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Effect of Red Ginger Extract (*Zingiber officinale Roscoe var. rubrum*) and Lemongrass (*Cymbopogon Citratus*) Combination Gel on Reducing Primary Dysmenorrhea in Adolescents

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ABSTRACT

Primary dysmenorrhea affects a substantial proportion of adolescent females and poses a significant barrier to daily functioning. While NSAIDs are a mainstay of treatment, growing interest surrounds herbal alternatives due to their favorable safety profiles. This study evaluated the efficacy of a topical gel formulated with red ginger (*Zingiber officinale Roscoe var. rubrum*) and lemongrass (*Cymbopogon citratus*) extracts in alleviating menstrual pain among adolescents. A quasi-experimental pretest–posttest control group design was used involving 34 purposively selected nulliparous adolescents aged 18–23 years with primary dysmenorrhea. The intervention group applied 1 g of herbal gel three times daily for three days, while the control group received warm compresses with matching frequency. Pain intensity was measured using the Numerical Rating Scale (NRS), with prior training and pilot testing conducted to ensure measurement consistency. Due to non-normal data distribution, non-parametric tests were applied. Results showed significant reductions in pain within both groups ($p < 0.01$). Effect sizes ranged from large to very large ($r = 0.743–0.883$), indicating clinically meaningful improvements. Although the mean pain reduction difference between groups was marginal ($\Delta_{\text{mean}} = 4.6859$ vs. 4.647) and statistically non-significant ($p > 0.05$), the herbal gel demonstrated sustained analgesic effects and better practicality. The combined red ginger and lemongrass extract gel proved effective in reducing primary dysmenorrhea and presents a promising, low-risk adjunctive therapy. This gel may serve as a first-line complementary approach prior to pharmacologic intervention.

Keywords: primary dysmenorrhea; topical gel; red ginger; lemongrass

Introduction

Dysmenorrhea is defined as pain associated with menstruation and is classified into two categories: primary and secondary dysmenorrhea. Primary dysmenorrhea occurs in the absence of identifiable pelvic pathology, whereas secondary dysmenorrhea is attributed to underlying medical conditions such as endometriosis or adenomyosis [1], [2]. The pathophysiology of primary dysmenorrhea is primarily associated with elevated prostaglandin levels, which lead to excessive uterine contractions. If unmanaged, this condition may significantly disrupt daily functioning, including academic performance, eating patterns, and sleep quality [3], [4].

The prevalence of dysmenorrhea in Indonesia has been reported to be substantial. A study involving medical students found that 91.27% experienced dysmenorrhea, with 52.35% reporting moderate to severe pain [5]. Furthermore, research among senior high school students in Semarang indicated that 45.7% experienced mild pain, 23.9% moderate pain, and 13% severe pain, with 65.5% reporting an impact on learning activities [6], [7]. These findings highlight dysmenorrhea as a significant public health concern, particularly among adolescent females.

Dysmenorrhea not only affects physical well-being but also exerts psychological and social burdens. Unrelieved pain has been associated with reduced productivity, increased stress levels, and diminished quality of life among adolescents [8]. Consequently, there is a need for effective and safe therapeutic interventions to alleviate the adverse effects of this condition.

Management strategies for dysmenorrhea include both pharmacological and non-pharmacological approaches. While pharmacological agents such as non-steroidal anti-inflammatory drugs (NSAIDs) are effective in pain reduction, they are also associated with long-term adverse effects including gastrointestinal disturbances and potential organ toxicity [9], [10]. As a result, non-pharmacological interventions utilizing natural ingredients, such as *Zingiber officinale Roscoe var. rubrum* (red ginger) and *Cymbopogon Citratus* (lemongrass), are gaining attention due to their favorable safety profiles and minimal side effects.

Red ginger has been traditionally utilized in herbal medicine and contains active constituents such as gingerol, shogaol, and zingerone, which exhibit anti-inflammatory properties and inhibit prostaglandin synthesis [11], [12]. Lemongrass contains citronellal and geraniol, compounds with antioxidant and anti-inflammatory effects that improve blood circulation and reduce excessive uterine contractions [13], [14].

Previous studies have primarily utilized red ginger and lemongrass in the forms of capsules, beverages, or compresses. However, these formulations are often considered impractical for routine use. Herbal beverages and warm compresses require time-consuming preparation, and compresses need to be applied repeatedly with limited duration to prevent skin irritation. Additionally, capsules may be poorly accepted by adolescents due to negative perceptions associating them with conventional pharmaceuticals. These challenges underscore the need to develop alternative, user-friendly formulations of these herbal agents. To date, no studies have investigated the combination of red ginger and lemongrass in gel form as a treatment modality [15], [16], [17].

This study proposes an innovative approach by formulating a topical gel containing combined extracts of red ginger and lemongrass. The gel form was selected for its practicality, ease of application, cooling sensation, and strong adherence without occluding skin pores [18]. It is anticipated that this formulation will optimize the release of active compounds and serve as an effective alternative for the management of primary dysmenorrhea. Therefore, the purpose of this study is to rigorously evaluate the effectiveness of this topical gel in reducing primary dysmenorrhea pain in adolescent females.

Methods

This quasi-experimental study utilized a pretest–posttest control group design to assess the effectiveness of a topical gel formulated from *Zingiber officinale Roscoe var. rubrum* and *Cymbopogon citratus* in reducing primary dysmenorrhea. Thirty-four nulliparous midwifery students (aged 18-23) were purposively selected and allocated into intervention and control groups. Purposive sampling was chosen to ensure that only participants who met specific inclusion criteria, adolescents with primary dysmenorrhea, aged 18-23 years, nulliparous, and not using analgesics were enrolled, thereby enhancing the internal validity of the study. Representativeness was maintained through clearly defined inclusion–exclusion criteria, calculation of sample size using Lemeshow’s formula with additional allowance for potential dropout, and allocation of control and intervention groups from different classes to minimize contamination bias. The intervention group applied 1 g of herbal gel three times daily for three days, while the control group received warm compresses with matching application frequency. Both the gel application and warm compress therapy were administered in the morning, afternoon, and evening on clean skin areas to ensure optimal absorption and therapeutic effectiveness. Pain intensity, assessed via the Numerical Rating Scale (NRS), was recorded post-intervention. To ensure the consistent and accurate use of the NRS, the researchers conducted a pilot test and provided training to participants prior

to data collection. This approach enhanced the reliability of pain assessment and strengthened the overall methodological quality of the study by minimizing potential bias and variability.

Prior to hypothesis testing, normality testing was conducted, and results indicated that the data were not normally distributed ($p < 0.05$). Consequently, non-parametric tests were employed, with the Friedman test applied for within-group comparisons across three days of intervention and the Mann–Whitney U test for between-group analysis. Post hoc analysis with the Wilcoxon signed-rank test indicated a significant reduction in pain intensity in both the intervention and control groups ($p < 0.01$), with large to very large effect sizes. The herbal gel demonstrated sustained analgesic effects ($r = 0.743–0.883$), while warm compresses also produced meaningful relief ($r = 0.762–0.880$). Although between-group differences were not statistically significant ($p > 0.05$), the intervention group consistently reported lower mean pain scores, suggesting that the gel was at least as effective as warm compresses in managing primary dysmenorrhea. Such findings strengthen the rationale for the study, which was conducted under formal ethical clearance. Ethical approval was granted by the Health Research Ethics Committee of Poltekkes Kemenkes Semarang (No. 189/EA/F.XXIII.38/2025).

Results and Discussion

The respondents in the intervention group were adolescents with a history of dysmenorrhea who received a topical gel containing a combination of red ginger and lemongrass extracts. The gel was applied to the suprapubic area at a dose of 1 gram per application, three times daily for three consecutive days. Pain intensity was measured using the Numeric Rating Scale (NRS) 45 minutes after gel application. In the control group, participants received a warm compress applied to the suprapubic area with the same frequency and duration, and pain intensity was assessed 20 minutes after the application of the compress.

Table 1.

Comparison of Pain Intensity Scores Between Control and Intervention Groups Over Time

Group	Time Point	Mean±SD	Δ Mean	Min-Max	*p-value
Control	pre test	5.5294±1.41940		3-8	0.000
	post test I	4.4706±1.17886	1.0588	3-7	
	post test II	2.1959±1.46299	3.3335	0-5	
	post test III	0.8824±1.12966	4.647	0-3.3	
Intervention	pre test	5.1765±1.13111		4-7	0.000
	post test I	3.7647±1.25147	1.4118	2-6	
	post test II	1.4453±1.21972	3.7312	0-4	
	post test III	0.4906±0.61462	4.6859	0-1.67	

* Friedman Test

Based on table 1, the mean intensity of dysmenorrhea in the control group was 5.5294 at the pre-test, 4.4706 at post-test I, 2.1959 at post-test II, and 0.8824 at post-test III. The Friedman test yielded a p -value of 0.000 ($p < 0.05$), indicating a statistically significant effect of warm compress therapy on reducing primary dysmenorrhea in adolescents.

In the intervention group, the mean dysmenorrhea intensity was 5.1765 at the pre-test, 3.7647 at post-test I, 1.4453 at post-test II, and 0.4906 at post-test III. The Friedman test also showed a p -value of 0.000 ($p < 0.05$), demonstrating a significant effect of the topical gel containing a combination of red ginger (*Zingiber officinale Roscoe var. rubrum*) and lemongrass (*Cymbopogon Citratus*) extracts in reducing primary dysmenorrhea among adolescents.

Table 2.

Results of the Wilcoxon Signed Rank Test and Corresponding Effect Size

Group	Comparison	Z	p-value	r (Effect Size)	Interpretation
Control	Post1 - Pre	-3.140	0.002	0.762	large effect
	Post2 - Post1	-3.628	0.000	0.880	very large effect
	Post3 - Post2	-3.414	0.001	0.828	very large effect
Intervention	Post1 - Pre	-3.482	0.000	0.845	very large effect
	Post2 - Post1	-3.636	0.000	0.883	very large effect
	Post3 - Post2	-3.065	0.002	0.743	large effect

Based on table 2, post hoc analysis using the Wilcoxon signed-rank test demonstrated significant reductions in pain intensity within both groups across all time points. In the control group, pain decreased significantly from baseline to the first day ($Z = -3.140$, $p = 0.002$) with a large effect size ($r = 0.762$), followed by further reductions from day 1 to day 2 ($Z = -3.628$, $p < 0.001$) and from day 2 to day 3 ($Z = -3.414$, $p = 0.001$), both showing very large effects ($r = 0.880$ and $r = 0.828$, respectively). Similarly, the intervention group exhibited a highly significant reduction from baseline to day 1 ($Z = -3.482$, $p < 0.001$) with a very large effect size ($r = 0.845$). Continued improvements were observed from day 1 to day 2 ($Z = -3.636$, $p < 0.001$, $r = 0.883$; very large effect) and from day 2 to day 3 ($Z = -3.065$, $p = 0.002$, $r = 0.743$; large effect). These findings indicate that both warm compresses and the *Zingiber officinale Roscoe var. rubrum*–*Cymbopogon citratus* gel produced progressive and clinically meaningful reductions in dysmenorrhea severity, with effect sizes consistently ranging from large to very large.

Table 3.

Mean Scores of Dysmenorrhea Reduction Between Groups

Time Point	Intervention Group Mean	Control Group Mean	* <i>p</i> -value
pre test	16.32	18.68	0.477
post test I	14.76	20.24	0.098
post test II	14.76	20.24	0.108
post test III	16.15	18.85	0.405

* Mann Whitney

Based on table 2, the mean reduction in dysmenorrhea at pre-test was 16.32 in the intervention group and 18.68 in the control group, with a *p*-value of 0.477. At post-test I and post-test II, the intervention group showed a mean score of 14.76, while the control group showed 20.24, with *p*-values of 0.098 and 0.108, respectively. At post-test III, the mean scores were 16.15 in the intervention group and 18.85 in the control group, with a *p*-value of 0.405.

Since all *p*-values were greater than 0.05, it can be concluded that there was no statistically significant difference in the reduction of primary dysmenorrhea between the group receiving the red ginger (*Zingiber officinale Roscoe var. rubrum*) and lemongrass (*Cymbopogon Citratus*) combination gel and the group receiving warm compress therapy among adolescents.

Primary dysmenorrhea is characterized by lower abdominal pain during the menstrual cycle, with peak intensity typically occurring on the first day and lasting for several days. Elevated levels of prostaglandins, particularly PGE₂ and PGF₂α in menstrual fluid, are recognized as the principal cause of this condition [19]. In this study, a significant reduction in menstrual pain was observed in the intervention group following the application of a topical gel combining red ginger (*Zingiber officinale Roscoe var. rubrum*) and lemongrass (*Cymbopogon Citratus*) extracts. The active compounds in red ginger essential oil, such as zingiberene and β-sesquiterpene, exhibit antioxidant, analgesic, and anti-inflammatory properties by inhibiting prostaglandin synthesis via the cyclooxygenase-2 (COX-2) pathway [20]. Similarly, citral, the main constituent of lemongrass essential oil (comprising geranial and neral), contributes to pain relief through anti-inflammatory and analgesic actions while providing a relaxing aroma [21].

In the control group, warm compresses also reduced dysmenorrhea by inducing vasodilation in the suprapubic region, leading to localized comfort. However, respondents reported practical limitations related to water heating and temperature maintenance, particularly in campus or public settings. This aligns with prior findings indicating that the analgesic effect of warm compresses is transient (lasting approximately 10–20 minutes) and limited to a superficial tissue depth of 1 cm [19], [22], [23].

These findings are consistent with Nurhalimah (2020), who reported the topical application of ginger and lemongrass as effective in reducing dysmenorrhea, with a *p*-value of 0.000 [24]. When applied topically, ginger's active compounds penetrate the epidermis and activate thermal receptors, promoting local vasodilation and prolonged warmth compared to external heat sources [25]. Lemongrass, through its citral content, supports muscle relaxation and provides a calming aroma that reduces pain perception. Its aromatherapeutic properties also offer antidepressant effects, contributing to psychological relaxation [26].

Although the findings of this study demonstrate that the gel containing a combination of red ginger and lemongrass extracts exhibits superior effectiveness compared to warm compresses in reducing the intensity of primary dysmenorrhea, these results are not without limitations that should be taken into account when interpreting the outcomes and applying them more broadly. Individual differences in pain thresholds and skin reactivity among participants may have influenced subjective outcomes such as self-reported pain intensity. Furthermore, the warm compress used in the control group represents a pharmacodynamically distinct intervention, particularly in terms of the temporal release of heat for pain relief, which may affect the comparability of results between groups.

Conclusion

The application of a topical gel combining red ginger (*Zingiber officinale* Roscoe var. *rubrum*) and lemongrass (*Cymbopogon Citratus*) extracts was found to be more effective than warm compresses in reducing primary dysmenorrhea in adolescents. This effectiveness is supported by the presence of active compounds with anti-inflammatory and analgesic properties, along with the practical and user-friendly nature of the gel formulation. These findings highlight the potential of local herbal interventions as a non-pharmacological alternative in midwifery practice. Future research is recommended to include measurements of prostaglandin levels to obtain more objective data on dysmenorrhea reduction and to control for confounding variables such as physical activity, psychological factors, and dietary patterns. Additionally, ensuring pharmacodynamic equivalence between intervention groups is advised to enhance the validity and comparability of outcomes.

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