

The Correlation of Progressive Muscle Relaxation (PMR) with Massage and Aromatherapy on Reducing Menstrual Pain Intensity (Primary Dysmenorrhea) among Female Students

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ABSTRACT

Primary dysmenorrhea is one of the most common reproductive health problems experienced by adolescent girls, characterised by lower abdominal pain caused by excessive uterine contractions without any organic abnormalities. High menstrual pain intensity negatively affects learning concentration, school attendance, and overall quality of life. Non-pharmacological management approaches, such as Progressive Muscle Relaxation (PMR), massage, and aromatherapy, are considered safe and effective methods for reducing pain intensity through mechanisms including muscle relaxation, endorphin release, and parasympathetic nerve stimulation. This study aimed to evaluate the effectiveness of combining PMR, massage, and aromatherapy in reducing menstrual pain intensity among female students at Dr. Soetomo High School, Surabaya. A quasi-experimental design with a pretest-posttest control group was employed. A total of 60 respondents were selected using purposive sampling and divided into 2 groups: the intervention group (PMR + massage + aromatherapy) and the control group (health education). Menstrual pain intensity was measured using the Numerical Rating Scale (NRS) before and after the intervention. Data were analysed using a Paired t-test for within-group comparisons and normality tests to assess data distribution. The results showed a significant reduction in pain intensity in the intervention group compared with the control group ($p = 0.001$). The median score in the intervention group decreased from 7.0 to 3.0, while the control group showed no significant change ($p = 0.216$). The combined intervention demonstrated a large effect size ($r = 0.72$), indicating a strong influence on pain reduction. Conclusion: The combination of PMR, massage, and aromatherapy is effective in reducing primary dysmenorrhea and can be recommended as a safe, affordable, and practical complementary therapy for adolescents.

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Introduction

Primary dysmenorrhea is a common condition experienced by adolescent girls during menstruation (Guimarães & Póvoa, 2020), characterised by cramping pain in the lower abdomen without any organic abnormalities in the reproductive structures (Simon et al., 2022). This condition not only causes physical discomfort but also significantly impacts quality of life (Brown & Brown, 2017), particularly in terms of learning, concentration and school attendance. In Indonesia, the prevalence of dysmenorrhea among adolescent girls has been reported to range from 55% to over 80%; for instance, a rate of 64.5% was recorded in Denpasar (Simon et al., 2022).

In the context of menstrual pain management, non-pharmacological approaches are increasingly considered due to their safety and accessibility. Techniques such as Progressive Muscle Relaxation (PMR), which combines systematic muscle tension and relaxation, have been shown to reduce muscle stiffness and improve blood circulation, thereby alleviating pain (Khir et al., 2024). Abdominal massage, particularly the effleurage method using aromatherapy oils such as rose oil (Pattanittum et al., 2016), is also known to effectively reduce menstrual pain intensity by improving blood flow and increasing endorphin release. In addition, aromatherapy has been proven to provide calming and analgesic effects by acting on the limbic system and modulating pain perception (Khir et al., 2024).

Although many studies have explored the effectiveness of each of these techniques individually, research on the combined application of PMR (Barcikowska et al., 2020), abdominal massage, and aromatherapy remains very limited, particularly among school-aged adolescent girls (Toussaint et al., 2021). Such an integrated approach has the potential to yield synergistic effects, with PMR reducing muscle tension, massage improving local circulation (Barcikowska et al., 2020), and aromatherapy inducing relaxation via the olfactory pathway, thereby offering greater benefits than single methods (Pathan et al., 2023).

The state of the art of this study lies in its integrated approach, combining Progressive Muscle Relaxation, abdominal massage, and lavender aromatherapy into a single intervention protocol. While previous literature has explored these methods in isolation, this research addresses the gap in synergistic non-pharmacological dysmenorrhea management specifically tailored for the adolescent demographic in a school setting.

Methods

This study was conducted from June to July 2025. A quasi-experimental design with a pretest-posttest control group approach was employed to examine the effectiveness of combining Progressive Muscle Relaxation (PMR), massage, and aromatherapy in reducing menstrual pain intensity among female students at Dr. Soetomo High School. The sample size was determined using the Lemeshow formula, resulting in 60 respondents divided into two groups:

- a) Intervention group: 30 respondents
- b) Control group: 30 respondents

The participants selected for this study were required to meet several specific criteria to ensure a homogenous sample. Inclusion was limited to female students at Dr. Soetomo High School aged 15–18 years who were experiencing primary dysmenorrhea at the time of the study. Based on the baseline data, eligible respondents were those reporting an initial pain intensity in the moderate (4–6) or severe (7–10) range on the Numerical Rating Scale (NRS). Participants were included regardless of their menstrual cycle regularity (regular or irregular); however, they were required to be in a generally healthy state and not currently using any pharmacological analgesics or other medical pain-relief treatments to avoid confounding the effects of the non-pharmacological intervention.

This study was conducted in strict accordance with ethical principles for research involving human subjects. Ethical approval was obtained from the relevant Health Research Ethics Committee prior to data collection. Each respondent was provided with a comprehensive explanation regarding the study's objectives, the triple-combination intervention procedure, and the voluntary nature of their participation. Written informed consent was obtained from all participants; for students under 18, parental or guardian consent was also obtained. To ensure privacy and data protection, a coding system was used to maintain respondents' anonymity. Furthermore, as an ethical obligation to the control group, the researchers provided the same PMR and aromatherapy training to participants following completion of the posttest measurements to ensure equitable access to the therapeutic benefits identified in the study.

Menstrual pain intensity was measured using the Numerical Rating Scale (NRS) with a score range of 0–10 (Li et al., 2024). An intervention observation sheet was used to ensure procedures were carried out in accordance with standard protocols. Pretest: Pain intensity was measured before the intervention in both groups. Intervention group:

1. PMR was performed for 15 minutes.
2. Abdominal massage using the effleurage technique was administered for 10 minutes.
3. Lavender aromatherapy was given through inhalation for 5 minutes.
4. Control group: Received standard menstrual health education.

The intervention was administered daily for three consecutive days during the participants' menstrual cycle. Each session lasted approximately 30 minutes, comprising 15 minutes of guided PMR, 10 minutes of abdominal massage, and 5 minutes of lavender aromatherapy inhalation. To ensure procedural consistency and the correct application of the effleurage massage technique, all interventions were performed by trained researchers rather than the participants themselves. This standardised approach minimised variability in the intensity and quality of treatment provided to the intervention group.

The control group received standard menstrual health education delivered through a structured 30-minute session. This educational intervention utilised printed leaflets and a presentation covering the physiology of primary dysmenorrhea, nutritional recommendations for pain management, the importance of hydration, and general menstrual hygiene practices. Unlike the intervention group, the control group did not receive any physical therapy or guided relaxation; instead, they were provided with theoretical knowledge to manage their symptoms through conventional lifestyle adjustments. A researcher conducted this session to ensure that all control participants received consistent and accurate health information.

Posttest: Pain intensity was measured again after the intervention. Data Analysis Normality testing was conducted using the Shapiro-Wilk test. Within-group analysis was performed using the paired t-test (for normally distributed data) or the Wilcoxon test (for non-normally distributed data). Between-group comparisons were conducted using the independent t-test or the Mann-Whitney test. The significance level was set at $p < 0.05$.

Results

Table 1. Baseline Characteristics of Respondents

Characteristics	Category	Intervention Group (n=30)	Control Group (n=30)
Age (years)	15–16	10 (33.3%)	12 (40.0%)
	17–18	20 (66.7%)	18 (60.0%)
Menstrual Cycle	Regular	24 (80.0%)	23 (76.7%)
	Irregular	6 (20.0%)	7 (23.3%)
Initial Pain Intensity	Mild (1–3)	0 (0%)	0 (0%)
	Moderate (4–6)	12 (40.0%)	11 (36.7%)
	Severe (7–10)	18 (60.0%)	19 (63.3%)

The findings of this study indicate that the combination of Progressive Muscle Relaxation (PMR), abdominal massage, and lavender aromatherapy was effective in reducing menstrual pain intensity among female students. The average reduction in pain intensity was 4.10 points higher compared to the control group. Respondents' demographic and clinical characteristics are presented in Table 1. A total of 60 respondents participated, equally distributed between the intervention (n = 30) and control (n = 30) groups. Most respondents were aged 17–18 years, accounting for 66.7% in the intervention group and 60.0% in the control group, while those aged 15–16 years comprised 33.3% and 40.0%, respectively. This indicates that the majority were late adolescents, which may influence their physiological and hormonal responses to menstrual symptoms.

Regarding menstrual cycle patterns, most respondents reported regular cycles (80.0% in the intervention group and 76.7% in the control group), while the rest experienced irregular cycles (20.0% and 23.3%). These results suggest that menstrual cycle characteristics were relatively homogeneous across both groups, minimising potential bias from hormonal fluctuations. In terms of baseline pain levels, no respondents reported mild dysmenorrhea. Instead, most experienced severe pain (60.0% in the intervention group and 63.3% in the control group), while the remainder reported moderate pain (40.0% and 36.7%). This confirms that the study population primarily consisted of individuals with moderate to severe dysmenorrhea, making them suitable for evaluating the effectiveness of the intervention.

Overall, the baseline characteristics of respondents in both groups were well-balanced with respect to age, menstrual cycle regularity, and baseline pain intensity. This minimised potential confounding factors and strengthened the study's internal validity. The dominance of adolescents with regular menstrual cycles and moderate to severe pain further provided an appropriate context to assess the intervention's effectiveness.

Table 2. Comparison of Pain Intensity Before and After Intervention

Group	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Δ Reduction	p-value
Intervention	7.20 ± 1.12	3.10 ± 1.05	4.10	<0.001
Control	7.10 ± 1.20	6.20 ± 1.15	0.90	0.082

Table 2 presents a comparison of pain intensity scores between the intervention and control groups at pretest and posttest. A significant reduction in pain was observed in the intervention group, decreasing from 7.20 ± 1.12 before the intervention to 3.10 ± 1.05 afterwards, with an average reduction of 4.10 points ($p < 0.001$). This demonstrates that the intervention was highly effective in alleviating

menstrual pain. Conversely, the control group experienced only a minimal decrease, from 7.10 ± 1.20 to 6.20 ± 1.15 , with an average reduction of 0.90 points ($p = 0.082$). The lack of statistical significance in the control group indicates that the observed changes may have resulted from natural variations rather than therapeutic effects.

The substantial difference in pain reduction between the two groups underscores the intervention's effectiveness in alleviating dysmenorrhea. With a large reduction value and statistically significant results, this study provides strong evidence that the applied intervention is a promising non-pharmacological approach for managing menstrual pain in adolescents.

Table 3. Comparison of Pain Intensity Using Paired t-test

Group	Pretest (Mean $\pm$ SD)	Posttest (Mean $\pm$ SD)	Δ Reduction	p-value (Paired t-test)
Intervention	7.20 ± 1.12	3.10 ± 1.05	4.10	<0.001
Control	7.10 ± 1.20	6.20 ± 1.15	0.90	0.082

Table 3 further illustrates the comparison of menstrual pain scores between the intervention and control groups before and after the intervention, using a paired t-test. Results confirmed a significant reduction in the intervention group, decreasing from 7.20 ± 1.12 at pretest to 3.10 ± 1.05 at posttest, with an average reduction of 4.10 points ($p < 0.001$). This finding demonstrates that the intervention effectively alleviated menstrual pain among respondents.

In contrast, the control group showed only a minimal reduction, from 7.10 ± 1.20 at pretest to 6.20 ± 1.15 at posttest, with an average decrease of 0.90 points ($p = 0.082$). Since the p-value exceeded 0.05, the reduction in pain intensity in the control group was not statistically significant, suggesting that the change was likely due to natural variation or external factors rather than the intervention.

The notable difference in reductions between the groups reinforces the effectiveness of the intervention as a non-pharmacological strategy for managing primary dysmenorrhea. These results are consistent with previous studies reporting that targeted interventions can significantly reduce menstrual pain and improve adolescents' quality of life.

Table 4. Between-Group Analysis (Independent t-test)

Variable	Group	p-value
Pretest Pain Score	Intervention	0.112
	Control	0.095
Posttest Pain Score	Intervention	0.067
	Control	0.083

Table 4 presents the results of normality testing for pain intensity scores in both groups. All p-values were greater than the significance threshold of 0.05, indicating that the data were normally distributed at both pretest and posttest measurements. Specifically, pretest pain scores yielded p-values of 0.112 in the intervention group and 0.095 in the control group, demonstrating normal baseline distributions.

Similarly, posttest pain scores produced p-values of 0.067 in the intervention group and 0.083 in the control group, both exceeding 0.05. These findings confirm that the assumption of normality was met, justifying the use of parametric tests such as the paired t-test for within-group analysis and the independent t-test for between-group comparisons.

Meeting the assumption of normality strengthens the validity of subsequent statistical analyses. It ensures that observed differences in pain reduction between groups are reliable and not influenced by violations of statistical assumptions.

Discussion

The primary finding of this study is a significant reduction in menstrual pain intensity in the intervention group, with a mean decrease of 4.10 points. In contrast, the control group did not show a statistically significant change ($p = 0.082$). This stark difference suggests that the combination of Progressive Muscle Relaxation (PMR), abdominal massage, and lavender aromatherapy is highly effective for managing primary dysmenorrhea. These results are consistent with research by Shi and Wu (2023), who argued that multimodal non-pharmacological interventions provide a more comprehensive pain management strategy than single-method approaches. Unlike the control group, the intervention group moved from "Severe" to "Mild-Moderate" levels, indicating a clinically significant improvement.

The success of this intervention can be attributed to several physiological pathways. PMR works by reducing sympathetic nervous system activity, thereby lowering muscle tension and psychological stress. According to Triwahyuningsih et al. (2024), reducing stress levels can significantly lower the perception of uterine cramping. In addition, abdominal massage addresses localised spasms. As noted by Shahr et al. (2014), massage improves local blood circulation and facilitates the "washout" of prostaglandins, the chemicals responsible for pain. Furthermore, lavender aromatherapy introduces linalool into the limbic system. This process stimulates the release of endorphins, which act as natural analgesics (Koulivand, 2013).

The demographic data revealed that the majority of respondents were aged 17–18 years. At this developmental stage, hormonal fluctuations are typically established, often leading to higher prostaglandin production. The fact that over 60% of respondents reported severe pain at baseline highlights the clinical urgency of the issue. As suggested by Goss (2023), late adolescents often experience more intense primary dysmenorrhea due to matured ovulatory cycles. The homogeneity of these baseline characteristics ensures that the observed pain reduction was due to the intervention rather than to demographic bias, thereby strengthening the study's internal validity. Implications for Non-Pharmacological Management: The data distribution was normal ($p > 0.05$), allowing robust parametric testing and confirming the results are statistically reliable. These findings provide strong evidence for implementing such strategies in school health programs. According to Gobba (2024), providing students with natural alternatives to medication can empower them to manage their reproductive health independently while avoiding potential side effects of NSAIDs.

This study reinforces the idea that integrated physical and sensory therapies can serve as a primary supportive care model for adolescents: limitations and future research. Despite the positive outcomes, this study acknowledges several limitations. The sample size of 60 respondents may limit the broader generalizability of the findings. Additionally, the study focused on immediate effects; therefore, the long-term sustainability remains to be explored. Future research should follow the recommendations to

involve larger, multi-centre cohorts and longitudinal designs to verify the persistence of the intervention's benefits across multiple menstrual cycles.

Conclusions

The findings of this study demonstrate that the applied intervention significantly reduced menstrual pain among adolescents. Respondents in the intervention group experienced a substantial decrease in pain scores compared to the control group, supporting the effectiveness of the intervention as a non-pharmacological strategy for managing primary dysmenorrhea. Future studies are recommended to include larger sample sizes and longer follow-up periods to confirm these findings and further explore the intervention's long-term effects. Mechanisms of action of the intervention include:

1. Progressive Muscle Relaxation (PMR): Helps reduce sympathetic nervous system activity and enhances muscle relaxation, thereby decreasing excessive uterine contractions.
2. Abdominal Massage: Improves blood circulation in the pelvic area, helps reduce muscle spasms, and alleviates pain.
3. Lavender Aromatherapy: Acts through the olfactory pathway, stimulating the limbic system of the brain that regulates pain perception, and provides sedative as well as analgesic effects.

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