EFFECTIVINESS OF RED GINGER NANOPARTICLES ON PRIMARY DYSMENORRHEA PAIN IN ADOLESCENT GIRLS

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ABSTRACT

Every month, adolescent girls experience painful menstruation (dysmenorrhea), which is caused by high levels of the hormone prostaglandin. High levels of prostaglandin cause uterine contractions during menstruation, resulting in pain. The prevalence of dysmenorrhea reaches 90%, with some experiencing severe pain that interferes with daily activities. Therefore, alternative treatments are needed to address the pain of dysmenorrhea. One such treatment is red ginger, as it contains gingerols, shogaols, and flavonoids, which can help relieve dysmenorrhea. Proving the effectiveness of red ginger nanoparticles in reducing the intensity of primary dysmenorrhea pain. This type of research is a true experiment with a pre-test and post-test with a control group design. The population in this study were adolescent girls experiencing primary dysmenorrhea and mild anemia in the Midwifery Department of Poltekkes Semarang. This study was conducted on two groups: the intervention group was given red ginger nanoparticles at a dose of 500 mg 3x2 daily for 14 days; and the intervention group was given red ginger nanoparticles at a dose of 500 mg 3x2 daily for 14 days. The results of the study showed that red ginger nanoparticles were significantly able to reduce the intensity of dysmenorrhea pain, with the results of the Mann Whitnay test statistical test obtaining a p value of 0.000. Red ginger nanoparticles are effective in reducing the intensity of primary dysmenorrhea pain and can be a complementary approach in obstetric practice to reduce dysmenorrhea symptoms.

Keywords: Adolescent Girls, Primary Dysmenorrhea, Red Ginger Nanoparticles.

INTRODUCTION

Menstruation is a physiological process experienced by all women of reproductive age. Menstruation is accompanied by abdominal pain, commonly known as dysmenorrhea. Pain during menstruation (dysmenorrhea) arises from high levels of the hormone prostaglandin, which can increase uterine contractions, causing pain. The prevalence of dysmenorrhea is very high, especially among adolescent girls. Studies show that nearly 90% of adolescent girls experience dysmenorrhea, and more than 50% of adult women also experience it. Approximately 10-20% of these women experience pain so severe that it interferes with activities and causes anxiety (Wang et al., 2022).

The impact of dysmenorrhea is not limited to physical aspects, but also affects women's psychological and social well-being, as well as

their quality of life. A study conducted (Alp Yilmac & Avci, 2020) confirmed that the majority of students experiencing dysmenorrhea face activity limitations and a reduced quality of life. Another study by Zaman et al. (2022) also reported that 80.6% of students with a history of dysmenorrhea experienced disruptions in daily activities and mood swings.

Dysmenorrhea can be managed in two ways: pharmacological and non-pharmacological (Gebeyehu et al., 2017). Nonsteroidal anti-inflammatory drugs (NSAIDs), ibuprofen, naproxen, and mefenamic acid, are commonly used in women with primary dysmenorrhea. Other medications, such as oral contraceptive pills (OCPs), antispasmodics, and acetaminophen, are also used. However, long-term use of NSAIDs and OCPs has several side effects, such as injury to the gastrointestinal mucosa, causing gastrointestinal discomfort. (Gao et al., 2017) These side effects encourage many women to seek alternative complementary treatments, such as herbs, food, or exercise (Parra-Fernandez et al., 2020).

One herb that has been proven effective in relieving menstrual pain is red ginger (Zingiber officinale var. rubrum). The use of red ginger, whether in powder, drink, or nanoparticle form, is a safe alternative with minimal side effects (Ozgoli et al., 2020)(Gurung et al., 2022)(Ankita Singh et al., 2020)(Rondanelli et al., 2020). Red ginger (Zingiber officinale var. rubrum) contains gingerol, shogaol, flavonoids, iron, and vitamin C which act as anti-inflammatory, analgesic, antioxidant, and increase iron absorption ((Akullo et al., 2023)(Ooi et al., 2022)(Endang et al., 2022).

Current advances in nanoparticle technology are opening up new opportunities to enhance the effectiveness of herbal ingredients for health therapies. Nanoparticles range in size from 1 to 100 nm, making them more easily absorbed by the body and increasing the surface area of active ingredients. The use of red ginger nanoparticles is expected to enhance the absorption of iron and other bioactive compounds, making them more effective in treating dysmenorrhea pain (Kumari & Chauhan, 2022)(Abbas & Fairouz, 2022)(Cahyanto, 2022)(Nafisah, 2020).

Based on these findings, the main research question can be formulated as: whether red ginger nanoparticles are effective in reducing the pain intensity of primary dysmenorrhea in adolescent girls. Specific research questions include the effectiveness of red ginger nanoparticles in reducing the pain of primary dysmenorrhea in adolescent girls.

LITERATURE REVIEW

Adolescence can be referred to variously as puberty, adolescence, or youth. The Latin word for adolescence is "adolescere," and in English, "adolescence," which means growing toward maturity. This maturity refers to physical, social, and psychological maturity. Therefore, adolescence is the transition from childhood to adulthood. This period lasts from 15 to 20 years of age. Developmental changes that occur during adolescence include physical, psychological, and psychosocial development. (Gainau, 2021).

Dysmenorrhea comes from the Greek words dys, meaning pain/difficulty/abnormal; meno, meaning month, and rhea, meaning flow. So, dysmenorrhea is pain during menstruation (Sultan et al.,

2021). According to ACOG (American College of Obstetricians and Gynecologists), dysmenorrhea is divided into two types: primary dysmenorrhea and secondary dysmenorrhea. Primary dysmenorrhea is menstrual pain that is not caused by organic disorders or pelvic pathology, usually beginning 6–12 months after menarche when ovulation cycles begin to occur regularly .

Primary dysmenorrhea is generally caused by increased production of prostaglandins, particularly prostaglandin F2α, which is produced by the endometrium during menstruation. Prostaglandins cause strong, irregular myometrial contractions, vasoconstriction, and decreased uterine blood flow, which leads to pain. Prostaglandins can also trigger systemic symptoms such as nausea, vomiting, and diarrhea (Naveed et al., 2022). *Dysmenorrhea typically lasts 48-72 hours after menstruation. It is often accompanied by symptoms such as sweating, headaches, diarrhea, and vomiting* (Menon et al., 2021).

Dysmenorrhea has a significant impact on life. It has a wide-ranging impact on a woman's mental and physical well-being, with long-term impairments to quality of life, personal relationships, and educational and career attainment. Furthermore, untreated dysmenorrhea can lead to hyperalgesia, which can lead to chronic pelvic pain (Puspitawati et al., 2024).

To reduce the symptoms of dysmenorrhea, nonsteroidal anti-inflammatory drugs (NSAIDs) can be used. NSAIDs provide analgesic effects by inhibiting the enzyme cyclooxygenase (COX-2) and reducing prostaglandin synthesis. As a result, NSAIDs relieve menstrual pain. However, there is a risk or side effect of NSAIDs in 20–25% of cases with frequent and long-term use. NSAIDs have side effects such as gastrointestinal disorders, stomach ulcers, and kidney failure, and there is a risk of heart and kidney failure with long-term use. Most women are unaware of the dangers or side effects of taking NSAIDs without a doctor's prescription and taking them for a long time (Gurung et al., 2022).

On the other hand, complementary therapies such as exercise and herbal remedies are known to relieve pain and symptoms of primary dysmenorrhea during the menstrual cycle. One such remedy is red ginger (Zingiber officiale Var. rubrum). Ginger contains over forty compounds with anti-inflammatory effects that can inhibit leukosterol synthesis and cyclooxygenase enzymes (COX-1 and COX-2) (Wulandari & Kumalasari, 2022)(Sundari et al., 2024). Various components found in red ginger, such as gingerol, shogaol, paradol, zingerone, and gingerdion, have anti-inflammatory properties and act as potent inhibitors of cyclooxygenase (COX-2), which inhibits prostaglandin and leukotriene biosynthesis. Therefore, ginger can inhibit inflammation during menstruation, which can reduce the risk of primary dysmenorrhea (Xu et al., 2020)(Sundari et al., 2024).

RESEARCH METHOD

This research is a quantitative study using a true experiment method, with a randomized pretest and posttest control group design. The study was conducted at the Midwifery Department of the Semarang Ministry of Health Polytechnic in April-May 2025.

This study used probability sampling with simple random

sampling. The sample calculation used the Lameshow formula, resulting in 30 respondents divided into two groups: 15 in the control group and 15 in the intervention group.

Measuring tool / Pain measurement instrument using NRS.The intervention group received red ginger nanoparticles at a dose of 500 mg, administered three times a day, while the control group received iron tablets at a dose of 60 mg, administered once a day. The pre-test was conducted on the first day of menstruation, and the post-test was conducted on the third day of menstruation.

RESEARCH RESULT

Tabel 1. Respondent Characteristics

Karakteristik	Kontrol			Intervensi			*P value*
	n	%	Mean±SD	n	%	Mean±SD	
Menarche Age	15	100	11,5±0,91	15	100	11,1±0,74	1,285
Menstrual Cycle							
Normal	15	100	29,3±1,38	15	100	29,2±1,43	0,116
Ab normal	-	-		-	-		
Length of Menstruation							
Normal	15	100	6,6±0,51	15	100	6,67±0,49	0,516
Ab Normal	-	-		-	-		
IMT							
Thin	5	33,3	1,80±0,68	3	20	2,07±0,70	0,924
Normal	8	53,4		8	53,3		
Fat	2	13,3		4	26,7		
*Uji Homogenitas *lavene test*							

Based on the data in table 1.1, it shows that the results of the Lavene test statistically on the characteristics of respondents with the intervention group and the control group are homogeneous or there is no significant difference as indicated by the value of f = > 0.05. Based on these data, it is concluded that all respondents in this study, both in the control group and the intervention group, are the same or homogeneous, which means there is no significant difference either before or after the intervention.

Tabel 2. Analysis of the Effect of Red Ginger Nanoparticles on the Intensity of Primary Dysmenorrhea Pain in Adolescent Girls

Variabel	Data	Intervensi	Kontrol	*P value*	*Cohen's d Effect*
		Mean±SD	Mean±SD		
Pain	Pre test	6,67±0,61	7±0,65	0,161**	
	Post test	1,06±0,59	2,67±0,89	0,000**	1,36
P value		0,000*	0,001*		
	Δ	5,61±0,63	4,33±1,17	0,000**	

**Wilcoxon test*
***Mann Whitney test*

Based on Table 2, The pain intensity in the intervention group before and after the intervention was given showed that the pain intensity in the intervention group decreased by an average of 5.61. Results of pain intensity measurements in the intervention group before and after the intervention showed an average decrease of 5.61 points in the intervention group. In the control group, pain was also decreased before and after the intervention by an average of 4.33 points.

The Wilxocon test for the intervention group showed a p-value of 0.000, indicating a decrease in pain intensity after consuming red ginger nanoparticles. The Wilxocon test for the control group showed a p-value of 0.001, indicating a decrease in pain intensity after consuming Fe tablets.

Data analysis using the Mann-Whitney test to test for differences in pain reduction between the control and intervention groups yielded a p-value of 0.000, indicating a significant difference in the average decrease in pain intensity between the control group given Fe tablets and the intervention group given red ginger nanoparticles.

Cohen's d effect size analysis in the intervention group and the control group was 1.36, which means >0.6 and it can be concluded that there was a large effect.

DISCUSSION

The use of red ginger (Zingiber officinale var. rubrum) as a therapeutic agent for pain relief, particularly in cases of dysmenorrhea, is a promising area of research due to the anti-inflammatory and analgesic properties of its key bioactive compounds, such as gingerols and shogaols. Based on various literature and research results, these two compounds are known to inhibit the activity of the cyclooxygenase (COX-2) enzyme, which plays a role in the synthesis of inflammatory mediators such as prostaglandins. Prostaglandins themselves are key mediators in the pain pathway during menstrual cramps. By suppressing prostaglandin production, red ginger can reduce excessive uterine contractions and lower the threshold for pain perception. (Krisnamurti & Fatchiyah, 2020)(Fajrin et al., 2021).

The effectiveness of red ginger in managing dysmenorrhea pain has been supported by various studies. These studies show that consuming red ginger can significantly reduce

pain intensity, with results comparable to non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen (Ozgoli et al., 2020)(Xu et al., 2020)(Gurung et al., 2022). For example, a meta-analysis by (Xu et al., 2020) confirmed that ginger effectively reduces pain in primary dysmenorrhea after one to two cycles of administration, thus red ginger can be recognized as a clinically relevant natural alternative for dysmenorrhea therapy. The dose shown to be effective in several clinical trials is 400 mg three times daily (Budhi et al., 2022) This also aligns with the dosage of red ginger nanoparticles used in recent experimental studies (500 mg, administered three times a day for 14 days).

In addition to its direct analgesic effects, red ginger also possesses significant antioxidant properties. Gingerol, the main component of red ginger, plays a role in counteracting oxidative stress, which can exacerbate inflammation and prolong pain, thus supporting the recovery of general body function.(Zhang et al., 2022)(Mintarsih & Rohmatin, 2022). These antioxidant properties also strengthen the argument that red ginger is safe for long-term use, especially when compared to NSAIDs which have the potential to cause gastrointestinal side effects if used continuously (Wulandari, 2024).

This research is more effective compared to previous research conducted by (Adib Rad et al., 2018) Because in previous research on the intensity of dysmenorrhea pain after consuming red ginger extract at a dose of 200 mg, the p-value was 0.053, while in my study, the p-value was 0.000. Therefore, from this p-value, it can be concluded that the current study is more effective in reducing the intensity of dysmenorrhea pain. Furthermore, the previous study only used flavonoids, while in my study, nanoparticles were used, resulting in a zeta potential. This zeta potential can affect the stability and bioavailability of the active compounds found in red ginger.

Another study conducted by (Cahya et al., 2024) By administering a red ginger drink at a dose of 1000 mg, the mean post-test pain intensity value after being given the red ginger drink was 4.29, while in this study, the mean post-test pain intensity value was 1.06. This indicates that this study is more effective than the previous study.

Advances in nanotechnology are further expanding red ginger's potential as a modern herbal medicine. Nanoparticle formulations of red ginger have been shown to increase the bioavailability of its active compounds, resulting in optimal therapeutic effects. (Sutarna et al., 2025). The results of this study specifically showed that administering red ginger nanoparticles to adolescent girls with primary dysmenorrhea significantly reduced pain intensity more than administering iron tablets alone. The mean pain score in the intervention group decreased from 6.67 to 1.01, while in the control group from 7.00 to 2.67 ($p = 0.000$; effect size Cohen's $d = 1.36$), indicating a strong and clinically significant analgesic effect.

Furthermore, the advantage of nanoparticles is that they can enhance the properties of the material, creating faster and more accurate effects and increasing sensitivity. Therefore, the use of nanoparticles can increase the effects even more significantly than other products, such as extracts (Devita et al., 2025).

Another advantage of red ginger is its minimal side effects, both in conventional and

nanoparticle forms. Toxicity studies have shown that ginger is safe to consume in various doses, even over long periods of time, with no significant toxic effects in animals or humans (Idang et al., 2019).

In addition, red ginger is also effective in treating other symptoms that often accompany dysmenorrhea, such as nausea, dizziness, and bloating (Zhang et al., 2022)(Sundari et al., 2024). This provides added value in a holistic approach to managing dysmenorrhea in adolescent girls.

In conclusion, existing scientific evidence strongly supports the use of red ginger as an effective and safe natural alternative for dysmenorrhea pain management. The combination of anti-inflammatory, analgesic, and antioxidant properties, along with innovative nanoparticle technology, makes red ginger a strong candidate for complementary therapy with the potential to replace or complement conventional pharmacological interventions. Further research is needed to address production challenges and ensure optimal clinical benefits in a broader population.

CONCLUSION

Consuming red ginger nanoparticles at a dose of 500mg 3x2 a day is effective in reducing the intensity of dysmenorrhea pain in adolescent girl. Red ginger nanoparticles are a non-pharmacological therapy with minimal side effects, making them an alternative to NSAIDs for treating primary dysmenorrhea in adolescent girls.

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