



The Effectiveness of The “KMJ” Intervention and Menstrual Dysmenorrhea Education Based on Roy’s Adaptation Theory In Recognizing and Reducing Menstrual Pain Among 10th- and 11th-Grade Students at Sma N X In Semarang

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Abstract

Primary dysmenorrhea remains a significant reproductive health concern among adolescent girls because it can impair comfort, daily activities, and school participation. This study evaluated the effectiveness of the KMJ intervention, consisting of warm compress application and ginger drink consumption, combined with dysmenorrhea education based on Roy’s Adaptation Model among Grade 10 and 11 female students at SMA N X in Semarang. A quasi-experimental pretest–posttest control group design was used with 100 participants, equally allocated to intervention and control groups. Knowledge was measured using a dysmenorrhea questionnaire, while menstrual pain intensity was assessed using the Numeric Rating Scale. The intervention group showed an increase in mean knowledge score from 5.10 to 9.08 and a decrease in pain intensity from 7.00 to 2.48. Wilcoxon tests showed significant pretest–posttest changes, while Mann–Whitney tests confirmed significant post-intervention differences between groups ($p < 0.001$). These findings indicate that the integrated KMJ and education intervention effectively improves dysmenorrhea knowledge and reduces menstrual pain, supporting its potential use as a simple school-based non-pharmacological management strategy. The approach may also strengthen adolescents’ capacity for informed and independent self-management.

Keywords: adolescents, dysmenorrhea, ginger, health education, warm compress.



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INTRODUCTION

Dysmenorrhea is one of the most common reproductive health problems among adolescent girls and is characterized by lower abdominal pain occurring before or during menstruation. This condition not only causes physical discomfort but may also impair concentration, school participation, daily productivity, and overall quality of life. A meta-analysis has shown that primary dysmenorrhea is highly prevalent among students and is influenced by various menstrual characteristics and individual factors (Wang et al., 2022). The substantial burden of dysmenorrhea during adolescence highlights the need for effective, safe, and easily applicable management strategies.

Physiologically, primary dysmenorrhea is associated with increased prostaglandin activity, which induces uterine contractions, vascular constriction, tissue ischemia, and subsequent menstrual pain. The risk and severity of dysmenorrhea may also be influenced by age, menstrual cycle characteristics, age at menarche, family history, psychological conditions, and lifestyle-related factors. Aouad et al. (2022) demonstrated the contribution of familial and genetic factors to primary dysmenorrhea, whereas Liu et al. (2024) identified several determinants associated with dysmenorrhea among young women. These multifactorial characteristics indicate that dysmenorrhea management should address not only pain reduction but also adolescents’ ability to recognize and respond appropriately to menstrual-related symptoms.

One non-pharmacological approach that can be used to alleviate dysmenorrhea is the application of a warm compress to the abdominal area. Heat exposure may promote local vasodilation and blood circulation, reduce muscular tension, and provide a relaxing effect that contributes to decreased pain perception. Agustin et al. (2022) reported that warm compress therapy may reduce the intensity of dysmenorrhea, while a systematic review by Safitri et al. (2023) also demonstrated the

potential effectiveness of thermal therapy in managing menstrual pain. Because it is simple, non-invasive, and relatively easy to perform, warm compress therapy may serve as a practical self-care intervention for adolescents experiencing dysmenorrhea.

In addition to heat therapy, ginger (*Zingiber officinale*) has increasingly been investigated as a non-pharmacological option for controlling menstrual pain. Ginger contains bioactive compounds, particularly gingerols and shogaols, which possess anti-inflammatory properties and may influence mechanisms involved in the production of pain-related mediators. A meta-analysis by Moshfeghinia et al. (2024) indicated that ginger has potential benefits in the management of primary dysmenorrhea, while Nazarpour and Simbar (2024) similarly reported favorable effects of ginger-based interventions for this condition. These findings provide a scientific basis for the use of ginger drinks as a complementary intervention that may be combined with warm compress therapy to achieve more optimal pain control.

Despite the availability of various management options, the effectiveness of dysmenorrhea management among adolescents is also strongly influenced by their level of knowledge regarding menstruation, the causes of pain, associated risk factors, and appropriate coping strategies. Inadequate knowledge may lead adolescents to perceive menstrual pain as a condition that must simply be tolerated, adopt inappropriate management practices, or fail to recognize when professional healthcare is needed. Health education has been shown to improve adolescents' understanding and ability to respond appropriately to dysmenorrhea, as demonstrated by Saputra et al. (2021) and Dewi Utari and Trisetiyaningsih (2019). Therefore, reproductive health education should be incorporated as an integral component of dysmenorrhea interventions, as improved health literacy may facilitate better health-related decision-making and self-management behaviors (Nutbeam & Muscat, 2021).

In the present study, dysmenorrhea education was developed using Roy's Adaptation Model as a theoretical framework to encourage adolescents to develop adaptive responses to the physiological stimuli associated with menstruation. This framework is relevant because the experience of dysmenorrhea is determined not only by the intensity of physical pain but also by an individual's ability to recognize bodily changes, understand the condition, and select appropriate responses. Structured education is expected to strengthen adolescents' capacity to recognize and manage dysmenorrhea, while physical interventions through warm compresses and ginger drinks are intended to reduce the pain stimulus itself. The integration of physical and educational interventions is consistent with the importance of multidimensional approaches in adolescent reproductive health management (Chen et al., 2024; Situmorang et al., 2024).

Previous studies have examined warm compress therapy, ginger administration, and health education as interventions for dysmenorrhea, although these approaches have generally been evaluated separately. Evidence supporting heat therapy has been reported in several studies, while the analgesic potential of ginger has also been strengthened by systematic reviews and meta-analyses (Safitri et al., 2023; Moshfeghinia et al., 2024). Meanwhile, educational interventions have largely focused on improving adolescents' knowledge and attitudes toward dysmenorrhea management (Saputra et al., 2021). This gap indicates the need to evaluate an integrated intervention combining warm compresses and ginger drinks, referred to as the KMJ intervention, with dysmenorrhea education based on Roy's Adaptation Model, while simultaneously assessing its effects on both knowledge and pain intensity.

Based on these considerations, the combination of the KMJ intervention and dysmenorrhea education has both conceptual and empirical justification as a non-pharmacological approach to supporting adolescents in managing menstrual pain. This intervention is expected not only to reduce pain intensity but also to enhance adolescents' cognitive ability to recognize dysmenorrhea and determine appropriate self-management strategies. The development of a simple and applicable intervention is particularly important in school settings because dysmenorrhea may adversely affect comfort, daily activities, and the learning process among adolescent girls (Wang et al., 2022; Situmorang et al., 2024). Therefore, this study aimed to analyze the effectiveness of the KMJ intervention and dysmenorrhea education based on Roy's Adaptation Model in improving knowledge and reducing menstrual pain intensity among Grade 10 and 11 female students at SMA N X in Semarang.

RESEARCH METHODS

This study employed a quantitative approach using a quasi-experimental pretest–posttest control group design to evaluate the effectiveness of the KMJ intervention and dysmenorrhea education based on Roy's Adaptation Model. The study was conducted among Grade 10 and 11 female students at SMA N X in Semarang who experienced dysmenorrhea. A total of 100 participants were recruited using a total sampling technique and allocated into two groups, consisting of 50 participants in the intervention group and 50 participants in the control group. The intervention group received the KMJ intervention, consisting of warm compress application and ginger drink consumption, combined with structured dysmenorrhea education based on Roy's Adaptation Model, whereas the control group received the standard treatment applied to the control condition.

Data were collected using a dysmenorrhea knowledge questionnaire and the Numeric Rating Scale (NRS) to assess menstrual pain intensity before and after the intervention. The knowledge questionnaire had undergone validity and reliability testing prior to its use in the study. Descriptive statistics were used to summarize participants' characteristics and the distribution of study variables, while the Shapiro–Wilk test was applied to assess data normality; because the data were not normally distributed, inferential analyses were conducted using the Wilcoxon Signed-Rank Test to examine within-group pretest–posttest differences and the Mann–Whitney U Test to compare outcomes between the intervention and control groups. The study was conducted in accordance with research ethics principles, including informed consent, anonymity, and confidentiality.

RESULTS AND DISCUSSION

Participant Characteristics and Baseline Profile

The study involved 100 adolescent girls, with 50 participants assigned to the intervention group and 50 to the control group. The equal group sizes provided a balanced basis for comparing changes following the KMJ intervention and dysmenorrhea education. Most participants were within the middle-to-late adolescent age range, a developmental period in which primary dysmenorrhea is commonly reported and can substantially interfere with daily functioning. Previous evidence has demonstrated that dysmenorrhea is highly prevalent among adolescents and young women and may negatively affect school attendance, academic performance, and social participation (Armour et al., 2019; Wang et al., 2022).

In terms of age distribution, 38.0% of participants were 17 years old, 32.0% were 16 years old, and 30.0% were 15 years old. This relatively narrow age distribution indicates that the sample represented a fairly homogeneous adolescent population with respect to developmental stage. Adolescence is particularly relevant to dysmenorrhea research because ovulatory cycles become more established following menarche, thereby increasing exposure to prostaglandin-mediated uterine contractions associated with primary dysmenorrhea. Studies among adolescents and young women have consistently identified age and reproductive maturation as important contextual factors in the occurrence and severity of menstrual pain (Aouad et al., 2022; Liu et al., 2024).

Regarding school grade, 52.0% of participants were Grade 10 students and 48.0% were Grade 11 students. The small difference between these proportions suggests that the study population was relatively balanced in terms of educational level. This characteristic is important because differences in schooling experience may influence adolescents' access to reproductive health information, their health literacy, and their ability to interpret menstrual symptoms. Health knowledge during adolescence can shape self-care decisions and responses to reproductive health problems, particularly when formal health education remains limited or inconsistent (Nutbeam & Muscat, 2021; Saputra et al., 2021).

Age at menarche also varied among participants, with 47.0% reporting menarche at 11–12 years, 26.0% at 13 years, and 27.0% at 14 years. Earlier menarche may increase the cumulative duration of exposure to menstrual cycles and has been discussed as one of several factors potentially associated with primary dysmenorrhea. A recent systematic review and meta-analysis identified menstrual and reproductive characteristics among the factors associated with dysmenorrhea in young women (Liu et al., 2024). Similar findings have also been reported in broader epidemiological investigations demonstrating that the occurrence of primary dysmenorrhea reflects the interaction of biological, reproductive, and behavioral factors rather than a single determinant (Wang et al., 2022).

The duration of menstruation was five days in 35.0% of participants, six days in 41.0%, and seven days in 24.0%, indicating that six days was the most frequently reported menstrual duration. Although these durations are generally within the expected range for adolescent menstruation, longer menstrual bleeding has been associated in some populations with more prolonged exposure to uterine contractions and menstrual discomfort. Dysmenorrhea is influenced by multiple reproductive and social determinants, and menstrual characteristics should therefore be considered when interpreting variations in pain severity among adolescents (Chen et al., 2024). The relatively similar menstrual profiles observed in this study support the comparability of the participants while also emphasizing the need to account for individual menstrual characteristics when evaluating intervention outcomes.

Table 1. Baseline Characteristics and Pre-intervention Measures of Participants

Variable	Category/Group	n	% / Mean $\pm$ SD
Study group	Intervention	50	50.0%
	Control	50	50.0%
Age	15 years	30	30.0%
	16 years	32	32.0%
	17 years	38	38.0%
Grade	Grade 10	52	52.0%
	Grade 11	48	48.0%
Age at menarche	11–12 years	47	47.0%
	13 years	26	26.0%
	14 years	27	27.0%
Menstrual duration	5 days	35	35.0%
	6 days	41	41.0%
	7 days	24	24.0%
Family history of dysmenorrhea	Yes	52	52.0%
	No	48	48.0%
Pre-intervention knowledge	Intervention	50	5.10 $\pm$ 0.839
	Control	50	4.96 $\pm$ 0.781
Pre-intervention NRS pain	Intervention	50	7.00 $\pm$ 0.904
	Control	50	7.02 $\pm$ 0.769

Family history of dysmenorrhea was reported by 52.0% of participants, whereas 48.0% reported no such history. The predominance of a positive family history, although modest, is clinically relevant because familial patterns have been repeatedly associated with primary dysmenorrhea. Aouad et al. (2022), using a twin-family approach, reported evidence of maternal transmission and genetic influence in primary dysmenorrhea, supporting the possibility that inherited and shared familial factors contribute to individual susceptibility. These findings suggest that family history should not be regarded merely as a demographic characteristic but as a potential component of the biological and behavioral context in which menstrual pain develops.

The family-history pattern identified in the present study is also consistent with broader evidence showing that dysmenorrhea is influenced by interacting biological and lifestyle-related determinants. A meta-analysis by Liu et al. (2024) identified a range of factors associated with primary dysmenorrhea, while research among Indonesian university students has similarly highlighted several demographic and reproductive risk factors associated with menstrual pain (Situmorang et al., 2024). Evidence from Indonesian student populations has also suggested relationships between family history, dietary patterns, and primary dysmenorrhea, indicating that familial vulnerability may interact with modifiable behaviors. Consequently, adolescent dysmenorrhea should be understood within a multidimensional framework rather than being attributed exclusively to menstrual physiology.

Before the intervention, the mean knowledge score was 5.10 $\pm$ 0.839 in the intervention group and 4.96 $\pm$ 0.781 in the control group. The small numerical difference suggests that both groups began the study with relatively comparable levels of dysmenorrhea-related knowledge. This baseline pattern is important because limited knowledge regarding the causes, symptoms, and appropriate management of dysmenorrhea may restrict adolescents' ability to undertake effective self-care.

Previous studies have shown that reproductive health education can improve adolescents' understanding and responses to menstrual pain, supporting the inclusion of structured education as an important component of dysmenorrhea management (Dewi Utari & Trisetiyaningsih, 2019; Saputra et al., 2021).

Baseline menstrual pain intensity was also highly comparable between groups, with a mean NRS score of 7.00 ± 0.904 in the intervention group and 7.02 ± 0.769 in the control group. These values indicate that participants generally entered the study with substantial menstrual pain, thereby reinforcing the clinical relevance of evaluating an accessible non-pharmacological intervention. Dysmenorrhea of this intensity may interfere with concentration, mobility, sleep, school attendance, and other daily activities, particularly among adolescents who lack effective symptom-management strategies. The high baseline pain levels observed in this study are consistent with evidence showing that primary dysmenorrhea constitutes a substantial health and functional burden among students (Armour et al., 2019; Rajput, 2021).

Taken together, the demographic, menstrual, and baseline outcome profiles indicate that the intervention and control groups were drawn from a broadly comparable adolescent population and experienced a meaningful burden of dysmenorrhea before treatment. Participants were predominantly in middle-to-late adolescence, almost half experienced relatively early menarche, more than half reported a family history of dysmenorrhea, and both groups demonstrated similar pre-intervention knowledge and pain scores. These characteristics strengthen the relevance of examining whether differences observed after treatment can be associated with the structured KMJ intervention and dysmenorrhea education rather than with major descriptive differences in the initial participant profile. At the same time, the multifactorial nature of dysmenorrhea documented in previous research underscores the importance of interpreting intervention effects in relation to biological, reproductive, behavioral, and social determinants (Chen et al., 2024; Situmorang et al., 2024; Wang et al., 2022).

Within-Group Effects of the KMJ Intervention and Dysmenorrhea Education

The results demonstrated a substantial improvement in dysmenorrhea-related knowledge among participants in the intervention group following the KMJ intervention and structured education. The mean knowledge score increased from 5.10 ± 0.839 at pretest to 9.08 ± 0.853 at posttest, indicating a marked gain after exposure to the intervention. The Wilcoxon Signed-Rank Test showed that this change was statistically significant ($Z = -6.193$, $p < 0.001$). This finding suggests that structured dysmenorrhea education, when integrated into a practical self-management program, can considerably strengthen adolescents' understanding of menstrual pain and its management (Saputra et al., 2021; Dewi Utari & Trisetiyaningsih, 2019).

The improvement in knowledge may be explained by the systematic delivery of information concerning the definition, causes, symptoms, risk factors, and management strategies for dysmenorrhea. Structured health education provides adolescents with an opportunity to replace misconceptions and experiential assumptions with more accurate health information. From a health literacy perspective, the ability to access, understand, evaluate, and use health information is an important prerequisite for informed self-care behaviors (Nutbeam & Muscat, 2021). Consequently, an increase in knowledge may have practical implications beyond cognitive outcomes by improving adolescents' capacity to recognize symptoms and select appropriate responses when menstrual pain occurs.

Although the control group also showed an increase in mean knowledge score from 4.96 ± 0.781 to 5.46 ± 0.862 , the magnitude of change was substantially smaller than that observed in the intervention group. The Wilcoxon analysis nevertheless indicated a statistically significant change in the control group, with $Z = -5.000$ and $p < 0.001$. Such improvement may reflect repeated measurement effects, informal exposure to information, discussions with peers, teachers, or family members, or increased awareness stimulated by participation in the study itself. Previous research has indicated that adolescents commonly obtain menstrual health information from multiple formal and informal sources, but information obtained without structured guidance may vary in accuracy and depth (Armour et al., 2019; Salam et al., 2020).

The intervention also produced a pronounced reduction in menstrual pain intensity. In the intervention group, the mean NRS score decreased from 7.00 ± 0.904 before treatment to 2.48 ± 0.505 after treatment, representing a large descriptive reduction in perceived pain. The Wilcoxon Signed-

Rank Test confirmed that the reduction was statistically significant ($Z = -6.203$, $p < 0.001$). These findings support the therapeutic potential of combining warm compress application and ginger consumption as a non-pharmacological strategy for primary dysmenorrhea (Agustin et al., 2022; Moshfeghinia et al., 2024).

The analgesic effect of warm compress therapy can be understood through several physiological mechanisms. Local heat promotes peripheral vasodilation, improves blood flow, reduces ischemic discomfort, decreases muscle tension, and may alter the transmission and perception of painful stimuli. Classical pain theory also proposes that stimulation of non-nociceptive sensory pathways may modulate pain transmission through spinal mechanisms, providing a theoretical basis for the use of thermal stimulation in pain management (Melzack & Wall, 1965). Previous clinical and systematic evidence has similarly shown that heat therapy can reduce menstrual pain and may provide a practical alternative or complement to pharmacological treatment (Navvabi Rigi et al., 2012; Safitri et al., 2023; Widiyanti et al., 2021).

Table 2. Pretest–Posttest Changes in Knowledge and Menstrual Pain within the Study Groups

Outcome	Group	Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	Z	p-value
Knowledge score	Intervention	5.10 $\pm$ 0.839	9.08 $\pm$ 0.853	-6.193	<0.001
Knowledge score	Control	4.96 $\pm$ 0.781	5.46 $\pm$ 0.862	-5.000	<0.001
NRS pain intensity	Intervention	7.00 $\pm$ 0.904	2.48 $\pm$ 0.505	-6.203	<0.001
NRS pain intensity	Control	7.02 $\pm$ 0.769	6.52 $\pm$ 0.909	-5.000	<0.001

In addition to heat therapy, ginger may have contributed to the substantial reduction in pain observed in the intervention group. Ginger contains several biologically active compounds, particularly gingerols and shogaols, which have anti-inflammatory and analgesic properties and may interfere with pathways involved in prostaglandin synthesis and inflammatory signaling. Systematic reviews have reported beneficial effects of oral or topical ginger for primary dysmenorrhea, supporting its use as a complementary strategy for menstrual pain management (Nazarpour & Simbar, 2024; Negi et al., 2021). More recent meta-analytic evidence also indicates that ginger can meaningfully reduce pain severity among women with primary dysmenorrhea (Moshfeghinia et al., 2024).

The control group experienced only a limited decrease in pain intensity, from a mean NRS score of 7.02 $\pm$ 0.769 to 6.52 $\pm$ 0.909, despite the statistically significant Wilcoxon result. This relatively small reduction may reflect the natural fluctuation of menstrual pain over time, spontaneous symptom resolution during the menstrual period, rest, relaxation, or self-initiated coping strategies not directly controlled by the study. Statistical significance therefore should not be interpreted independently of the magnitude and clinical relevance of change. In this study, the much larger numerical reduction in the intervention group suggests that the combination of warm compresses and ginger produced a more meaningful therapeutic response than the changes observed under the control condition.

The findings are consistent with previous evidence supporting non-pharmacological interventions for dysmenorrhea. Agustin et al. (2022) reported that warm compresses combined with relaxation techniques reduced dysmenorrhea pain intensity, while Safitri et al. (2023) found that thermal interventions may be effective in managing menstrual pain. Clinical research comparing heat therapy with conventional analgesic approaches has also indicated that topical heat may provide meaningful pain relief in primary dysmenorrhea (Akin et al., 2022; Navvabi Rigi et al., 2012). These findings reinforce the possibility that simple physical interventions can be incorporated into adolescent reproductive health programs, particularly in school environments where accessibility, safety, and ease of use are important considerations.

The observed improvement may also reflect the complementary nature of the KMJ components rather than the effect of a single modality. Warm compresses primarily provide local thermal and muscular relaxation effects, whereas ginger may contribute through systemic anti-inflammatory and analgesic pathways. Evidence regarding the health-related biological properties of ginger further supports its potential role as a complementary intervention, although the magnitude of benefit may

depend on preparation, dosage, frequency, and participant characteristics (Popławska et al., 2024; Nazarpour & Simbar, 2024). Combining interventions that operate through different mechanisms may therefore offer a broader approach to dysmenorrhea management than relying exclusively on a single self-care strategy.

From a nursing and adolescent health perspective, the simultaneous improvement in knowledge and reduction in pain is particularly important because effective dysmenorrhea management requires both symptom control and self-management competence. An intervention that reduces pain without improving understanding may provide only temporary relief, whereas education without an accessible symptom-management strategy may have limited practical impact during menstruation. The current findings indicate that combining structured education with the KMJ intervention may address both dimensions by strengthening cognitive preparedness and providing adolescents with practical non-pharmacological techniques. This integrated approach is consistent with contemporary efforts to promote adolescent reproductive health through interventions that enhance knowledge, self-efficacy, and adaptive health behaviors while reducing the functional burden of menstrual pain (Salam et al., 2020; Wang et al., 2022).

Between-Group Differences and Interpretation of the Integrated KMJ–Education Intervention

The between-group analysis demonstrated a clear difference in post-intervention knowledge between adolescents who received the integrated KMJ intervention with dysmenorrhea education and those in the control group. The intervention group achieved a mean rank of 75.50, whereas the control group had a mean rank of 25.50, with a Mann–Whitney analysis indicating a statistically significant difference ($Z = -8.747$, $p < 0.001$). This result confirms that the improvement observed within the intervention group was not merely attributable to repeated measurement or the natural acquisition of information during the study period. Rather, structured education appears to have provided a substantial additional benefit in strengthening adolescents' understanding of dysmenorrhea and its appropriate management (Dewi Utari & Trisetiyaningsih, 2019; Saputra et al., 2021).

The difference in knowledge between groups can be interpreted through the role of structured reproductive health education in transforming health information into practical understanding. Adolescents who receive organized information regarding the causes, symptoms, risk factors, consequences, and management of dysmenorrhea are more likely to recognize menstrual pain as a manageable reproductive health condition rather than an unavoidable experience. Health literacy is particularly important in this context because knowledge alone becomes clinically useful when individuals are able to interpret information and apply it to health-related decisions (Nutbeam & Muscat, 2021). The present findings therefore suggest that education incorporated into the KMJ program may strengthen adolescents' cognitive readiness to make appropriate self-care decisions during menstruation.

The between-group analysis also revealed a substantial difference in post-intervention menstrual pain intensity. The intervention group demonstrated a mean rank of 25.50 compared with 75.50 in the control group, and the Mann–Whitney U Test showed a statistically significant difference between the groups ($Z = -8.812$, $p < 0.001$). The lower mean rank in the intervention group indicates lower post-intervention pain intensity following exposure to warm compress therapy, ginger consumption, and dysmenorrhea education. This finding is consistent with accumulating evidence that non-pharmacological approaches, particularly thermal interventions and ginger-based therapies, may provide meaningful relief from primary dysmenorrhea (Moshfeghinia et al., 2024; Nazarpour & Simbar, 2024).

The magnitude of the descriptive change further supports the clinical relevance of the between-group difference. Pain intensity decreased from a mean NRS score of 7.00 to 2.48 in the intervention group, while the control group showed only a modest decrease from 7.02 to 6.52. The substantially greater reduction among participants receiving KMJ indicates that the intervention may provide benefits beyond the natural decline in menstrual pain that can occur as menstruation progresses. This interpretation is compatible with previous evidence demonstrating the analgesic potential of heat application and ginger in primary dysmenorrhea (Agustin et al., 2022; Negi et al., 2021; Safitri et al., 2023).

The observed effect is biologically plausible because the two principal components of KMJ may influence pain through complementary pathways. Heat application may increase local blood

flow, reduce muscular tension, and modify sensory transmission, whereas ginger-derived compounds such as gingerols and shogaols possess anti-inflammatory properties potentially associated with modulation of prostaglandin-related pathways. Previous research has demonstrated beneficial effects of heat therapy in dysmenorrhea, while systematic reviews have consistently supported the potential of ginger as a complementary intervention for menstrual pain (Navvabi Rigi et al., 2012; Moshfeghinia et al., 2024). The combination of these mechanisms may therefore explain why the intervention group experienced a markedly larger reduction in pain than the control group.

Table 3. Between-Group Comparison of Post-intervention Knowledge and Pain Intensity

Outcome	Group	Mean Rank	Z	p-value	Direction of Difference
Post-intervention knowledge	Intervention	75.50	-8.74 7	<0.001	Higher knowledge
	Control	25.50			
Post-intervention pain	NRS Intervention	25.50	-8.81 2	<0.001	Lower pain intensity
	Control	75.50			

The findings can also be interpreted within the conceptual orientation of Roy's Adaptation Model used in this study. Menstrual pain can be viewed as a physiological stimulus requiring an adaptive response, while inadequate knowledge may limit an adolescent's ability to recognize the stimulus and choose an appropriate coping strategy. Through structured education, participants were encouraged to understand dysmenorrhea and identify appropriate responses, while the KMJ components provided practical strategies for managing the physical manifestation of pain. The concurrent improvement in knowledge and reduction in pain therefore suggests that an intervention addressing both cognitive and physiological dimensions may facilitate a more adaptive response to dysmenorrhea.

This multidimensional interpretation is particularly relevant because primary dysmenorrhea is not determined exclusively by uterine physiology. Systematic and epidemiological evidence indicates that pain severity may be associated with family history, menstrual characteristics, lifestyle factors, psychological conditions, and broader social determinants of health (Aouad et al., 2022; Chen et al., 2024; Liu et al., 2024). Studies among university students have likewise documented multiple determinants of dysmenorrhea severity, reinforcing the need for interventions that move beyond a single symptom-focused approach (Ullah et al., 2022; Situmorang et al., 2024). The integrated KMJ-education strategy may therefore be particularly useful because it simultaneously provides symptom-relief techniques and improves adolescents' capacity to understand and manage their condition.

The findings also have practical implications for school-based nursing and adolescent reproductive health services. Dysmenorrhea can substantially interfere with learning activities, concentration, attendance, and participation in routine school activities, making accessible management strategies especially important in educational environments (Armour et al., 2019; Wang et al., 2022). Warm compresses and appropriately prepared ginger drinks represent relatively simple interventions that may be incorporated into reproductive health education and self-care programs when applied with appropriate guidance. Such strategies may complement existing approaches to pain management and potentially reduce excessive dependence on pharmacological analgesics, although pharmacological treatment remains clinically important when indicated (Chebotareva & Petrov, 2022).

Nevertheless, the present findings should be interpreted with consideration of the multifactorial nature of dysmenorrhea. Dietary patterns, family history, reproductive characteristics, stress, physical activity, and other behavioral factors may modify the occurrence or severity of menstrual pain, and not all of these variables were controlled in the present study (Liu et al., 2024; "Sugary Food and Beverages Consumption, Family History, and Primary Dysmenorrhea," 2023). In addition, because KMJ combined warm compresses, ginger consumption, and education into a single intervention package, the independent contribution of each component cannot be determined from the present design. Future studies should consider factorial or multi-arm designs that compare warm compress

therapy, ginger supplementation, structured education, and their combinations separately to clarify the relative and synergistic effects of each component.

The between-group findings provide consistent evidence that the integrated KMJ intervention and dysmenorrhea education were associated with better outcomes than the control condition. Participants receiving the intervention demonstrated substantially higher post-intervention knowledge and markedly lower menstrual pain intensity, supporting the value of combining educational and non-pharmacological approaches within adolescent reproductive health management. These findings are consistent with previous evidence concerning thermal therapy, ginger-based pain management, reproductive health education, and the multidimensional determinants of primary dysmenorrhea (Widianti et al., 2021; Wang et al., 2022; Moshfeghinia et al., 2024; Situmorang et al., 2024). Accordingly, the KMJ–education intervention represents a potentially practical school-based strategy for improving adolescents' ability to recognize, adapt to, and independently manage menstrual pain.

CONCLUSION

The KMJ intervention, consisting of warm compress application and ginger drink consumption combined with dysmenorrhea education based on Roy's Adaptation Model, was effective in improving knowledge and reducing menstrual pain intensity among Grade 10 and 11 female students. The intervention group demonstrated a substantial increase in mean knowledge score from 5.10 to 9.08 and a marked decrease in mean pain intensity from 7.00 to 2.48. Statistical analysis confirmed significant pretest–posttest changes in the intervention group and significant post-intervention differences between the intervention and control groups ($p < 0.001$), indicating that the integrated intervention produced better outcomes than the control condition.

These findings support the potential implementation of the KMJ intervention and structured dysmenorrhea education as a practical, accessible, and non-pharmacological approach to menstrual pain management among adolescents. School health services and nurses may incorporate this intervention into reproductive health education programs to strengthen adolescents' knowledge and self-management abilities while reducing the functional burden of dysmenorrhea. Future studies should employ longer follow-up periods and multi-arm experimental designs to separately evaluate the effects of warm compresses, ginger drinks, and educational interventions.

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