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The effectiveness of aromatherapies with lavender and cinnamon essential oils on prostaglandin E2 levels in adolescent girls with primary dysmenorrhea

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***Abstract*---**Background: Dysmenorrhea is a gynecologic complaint characterized by the presence of painful cramps before and during menstruation due to elevated levels of prostaglandin E2 and F2α, resulting in hypercontraction in the endometrium. Objective: This

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study aims at analyzing the effectiveness of aromatherapies with lavender and cinnamon essential oils on prostaglandin E2 levels in adolescent girls with primary dysmenorrhea. Methods: This research applied the pretest-posttest randomized experimental design and was conducted at Hidayatullah Islamic boarding school Makassar. The number of samples is 36 respondents that are obtained by purposive sampling. These respondents are divided into three groups: aromatherapy with lavender, aromatherapy with cinnamon, and control, each consisting of 12 respondents. The intervention is conducted three times on the first and second days of the menstruation cycle. This research also uses ELISA Kit at Hasanuddin University Laboratory to measure the levels of prostaglandin E2. Findings: There is a significant decrease in prostaglandin E2 levels in both aromatherapies with lavender and cinnamon groups ($p<0.05$), whereas there is only an increase in prostaglandin E2 levels of 5.46 pg/ml in the control group ($p>0.05$). Conclusion: Aromatherapies with Lavender and Cinnamon Essential Oils effectively reduce prostaglandin E2 levels.

***Keywords*---**Dysmenorrhea, Lavender, Cinnamon, Prostaglandin E2, aromatherapy.

Introduction

Dysmenorrhea is a gynecologic complaint characterized by the presence of painful cramps during menstruation due to inflammation of the endometrium and is most commonly experienced by adolescent girls[1]. Dysmenorrhea usually begins a few hours before or during menstrual bleeding and persists for 2 to 3 days. The most painful period is in the first 24 to 72 hours of the menstruation cycle[2]. A study found that the prevalence of primary dysmenorrhea is 76.5% in Spain[3], 85.1% in China[4], 84% in Mexico, 70% in Malaysia, and 85% in Australia[5]. Meanwhile, in Indonesia (out of 64.52%), primary and secondary dysmenorrhea prevalence is 54.89% and 9.36%, respectively[1].

The cause of primary dysmenorrhea is often associated with high levels of prostaglandins (PGF2α and PGE2) and leukotrienes which are mediators of inflammation in the endometrium. The elevated levels of prostaglandins respond to the rise and fall of progesterone after ovulation[6]. Overproduction of prostaglandins in the endometrium will result in myometrium hypercontractility and vasoconstriction. Vasoconstriction of the uterine blood vessels will reduce blood flow, muscle ischemia, and an increase in sensitivity to pain receptors, all of which cause menstrual pain. Prostaglandin levels in adolescents with dysmenorrhoea were twice as high as those without dysmenorrhea[7].

In the current midwifery services, complementary-based treatments have been developed to reduce pain and prostaglandin levels. One of the simple, affordable, and safe complementary therapies is aromatherapy – the use of essential oils for therapeutic purposes. This research uses lavender essential oils to inhibit prostaglandin synthesis as it has anti-inflammatory properties. Lavender also has

sedative properties that inhibit the prostanoids that produce prostaglandins E2 and F2α in the uterus[9]. In addition, another essential oil that has been used for a very long time in aromatherapy is cinnamon. This is because the main constituents of cinnamon essential oil are 55-57% of cinnamaldehyde and 5-18% of eugenol, which have an antispasmodic effect of inhibiting prostaglandin biosynthesis, reducing inflammation, and increasing beta-endorphins as a means to reduce menstrual pain[10].

Methods

Research Design: Pre- and post-tests for true experimental and control group designs, This study consisted of an intervention group and a control group. In the intervention group, that is, the group given lavender aromatherapy and cinnamon aromatherapy, prostaglandin levels were measured before and after the intervention. In the intervention group, 5 drops of lavender and cinnamon aromatherapy were added to 30 ml of water for 20 minutes using a diffuser with a olfactory distance of 30 cm from the head given 3 times (1st administration on the first afternoon of menstruation, 2nd intervention on in the morning and the third on the afternoon of the second menstruation) by inhalation.

Research Site and Time*:* The research was conducted at Hidayatullah Islamic Boarding School Makassar and the Laboratory of Hasanuddin University after obtaining ethical clearance (number: 584/ UN4.14.1/ TP.01.02/2022) issued by the ethical committee of Faculty of Public Health, Hasanuddin University, Makassar.

Population and Samples: The population is the entire high school students at Hidayatullah Islamic Boarding School Makassar, totaling 67 students. The technique of sampling uses purposive sampling and obtains 36 respondents. They are then divided into 3 groups: aromatherapy with lavender, aromatherapy with cinnamon, and control, each consisting of 12 respondents.

Methods of Data collection: The data collection employs questionnaires containing personal data and menstrual and gynecological histories. This research also uses ELISA Kit to measure the levels of prostaglandin E2.

Methods of Data Analysis: The collected data are then analyzed using SPSS 22. Friedman test is used for age characteristics of the respondents, Kruskal Wallis test is used for ordinal data, comprising Body Mass Index and class of respondents, Chi-square test is used for nominal data, including family history, age of menarche, menstrual duration, vaginal discharge history, exercise habits, and caffeine consumption history. Data of prostaglandin E2 levels are analyzed using the Repeated-Measure Anova and Benferonni Post Hoc tests.

Results

The following are the character descriptions of respondents in both intervention and control groups.

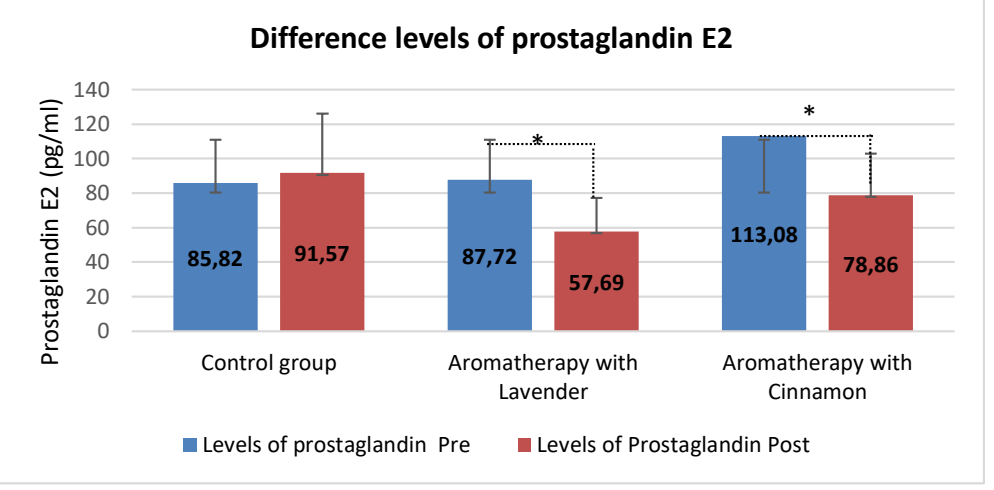
Table 1
Characteristics of Respondents

Characteristics	Group						Total		Homogeneity-Test	P-Value
	Aromatherapy with Lavender		Aromatherapy with Cinnamon		Control					
Respondents' Age Mean ± SD	16.16±1.64		15.8±1.69		16.25±1.71					0.378*[a]
	N	%	n	%	N	%	n	%		
Class										
10th Grade	8	22.2	5	13.9	4	11.1	17	47.2		
11th Grade	1	2.8	3	8.3	2	5.6	6	16.7	0.89	0.28*[c]
12th Grade	3	8.3	4	11.1	6	16.7	13	36.1		
Age of Menarche										
12-14 Years Old	10	27.8	11	30.6	11	30	32	88.9	0.37	0.755*[b]
<12 and >14 Years Old	2	5.6	1	2.8	1	,6 2.8	4	11.1		
Menstrual duration										
2-8 Days	10	27.8	9	25	11	30.6	30	83.3	0.09	0.549*[b]
<2 and >8 days	2	5.6	3	8.3	1	2.8	6	16.7		
BMI										
Underweight	2	5.6	1	2.8	1	2.8	4	11.1		0.85*[c]
Normal	9	25.0	10	27.8	9	25,	28	77.8	0.49	
Overweight	1	2.8	1	2.8	2	0 5.6	4	11.1		
Family History										
Yes	8	22.2	11	30.6	11	30.6	30	83.3	1.00	0.165*[b]
No	4	11.1	1	2.8	1	2,8	6	16.7		
Vaginal Discharge History										
Yes	4	11.1	6	16.7	5	13.9	15	41.7	0.42	0.710*[b]
No	8	22.2	6	16.7	7	19.4	21	58.3		
Exercise Habits										
Every day	3	8.3	2	5.6	3	8.3	8	22.2	0.51	0.852*[b]
1x a week	9	25.0	10	27.8	9	25.0	28	77.		

								8		
Caffeine Consumption Every day 1x a week	2 10	5.6 27.8	3 9	8.3 25.0	2 10	5.6 27.8	7 29	19.4 80.6	0.54	0.837*[b]

*[a]*Friedman test *[b]*Chi-square *[c]*Kruskall Wallis test*

Table 1 shows that the research is dominated by respondents aged 16 years in the lavender and control groups, whereas the average age of respondents in the cinnamon group is relatively younger (15 years) with a p-value of 0.37. The majority of the age of menarche is 12-14 years old within all groups totaling 32 respondents (88.9%) with a p-value of 0.755. The majority of menstrual duration is 2 to 8 days with a p-value of 0.549. The majority of the respondents are the 1st graders in both lavender and cinnamon groups, totaling 8 students (22.2%) and 5 students (13.9%), respectively. Meanwhile, the majority of respondents in the control group are the 3rd graders, totaling 6 students (16.7%) with a p-value of 0.28. Furthermore, the p-value of the majority of respondents with normal body mass index is 0.85. The majority of respondents also answered yes to a family history of experiencing primary dysmenorrhea (p-value = 0.165), the majority of respondents do not have vaginal discharge history (p-value = 0.710), exercising once a week (0.857), and consuming caffeine for once a week such as tea, coffee, milk (p-value= 0,837).



Graph 1 Prostaglandin E2 Level Differences in Aromatherapy with Lavender, Aromatherapy with Cinnamon, and Control Groups

Graph 1 shows that the mean of prostaglandin E2 levels in the cinnamon group is higher at 113.08 pg/ml than in the lavender group at 87.72 pg/ml before intervention. Meanwhile, the lowest prostaglandin E2 levels are found in the control group at 85.82 pg/ml. After the intervention, the mean of prostaglandin E2 level in the lavender group reached the lowest of 57.69 pg/ml, which dropped by 30.03 pg/ml. The prostaglandin level in the cinnamon group is at 78.86

pg/ml, which drops the lowest by 34.22 pg/ml. However, the control group undergoes an increase in prostaglandin levels of 91.57 pg/ml (+5.46 pg/ml).

Table 2
Results in Analysis of Prostaglandin E2 Level Differences

Groups	N	P-Value	Post-Hoc
Controls	12	0.000*a	1.000*b
Aromatherapy with Lavender	12		0.008*c
Aromatherapy with Cinnamon	12		0.008*c

**a Repeated Measures Anova *b Benferroni Post-Hoc*

Table 2 shows the results of the Parametric test of repeated measures ANOVA that describes significant differences in prostaglandin E2 levels between the three groups with p = 0.000 <0.05. This means that it is necessary to conduct a Bonferroni posthoc test to determine which groups significantly affect the decrease of prostaglandin E2 levels. Based on the test reveals that aromatherapy with lavender is effective in reducing the prostaglandin E2 levels (0.008 <0.05). In addition, the statistical test shows that aromatherapy with cinnamon also has a significant effect with a p-value of 0.008<0.05. Furthermore, the control group shows that the p-value is 0.596>0.05, which means no significant change in prostaglandin E2 levels (p-value>0,05).

Discussion

Statistical tests to analyze differences in prostaglandin E2 levels in the intervention and control groups show a p-value < 0.05. This signifies that aromatherapies with lavender and cinnamon effectively reduce prostaglandin E2 levels compared to the control group. It is in line with Zayeri et al. (2019)[9] in Iran, where the average pain intensity is lower in the lavender group than in the control group after the intervention. Furthermore, research conducted by Alkaya et al. (2018)[11] in Turkey also pointed out that inhalation aromatherapy with lavender is effective to lessen symptoms of premenstrual syndrome (PMS) such as abdominal pain, fatigue, nervousness, anxiety, and swelling (p<0.05). In addition, based on research by Bagheri et al. (2020)[12] in Iran, aromatherapy with lavender aromatherapy is effective for postoperative pain in hernia patients.

Aromatherapy with lavender effectively reduces pain because lavender has anti-inflammatory properties to inhibit prostaglandin synthesis. Lavender also has sedative properties that inhibit the prostanoids that produce prostaglandins E2 and F2α in the uterus[9]. In addition, lavender contains a main component called linalyl acetate, which can loosen or relax the nerve system and strained muscles[13].

Aromatherapy with lavender can increase alpha brain waves that help adolescent girls remain calm and relaxed, eventually leading to pain reduction[9]. Aromatherapy with lavender contains linalool and linalyl acetate, which serves as an analgesic. After being exposed to aroma inhalation for 7-10 seconds, it will work in the brain and stimulate the olfactory nerve on the limbic system, where the hypothalamus releases endorphins that trigger positive feelings e.g.,, calm, relaxation, and happiness. These feelings act as an antispasmodic that can inhibit nociceptive information where it inhibits the release of substance P so that pain impulses are unable to pass through projection neurons which causes pain during dysmenorrhea[14].

In addition to aromatherapy with lavender, this research also demonstrates the effectiveness of aromatherapy with cinnamon essential oil in significantly reducing pain and prostaglandin E2 levels ($p<0.05$). This is supported by the study conducted by Jahangirifar et al. (2018)[10] in Iran, where cinnamon as a pain reduction therapy is much more effective than a placebo. Furthermore, research in China by Xu et al. (2020)[16] also reported that cinnamon is able to reduce pain duration and intensity. Similarly, the research conducted by Alotaibi (2016)[17] in Saudi Arabia indicated that cinnamon could reduce uterine contractions. This is because cinnamon essential oils contain cinnamaldehyde (55-57%) which has an antispasmodic effect, and Eugenol (5-18%), which can inhibit prostaglandin biosynthesis and inflammation that become the leading cause of primary dysmenorrhea[15].

Aromatherapy with cinnamon is an alternative solution to reduce the pain intensity of primary dysmenorrhea by inhalation as it works by stimulating cells, olfactory receptors, and impulses that are transmitted to the brain's center of emotion or limbic system, which generates a calming effect and increases the blood circulation resulting in the reduction of pain intensity of primary dysmenorrhea[18]. Another chemical constituent of cinnamon as it is widely used in the pharmaceutical world is eugenol which has pharmacological properties as anti-microbial, analgesic, and anti-inflammatory. Eugenol functions to inhibit the cyclooxygenase enzyme in order to reduce the production of prostaglandins.

Conclusion

Aromatherapies with Lavender and Cinnamon Essential Oil Groups are effective in significantly reducing the prostaglandin E2 levels ($p<0.05$), whereas the control group exerts an insignificant effect ($p<0.05$) but instead undergoes an increase in prostaglandin E2 levels.

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References

1. Asrina, A., Arsyad, A. & Nilawati, A. Prostaglandin and Endorphin Levels in Adolescent Primary Dysmenorrhea Given Warm and Cold Hydrotherapy. *J. Ris. health.* 12, 115–121 (2020).
2. Barcikowska, Z. *et al.* Dysmenorrhea and Associated Factors among Polish Women: A Cross-Sectional Study. *Pain Res. Manag.* 2020, (2020).
3. Yacubovich, Y., Cohen, N., Tene, L. & Kalichman, L. The prevalence of primary dysmenorrhea among students and its association with musculoskeletal and myofascial pain. *J. Bodyw. Mov. ther.* 23, 785–791 (2019).
4. Abu Helwa, HA, Mitaeb, AA, Al-Hamshri, S. & Sweileh, WM Prevalence of dysmenorrhea and predictors of its pain intensity among Palestinian female university students. *BMC Women. Health* 18, 1–11 (2018).
5. Baidhya, N. & Prasad Paneru, D. Prevalence of Dysmenorrhea and its Associated Factors among Adolescent Girls Studying in Technical Schools of Dang, Nepal. *J. Heal. Allied Science.* 10, 24–29 (2020).
6. Gerri Hewitt, M. Dysmenorrhea and Endometriosis. *Clin. Obstetrics. Gynecol.* 63, 536–543 (2020).
7. Ryan, SA The Treatment of Dysmenorrhea. *pediatrician. Clin. North Am.* 64, 331–342 (2017).
8. Lee, M., Lee, H., Khalil, M., Lim, H. & Lim, H.-J. Aromatherapy for Managing Pain in Primary Dysmenorrhea: A Systematic Review of Randomized Placebo-Controlled Trials. *J. Clin. Med.* 7, 434 (2018).
9. Zayeri, F., Dehkordi, ZR & Hosseini-Baharanchi, FS The clinical efficacy of lavender oil inhalation on intensity of menstrual pain from primary dysmenorrhea. *J. HerbMed Pharmacol.* 8, 218–223 (2019).
10. Jahangirifar, M., Taebi, M. & Dolatian, M. The effect of cinnamon on primary dysmenorrhea: A randomized, double-blind clinical trial. *complement. ther. Clin. practice.* 33, 56–60 (2018).
11. Uzunçakmak, T. & Ayaz Alkaya, S. Effect of aromatherapy on coping with premenstrual syndrome: A randomized controlled trial. *complement. ther. Med.* 36, 63–67 (2018).
12. Bagheri, H. *et al.* The Effects of Inhalation Aromatherapy Using Lavender Essential Oil on Postoperative Pain of Inguinal Hernia: A Randomized Controlled Trial. *J. Perianesthesia Nurs.* 35, 642–648 (2020).
13. Dasih Sahlul Kasanah. The Effect of Lemon Aromatherapy on Decreasing Dysmenorrhea Pain in Young Women. *Hum. Relations* 3, 1–8 (2020).
14. Es-Haghee, S. *et al.* The Effects of Aromatherapy on Premenstrual Syndrome Symptoms: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. *Evidence-based Complement. alternating. Med.* 2020, (2020).
15. Xu, Y., Yang, Q. & Wang, X. Efficacy of herbal medicine (cinnamon/fennel/ginger) for primary dysmenorrhea: a systematic review and meta-analysis of randomized controlled trials. *J. Int. Med. res.* 48, (2020).
16. Hu, Z., Tang, L., Chen, L., Kaminga, AC & Xu, H. Prevalence and Risk Factors Associated with Primary Dysmenorrhea among Chinese Female University Students: A Cross-sectional Study. *J. Pediatrics. Adolescent. Gynecol.* 33, 15–22 (2020).
17. Alotaibi, M. The effect of cinnamon extract on isolated rat uterine strips. *Reprod. Biol.* 16, 27–33 (2016).

18. Evayanti, Y. & Hidayat, SA The effect of cinnamon on pain among teenage girls with primary dysmenorrhea in Lampung Indonesia. *Malahayati Int. J. Nurs. heal. science.* 2, 59–65 (2019).
19. Sun, L. *et al.* The essential oil from the twigs of Cinnamomum cassia Presl inhibits oxytocin-induced uterine contractions in vitro and in vivo. *J. Ethnopharmacol.* 206, 107–114 (2017).