR, Kelder SH. Prevalence and impact of dysmenorrhea on Hispanic female adolescents. *Archives of Pediatrics and Adolescent Medicine* 2000;**154**(12):1226.

6. Alonso C, Coe CL. Disruptions of social relationships accentuate the association between emotional distress and menstrual pain in young women. *Health Psychology* 2001;**20**(6):411.

7. Irvani M. The effect Zataria Multiflora on primary dysmenorrhea. *Herbal Drogs Journal* 2009;**11**(2):55—60.

8. Berek JS, Novak E. *Berek and Novak's gynecology*. Philadelphia: Lippincott Williams & Wilkins; 2007.

9. Jamieson DJ, Steege JF. The prevalence of dysmenorrhea, dyspareunia, pelvic pain, and irritable bowel syndrome in primary care practices. *Obstetrics & Gynecology* 1996;**87**(1):55—8.

10. Poureslami M, Osati-Ashtiani F. Assessing knowledge, attitudes, and behavior of adolescent girls in suburban districts of Tehran about dysmenorrhea and menstrual hygiene. *Journal of International Women's Studies* 2002;**3**(2):10—1.

11. Noroozi A, Tahmasebi R. Pattern of menstruation, hirsutism and dysmenorrhea in students of Boushehr Medical and Khalig-e-Fars (2002—2003). *Medical Journal of Hormozgan University* 2004;**7**(4):203—9.

12. Panahzadeh Z, Pakzad Z, Ashouri R. Survey the prevalence, knowledge and practice of Guilan University students about dysmenorrhea. *Journal of Guilan University of Medical Sciences* 2008;**17**(2):87—94.

13. Agarwal AK, Agarwal A. A study of dysmenorrhea during menstruation in adolescent girls. *Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine* 2010;**35**(1):159.

14. George A, Bhaduri A. Dysmenorrhea among adolescent girls-symptoms experienced during menstruation. *Health Promotion and Education* 2002;**17**:4.

15. Andersch B, Milsom I. An epidemiologic study of young women with dysmenorrhea. *American Journal of Obstetrics and Gynecology* 1982;**144**(6):655.

16. Balbi C, Musone R, Menditto A, Di Prisco L, Cassese E, D'Ajello M, et al. Influence of menstrual factors and dietary habits on menstrual pain in adolescence age. *European Journal of Obstetrics & Gynecology and Reproductive Biology* 2000;**91**(2):143—8.

17. Singh A, Kiran D, Singh H, Nel B, Singh P, Tiwari P. Prevalence and severity of dysmenorrhea: a problem related to menstruation, among first and second year female medical students. *Indian Journal of Physiology and Pharmacology* 2008;**52**(4):389—97.

18. Hillen TIJ, Grbavac SL, Johnston PJ, Straton JAY, Keogh JMF. Primary dysmenorrhea in young Western Australian women: prevalence, impact, and knowledge of treatment. *Journal of Adolescent Health* 1999;**25**(1):40—5.

19. Jun EM, Chang S, Kang DH, Kim S. Effects of acupressure on dysmenorrhea and skin temperature changes in college students: a non-randomized controlled trial. *International Journal of Nursing Studies* 2007;**44**(6):973—81.

20. Han SH, Hur MH, Buckle J, Choi J, Lee MS. Effect of aromatherapy on symptoms of dysmenorrhea in college students: a randomized placebo-controlled clinical trial. *Journal of Alternative & Complementary Medicine* 2006;**12**(6):535—41.

21. Kadir R, Aledort L. Obstetrical and gynaecological bleeding: a common presenting symptom. *Clinical & Laboratory Haematology* 2000;**22**(s1):12—6.

22. Kjerulff KH, Erickson B, Langenberg P. Chronic gynecological conditions reported by US women: findings from the National Health Interview Survey, 1984 to 1992. *American Journal of Public Health* 1996;**86**(2):195—9.

23. Cho M-Y, Min ES, Hur M-H, Lee MS. Effects of aromatherapy on the anxiety, vital signs, and sleep quality of percutaneous coronary intervention patients in intensive care units. *Evidence-Based Complementary and Alternative Medicine* 2013;**2013**:381.

24. Segen JC, Segen J. *Dictionary of alternative medicine*. Stamford, CT: Appleton & Lange; 1998.

25. Chiravalle P, McCaffrey R. Alternative therapy applications for postoperative nausea and vomiting. *Holistic Nursing Practice* 2005;**19**(5):207.

26. Buckle J. Clinical aromatherapy and touch: complementary therapies for nursing practice. *Critical Care Nurse* 1998;**18**(5):54—61.

27. Cavanagh HMA, Wilkinson JM. Lavender essential oil: a review. *Healthcare Infection* 2005;**10**(1):35—7.

28. Lee I. Effects of Lavender fragrance on depression and anxiety of nursing students intending to take the National Licensing Examination. *Journal of Korean Academy of Public Health Nursing* 2006;**20**(1):87—94.

29. Seo JY. The effects of aromatherapy on stress and stress responses in adolescents. *Journal of Korean Academy of Nursing* 2009;**39**(3):357—65.

30. Apay SE, Arslan S, Akpinar RB, Celebioglu A. Effect of aromatherapy massage on dysmenorrhea in Turkish students. *Pain Management Nursing* 2010;**13**(4):236—40.

31. Keville K, Green M. *Aromatherapy: a complete guide to the healing art*. New York: Random House Digital, Inc.; 2012.

32. Cavanagh HM, Wilkinson JM. Lavender essential oil: a review. *Healthcare Infection* 2005;**10**(1):35—7.

33. Staicov V, Chingova B, Kalaidjiev I. Studies on several lavender varieties. *Soap, Perfumery & Cosmetics* 1969;**42**:883—7.

34. Buchbauer G, Jirovetz L, Jager W, Dietrich H, Plank C, Singh S, et al. Aromatherapy: evidence for sedative effects of the essential oil of lavender after inhalation. *Zeitschrift fur Naturforschung Teil C* 1991;**30**:395—6.

35. Jirovetz L, Buchbauer G, Jäger W, Raverdino V, Nikiforov A. Determination of lavender oil fragrance compounds in blood samples. *Fresenius' Journal of Analytical Chemistry* 1990;**338**(8):922—3.

36. Rhie S-J, Sim M-J, Kim Y-C. Effect of lavender oil on the ultraviolet-damaged mice skin. *Journal of Environmental Toxicology* 2007;**23**(4):315—23.

37. Ghelardini C, Galeotti N, Salvatore G, Mazzanti G. Local anaesthetic activity of the essential oil of *Lavandula angustifolia*. *Planta Medica* 1999;**65**(08):700—3.

38. Jager W, Buchbauer G, Jirovetz L, Fritzer M. Percutaneous absorption of lavender oil from a massage oil. *Journal of the Society of Cosmetic Chemists* 1992;**43**(1):49—54.

39. Attarha M, Vakilian K, Rozbahany N, Bekhradi R. Effect of perineal massage with lavender essence on episiotomy and laceration. *Journal of Babol University of Medical Sciences* 2009;**11**(4):25—30.

40. Burnett KM, Solterbeck LA, Strapp CM. Scent and mood state following an anxiety-provoking task. *Psychological Reports* 2004;**95**(2):707.

41. Campenni C, Crawley EJ, Meier ME. Role of suggestion in odor-induced mood change. *Psychological Reports* 2004;**94**(3):1127—36.
42. Cavanagh H, Wilkinson J. Biological activities of lavender essential oil. *Phytotherapy Research* 2002;**16**(4):301—8.
43. Hillard PJA. Consultation with the specialist dysmenorrhea. *Pediatrics in Review* 2006;**27**(2):64—71.
44. Higham JM, O'brien P, Shaw R. Assessment of menstrual blood loss using a pictorial chart. *BJOG: An International Journal of Obstetrics & Gynaecology* 1990;**97**(8):734—9.
45. Song M, Park K, Cho S, Cha J. An analysis of the researches on aromatherapy intervention. *Journal of Korean Complement and Alternative Nursing Research* 2009;**1**(1):47—56.
46. Lehrner J, Marwinski G, Lehr S, Johren P, Deecke L. Ambient odors of orange and lavender reduce anxiety and improve mood in a dental office. *Physiology & Behavior* 2005;**86**(1):92—5.
47. Kenner D. Using aromatics in clinical practice. *California Journal of Oriental Medicine* 1998;**9**:30—2.
48. Schulz V, Hänsel R, Tyler VE. *Rational phytotherapy a physician's guide to herbal medicine*. 4th ed. Berlin: Routledge; 2001.
49. Fleming T. *PDR for herbal medicines*. Montvale, NJ: Medical Economics Company: Inc.; 1998.
50. Holmes P. *The energetics of western herbs: treatment strategies integrating western and oriental herbal medicine*. 3rd rev. ed. Boulder: Snow Lotus Press; 1998.
51. Chu CJ, Kemper KJ. *Lavender (Lavandula spp.)*. Boston: Longwood Herbal Task Force; 2001. p. 2.
52. Combest WL. Alternative therapies: lavender. *US Pharmacist* 1999;**24**(8):24—33.
53. Duke JA. *Handbook of medicinal herbs*. Boca Raton: CRC Press; 2002.
54. Marzouk TM, El-Nemer AM, Baraka HN. The effect of aromatherapy abdominal massage on alleviating menstrual pain in nursing students: a prospective randomized cross-over study. *Evidence-Based Complementary and Alternative Medicine* 2013;**2013**:742421.
55. Tisserand R. Lavender beats benzodiazepines. *International Journal of Aromatherapy* 1988;**1**(2):1—2.
56. Tisserand R, Balacs T. *Essential oil safety: a guide for health care professionals*. London: Churchill Livingstone; 1995.
57. Edge J. A pilot study addressing the effect of aromatherapy massage on mood, anxiety and relaxation in adult mental health. *Complementary Therapies in Nursing and Midwifery* 2003;**9**(2):90—7.
58. Okamoto A, Kuriyama H, Watanabe S, Aihara Y, Tadi T, Imanishi J, et al. The effect of aromatherapy massage on mild depression: a pilot study. *Psychiatry and Clinical Neurosciences* 2005;**59**(3):363.
59. Yim V, Ng AKY, Tsang HWH, Leung AY. A review on the effects of aromatherapy for patients with depressive symptoms. *Journal of Alternative and Complementary Medicine* 2009;**15**(2):187—95.
60. Snow LA, Hovanec L, Brandt J. A controlled trial of aromatherapy for agitation in nursing home patients with dementia. *Journal of Alternative and Complementary Medicine* 2004;**10**(3):431—7.
61. Fujii M, Hatakeyama R, Fukuoka Y, Yamamoto T, Sasaki R, Moriya M, et al. Lavender aroma therapy for behavioral and psychological symptoms in dementia patients. *Geriatrics and Gerontology International* 2010;**8**(2):136.
62. Mijong Kim MK, Yun Jung Kwon YJK. Effects of aroma inhalation on blood pressure, pulse, visual analog scale, and mcNair scale in nursing students practicing intravenous injection at the first time. *International Journal of Advanced Science and Technology* 2010;**23**:21—32.
63. Smith C, Collins C, Crowther C. Aromatherapy for pain management in labour. *Cochrane Database of Systematic Reviews* 2011;**7**:CD009215.
64. Linn ES. General gynecology: the requisites in obstetrics and gynecology. *Medscape General Medicine* 2007;**9**(4):50.
65. Carlson KJ, Eisenstat SA, Ziporyn TD. *The new harvard guide to women's health*. Cambridge: Harvard University Press; 2004.
66. Han S, Heo M. A study on the menstrual pain and dysmenorrhea, factors influenced to them, and self-management method for them of college students. *Journal of Korean Academic Society of Nursing Education* 1999;**5**(2):359—75.
67. Akhavan A, Tork S, Mojab F, Majd H. The effect of fennel essential oil on duration and amount of bleeding of menstrual cycles in female students of Shahid Beheshti University. *Medicinal Plants* 2010;**9**(2):117—23.
68. Mirbagher AN, Hafezi M, Salehi S, Tayebi A, Shenasa F, Zahtabchi S. Comparing the effect of pure and impure honey on severity of pain, amount of bleeding, and duration and interval of menstrual cycles in female students with primary dysmenorrhea. *Evidence Based Care* 2012;**2**(1):23—33.
69. Bonab MZ, Farimani M, Nasr ESH. Efficacy of mefenamic acid and vitex in reduction of menstrual blood loss and HB changes in patients with a complaint of menorrhagia. *Iranian Journal of Obstetrics, Gyneocology and Infertility* 2007;**10**(1):79—86.